KORALEWSKI
INDUSTRIE - ELEKTRONIK

Voltage – Frequency Guard SFW-7

protective function according to DIN V VDE V 0126-1-1 and according to DIN VDE-AR-N 4105:2011-8

monitoring of rate of change of frequency (ROCOF – Δf / Δt)

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Index

1 General Remarks 3
2 Overview 3
2.1 Digital Inputs 4
2.2 Digital Outputs 4
2.3 Analogue Outputs (optionally available) 5
2.4 Communication Interfaces 5
3 Operation 6
3.1 Language Selection 6
3.2 Release 6
3.2.1 Prevent successive triggering 7
3.2.2 Indication of triggering Event 7
3.3 Limit Value Settings 7
3.3.1 Behaviour of the Limit Values 7
3.3.2 Voltage Release 7
3.3.3 Frequency Release 8
3.3.4 Vector Surge Release 8
3.3.5 Delta f to Delta t (ROCOF) 8
3.3.6 Angle Error Release 8
3.3.7 Voltage Asymmetry Release 9
3.3.8 Deviation of Mean value 9
3.3.9 Rotary Field Detection 9
3.3.10 Voltage Quality 9
3.4 Reset manually- / automatically 10
3.5 Release Storage 10
3.6 Voltage Indication / Transducer Factors 11
3.7 Protective Function according to DIN V VDE V 0126-1-1 11
3.8 Protective Function according to DIN VDE-AR-N 4105:2011-08 12
4 Measurement 13
4.1 3-Wire – and 3-Wire + N – Systems 13
4.2 Behaviour at low Voltages 13
4.3 Phase Voltage 13
4.4 Collective Fault 1+2 13
5 Parameterisation 14
5.1 Database 14
5.2 Setting the Time 14
5.3 Editing at the Device 14
5.3.1 Protection of Input with PIN 14
5.3.2 Parameter Setting 14
5.3.3 Manually Selection of Tables 15
5.3.4 Manual Editing 15
5.3.5 Return to the Selection of Line respectively Table 15
6 List of Parameters – Table Summary 15
7 Connection Diagram 18
7.1 DIL-Switch 18
7.2 Accessories 18
8 Technical Data 19
8.1 Triggering Values 19
8.2 Ordering Information 19
9 Connection Example 20

1 General Remarks

The SFW-7 is a device for the monitoring of a three-phase mains system on frequency, voltage, phase sequence, angular shift, rate of change of frequency (ROCOF - requires firmware V1.09 or later) and vector surge. Measurement can be done either with or without neutral conductor. A separate frequency measuring is available for each of the 3 phases. The detection of vector surge can be assigned to a single phase or all phases. Triggering values are stored and the last 38 triggering events may be retrieved from the device at least. Due to a special internal wiring of the terminals, the loss of the neutral conductor can be detected in a 3-wire + N - system.

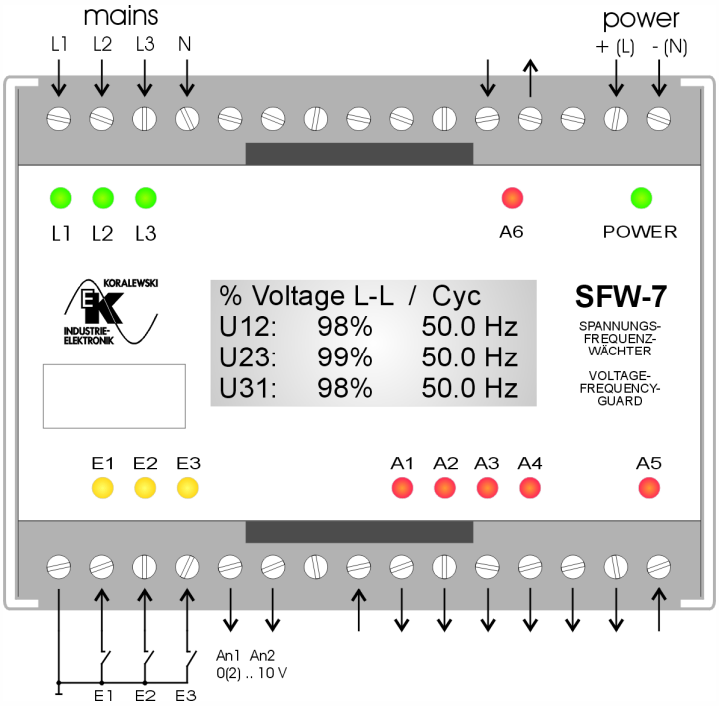
The monitoring on nominal voltage and frequency in accordance to DIN V VDE 0126-1-1 (requires firmware version V1.04 and later) and / or DIN VDE-AR-N-4105:2011-08 (requires firmware version V1.09 or later) can be enabled by setting of the corresponding parameters.

The capabilities of microcontroller- and PC database technology provide the conveniently configuration of all settings using our parameterisation software 'device manager' (GV_2.exe - Version V2.31 or later recommended). Values, but not texts, alternatively can be entered directly at the device. The input to the device can be protected by use of a PIN. The output of display-texts takes place in 2 languages, default is German and English (switching between languages is possible at any time during operation). Alternative languages, suitable to the customers requirements, can be configured and conveniently made available, by means of our parameterisation software ‘device management’.

Note: A separate variant of the SFW-7 is available for measuring voltages ≤ 100 V.

2 Overview

Almost all functions, e.g. undervoltage or angular errors are configurable by the user. This especially includes the freely configurable assignment of relay functions and of the digital inputs or the selection of text images on the device-display.



2.1 Digital Inputs

The SFW-7 features 3 digital inputs, which can each be assigned to one of the following functions:

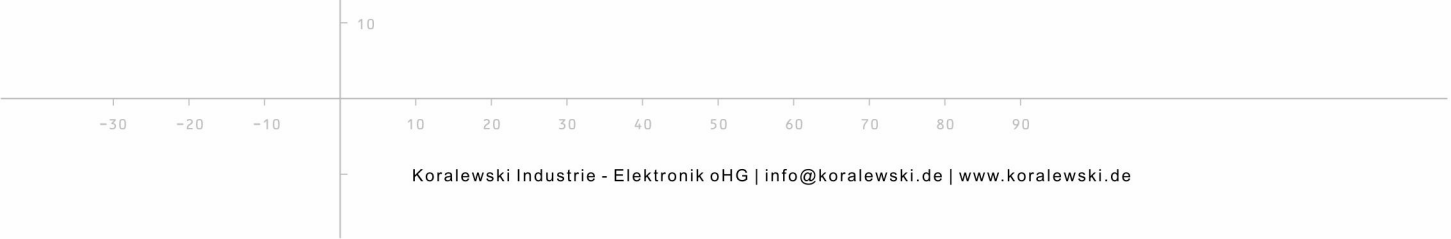
No.	Function	No.	Function
1	disable all releases (default E1)	**9**	disable frequency release 1 + 2
2	disable vector jump (default E2)	**10**	disable voltage asymmetry release
3	error - reset (default E3)	**11**	disable angle asymmetry release
4	disable low voltage release 1 + 2	**12**	release on rotary field error
5	disable high voltage release 1 + 2	**13**	change language (switchover display mode)
6	disable voltage release 1 + 2	**14**	switch-on release for VDE0126 (*firmware V1.09 ol*)
7	disable low frequency release 1 + 2	**15**	VDE4105 test button (*firmware V1.09 or later*)
8	disable high frequency release 1 + 2	**16**	disable VDE4105 release (*firmware V1.14 or later*)

2.2 Digital Outputs

The SFW-7 features 3 groups of digital outputs (A1 - A4, A5 and A6) with in total 6 relays. These can be assigned to the following functions:

No.	Function	No.	Function
1	low voltage 1 : L1 or L2 or L3 (default A1)	**26**	vector surge 2 : L1 and L2 and L3
2	high voltage 1 : L1 or L2 or L3 (default A2)	**27**	vector surge 1 : L1
3	low frequency 1 : L1 or L2 or L3 (default A3)	**28**	vector surge 1 : L2
4	high frequency 1 : L1 or L2 or L3 (default A4)	**29**	vector surge 1 : L3
5	vector surge 1 L1 / L2 / L3 (default A5 potential-free)	**30**	collective fault 1
6	ready for use (default A6 potential free)	**31**	collective fault 2
7	low voltage 2 : L1 or L2 or L3	**32**	deviation from mean value
8	high voltage 2 : L1 or L2 or L3	**33**	DIN V VDE V 0126-1-1 [1]
9	low frequency 2 : L1 or L2 or L3	**34**	low voltage 1 or 2 [2]
10	high frequency 2 : L1 or L2 or L3	**35**	high voltage 1 or 2 [2]
11	vector surge 2 : L1 or L2 or L3	**36**	low frequency 1 or 2 [2]
12	voltage 1 OK (X1 < U < Y1)	**37**	high frequency 1 or 2 [2]
13	voltage 2 OK (X2 < U < Y2)	**38**	switching on VDE0126 and switch-on release [3]
14	frequency 1 OK (X3 < F < Y3)	**39**	ROCOF 1 [3]
15	frequency 2 OK (X4 < F < Y4)	**40**	ROCOF 2 [3]
16	voltage asymmetry	**41**	VDE4105 [3]
17	angle < X1	**42**	switching on VDE4105 [3]
18	angle > X2	**43**	voltage quality [3]
19	angle OK (X5 < Delta < Y5)	**44**	switching on VDE4105 and switch-on release [3]
20	rotary field error	**45**	VDE0126 with vector surge 1 [4]
21	collective fault	**46**	VDE0126 OK & switch-on rel. with vector surge 1 [4]
22	input 1	**47**	VDE4105 OK & switching-on with vector surge 1 [4]
23	input 2	**48**	VDE4105 OK, switch-on & release w. vect.-surge 1 [4]
24	input 3	**49**	VDE4105 with disabling function [5]
25	vector surge 1 : L1 and L2 and L3		

[1, 2, 3, 4] function available with firmware version: [1] V1.04, [2] V1.07, [3] V1.09, [4] V1.11, [5] V1.14 or later;



2.3 Analogue Outputs (optionally available)

The SFW-7 is available optionally with two 0(2) ... 10 V outputs, which can be freely assigned to various functions, listed in the table below. The, in relation to the respective nominal value adjusted range of a measuring value, e.g. 'voltage L1 - N' = start value: 60%: to end value: 110% (each based on the set nominal voltage), is mapped to the voltage range of 0 (2) to 10 volts at the analogue output. To be observed: due to the system, the resolution of the signal at the analogue output decreases with adjusted measuring value-ranges of less than 100 percentage points.

Example:

- adjusted range from 10 to 100 %, value-range = 90 %, resolution: 0,1 %;
- adjusted range from 90 to 110 %, value-range = 20 %, resolution: 0,5 %;

No.	Function
1	voltage L1 - N (default An1)
2	voltage L2 - N (default An2)
3	voltage L3 - N
4	voltage L1 - L2
5	voltage L2 - L3
6	voltage L3 - L1
7	frequency L1
8	frequency L2
9	frequency L3
10	frequency L1 absolute * (*with firmware version V1.15 or later*)

* The Parameterisation of the analogue output is done by use of absolute frequency values.

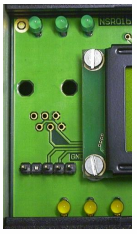
Note: Current outputs 0(4) ... 20 mA are not supported. In case of 0 (4) ... 20 mA applications adequate converters are needed.

2.4 Communication Interfaces

The SFW-7 standardly features an RS-232 interface (database interface) for the configuration. A second interface is available on customers request. Hereby alternatively an RS-232 or RS-485 version is available.

For this, transfer protocols according to customers request can be created. For example: Modbus, RK-512, ...

database interface



3 Operation

The SFW-7 features a range of display text images. The standard text image (standard-display) is selected using the device manager. Scrolling through the various text images is done by using the UP button. After scrolling through the text images, the SFW-7 returns back to the pre-selected standard-display after the view reset time, which is configured by the device management. If this time is set to the value 0 s via device management, the last selected text image remains until devices reset. This may be particularly useful for start-up of the plant.

The following text images will be displayed by scrolling with the UP button:

Voltage L-N / Cyc
U1n: 231 V 50.0 Hz
U2n: 230 V 50.0 Hz
U3n: 231 V 50.0 Hz

text image 0

Voltage L-L / Cyc
U1n: 401 V 50.0 Hz
U2n: 400 V 50.0 Hz
U3n: 401 V 50.0 Hz

text image 1

% Voltage L-N / Cyc
U1n: 99 % 50.0 Hz
U2n: 100 % 50.0 Hz
U3n: 99 % 50.0 Hz

text image 2

% Voltage L-L / Cyc
U12: 101% 50.0 Hz
U23: 100% 50.0 Hz
U31: 99% 50.0 Hz

text image 3

Frequency/angle
F1: 49.98 D1-2: 120°
F2: 49.99 D2-3: 121°
F3: 49.98 D3-1: 120°

text image 4

Last Event:
Time: 16.08 28.11.04
low Volt. 1 < 85 %
Event counter: 12

text image 5

Last Event:
U1n: 101% 50.0 Hz
U2n: 100% 50.0 Hz
U3n: 75% 50.0 Hz

text image 6

Last Event:
U12: 101% 50.0 Hz
U23: 81% 50.0 Hz
U31: 79% 50.0 Hz

text image 7

Last Event:
V1 : 0 ° F1 : 50.0 Hz
V2 : 0 ° F2 : 50.0 Hz
V3 : 0 ° F3 : 50.0 Hz

text image 8

Last Event:
F1 : 50.0 Hz D1-2 120°
F2 : 50.0 Hz D2-3 120°
F3 : 50.0 Hz D3-1 120°

text image 9

3.1 Language Selection

Basically the display texts of device are available in two languages. The standard ex works is german (*factory default*) and english. Additional languages, suitable to the customers requirements, can be configured and made available, by means of the device management.

Spg L-N / Freq
U1n: 231 V 50.0 Hz
U2n: 230 V 50.0 Hz
U3n: 231 V 50.0 Hz

1st language

Voltage L-N/ Frequency
U1n: 231 V 50.0 Hz
U2n: 230 V 50.0 Hz
U3n: 231 V 50.0 Hz

2nd language

Switching between the two display languages can be done either using the parameterisation software, the switch DIL-3, or via an appropriate configured input. If DIL-3 or the appropriate input closes, then the device switches over to the 2nd language.

3.2 Release

If one of the measuring values exceeds or falls below the set limit values for longer then the set delay, the associated triggering takes place. A separate triggering delay is associated to each limit value. This triggering delay is defined in periods from 0 to 100, and is therefore frequency dependent.

Note: the release delays for the limit values of over- / under-voltage 2 and over- / under-frequency 2 is time dependent, and adjustable in the range of 0 upto 120 seconds. For the release of the voltage quality limit (see chap. 3.3.10) a fixed delay time of 5 periods is preset.

Each generated trip signal has a duration minimum, which is as well adjustable in the range of 0,0 upto 10,0 s in 100 ms steps. If set, this option takes effect when the triggering signal retains for at least 20 ms. This means that for example at voltage outage, which is shorter than the adjusted signal duration, the corresponding triggering signal anyhow will still be present for the set time. If the voltage outage lasts longer than the set signal duration time, the reset takes place immediately after the measurement is OK again.

Each single signal can be adjusted to manually reset (see also chap. 3.4). This means that, for example the signal high frequency 1 remains present, until the reset is done either by ENTER key or a respectively parameterised digital input. The activation of manual reset is done by entering 0 s for the minimum impulse duration or by actuating the corresponding button within the parameterisation-software.

If a locking function (disable of release) is set on an input, and this one is activated, the corresponding triggering signal will be suppressed.

3.2.1 Prevent successive triggering

It is possible to parameterise the device, whether it shall indicate only the first triggering error or to display all triggerings. This means that in the event of a triggering, e.g. low frequency at loss of one phase, the in consequence occurring after-effect, e.g. low voltage, will not be evaluated. If the displaying of sequence errors is released, the appropriate signal will be generated.

3.2.2 Indication of triggering Event

Basically the last triggering event of several trippings is shown on the device - display, regardless of whether it is still present or not.

3.3 Limit Value Settings

First the nominal voltage of the installation as well as the converter ratios are to be checked. The corresponding values are to adjust, if necessary. Factory default setting for the nominal voltage of the installation (*not rated voltage of device!*) is 230 V. For the converter voltage (L-L) primary as well as secondary 230 V and '3-wire + N - system' are adjusted ex works.

The entering of voltage limit values is done solely as percentage, relative to the nominal voltage. Each limit value may be deactivated by entering the value '0', or activating the respective switch within the parameterisation - software 'device manager'. It is recommended to make the entry of all limit values with the device manager.

For the frequency, the limit values are adjustable in 0.1 Hz steps. The triggering occurs at exceeding or falling below of the appropriate limit value. Thus, if for example 50.1 Hz is set as overfrequency, the triggering takes place at 50.2 Hz. The tolerance at this switching point ranges at ± 0.05 Hz.

3.3.1 Behaviour of the Limit Values

Each limit value can be assigned separately to one relay, or one of the two collective fault signals. Each adjusted and active limit value is displayed as triggering event on the device-display, regardless of whether the respective limit value is assigned to a relay or one of the fault alarms.

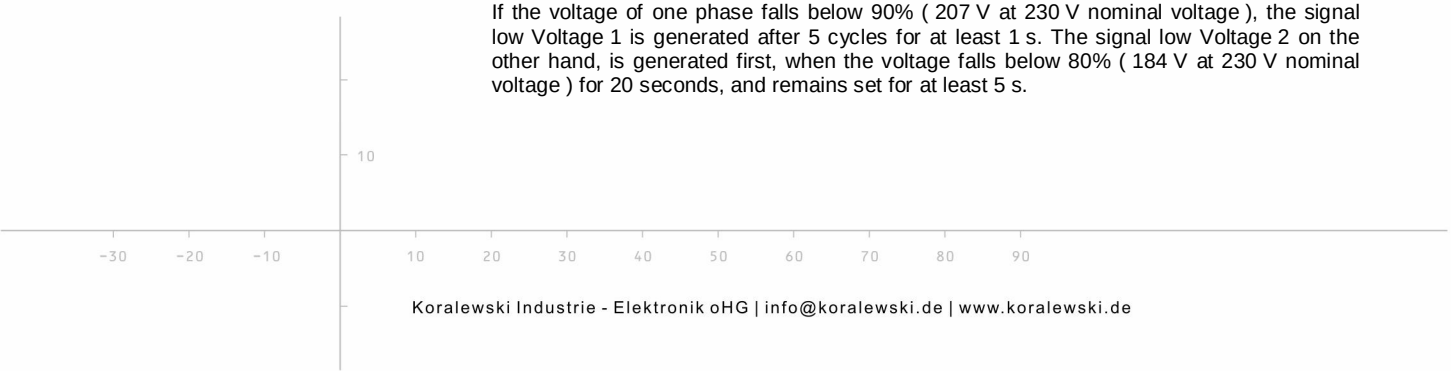
3.3.2 Voltage Release

For the under- / overvoltage detection 2 different limit values are adjustable. Each limit value has its own triggering delay and minimum impulse duration.

Example:

- U min 1 : 90 % delay 5 per. duration 10*100ms
- U min 2 : 80 % delay 20 s duration 50*100ms

If the voltage of one phase falls below 90% (207 V at 230 V nominal voltage), the signal low Voltage 1 is generated after 5 cycles for at least 1 s. The signal low Voltage 2 on the other hand, is generated first, when the voltage falls below 80% (184 V at 230 V nominal voltage) for 20 seconds, and remains set for at least 5 s.



3.3.3 Frequency Release

For the under- / over-frequency detection 2 different limit values are adjustable as well. Each limit value has its own triggering delay and minimum impulse duration.

Example:

- F max. 1 : 51.2 Hz delay 25 per. duration 2*100ms
- F max. 2 : 54.0 Hz delay 5 s duration 20*100ms

If the frequency of one phase exceeds 51.2 Hz, the signal high Frequency 1 is generated after 25 cycles for at least 200 ms. The signal high Frequency 2 on the other hand, is generated first, when the frequency exceeds 54.0 Hz for 5 seconds, and remains set for at least 2 s.

3.3.4 Vector Surge Release

For the vector surge detection, different combinations are selectable and to assign to output relays. 'L1 or L2 or L3' or 'L1 and L2 and L3'. The input is done in angular degrees relative to a full circle with 360°.

Two different limit values can be parameterised. The signal vector surge always is triggered undelayed. Nevertheless a delay time (requires firmware version V1.15 or later) for the start of vector surge monitoring after a release has taken place (relevant disabling of trig-gerings has been nullified) can be set as well, as the impulse duration of the signal.

Example:

- Vector Jump 1 : 12° duration 4*100ms
- Vector Jump 2 : 8° duration 35*100ms

If a vector surge of 9° occurs on one phase, the signal high Vector Jump 1 is generated for 3.5 s. If the vector surge amounts over 12°, the signal Vector Jump 2 as well as the signal Vector Jump 1 will be generated. Vector Jump 2 will be active for at least 3.5 s, Vector Jump 1 is activated for 400 ms.

3.3.5 Delta f to Delta t (ROCOF)

The SFW-7 can indicate the rate of change of frequency (ROCOF - requires firmware V1.09 or later). This monitoring function (Δf to Δt) is double-stage designed. Limit values can be parameterised from 1,0 Hz/s up to 10,0 Hz/s with delay times from 5 up to 50 periods. The evaluation of rate of change takes place each period. Triggering occurs, when the adjusted limit is exceeded for the set duration of periods.

The measuring accuracy at monitoring the frequency change-rate at ... amounts to ...

- freq. = 50 Hz and Δf / Δt = 1,0 Hz/s better +/- 0,2 Hz/s (< 1,0 % rated frequency);
- freq. = 50 Hz and Δf / Δt = 10,0 Hz/s better +/- 0,7 Hz/s (< 1,5 % rated frequency).

Note: Monitoring of rate of change of frequency is only available with firmware version V1.09 or later!

Important: For the parameterisation of this monitoring function, the parameterisation soft-ware (device manager GV_2), version V2.31_01 or later is required.

3.3.6 Angle Error Release

Normally the phase angle is 120 °. For the angular error release a lower limit (Angle min) and an upper limit (Angle max) is adjustable. If the phase angle of all 3 phases ranges within this array, no signal is generated. If one of the phase angles exceeds the upper limit, or falls below the lower limit, the signal will be generated for the minimum duration time after elapse of the delay time.

Example:

- Angle Δ min : 110° delay 5 per. duration 4*100ms
- Angle Δ max : 135° delay 5 per. duration 4*100ms

If the angle between Lx – Ly becomes less than 110°, the signal 'angle too small' is generated for at least 400 ms after elapse of 5 cycles.

Note: The angle error is triggered as well on loss of a phase voltage.

3.3.7 Voltage Asymmetry Release

For the asymmetry monitoring a limit value on the maximum deviation is entered.

Example:

- Delta : 25 % delay 25 Per. duration 8*100ms

If the voltages Lx - Ly differ from each other for more than 25% of the nominal voltage, the signal voltage asymmetry is generated for at least 800 ms after elapse of 25 cycles.

Note: The voltage asymmetry release is triggered as well on loss of a phase voltage.

3.3.8 Deviation of Mean value

If deviation of mean value is enabled, the SFW-7 monitors the average of the 3 external conductor voltages on fall below the set limit. So:

X % < ((U12% + U23% + U31%) / 3)

Example 1: X = 80%
U12 = 100%, U23 = 102%, U31 = 80%
mean value = 94% - no release

Example 2: X = 80%
U12 = 91%, U23 = 90%, U31 = 58%
mean value = 79% - release

The criteria for the undervoltage detection remain excluded hereby.

3.3.9 Rotary Field Detection

The SFW-7 is set ex work without rotary field error. When rotary field error is activated, the smallest / largest of the 3 phase angles is used as triggering criterion. If it falls below - , respectively if it exceeds 180°, the signal rotary field error is generated. The rotary field error has no effect on the other error signals. The monitoring can be adjusted on left or right rotary field by the parameterisation software.

Note: The rotary field release is triggered as well on loss of a phase voltage.

3.3.10 Voltage Quality

The SFW-7 controls the voltage quality in accordance to DIN V VDE 0126-1-1 and / or DIN VDE-AR-N 4105:2011-08. This function observes the voltage on exceeding of a limit value, which can be adjusted in the range from 110 % up to 115 % of the nominal voltage, using a sliding average of values, measured over a time frame of 10 minutes (600 seconds).

Note: This function works independent of activation of the VDE0126 protective function and / or the VDE4105 protective function. Its release delay time ist fixed preset at 5 periods.

3.4 Reset manually- / automatically

By setting within the parameterisation - software an impulse duration minimum as well as a triggering delay is individually adjustable for each limit value. It is also adjustable to whether a signal is to be reset manually. This behaviour can be set separate for each signal.

Example 1: reset: manually

high Voltage 2 minimum impulse duration deactivated

In case of overvoltage the signal 'high Voltage 2' remains set until manually reset after elapse of the delay time. The reset is done either by pressing the ENT key or a respectively parameterised digital input.

Example 2: reset automatically

low Voltage 2 impulse duration 10*100 ms (min.)

In case of undervoltage the signal 'low Voltage 2' is generated after elapse of the delay time for the duration of the event. If this duration is shorter than the minimum impulse duration, the signal remains present for the minimum impulse duration.

If DIL-S1 is closed (ON) the reset of releases can only be done via a digital input or by actuating the reset – button (Enter) and the triggering values are indicated on the device-display until reset of the release.

3.5 Release Storage

The SFW-7 saves the values of the triggerings. The error memory always contains at least the last event, even after erasure. The action levels are permanently stored with date and time in a flash - module and are retained, even on loss of the auxiliary voltage. The error memory can contain about 38 up to 49 releases. The release values can be read on the device display, or be output to a terminal program via the RS-323 interface. During operation, the release values retrievable via DIL-S4 Switch.

If DIL-S4 is closed, the last release event is displayed first. The various values of this release can be observed by actuating the UP – key. The use of the ENT – key causes a scrolling backwards through the stored release events.

For an output via RS-232 interface both keys have to be pressed down for approx. 5 seconds. In doing so, the display may flicker briefly. This gives the following display within the terminal program of the PC:

```
Output error memory from : 2004.11.28 Event counter: 00021;
Date :   ;Time ;Art;U1n;U2n;U3n;U12;U23;U31;F1  ;F2  ;F3  ;V1  ;V2  ;V3
JJJJ.MM.TT;hh:mm;   ;[%];[%];[%];[%];[%];[%];[Hz];[Hz];[Hz]; [°]; [°]; [°]
2004.11.28;04:02;<U1;089;113;111;097;112;104;50.0;50.0;50.0; 000; 000; 000;
2004.11.28;04:01;<U1;000;113;111;064;111;064;00.0;50.0;50.0; 000; 000; 000;
2004.11.28;03:54;<U1;089;113;111;032;111;082;50.0;50.0;50.0; 000; 000; 000;
2004.11.28;03:54;>U1;121;113;110;035;111;094;50.0;50.0;50.0; 000; 000; 000;
```

Terminal program of Windows: *Hyper Terminal*
(Start/Programs/Accessories/Communications...)

The output takes place in CVS format and thereby conveniently to import into spreadsheets or databases. Interface setting: 38400,8,N,1

To erase the stored triggering values, the ENT – key has to be pressed down for approx. 10 seconds:

After elapse of this time, all releases will be deleted except of the last.

** Attention **
Error Memory
will be cleared
in 4 s

3.6 Voltage Indication / Transducer Factors

For a correct adjustment to the respective switching system the transformer ratios have to be entered. The input format is transducer voltage primary / transducer voltage secondary. The depiction of numbers on the devices display (format) is adjustable via the exponent for voltage indication. The input within the parameterisation software is done via a selection in a drop-down box. The exponent hereby is internally adjusted automatically. The setting of voltage indication has no effects on the release of limit values, which is always evaluated on a percentage basis.

setting	format of indication
0	99.9 V
1	999 V
2	9.99 kV

Voltage L-N / Cyc
U1n: 231 V 50.0 Hz
U2n: 230 V 50.0 Hz
U3n: 231 V 50.0 Hz

setting = 1

Voltage L-N / Cyc
U1n: 1.56 kV 50.0 Hz
U2n: 1.56 kV 50.0 Hz
U3n: 1.55 kV 50.0 Hz

setting = 2

For the star point voltage a maximum up to 1.8 kV can be set. The setting for the phase-conductor voltage shall not exceed 3.2 kV. The input of higher values is possible as well, but this may lead to faulty indications or functions.

***Note*:** For plants that operate with voltages above 3,200 V, the SFW-7 must be configured in the way, that the indication of voltages takes place via secondary voltages. For the transducer factors in this case, a ratio of 1:1 or 230:230 is to be selected. The secondary voltage is to adjust as nominal voltage.

3.7 Protective Function according to DIN V VDE V 0126-1-1

This monitoring function according to DIN V VDE V 0126-1-1 can be activated by the appropriate configuration of one of the relay contacts (see chap 2.2 'digital outputs'). If none of the relays is assigned to this function, the protective function is deactivated.

Voltage and frequency are observed when function is activated:

- U ≤ VDE 0126 limit value 80 %
- U ≥ VDE 0126 limit value 115 %
- F < VDE 0126 limit value 47.5 Hz
- F > VDE 0126 limit value 50.2 Hz

Note: These values can not be changed!

In addition a monitoring of the voltage quality in accordance to DIN V VDE V 0126-1-1 takes place. In order to do this, an over a 10-minute-interval measured sliding voltage-average for each of the three phases is monitored for exceedance of limit. This value ex works is set on 110%. Only permitted by arrangement with the respective grid operator, this limit value can be adjusted in the range of 110 % up to 115 %.

To activate a contactor directly, the output function VDE0126 (33) can be linked with the input function 'activation release' (14 - see chap 2.1 digital inputs) for VDE0126. To take effect, it is required to parameterise another digital output with the function 'VDE0126 ok & activation' (38 - see chap 2.2 digital outputs).

The relay switches not until:

1. the measuring values lie within the VDE 0126 – limits, and
2. the related input is activated.

3.8 Protective Function according to DIN VDE-AR-N 4105:2011-08

Additional monitoring functions can be activated by parameterisation of a relay-contact (see chap 2.2 'digital outputs') with the function VDE4105 (41, with disabling function: 49) or VDE4105_ok&activation (42). With these options the SFW-7 meets the limit value- and switch-on conditions according to DIN VDE-AR-N 4105:2011-08.

On activation, voltage and frequency are monitored:

- U < VDE 4105 limit value : 80 %
- U >> VDE 4105 limit value : 115 %
- F < VDE 4105 limit value : 47.5 Hz
- F > VDE 4105 limit value : 51.5 Hz

additionally: voltage quality (*average over 10 min interval*)

- U > VDE 4105 limit value : 110 ... 115 %

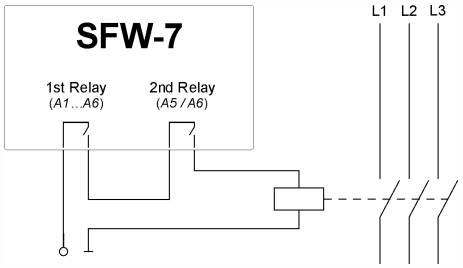
Note: These values can not be changed!

The output function VDE4105 (41/49) on the appropriately parameterised relay as soon as one of the limit values (shown above) is exceeded or undershot.

The relay-function VDE4105_ok&activation (42) is linked with the switching-on monitoring as per DIN VDE-AR-N 4105:2011-08. This means, that switching-on (connection to mains) only takes place when the, as per standard prescribed conditions (voltage = 80 - 110 % of nominal voltage, frequency = 47 - 50,05 Hz) are maintained for at least 60 seconds. Switching off takes place, when the limit values (shown above) are exceeded or undershot.

To ensure intrinsic safety on loss of voltage, this relay function must be parameterised with the switching behaviour ‘open circuit’. Additionally two relay contacts (recommended relays ‘A5’ and ‘A6’), which are assigned to this function, have to be connected in series.

Example of a series connection of 2 SFW-7 relays, which are configured with the protective function according to DIN VDE 4105-AR-N (*pict. right*).



Using the input function (see chap 2.1 'digital inputs') VDE4105 test button (15) it is possible to execute a test of the monitoring function (error simulation). The activation of the appropriately configured input leads to the de-energising of the relays, which are configured for monitoring, and to the restart of the switching-on monitoring (described above).

Notes on measurement accuracy:

- maximum voltage tolerance +/- 1%;
- maximum frequency tolerance +/- 0.1 % → corresponds to +/- 0.05 Hz;

Note: By activating of protective function according to VDE 4105 with disabling function (49 - see chap. 2.2 'digital outputs'), the option of temporary blocking of releases at the respectively related relay is given by using an, with the function ‘disable VDE4105 release’ (16 - see chap. 2.1 'digital inputs') parameterised input. The protective function according to DIN VDE-AR-N 4105:2011-08 is available only with firmware version V1.09, including disabling function V1.14 or later!

Important: For the parameterisation of this monitoring function, the parameterisation software (device manager GV_2), version V2.31_01 or later is required.

Note on detection of island grid:

The SFW-7 is suitable for passive islanding detection in systems without an inverter or at single-phase feed-ins due to the 3-phase voltage monitoring (according to DIN VDE-AR-N 4105:2011-08). The parallel use of additional protection functions of the SFW-7, such as vector surge detection is of course possible.

4 Measurement

The voltage measurement is a true root mean square measurement. The three measuring paths are measured simultaneously and the 3 frequencies are captured independently.

***Note*:** For plants that operate with voltages above 3,200 V, the SFW-7 must be configured in the way, that the indication of voltages takes place via secondary voltages. For the transducer factors in this case, a ratio of 1:1 or 230:230 is to be selected. The secondary voltage is to adjust as nominal voltage.

4.1 3-Wire – and 3-Wire + N – Systems

Measuring with or without star point may be selected by the choice of the measurement method. When measuring without star point it is not necessary to connect a neutral conductor. Due to a special internal wiring of the terminals, in a 3-wire + N – system the loss of the neutral conductor can be detected and indicated in form of a voltage asymmetry or undervoltage Lx. At measuring voltages ≤ 100 V a reliable detection of the loss of the neutral conductor is only guaranteed by using the 100 / 57 V – version of the SFW-7.

4.2 Behaviour at low Voltages

Due to the construction, the frequency measurement occurs only above of an input voltage phase – N of about 50 V with the 400 / 230 V – Version, resp. 13 V with the 100 / 57 V – Version. If the voltage ranges below this value, the unit works with the set parameters of nominal frequency (50 or 60 Hz). A correct frequency measurement is indicated by the 3 green LEDs near the connecting terminals.

4.3 Phase Voltage

The voltage measurement starts at a phase voltage of about 35 V phase – N.

4.4 Collective Fault 1+2

The device offers the possibility to form 2 independent collective fault signals. These are compounded of the individual limit values. At this way, the user can configure a specific event itself.

Example:

- low Voltage 1 or low frequency 2 or Vector Jump 1 = Collective Fault 1
- Collective Fault 1 = Relay 5

This leads to the activation of relay 5 in case of one of the 3 events listed above.

5 Parameterisation

For a correct adjustment to each individual application, the parameterisation of the device is required. Before start-up, trigger values, nominal voltage and transducer values have to be parameterised and adjusted. For parameterisation the use of the supplied, respectively for downloading on our homepage www.koralewski.de available parameterisation software 'device manager' is recommended. The modification of limit value settings by direct input at the device is possible as well.

5.1 Database

The setting values which are used by the SFW-7 and stored within the device, can be read out at any time from the device, stored on a PC and printed out for documentation purposes, using the parameterisation software 'device manager'. For detailed user instructions of device management, see the related description.

5.2 Setting the Time

The time can be manually entered at the device or be adjusted automatically via the PC connection. To set the time at the device, the Switches DIL-S2 an DIL-S4 are to be closed.

By pressing the ENT – key all the digits of the time / date display successively can be changed with the UP – key.

Time and Date:
Time: 10:34 56 s
Date: 28.11.2004
edit with ENT

5.3 Editing at the Device

The setting of most of the values is also possible directly at the device. Hereinafter the procedure for entering at the device is described. Parameter data, listed in the tables on the following pages, have to be observed.

5.3.1 Protection of Input with PIN

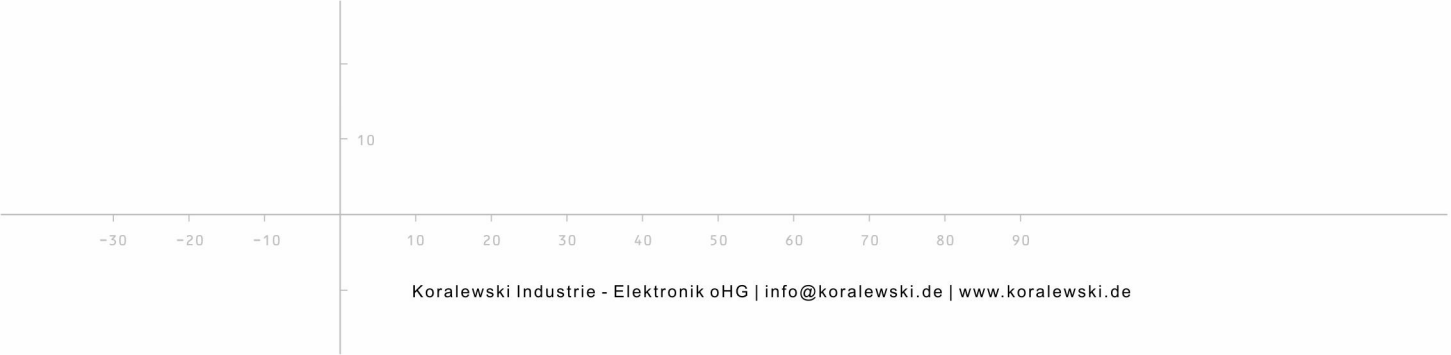
Mains Protect Relay
SFW-7 English
PIN input : ___0

To protect the stored data a PIN - protection for input at the device may be activated using the parameterisation software. With activated PIN - protection inspection and altering of the setting values is possible only after entering of the correct PIN. For the PIN - code is a numeric value from 1 up to 9999 is required.

For the input of the PIN close DIL-2 and press ENTER - button. The cursor jumps to the last digit. The digit can be altered by actuating the UP - button. By pressing the ENTER - button, the cursor jumps to the next position. After all 4 digits have been adjusted the ENTER - button is one more time to actuate. If the PIN is entered correctly, the parameter input level is reached. At wrong PIN - entry the display jumps back to 0.

5.3.2 Parameter Setting

When closing DIL-2 (ON), one arrives into the parameterisation. The switching back of DIL-2 (OFF) will leave it. When leaving the parameterisation without finishing the current entry, the latest adjusted value is lost. The set values are permanently stored within the microcontroller. For this, no battery buffering is required.



5.3.3 Manually Selection of Tables

Within the parameters, first the table with the values to change has to be selected, using the UP - button. The table name is indicated in the second line of display. If the desired table is selected, the choosing is confirmed by pressing Enter.

The following tables are available:

Edit Table No: 1
Analog. Ausg. / OUT
scroll - UP
Choosing - ENT

1: analogue values

2: digital outputs

3: digital inputs

4: limit values

5: texts (view only)

7: setting values

5.3.4 Manual Editing

The selection of the line is done, as described above, by actuating the UP – Button. The designation of the selected value is shown in the third line. After selecting the line, the column selection is opened by pressing the Enter button. After selecting of the column, the editing starts in turn by pressing Enter. Depending on the value that shall be altered, 3 or more digits are to be entered (see also chap. 5.3.1). Editing is finished, when the cursor jumps back again to the selection of columns.

5.3.5 Return to the Selection of Line respectively Table

The return to the respective superordinated selection is made by pressing and holding down (about 2 seconds) of the UP – button.

6 List of Parameters – Table Summary

Column	Analogue Assignment Table (Output x) Line 1 up to 2		Default
3	voltage range	1 (0 up to 10 V) **or** 0 (2 up to 10 V)	0
4	initial value	value at 0(2) V	0 %
5	final value	value at 10 V	100 %
7	function	see chap. 2.3 analogue outputs	X

Column	Relay Assignment Table (Ox RELx) Line 1 up to 6		Default
3	function	see chap. 2.2 digital outputs	X
4	switching behaviour	open circuit (0), closed circuit (255)[1)]	0

Column	Input Assignment Table (INx) Line 1 up to 3		Default
3	function	see chap. 2.1 digital inputs	X
4	switching behaviour	open circuit (0), closed circuit (255)[1)]	0

Limit Values Table

Line	Function	Range	Hysteresis	Delay [1] Periods* / s	Duration (in 100ms)	Reset manually	Collective Fault 1	Collective Fault 2
		(Column 3)	(Col. 4)	(Col. 5) [1]	(Col. 6)	(Column 8) [2]	(Column 10) [2]	(Column 11) [2]
1	low voltage 1	0 ... 200 %	0 ... 50 %	0 ... 100 per.	0 ... 100	1 [2] = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
2	high voltage 1	0 ... 200 %	0 ... 50 %	0 ... 100 per.	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
3	low voltage 2	0 ... 200 %	0 ... 50 %	0 ... 120 s [1]	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
4	high voltage 2	0 ... 200 %	0 ... 50 %	0 ... 120 s [1]	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
5	low frequency 1 [Hz]	35.0 – 65.0	0.0 – 2.0	0 ... 100 per.	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
6	high frequency 1 [Hz]	35.0 – 65.0	0.0 – 2.0	0 ... 100 per.	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
7	low frequency 2 [Hz]	35.0 – 65.0	0.0 – 2.0	0 ... 120 s [1]	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
8	high frequency 2 [Hz]	35.0 – 65.0	0.0 – 2.0	0 ... 120 s [1]	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
9	vector jump 1	0 ... 90°	–	0,0 ... 10,0s [1]	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
10	vector jump 1	0 ... 90°	–	–	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
11	vector jump 1	0 ... 90°	–	–	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
12	vector jump 2	0 ... 90°	–	–	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
13	vector jump 2	0 ... 90°	–	–	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
14	vector jump 2	0 ... 90°	–	–	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
15	angle error L-L < X	0 ... 240°	0 ... 90°	0 ... 100 per.	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
16	angle error L-L > X	0 ... 240°	0 ... 90°	0 ... 100 per.	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
17	voltage asymmetry	0 ... 100 %	0 ... 50 %	0 ... 100 per.	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
18	rotary field error	180°	–	–	–	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no
19	mean value deviation	0 ... 100 %	0 ... 50 %	0 ... 100 per.	0 ... 100	1 = yes; 0 = no	1 = yes; 0 = no	1 = yes; 0 = no

** Delay time in relation to the frequency of measuring voltage.*

Limit Values Table – Defaults

Line	Function	Value	Hysteresis	Delay [1] Periods* / s	Duration (in 100ms)	Reset manually	Collective Fault 1	Collective Fault 2
		(Column 3)	(Col. 4)	(Col. 5) [1]	(Col. 6)	(Column 8) [2]	(Column 10) [2]	(Column 11) [2]
1	low voltage 1	90 %	5 %	5 per.	20	0	1 (255) [2]	0
2	high voltage 1	110 %	5 %	5 per.	20	0	1 (255)	0
3	low voltage 2	0 %	5 %	20 s [1]	20	0	0	0
4	high voltage 2	0 %	5 %	20 s [1]	20	0	0	0
5	low frequency 1 [Hz]	49.2	0.5	5 per.	20	0	1 (255)	0
6	high frequency 1 [Hz]	50.8	0.5	5 per.	20	0	1 (255)	0
7	low frequency 2 [Hz]	0	0.5	5 s [1]	20	0	0	0
8	high frequency 2 [Hz]	0	0.5	5 s [1]	20	0	0	0
9	vector jump 1	8°	–	0,0 s [1]	20	0	1 (255)	0
10	vector jump 1	8°	–	–	20	0	1 (255)	0
11	vector jump 1	8°	–	–	20	0	1 (255)	0
12	vector jump 2	0°	–	–	20	0	0	0
13	vector jump 2	0°	–	–	20	0	0	0
14	vector jump 2	0°	–	–	20	0	0	0
15	angle error L-L < X	0°	10°	5 per.	20	0	0	0
16	angle error L-L > X	0°	10°	5 per.	20	0	0	0
17	voltage asymmetry	0 %	5 %	5 per.	20	0	0	0
18	rotary field error	180°	–	–	–	0	0	0
19	mean value deviation	0 %	5 %	5 per.	20	0	0	0

[1] ***Attention:*** Observe the notes on the firmware version (*following page*)! [2] The value '1' is displayed as '255' before and after editing..

Notes on the Firmware Version:

From SFW-7 firmware version V 1.06 on the delay time for the release of the limit values 'low voltage 2', 'high voltage 2', 'low frequency 2' and 'high frequency 2', can be set within a range from 0 up to 120 seconds. In divergence to this, only the smaller setting range from 0 up to 100 periods* is allowed with previous versions of the firmware! From SFW-7 firmware version V 1.15 on a delay time of 0,0 up to 10,0 seconds for the start of vector surge monitoring after a release (relevant disabling of triggerings has been nullified) can be set.

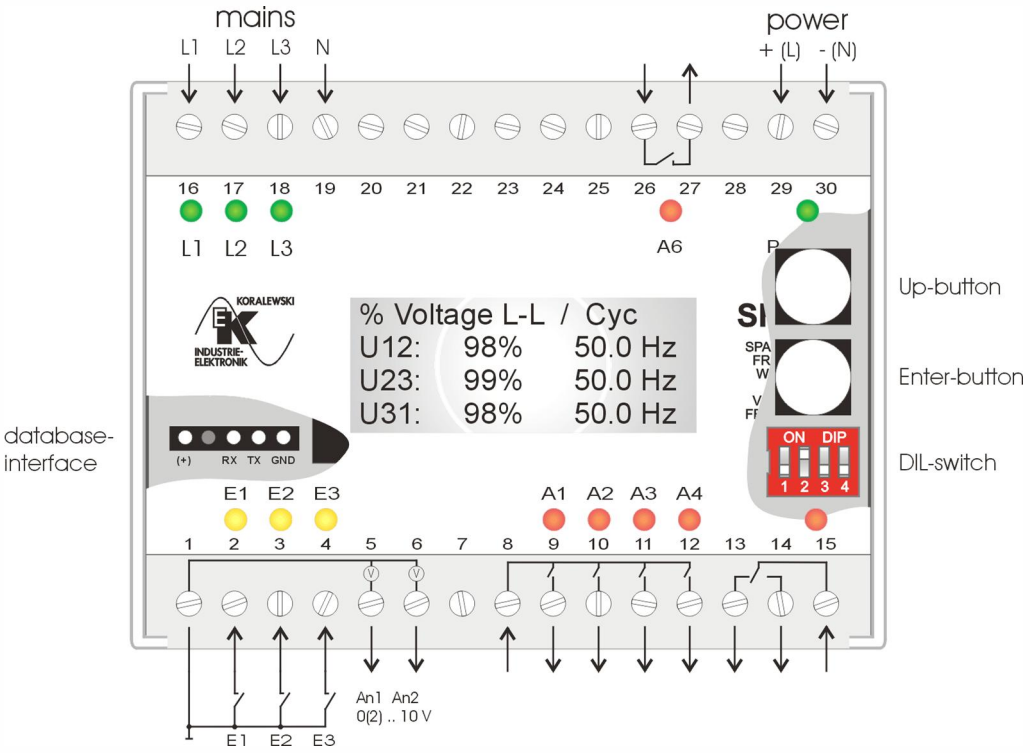
** Delay time in relation to the frequency of measuring voltage.*

Configuration Table

Column	Value	Range	Default
4	standard language	1 or 2	1
6	three-wire system	11) for 'yes' or 0 for 'no'	0
7	display only first error	11) for 'yes' or 0 for 'no'	0
8	parameter input locked	11) for 'yes' or 0 for 'no'	0
12	nominal voltage Phase-N	0 up to 32000 V	230
15	nominal frequency 50 or 60 Hz	1[1)] for '60 Hz' or 0 for '50 Hz'	0
18	display exponent (s. at 3.6 Voltage Indication / Transducer Factors)	0 up to 3	1
20	voltage transducer primary voltage	1 up to 32000	230
21	voltage transducer secondary voltage	1 up to 32000	230
24	standard – display	0 ... 4 (see chap 3)	0
25	view reset time	0 ... 200 s (see chap 3)	10
30	parameterisation – PIN	0 ... 9999	1
31	device code – locked	11) for 'yes' or 0 for 'no'	0
33	rotary field monitoring	11) for 'yes' or 0 for 'no'	0
34	rotary field right / left	1[1)] for 'right' or 0 for 'left'	1

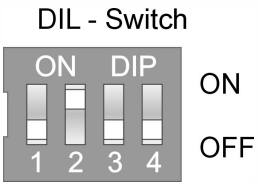
[1)] The value '1' is displayed as '255' before and after editing.

7 Connection Diagram



7.1 DIL-Switch

The DIL-switches have the following functions:



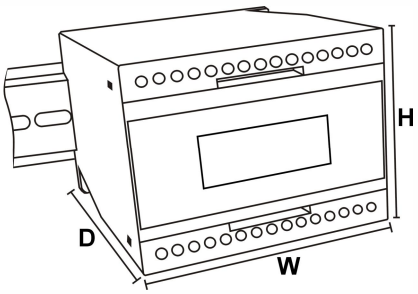
S1:	OFF	– automatically reset
	ON	– reset via input or reset-key (Enter)
S2:	ON	– editing of parameters
S3:	ON	– change-over language
S4:	ON	– error memory - view / print / erase
S2 + S4:	ON	– setting the time

7.2 Accessories

- Parameterisation data cable for PC connection (*pictured below*).
  Replenishment order under Part No. KC0034
- Parameterisation software is supplied on CD or
  available for download at www.koralewski.de .
- Switch panel installation frame (Part No. GI0106)

8 Technical Data

Only properly trained personnel may be deployed for assembly and starting up.
Connection in compliance with VDE 0160.



Auxiliary voltage	24 V DC (18 ... 36 V) optional. 230 V AC / 12 V DC
Power consumption	approx. 4 W at 24 V DC, approx. 6 VA at 230 V AC
Digital inputs	LowActive (contact voltage 12 V, 5 mA, opto-decoupled), cables not longer than 3 m
Relay outputs	230 V / 50 Hz / 2 A (potential-free)
Analogue outputs (optionally)	0 .. 10 V +/- 0.05 V max. 10,5 V
Measuring range	approx. 50 up to 230 / 400 V, tolerance < 0,5 % of full scale (270 / 480 V)
Frequency measuring	35.0 Hz up to 65.0 Hz at approx. 60 V L-N / adjustable in 0.1 Hz steps, repeatability +/- 0.05 Hz
Ambient temperature	-20 ... 55 °C
Housing dimensions	W / H / D : 100 x 75 x 110 mm DIN top-hat rail mounting 35 mm

8.1 Triggering Values

	Setting Range	Resolution	Repeatability	Minimum Triggering Delay *
Over- / Underfrequency	40,0 ... 65,0 Hz	0,1 Hz	< 0,03 Hz	< 60 ms, typ. 48 ms
Over- / Under-Voltage	0 bis 100 % Nennspannung	1 %	< 1 %	< 60 ms, typ. 48 ms
Vector Jump	0 ... 99°	1°	1°	60 ... 80 ms *

*** Setting Range / Triggering Delay** 0 ... 100 periods, minimum triggering delay < 60 ms
(this doesn't apply to vector jump, here is triggered directly in any case)

8.2 Ordering Information

Voltage - Frequency Guard SFW-7	Part number
100 V / 24 V DC – version:	**E1573**
100 V / 230 V AC – version:	**E1574**
400 V / 24 V DC – version: *optionally* with analogue output:	**E2085** **E1079**
400 V / 230 V AC – version:	**E2086**
Accessories	
Switch panel installation frame	**GI0106**
Parameterisation data cable	**KC0034**

9 Connection Example