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ES-SV11.2

Signal Preprocessing Device

Description

1 Connection Example

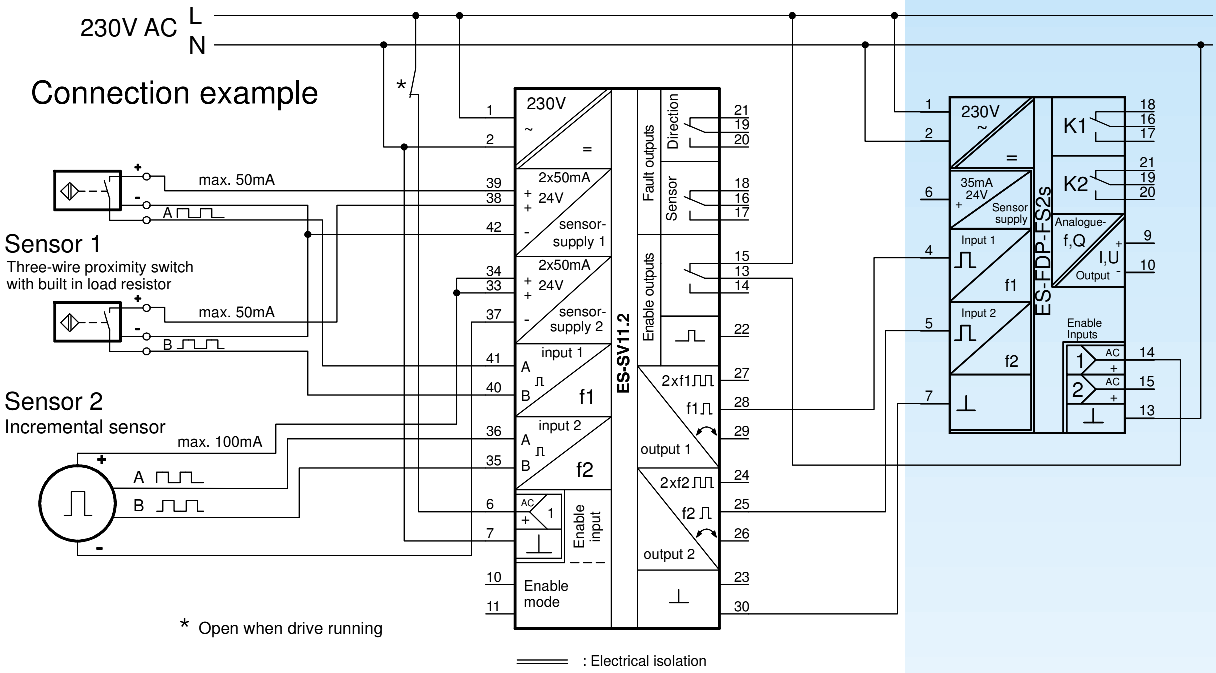

Fig. 1: Connection Example for a supervision with ES-SV11.2 and ES-FDP-FS2s

The function of the signal preprocessing device ES-SV11.2 is to supply the sensors with power and to process the output pulses for further evaluation by a slip controller **ES-FDP-FS8s** or **ES-FDP-FS2s**. The device also monitors every sensor for short circuits and breaks in the connection lines.

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2 Differences between ES-SV11 and ES-SV11.2

- On the new version ES-SV11.2, there are pilot LEDs for checking operation and the states of the relay outputs on the front of the unit.
- In the case of the original version ES-SV11, the direction outputs' polarity (terminal 29 for channel 1 and terminal 26 for channel 2) did not conform to the operating instructions. This has been rectified on the ES-SV11.2. The current version also corresponds to the direction outputs of the ES-SVGL2 (H-level when phase A switches before phase B).

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.

This discription corresponds to the technical status of the unit in March 2019. The current software version is V2.0. **Subject to change.**

3 Function

3.1 Block schematic

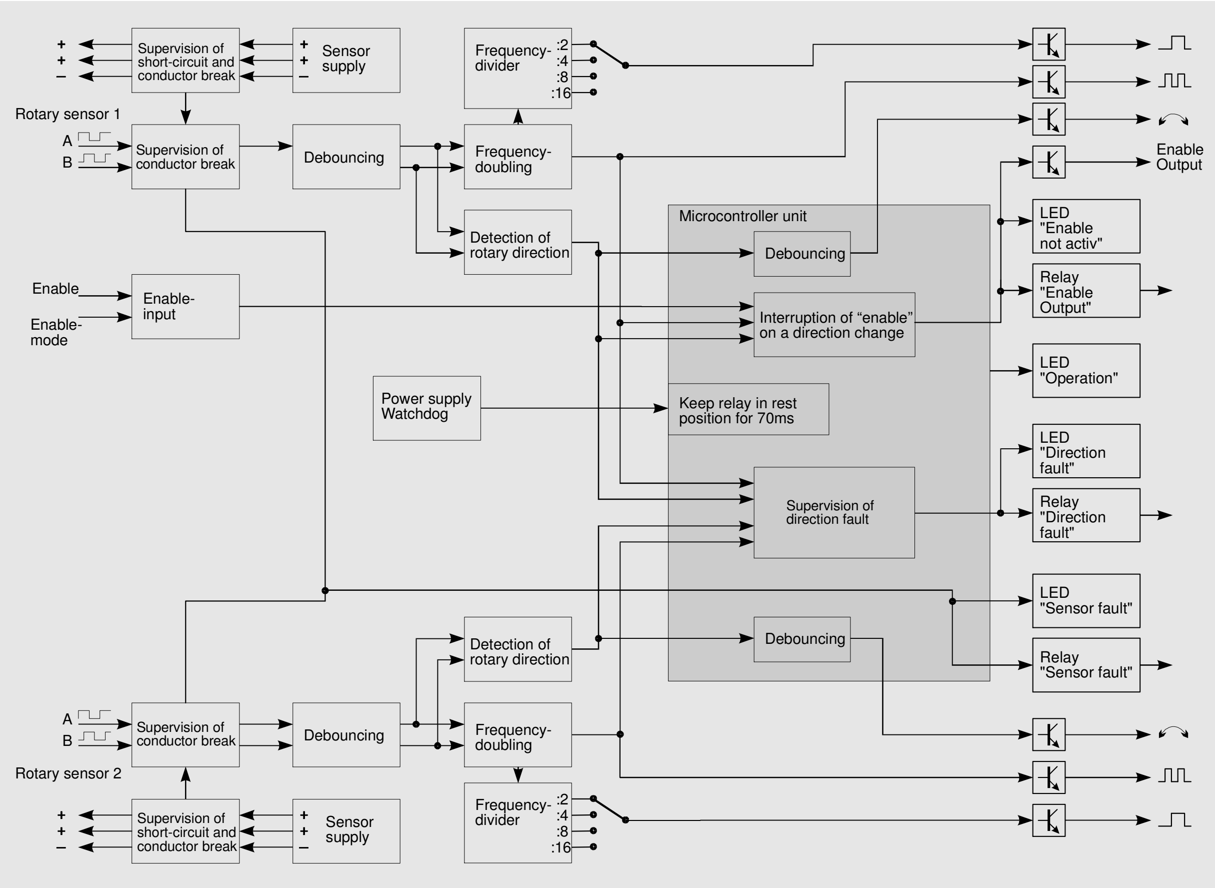


Fig. 2: Block schematic of **ES-SV11.2**

The block schematic explains the unit's functions. By evaluation of two-phase transmitter signals, the unit suppresses bounce and performs direction detection, and forwards the conditioned signals to the evaluation unit (e.g. gear breakage monitor ES-FDP-FS…). Fault states are signalled via relays and an enable signal is generated for the evaluation unit.

3.2 Front panel view

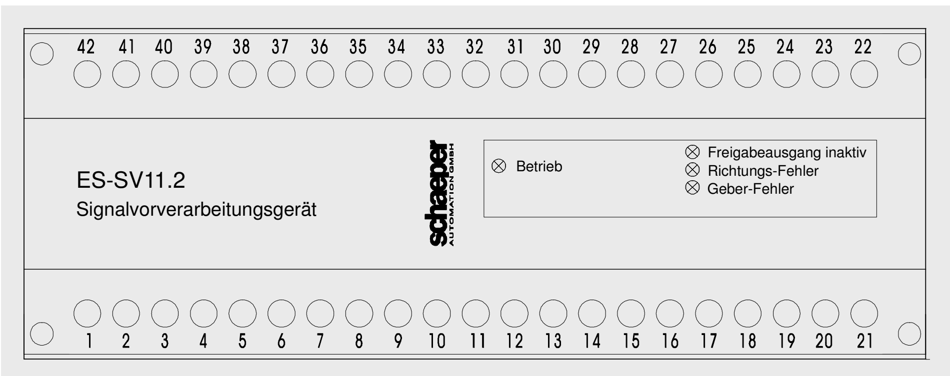


Fig. 3: Front panel view of ES-SV11.2

On the front panel of the unit, there are 4 LED's with the following functions:

Betrieb *(= Operation)* (green): The supply voltage is applied and operation has been assumed.

Freigabeausgang inaktiv *(= Enable output inactive)* (yellow): The enable relay is in the position “enable interuption” and the assigned function of the connected evaluation unit is thus disarmed.

Richtungs-Fehler *(= Direction error)* (red): A direction error has been detected and the associated relay has dropped out.

Geberfehler *(= Sensor fault)* (red): Sensor monitoring has detected a short-circuit or a wire discontinuity on one of the sensors. The associated relay has dropped out.

4 Sensor connection and functions of the input stage

4.1 Sensor Inputs

The sensor inputs evaluate phase shifted pulse sequences, such as those created by incremental sensors or two proximity switches mounted in a shifted manner. On the one hand, the **direction of rotation** is determined from this and, on the other hand, **bouncing** of the pulses is suppressed, e.g. due to torsional vibration or suspension of the drive line. Bouncing exists when the pulses are not strictly alternating in the two phase-shifted pulse sequences:

Fig. 4: Example of bouncing in the case of a two-phase sensor signal

The unit generates interruption of the enable signal for a subsequently connected gear breakage monitor ES-FDP-FS… in the event of a change of rotation direction of sensor 1.

For correct generation of the enable signal, the motor-end sensor must be connected to sensor input 1 and the drum-end sensor to sensor input 2.

The sensor inputs are optionally available for three-wire proximity switches (or incremental sensor) or for two-wire proximity switches.

4.2 Mechanical Mounting of the rotary sensors

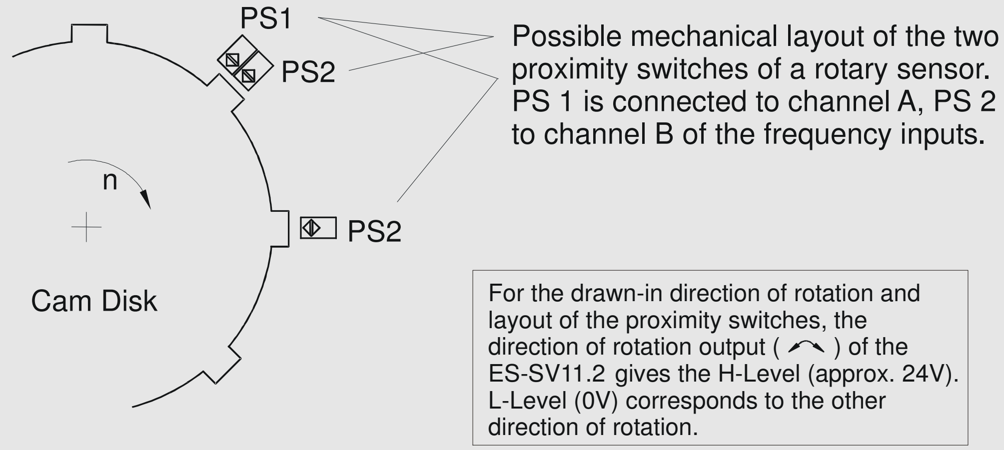
The rotary sensors must be mounted such that they are mechanically stable and low on vibration. Inaccuracies and play with the assembly of the rotary sensors could drastically worsen the characteristics of the monitoring equipment.

Radial play in the connection of cable drum to incremental sensor or in the mounting of the incremental sensor casing results in increased or reduced pulse frequencies occurring for a short time during load and direction changes. Suppression of such faults would require time delays in the signals, which would naturally also delay emergency braking in the event of a break in the driving assembly!

The incremental transmitters must therefore be flange-mounted on to the shafts with a torsion-proof coupling capable of balancing out the axial offset. An alternative are incremental transmitters with hollow shafts; here the casing must be mounted torsion-proof.

If a cam disk in combination with proximity switches (PS) is used as rotary sensor, then care must be taken to ensure the distance of the cams is exactly the same, especially on the side with the lower speed (e.g. the cable drum). The slip controller **ES-FDP-FS...** evaluates every pulse gap of the lower input frequency without signalling and therefore unequal cam distances lead to incorrect measured values and incorrect switching of the output relay.

If proximity switches are used, two proximity switches must be mounted in such a way that their output pulses overlap, but are not emitted at the same time. The interval between switching of the two phases must be at least 50µs. This produces the phase offset required for detection of the direction of rotation. This phase offset therefore refers to the electric response. The mechanical configuration and correct time response of the output signals is shown in **Fig. 5**.



Output pulses of the proximity switches

(Constant speed and direction of rotation of the cam disk as shown in the figure above)

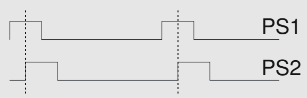
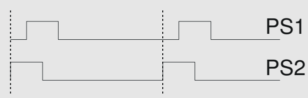
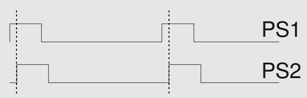
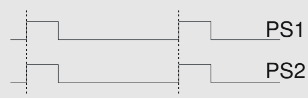
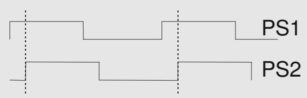
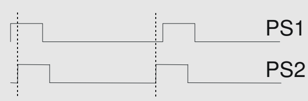
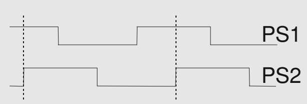
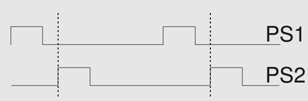
Examples of correct output signals	Examples of wrong output signals	Possible cause / Effect
		PS1 and PS2 are interchanged / Direction of rotation will be wrongly detected
		Wrong distance between PS1 and PS2 / Supervision unit does not function
		Irregular distances of the cam / Supervision unit does not function
		Wrong distance between PS1 and PS2 / Supervision unit does not function

Fig. 5: Mechanical layout of proximity switches to obtain phase-shifted pulse

4.3 Version for connection of incremental or three-wire sensors

4.3.1 Sensor supply

Each output for the sensor supply (24V DC) may be loaded with max. 50mA. For supply of the incremental sensors, two outputs are switched in parallel, so that 100mA is available. At higher currents the internal current limiter works. In that case the sensors do not output correct signals, so computing of the signals is not possible. The device signals sensor fault.

4.3.2 Suitable sensors

Sensors that assume a high resistance in a mode of operation cannot be monitored for wire breakage. Therefore, for correct functioning of sensor monitoring, **incremental sensors with a complementary output or proximity switches with a built-in load resistor** (max. 10 kΩ) must be used.

4.3.3 Connection Example

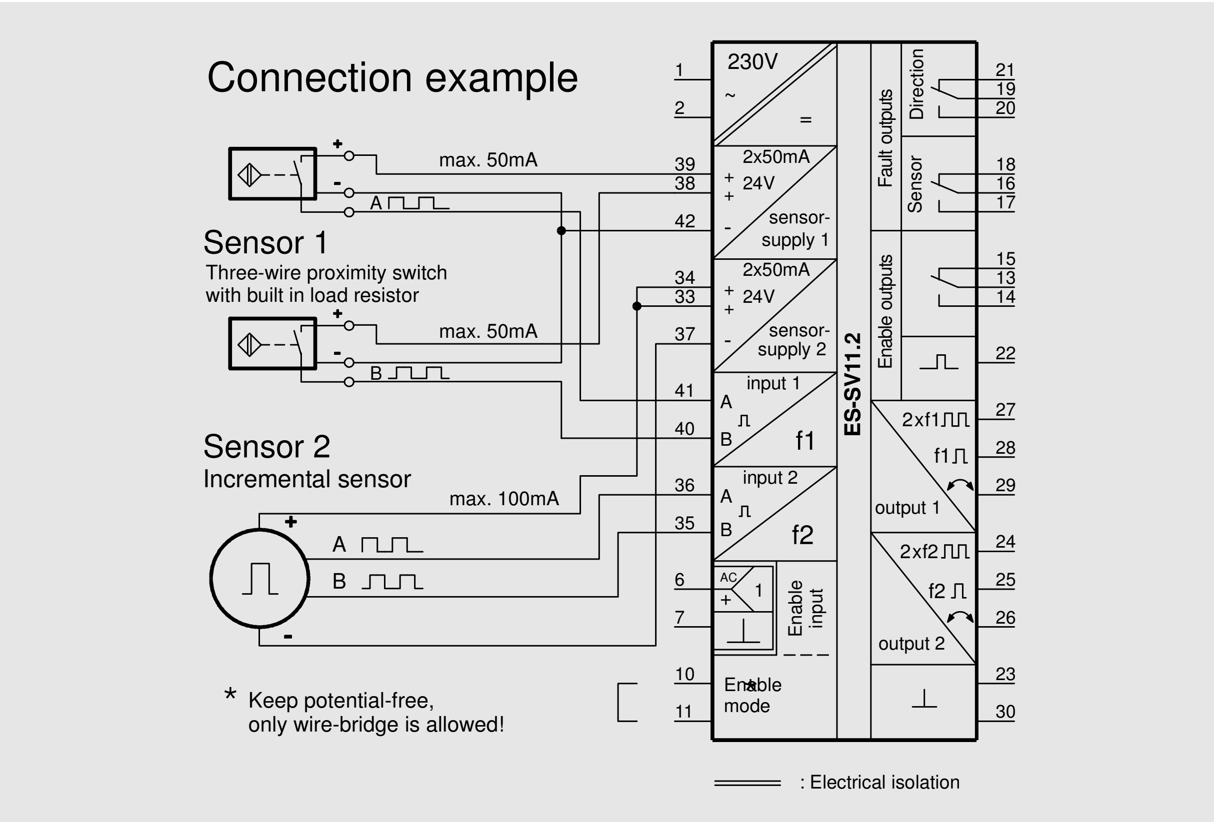


Fig. 6: Connection of Incremental sensors or Three-wire proximity switches

4.4 Version for connection of two-wire sensors

The unit is also optionally available for the connection of two-wire proximity switches. The sensor is then supplied with 24V DC with an internal resistance of 2.4 kΩ.

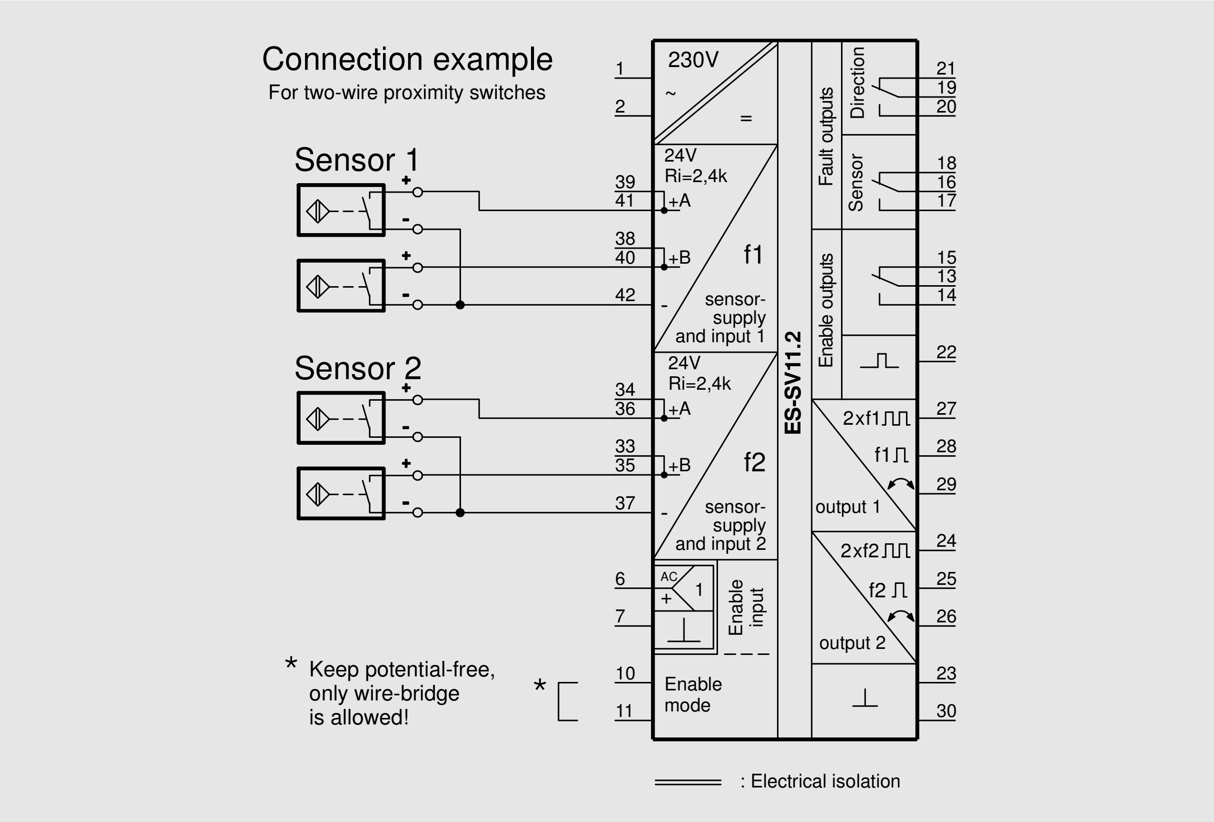


Fig 7: Connection of Two-wire proximity switches

5 Fault and signal outputs

5.1 Relay Sensor Fault

Monitoring of short-circuits and interruptions in the connection lines to the sensors is carried out separately for each sensor with the assistance of the current consumption. With this, the sensors are continuously monitored (also when the drive is standing still), to the extent that the proper mains power is supplied for the ES-SVGL2. Faults cause the relay *Sensor Fault* to trip.

For correct functioning of this monitoring mode, the sensors used must not assume a high resistance in any mode of operation.

5.2 Relay Direction Fault

Should the rotary sensors 1 and 2 not report the same direction of rotation, the relay *Direction Fault* trips. The causes of this can be incorrectly connected sensors or mechanical faults in the driving assembly. A direction fault is only detected if, after a change in the direction of rotation, two pulses are found to be in the wrong direction at the input for sensor 2 **(Fig. 8)**.

This relay can signal incorrectly if a high degree of play occurs in the driving assembly or couplings with low torsional rigidity are used. This danger exists when, after a direction change detected by rotary sensor 1 (drive side), the downthrust side (rotary sensor 2) continues to run in the original direction because of the play long enough for sensor 2 to supply more than two pulses. The higher the pulse resolution of rotary sensor 2 is, the lower the play in the driving assembly must be.

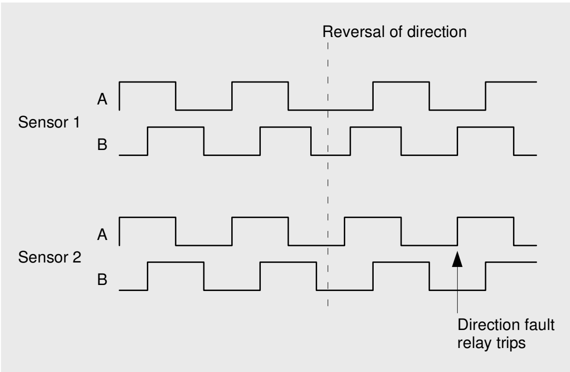


Fig. 8: Condition for tripping of the relay Direction Fault

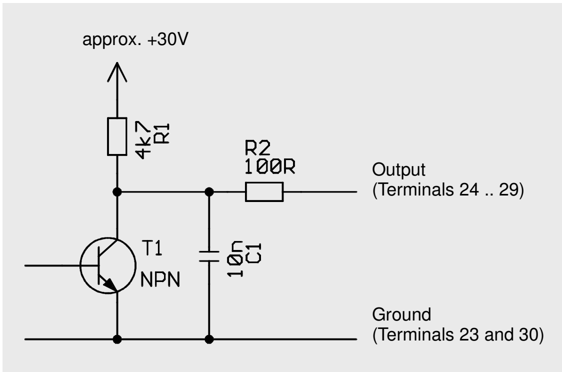


Fig. 9: Circuit diagram of the output stages

5.3 Frequency and direction outputs

The **ES-SV11.2** has three transistor outputs for each of the two sensors. One output supplies pulses with the frequency of the input pulse ( ), while the second output supplies pulses with the doubled frequency of the input pulse ( ) and the third output signals the direction of rotation ( ). The allocation of the direction of rotation and signal level of the output is shown in **fig. 5**. Switching of phase A before phase B results in H-level.

Fig. 9 shows the electrical structure of the output stages. They are designed for the connection of frequency monitors of the series **ES-FDP..** .

Attention:
The second output ( ) should only be used for further processing if the pulse has the sensing ratio 1:1 and approx. 90° phase shift at the inputs A and B.

5.4 Enable input and enable mode

All monitoring functions of the ES-SV11.2 are permanently active and do not depend on the signal at the enable input.

The enable input serves to enable the subsequently connected gear breakage monitor. The signal applied is conditioned and is forwarded to the gear breakage monitor via the enable outputs.

The enable input is optionally available for control with 230V AC/DC or 24V DC. The enable input is electrically isolated from all other inputs and outputs.

The input for enable mode is not electrically isolated and must therefore be kept in a floating state. **Here, only a short wire jumper may be connected to the terminals! Table 1** shows the meaning of enable mode.

If the enable outputs are to be permanently active, no external connection is established (no enable signal and no jumper at the "enable mode" terminals).

5.5 Enable signal for subsequent gear breakage monitor

The frequency relationship between the pulses of sensor 1 and sensor 2 normally does not correspond to the reference value during a reversal in the direction of rotation of the driving assembly. The digital slip monitor **ES-FDP-FS...** must therefore be deactivated for a short time to avoid an incorrect error message. For systems that cannot interrupt the enable signal during a direction change the interruption is effected by the enable output of the **ES-SV11.2**.

The SV11 detects a direction of rotation reversal on the basis of the pulses of sensor 1. This leads (if the enable output is active; **cf. Table 1**) to an interruption of enabling for the connected evaluation unit (e.g. **ES-FDP-FS..**). The interruption time is approximately 80 ms. If required, the interruption time can be extended with the aid of the programmable enable interruption delay on the slip monitor **ES-FDP-FS...**.

Enable mode	Signal at the enable input	Enable output	
Not jumpered	Off	Active	(Enabling for gear breakage monitor, which is interrupted in the event of a direction of rotation reversal)
	On	Off	(No enabling for gear breakage monitor)
Jumpered	Off	Off	(No enabling for gear breakage monitor)
	On	Active	(Enabling for gear breakage monitor, which is interrupted in the event of a direction of rotation reversal)

Table 1: Meanings of enabling mode

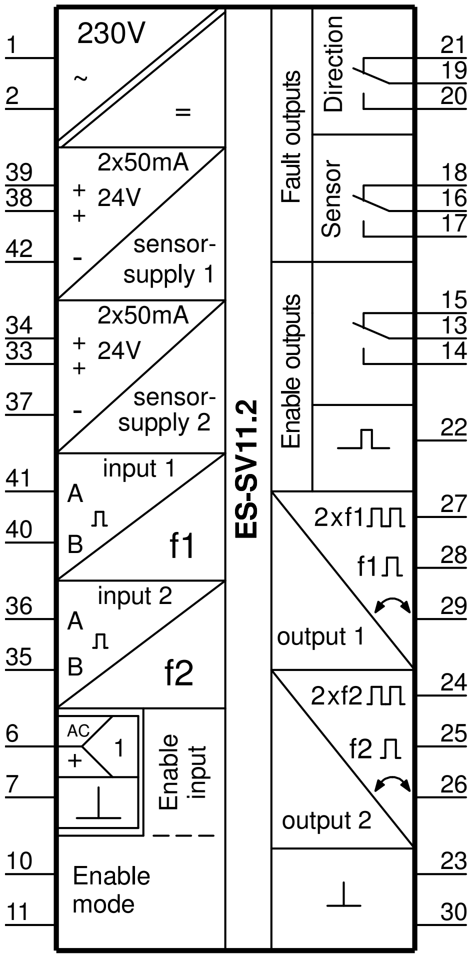
When the enable output is active, the transistor output supplies L-level (0 V) to the enabling circuit and the relay output is in release state. When enabling is disarmed and during an enabling interruption, the transistor output supplies H-level (24 V at I=1mA), and the relay output is in the operating position.

Enable outputs	Switching transistor	Relay
Active (armed)	L-level, H-level in the event of direction of rotation reversal	Release state, operating position in the event of direction of rotation reversal
Off (disarmed)	Always H-level	Always operating position

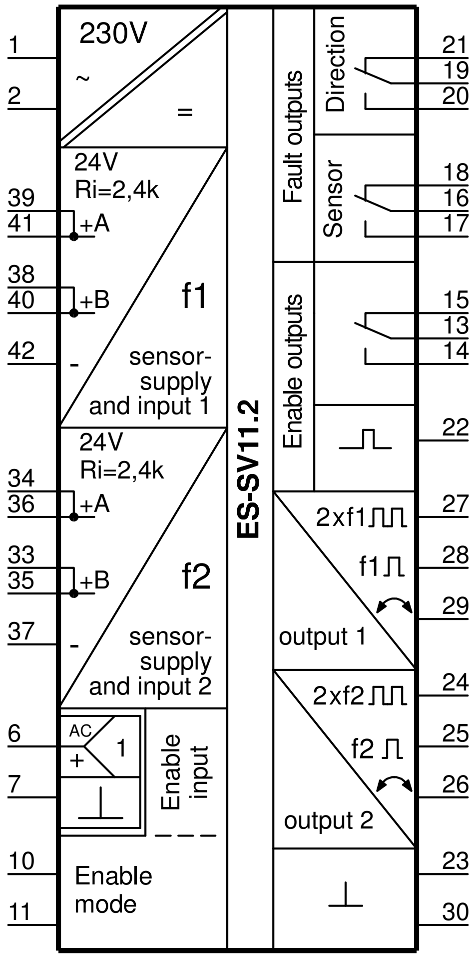
Table 2: Switching states of the enable outputs (H-level = 24V (at 1mA), L-level = 0V)

Important: disarming the enable outputs always corresponds to H-level or the operating position.

6 Wiring Symbol



Device for Incremental sensors or Three-wire proximity switches



Device for Two-wire proximity switches

7 Technical Specifications

Measurement inputs:

4 input stages for connecting 2 incremental sensors (with phases A and B) or 4 proximity switches,
each input stage with integrated wire breakage monitoring.

Version for incremental sensor or 3-wire proximity switches:
for sensors with push-pull output stage or with built-in load resistor (the sensors must not switch to a high resistance in any mode of operation as otherwise wire breakage will be detected)

Version for 2-wire proximity switches:
Sensor data for operation at 24V with Ri=2.4kΩ:
Current in the blocked state: 0.4 … 2.5mA
Current in the conductive state: 5.2 … 8.5mA
(optional: adjustment to 2-wire sensor with other characteristic data)

Input frequency:

Version for incremental sensor or 3-wire proximity switches:
For sensors with push-pull output stage: f_{max} = 2 kHz,
Time between switching of phases A and B: >50µs
For 3-wire sensors with load resistor R_L =10kΩ: f_{max} = 2 kHz,
Time between switching of phases A and B: >80µs

Version for 2-wire proximity switches:
(Sensor data for operation at 24V with Ri=2.4kΩ)
For sensors with Ioff<2.5mA, Ion>5.2mA: f_{max} = 2kHz
Time between switching of phases A and B: >100µs
For sensors with Ioff<2.0mA, Ion>5.5mA: f_{max} = 2kHz
Time between switching of phases A and B: >50µs

Sensor supply:

Version for incremental sensor or 3-wire proximity switches:
Four 24 V DC/50 mA outputs with integrated short-circuit and wire breakage monitoring,
wire breakage threshold approx. 0.75mA, short-circuit threshold > 50mA.
When incremental sensors are used, two outputs each are connected in parallel (100 mA)

Version for 2-wire proximity switches:
4 x sensor supply 24V with Ri=2.4kΩ,
Wire breakage threshold approx. 0.22mA
Approx. short-circuit threshold at $Ri,_{sensor}$ < 240Ω

Enable input:

230 V AC/DC ± 15 %
or
24 V DC ± 20 %

Enable mode:

Changeover of the enable input from idle to working current,
(note: keep volt-free, only wire jumpers allowed)

Enable outputs:

Relay, 1 changeover contact, 250V AC, 5A
30V DC, 5A
and
Transistor, 24 V/1 mA, 30 V unloaded
Enable interruption in a direction change about 80 ms

Frequency and direction outputs:

Transistor, 24 V/1 mA, 30 V unloaded, only for connecting of frequency monitors ES-FDP-…

Fault outputs:

2 relays, 1 changeover contact, 250V AC, 5 A
30V DC, 5 A

Power supply:	230V AC +10/–15%, 50 ... 60Hz (at total sensor supply of 100mA) 230V AC +/–10%, 50 ... 60Hz (at total sensor supply of 200mA)
Power consumption:	Approx. 24 VA
Fuse:	Type TR5 160 mA / 250 V, slow-blow (wired-in)
Ambient temperature:	-10 ... + 50℃ (operation) -20 ... + 70℃ (storage)
Housing dimensions:	L = 200mm, W = 75mm, H = 126mm with screw and snap fastening (DIN 46277, 35mm profile rail)
Fire behaviour (housing):	According to UL: V-O and according to VDE 0304: stage 1 respectively
Connection terminals:	**Detachable terminal strips**, with self-disengaging BI-slotted screws for 2x2.5 mm^2, including terminal covers with contact protection according to VBG 4 and VDE 0106, part 100
Creep resistance:	Insulation group C 250 VE/300 VG (creep distance 4 mm) according to DIN 57 110 and VDE 0110
Degrees of protection of enclosures:	IP40
Weight:	Approx. 1200 g

(Subject to change)