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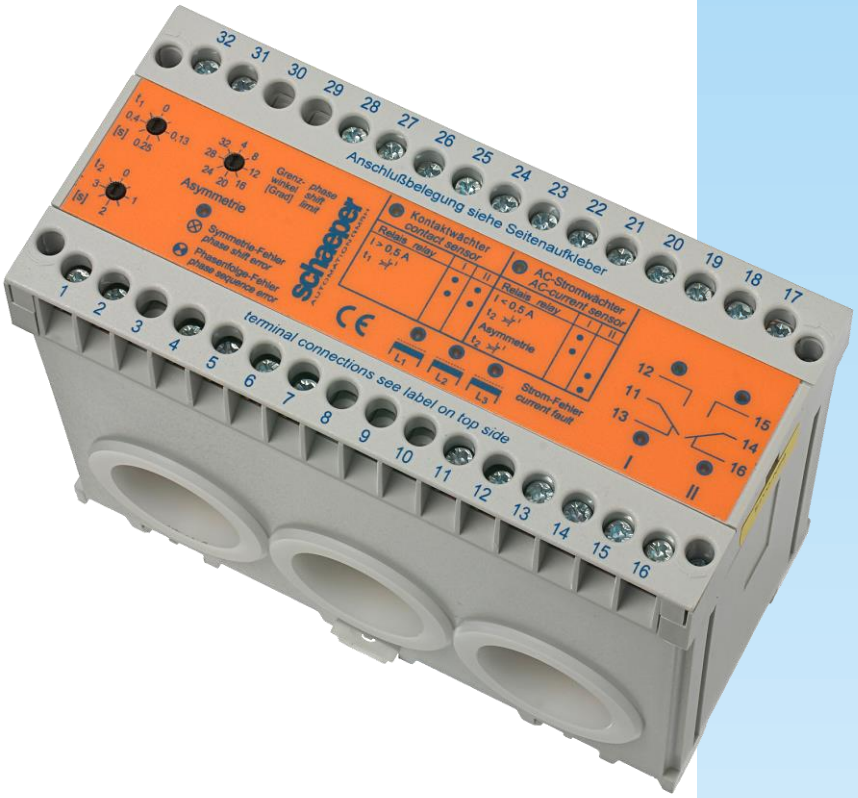
ES-USIY314

AC Current and Contact Sensor



Application

The AC current and contact sensor *ES-USIY 314* monitors the correct electrical supply of three-phase consumers, such as hoisting and chassis motors on cranes, fan motors, solenoid actuators, heating etc.

Three current transformers integrated in the unit register the load current. Based on this working principle, all components located in the current paths, such as supply units, fuses and contacts, are monitored.

Features

- ☺ Current range: I_N = 0.5 ... 600AW (ampere windings)
- ☺ **Fault memory** and indication for each phase
- ☺ **Switchable in operation** between AC current and contact sensor
- ☺ Activation via enable inputs
- ☺ Fault signalling via 2 relays (1 changer each) and 3 optocoupler outputs
- ☺ LED's to display the state of operation
- ☺ Double LED display (red, green) for relay setting
- ☺ Easy to service due to **detachable screw terminals** (interchange-proof)
- ☺ **AC current sensor**
  - Delayed activation of the fault signallings (adjustable from 0 ... 3.8 sec.)
  - Fault signalling with **asymmetric currents** (permissable deviation of the **phase angle** adjustable from 4 ... 34 degrees)
  - Fault signalling with **incorrect phase sequence** (optionally deactivated)
- ☺ **Contact sensor**
  - Delayed activation of the fault signallings (adjustable from 0 ... 0.5 sec.)

Function

A detected current fault is stored together with the operating state, so that it is possible to determine whether a power failure and/or phase shift error occured (AC current sensor) or if an impermissible current arose (contact sensor). Depending on the selected mode of operation, the following monitoring functions are carried out.

AC current sensor

This mode of operation is selected if the enable input *I/K* (terminal 5) is without a signal. It is displayed on the front of the unit by lighting up of the yellow LED in the AC current sensor field.
Approx. 120ms (t_0) after a signal is applied to *FG1*, it is determined whether an alternating current of at least 0.5AW is flowing in all three phases L1, L2 and L3. In this case, relay I remains in the working position (**WP**). If there is no current in one, two or three phases, then relay I switches into the normal position (**NP**) after a basic delay of max. 50ms and the corresponding current fault LED's light up on the front of the unit. A further delay of up to 3.8 sec. can be set with t_2. Until a reset signal is applied, the unit stores this condition.

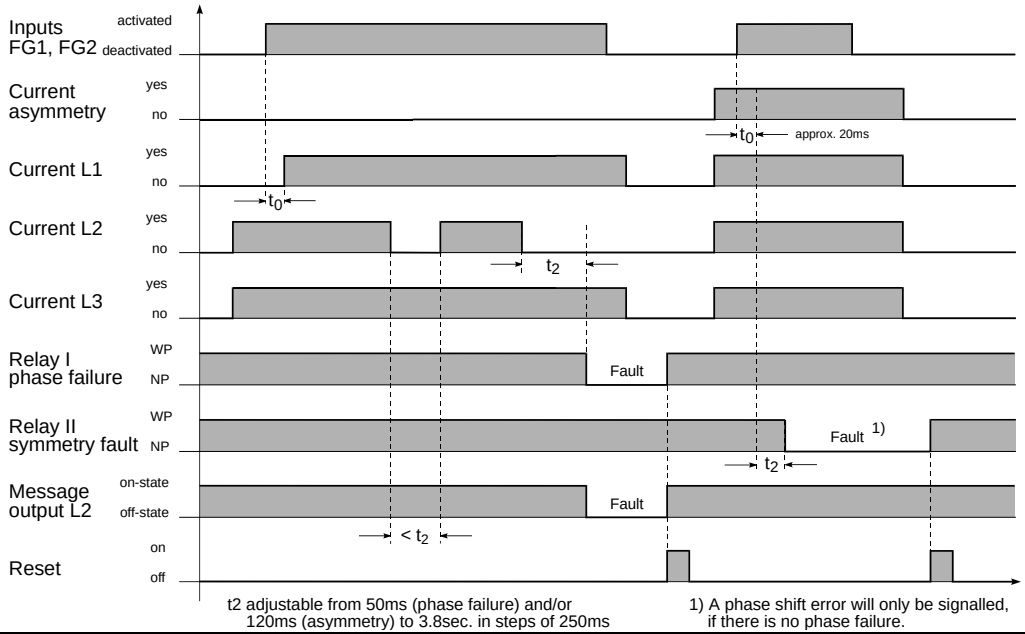
After additional applying of a signal to *FG2*, an angle asymmetry of the current in the three phases is detected for currents with a frequency of 50Hz or 60Hz and signalled by switching of the relay II to the normal position (also time-delayed with t_2) as well as continuous lighting up of the red LED "Phase shift error". The phase shift limit for the permissible asymmetry can be set in steps of 2 degrees from 4 to 34 degrees. The asymmetry supervision is designed for standard units with a frequency of 50Hz or 60Hz. Other frequencies are available on request!

Attention: If the frequency of the current deviates from the frequency, for which the unit is designed, then proper asymmetry supervision is not possible. A simple conversion of the set phase shift limit to another frequency is not possible!

With a phase failure, no phase shift error is indicated. **Differing amplitudes of the currents in the three phases, which do not cause asymmetry of the phase angles (e.g. with a connected zero lead), are not evaluated by this unit!**

In addition, with enable with FG2, an incorrect **phase sequence** is indicated by switching of the relay II to the normal position (also time-delayed with t_2) as well as flashing of the red LED "Phase shift error". Units with the option /oP do not evaluate the phase sequence.

Function diagram **AC current sensor**



t2 adjustable from 50ms (phase failure) and/or 120ms (asymmetry) to 3.8sec. in steps of 250ms

1) A phase shift error will only be signalled, if there is no phase failure.

Contact sensor

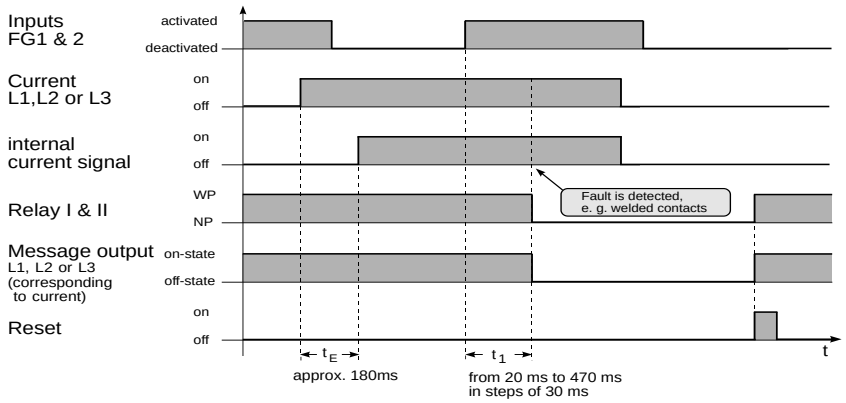
This mode of operation is selected if there is a signal at the enable input I/K (terminal 5). It is displayed on the front of the unit by lighting up of the yellow LED in the contact sensor field.

With an enabled unit (signal at *FG1* and *FG2*), it is determined whether there an alternating current greater than 0.5AW is flowing in **none** of the three phases L1, L2 and L3. In this case, relay I and relay II remain in the working position. If current is flowing in at least one phase, then relay I and relay II switch to the normal position after a basic delay of max. 50ms and the corresponding current fault LED's light up on the front of the unit. A further delay of up to 0.5 sec. can be set with t_1. Until a reset signal is applied, the unit remains in this condition.

The asymmetry and phase sequence supervision are not active in this mode of operation.

Fault memory
Each current fault is stored and keeps the unit in the mode of operation, which had been selected when the first fault occurred. As long as the signal at the enable input *I/K* (terminal 5) does not change, sequence faults are also still stored. After the enable signal changes, the unit is switched to the inactive state until a reset signal is applied, so that no further fault signalling is possible. If current asymmetry and phase failure are announced at the same time, then aysmmetry was the first fault to occur.

Function diagram **Contact sensor**



Inputs

The various input groups are galvanically isolated from each other and from the outputs.

Measuring inputs (current transformers)
The bushing transformers have an inner diameter of 32mm. The phases must be led through the transformer in the sequence, which is specified on the side label, so that the asymmetry supervision can function properly. The maximum current through the transformer amounts to 600AW, while a short current peak of up to 7 times this value is permissible. The input sensitivity is at max. 0.5AW. With multiple lead-throughs of a lead, the unit can also be used for the supervision of lower currents. The frequency of the currents must be situated in the range of 35 to 500Hz, whereby the asymmetry supervision, however, only functions properly at 50Hz or 60Hz (see technical data). Other frequencies are available on request.

Mains voltage
The mains voltage input is protected against switching overvoltages by means of a varistor and is equipped with a thermistor fuse. If the thermistor fuse is tripped (e.g. due to overvoltage, overtemperature or a unit defect), the mains voltage should be switched off. The mains voltage can be applied again after waiting a sufficient amount of time for the unit to cool down. If the cause for the fuse being tripped has meanwhile been eliminated, then the unit will work again perfectly afterwards.
After the mains voltage has been applied, an approx. 80ms long initialization phase starts that disables the monitoring function and keeps the outputs in the acceptance state. Afterwards, the delay times for the enable inputs are expired (if activated) and then the outputs switch accordingly to the currents in the three phases.

Enable inputs
The three enable inputs *FG1*, *FG2* and *I/K* have a mutual ground connection. The input *I/K* serves for the changeover of the modes of operation of the unit; without a signal, the unit functions as an AC current sensor, with a signal as a contact sensor. The input *FG1* activates the AC current sensor when a signal is applied, while *FG2* additionally activates the asymmetry supervision. To activate the contact sensor, a signal must be applied to both inputs *FG1* and *FG2*. The inverted function of the enable inputs *FG1* and *FG2* is also available as an option.
The time of application of the last signal to one of the three enable inputs until the actual activation of the contact sensor amounts to max. 20ms. The time from application of a signal to *FG1* and/or switching off of the signal at *I/K* until the actual activation of the AC current sensor amounts to approx. 120ms. For *FG2*, this time amounts to max. 20ms.

Control inputs
The two control inputs "Reset" and "Test" have two mutual ground connections. A signal to "**Reset**" deletes any stored fault messages, switches the relays back to the working position, switches the fault LED's off and switches the message outputs L1, L2 and L3 on again.

A signal to the input "**Test**" activates the supply of a test current in the three current transformers. The test current has the same phase position in all three transformers. For this reason, with a properly

functioning, enabled (activated) unit in the mode of operation of AC current sensor, the phase shift fault LED is continuously lit or flashing, relay I is in the working position and relay II is in the normal position, if the test current is activated simultaneously or before the enable signal *FG1* and the outer current circuits through the transformer are **open**. The behaviour of the unit with an activated test current must correspond to the normal operating behaviour with exception of the phase shift error (see function diagrams *AC current sensor* and *contact sensor*).

Outputs

The relay contact and the message outputs are galvanically isolated, while the 24 V DC output is connected to the internal electronics.

Relay outputs

The relay outputs are in the working position (WP) with proper current flow in the transformers (green LED lit up) and switch time delayed to the normal position (NP) in the case of current faults and an enabled sensor unit (red LED lit up). In the mode of operation of contact sensor, both relays switch to the normal position in the case of impermissible current flow after a basic delay of max. 50ms. A further delay of up to 0.5 sec. can be set with t_1.

In the mode of operation of AC current sensor, relay I announces a current interruption and relay II a phase shift error (asymmetry) or a phase sequence error of the current. Relay I has a basic delay of max. 50ms, while relay II has a basic delay of max. 120ms. A further delay of up to 3.8 sec. can be set with t_2.

Any fault that arises remains stored along with the corresponding mode of operation of the unit until a signal is applied to the reset input. A continuous reset signal suppresses all fault messages!

Message outputs

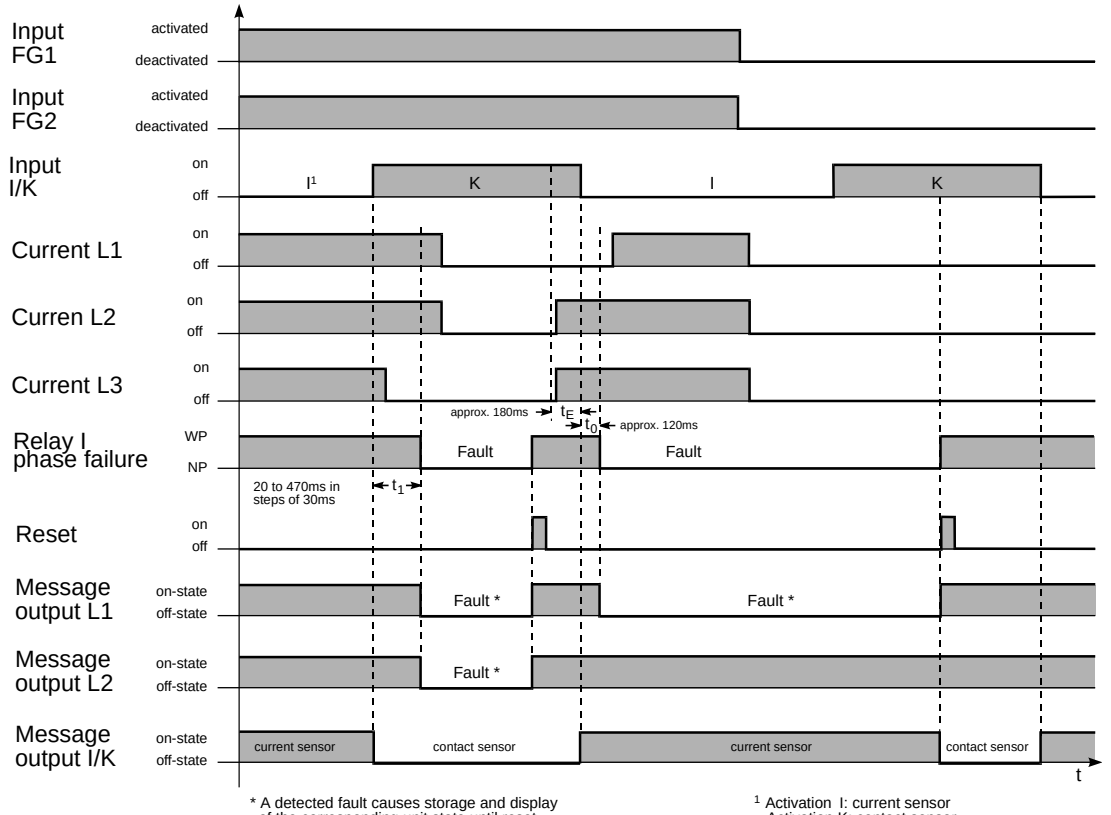
The message outputs have open-collector NPN transistors as contactless semiconductor switches with a mutual minus connection. They are disabled with polarity reversal and may be loaded with max. 20mA and 32V. The outputs L1, L2 and L3 are switched on in the case of correct current flow through the transformers. They are switched off if the current through the corresponding transformer is less than 0.5AW.

The state of the output I/K indicates the current mode of operation of the unit. Active means AC current sensor, disabled means contact sensor.

Any fault that arises remains stored along with the corresponding mode of operation of the unit until a signal is applied to the reset input. A continuous reset signal suppresses all fault messages!

Function diagram

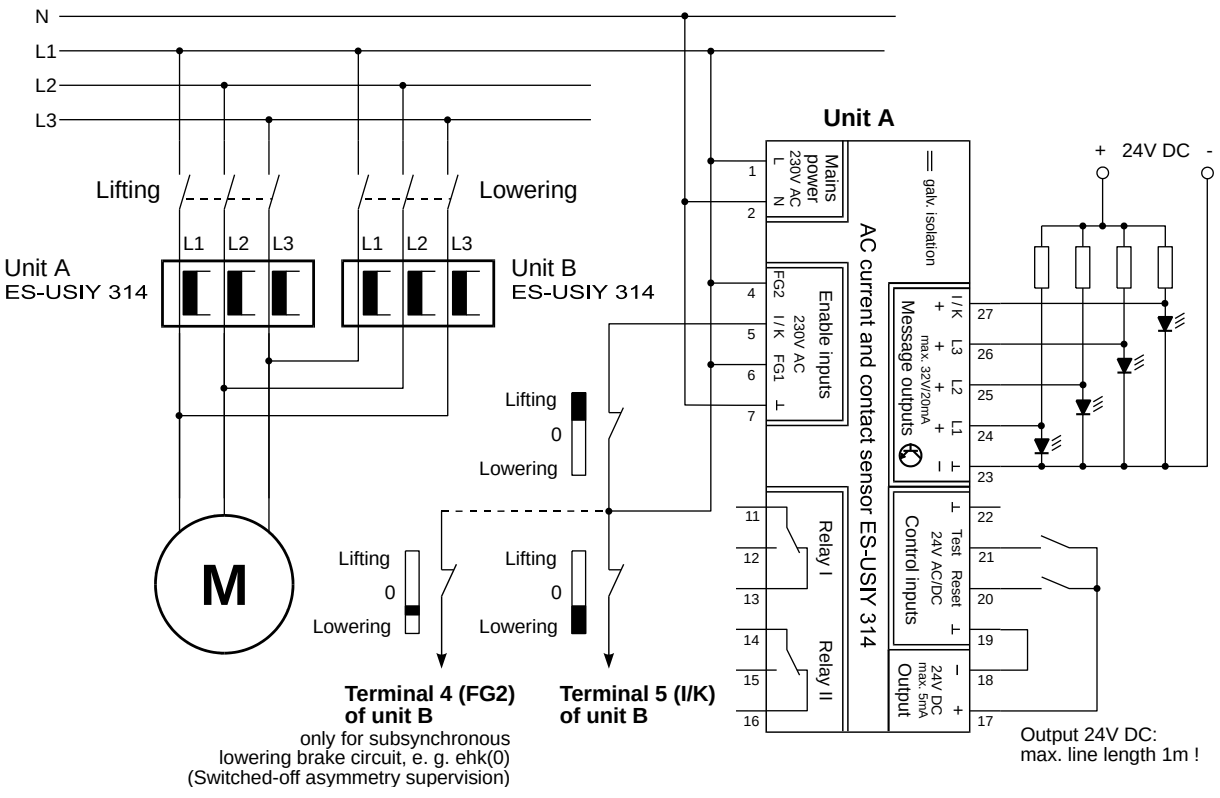
Changeover AC current sensor ↔ contact sensor



* A detected fault causes storage and display of the corresponding unit state until reset. After the signal changes at input I/K, the unit is then inactive and can therefore no longer carry out any monitoring functions.

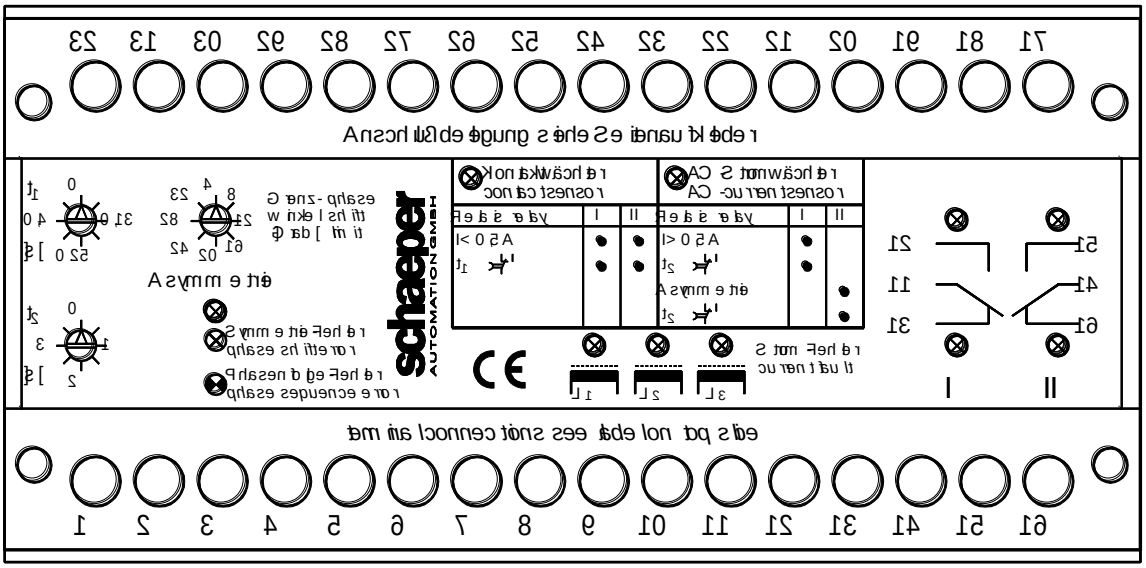
[1] Activation I: current sensor
Activation K: contact sensor
The current effective state of operation of the unit can be seen at the message output I/K.

Connection principle



Frontal view *(approx. original size)*

ES-USIY 314



Unit versions

Function	Type
Standard, 230V AC, 50Hz to 60Hz	ES-USIY 314
Supply voltage 115V AC (or 24V, 42V, 48V)	/115V (or /24V, /42V, /48V)
Without phase sequence monitoring	/oP
Inverted enable inputs FG1 and FG2	/iFG

Technical data

Supply voltage:
Terminals (1) and (2)
U_V = 205 … 253V AC; 50 - 60Hz; 25mA
U_V = 103 … 127V AC; 50 - 60Hz; 50mA **for unit option /115V**
U_V = 38 … 46V AC; 50 - 60Hz; 140mA **for unit option /42VFuse:**
Soldered PTC resistor fuse

Current transformer: I_N = 0.5 ... 600AW, f = 35 ... 500Hz, inner dia.: 32mm
(7x switch-on peak permissable)

Current asymmetry: Adjustable from 4 to 34 degrees,
valid for the standard version with the current frequency 50Hz
(Fault < ±3 degrees with frequency deviations of ±1Hz)
or for the unit option /F60 with current frequency 60Hz
(Fault < ±2 degrees with frequency deviations of ±1Hz)

Enable inputs
***FG1, FG2, I/K*:**
Terminals (4, 5, 6) and (7)
on: U = 195 ... 260V AC/DC
off: U < 100V AC/DC
on: U = 98 ... 130V AC/DC **for unit option /115V**
off: U < 50V AC/DC
on: U = 20 ... 80V AC/DC **for unit options /48V, /42V, /24V**
off: U < 8V AC/DC
galv. isolated (U_{Isol} = 3.75kV AC) from other inputs/outputs

Control inputs
***Reset, Test*:**
Terminlas (20, 21) and (19, 22)
on: U = 20 ... 80V AC/DC off: U < 8V AC/DC
galv. isolated (U_{Isol} = 3.75kV AC) from other inputs/outputs

Relay outputs:
Terminals (11) to (16)
1 changeover switch, 250V/5A AC, 30V/5A DC,
electrical contact service life: 1 x 10^5 switching plays

Message outputs:
Terminals (24) to (27) and (23)
U_{max} = 32V DC, I_{max} = 20mA DC (Transistor),
disabled: fault message, active: faultless
galv. isolated (U_{Isol} = 3.75kV AC) from other inputs/outputs

Fault memory: Fault messages remain stored until a reset signal is applied, even if the supply voltage has meanwhile been switched off

24V output:
Terminals +(17) and –(18)
I_{max} = 5mA DC, only for activation of the inputs Reset and Test
via short lines (< 1m long)

Delay times:
AC current sensor:
Recognition time t_0 for enable FG1 (phase failure): approx. 0.12sec.
Recognition time t_0 for enable FG2 (asymmetry): approx. 0.02sec.
t_2 (click-stop switch, no stopper) Message delay t_2 for phase failure: 0.05 to 3.80sec.
t_2 (click-stop switch, no stopper) Message delay t_2 for phase shift fault: 0.12 to 3.80sec.
Contact sensor:
Recognition time t_E for current flow: approx. 0.20sec.
t_1 (click-stop switch, no stopper) Recognition time t_1 for enable FG1 and FG2: 0.02 to 0.47sec.

EMC-Directive:
CE
Emission: According to EN 50081-1, 1993
(Residential, commercial) and EN 55022
Immunity: According to EN 50082-2, 1995
(Industrial environment) and EN 61000-4-2, -3, -4, -6

Low Voltage Directive:
Safety: According to DIN VDE 0106, part1, 1982
and VBG 4, 1979
Conditions of use: degree of contamination 1 or 2
according to DIN VDE 0110, part1, 1989

Ambient temperature: -10 ... +50 °C, no condensation (operation)
-20 ... +85 °C (storage)

Housing: L = 152mm, W = 75mm, H = 121mm, partially cast
with snap-on fastening for DIN EN mounting rails ⊓⎽⊓

Connection terminals: Detachable screw terminals (interchange-proof)
2 x 2.5mm² solid or 2 x 1.5mm² strand wire with sleeve acc. to DIN 46288

Behaviour in fire: Housing made of polycarbonat:
according to UL94: V-0 according to VDE 0304: stage 1

Mass: approx. 1100g