# VARIMETER PRO
# Multifunction Measuring Relay
# MK 9300N, MH 9300

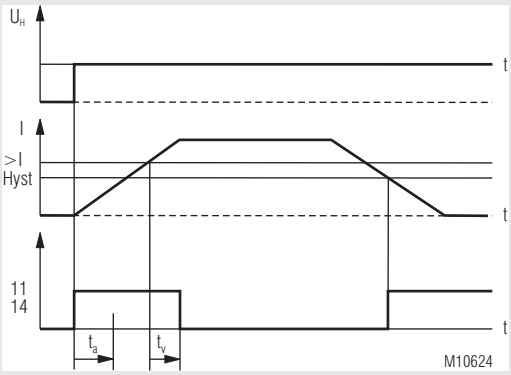
**Translation of the original instructions**

0268581

## Product Description

The universal measuring relays MK 9300N / MH 9300 of the VARIMETER PRO series monitor up to 9 parameters simultaneously. These are under-, over-voltage, voltage range, voltage asymmetry, under-, overcurrent, cos phi, effective-, apparent- and reactive power, frequency and phase sequence, The measurement in 3-phase or single-phase systemes is very simple and without extensiv wiring. Because of the menue structure the multifunctional measuring relays can be used easyly and intuitively.
The early detection of up-coming break downs and preventive maintenance avoid expensive damages. As user you profit from the reliability and availability of your plant.

## Function Diagram




Example: Overvoltage monitoring with closed circuit operation

**Your Advantage**
- Min-, Max. value or window monitoring
- Simultaneous monitoring of up to 9 different parameters
- Simple configuration and fault diagnostic
- Different fault indications
- Large measuring range 3 AC 24 ... 690 V
- Auxiliary voltage ranges DC 24 V, AC 230 V or AC/DC 110 ... 400 V
- Early detection of irregular states
- Space and cost saving
- Reduced wiring

**Features**
- Multifunction measuring relay acc. to EN 60255-1
- Voltage monitoring (1- and 3-phase)
- Current monitoring
- Frequency monitoring
- Power factor cos phi
- Phase sequence, phase failure, asymmetry
- Effective-, reactive- and apparent power
- Start up time delay, on delay
- Adjustable hysteresis 0.2 ... 50 % of response value
- Manual reset
- LCD for indication of the measuring values
- Relay output
  MK 9300N: 1 changeover contact
  MH 9300: 2 x 1 changeover contacts
- Relay function selectable (energized/de-energized on trip)
- As option with plugable terminal blocks for easy exchange of devices
  - With screw terminals
  - Or with cage clamp terminals
- MK 9300N: Width 22,5 mm
  MH 9300: Width 45 mm

## More Information

- **MK 9300N**
  The MK9300N has 1 relay output.
  Monitoring parameters can be set independently

- **MH 9300**
  The MH 9300 has 2 relay outputs.
  Monitoring parameters can be set independently
  Each monitoring function can be assigned ro relay 1 and /or relay 2

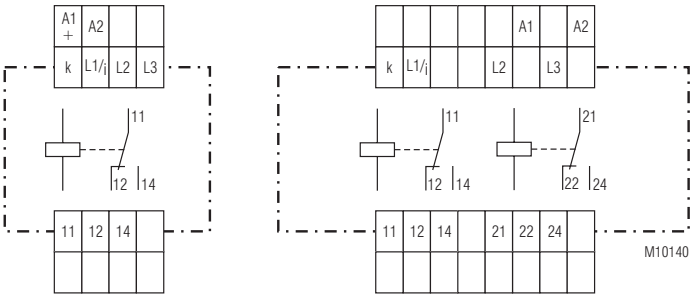
## Approvals and Markings

## Applications

- Monitoring of single and 3-phase loads
- Emergency power supplies
- Voltage dependent switching at under- or overvoltage
- Voltage monitoring of portable equipment
- Motor protection on Phase failure
- Transformer protection on asymmetric load
- Frequency monitoring on inverter outputs

All technical data in this list relate to the state at the moment of edition. We reserve the right for technical improvements and changes at any time.

## Circuit Diagrams




MK 9300N.11 MH 9300.12

## Connection Terminals

| Terminal designation | Signal description |
|---|---|
| A1 (+), A2 | Auxiliary voltage AC or DC |
| L1/i, L2, L3 | Voltage measuring input AC |
| L1/i , k | Current measuring path AC |
| 11, 12, 14 | Indicator relay (C/O contact) |
| 21, 22, 24 | Indicator relay (C/O contact) |

## Function

After connecting the auxiliary supply to terminals A1-A2 the start up time delay disables the monitoring function so that changes on the input have no influence on the relay output of the VARIMETER PRO. The device is in display (RUN) mode and continuously measures the actual values. The buttons ↑ and ↓ toggle between the different values. Pressing Esc for more than 3 sec starts the input mode.

One or more measuring values can be assigned to the relay output. If the setting value of at least one function is exceeded the relay switches and the display indicates this state. The display is inverted, flashes and shows measuring function and fault.

The fault memory is selectable
With button ↵ the fault memory can be deleted.

On the unit MH 9300 it is possible to assign different values to the different relays so one can be used as pre-warning and the other as alarm output. Relay output 1 switches when actual value exceeds the pre-warning setting of at least one assigned measuring function.
If a second setting assigned to relay output 2 with the same measuring function the unit gives an Alarm signal.

## Remarks

To provide correct function the measuring voltage on L1/L2 has to be at least 20 V.

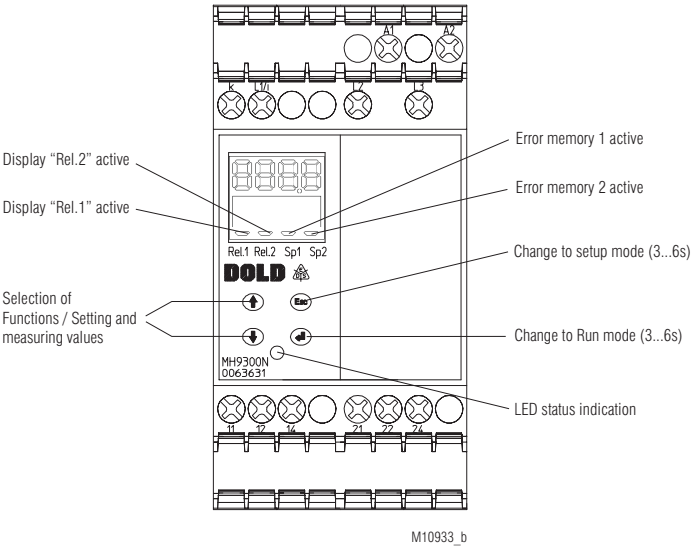
Due to the measuring principle a symmetric load on all 3 phases as you have it usually with motors.

The unit can also be used for single phase monitoring by bridging terminals L2 and L3. The display shows U instead of $U_{min}$ / $U_{max}$.

Overload within the current range is indicated by fast flashing of the LED.

When using phase sequence evaluation, asymmetry or undervoltage monitoring is recommended.

## Setting

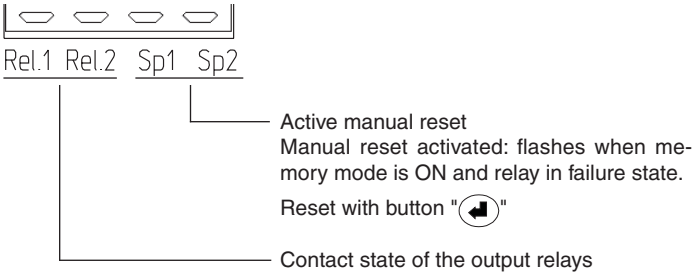



## Indicators

The LED indicate the state.

| | |
|---|---|
| Green LED $U_N$ : | On, when auxiliary voltage present |
| Red LED (flashes) | At overload at current path |
| Orange LED: | No measurement, unit in input mode |

## Cursor LCD Display



## Operating

### UP / DOWN

**Display (Run) - Mode**

After power up the relay is in display (Run) mode.

Scrolls the display to show one of the 10 possible values.

If a values exceeds the setting, the values is indicated flashing on inverted display. In the case of a fault display the display always returns to the fault value after pressing . If voltage is missing on the measuring input some values cannot be calculated and a no value is shown.

**Input-Mode**

The measurement is interrupted, the relays are in failure state and the indicator LED has orange color

Selection of parameters and setting of thresholds.

### ENTER

**Display (Run) - Mode:**

Manual reset, when manual reset is selected for output relay

Reset works only when fault is removed

**Input-Mode:**

- Shifts cursor to the right
- Saves the value no-voltage safe
- Pressing for more than 3 sec: Change to display (Run) mode.

### Esc

**Display (Run) - Mode:**

- Pressing for more than 3 sec: Change to input mode

**Input-Mode:**

- Shifts cursor to the left
- Leave setting without saving

### LCD-Display

Setting of response values

| | |
|---|---|
| < | Fault, when value drops under set point |
| > | Fault, when value exceeds set point |
| OFF | Measurement disabled |

If the adjusted threshold of at least one measuring function is exceeded, the corresponding relay output switches after the selected on delay $t_v$ and the fault is indicated on the display.

Manual reset can be activated or de-activated and is operated with on the unit.

## Adjustable Parameter

Limit values for Rel.1 and Rel.2
Selectable with buttons ⬆ ⬇.

| Name | Description | Value range | Step size | Factory setting* |
|---|---|---|---|---|
| $U_{min}$ | Response value undervoltage,<br>Lowest phase to phase voltage<br>(Undervoltage relay)<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br><br><br>OFF, 0 - 440 V<br>OFF, 0 - 760 V | <br><br><br>1 V<br>1 V | <br><br><br>OFF<br>OFF |
| $U_{max}$ | Response value overvoltage,<br>Highest phase to phase voltage L1, L2 or L3<br>(Overvoltage relay)<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br><br><br>OFF, 0 - 440 V<br>OFF, 0 - 760 V | <br><br><br>1 V<br>1 V | <br><br><br>440 V<br>760 V |
| Asym | Response value voltage asymmetry,<br>Percentage of highest to lowest phase to<br>phase voltage<br>(Asymmetry relay) | OFF, 0 - 100 % | 1 % | 20 % |
| <I | Response value current at current path L1<br>(Undercurrent) | OFF, 0 - 12,00 A | 0,01 A | OFF |
| >I | Response value current at current path L1<br>(Overcurrent) | OFF, 0 - 12,00 A | 0,01 A | 8,00 A |
| <Cosφ | Response value phase displacement between current and voltage<br>(Underload monitor) | OFF, 0 - 1,00 | 0,01 | OFF |
| >Cosφ | Response value phase displacement between current and voltage<br>(Overload monitor) | OFF, 0 - 1,00 | 0,01 | OFF |
| <P | Response value effective power 3-phase<br>Independent of phase sequence switches at adjusted value<br>also at reverse power (Underload)<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br><br><br>OFF, 0 - 8000 W<br>OFF, 0 - 15,79 kW | <br><br><br>1 W<br>0,01 kW | <br><br><br>OFF<br>OFF |
| <P | Response value effective power 3-phase<br>Independent of phase sequence switches at adjusted value<br>also at reverse power (Overload)<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br><br><br>OFF, 0 - 8000 W<br>OFF, 0 - 15,79 kW | <br><br><br>1 W<br>0,01 kW | <br><br><br>OFF<br>OFF |
| <S | Response value apparent power 3-phase<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br>OFF, 0 - 8000 VA<br>OFF, 0 - 15,78 kVA | <br>1 VA<br>0,01 kVA | <br>OFF<br>OFF |
| >S | Response value apparent power 3-phase<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br>OFF, 0 - 8000 VA<br>OFF, 0 - 15,78 kVA | <br>1 VA<br>0,01 kVA | <br>OFF<br>OFF |
| <Q | Response value reactive power<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br>OFF, 0 - 8000 var<br>OFF, 0 - 15,78 kvar | <br>1 var<br>0,01 kvar | <br>OFF<br>OFF |
| >Q | Response value reactive power<br>Measuring range 3 AC 400 V:<br>Measuring range 3 AC 690 V: | <br>OFF, 0 - 8000 var<br>OFF, 0 - 15,78 kvar | <br>1 var<br>0,01 kvar | <br>OFF<br>OFF |
| <f | Response value frequency<br>(Underfrequency) | <br>OFF, 1 - 400 Hz | <br>0,1 Hz | <br>OFF |
| >f | Response value frequency<br>(Overfrequency) | <br>OFF, 1 - 400 Hz | <br>0,1 Hz | <br>OFF |
| Hyst | Hysteresis of response value | 0,2 - 50 % | 0,1 % | 4,0 % |
| $t_v$ | On delay for relays | 0 - 10 s | 0,1 s | 0 s |
| Phseq | Monitoring phase sequence | ON<br>OFF | - | ON |
| A / R | Seting open- / closed circuit operation | A<br>R | - | R |
| Sp | Error storage | ON<br>OFF | - | OFF |

* applies to Rel.1 and Rel.2

## Further Setting Parameter

| Name | Description | Value range | Step size | Factory setting |
|---|---|---|---|---|
| $t_a$ | Start up delay, when auxiliary voltage connected | 0,2 - 10 s | 0,1 s | 0,2 s |

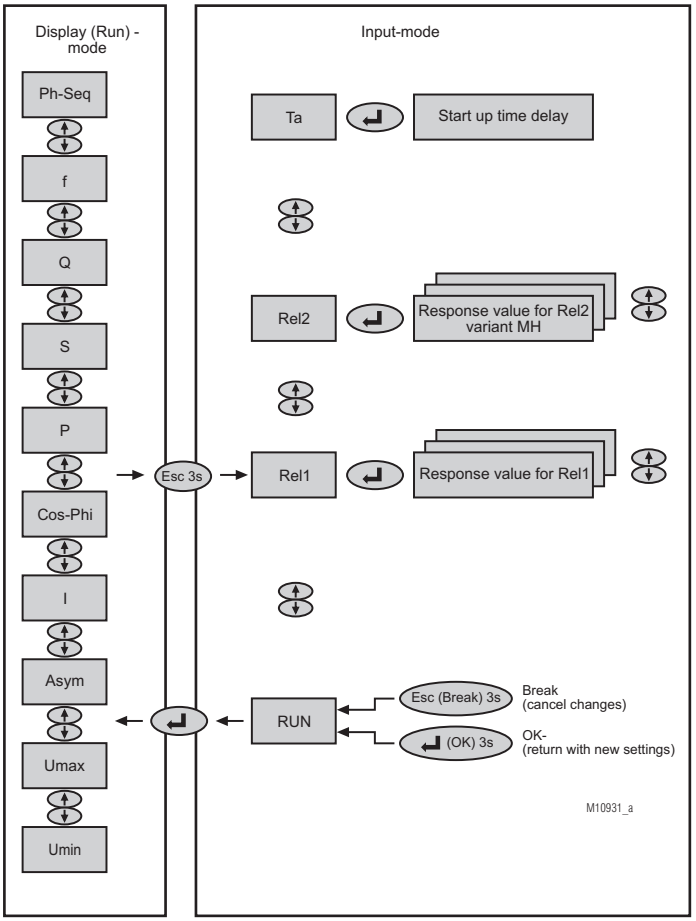
## Restore Factory Settings

(Restore factory settings)
Before auxiliary voltage connected press button (Esc) .
During start press and hold.

## Indicator output

Monitoring parameters can be set independently.
The MK9300N has 1 relay output.
The MH 9300 has 2 relay outputs.
Each monitoring function can be assigned to Relay 1 and/or to Relay 2.
The switching mode energized or de-energized on trip can be set in input mode.

## Operating




After connecting the auxiliary supply A1/A2 the unit is in display (Run) mode**:**

The display is inverted when a measured value is exceeds the settings.

With button ↵ the fault memory is reset.

The actual measured values can be toggled with the ↑ ↓ buttons.

Pressing button Esc for more than 3 sec the unit changes to input mode.

In input mode the measurement is disabled, the relays are in failure mode and the indicator LED is orange.

With the buttons ↑ ↓ the different setting values can be chosen.

Move cursor position

↵ One character to the right

Esc One character to the left

**Back to the Display (Run)-Mode**

Press button ↵ 3 s OK New values stored

or

Press button Esc 3 s; Break Values unchanged

RUN on the display confirm with ↵ to change to display (Run) mode.

| Display (RUN) Mode | Input-Mode |
|---|---|
| Display inverted when the actual value is in failure state. | Measurement interrupted, relays are in failure state, indicator LED orange color |
| ↑ ↓ Scroll display between the 10 different measuring values. | ↑ ↓ Chose Rel1, Rel2, $T_a$ and RUN<br>As option address for RS485 Bus<br>↑ ↓ Chose parameter<br>Change and set response values for Rel1 and Rel2. |
| Reset fault memory: ↵ | Esc Shift cursor to the left<br>↵ Shift cursor to the right |
| Esc For more the 3 sec, change to input mode | ↵ For more than 3 sec, change to display mode |

## Operating - Display - Menü (RUN) Mode

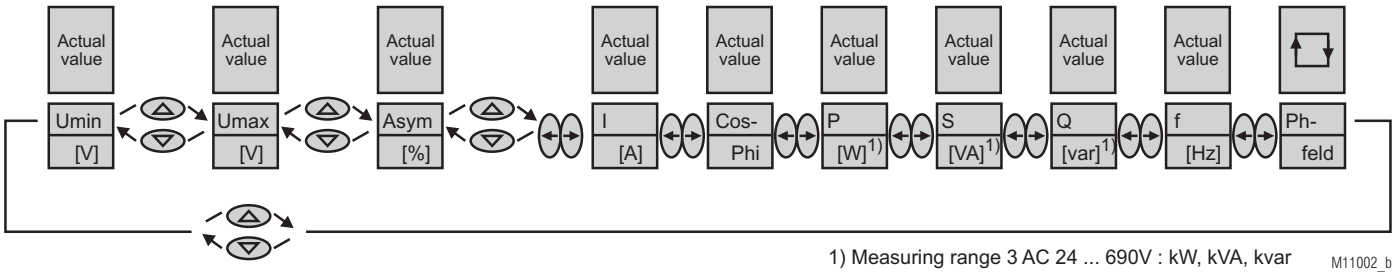
Cursor-display

R1 R2 relay 1 energized

R1 R2 relay 2 energized

R1 R2 relay 1 and 2 energized

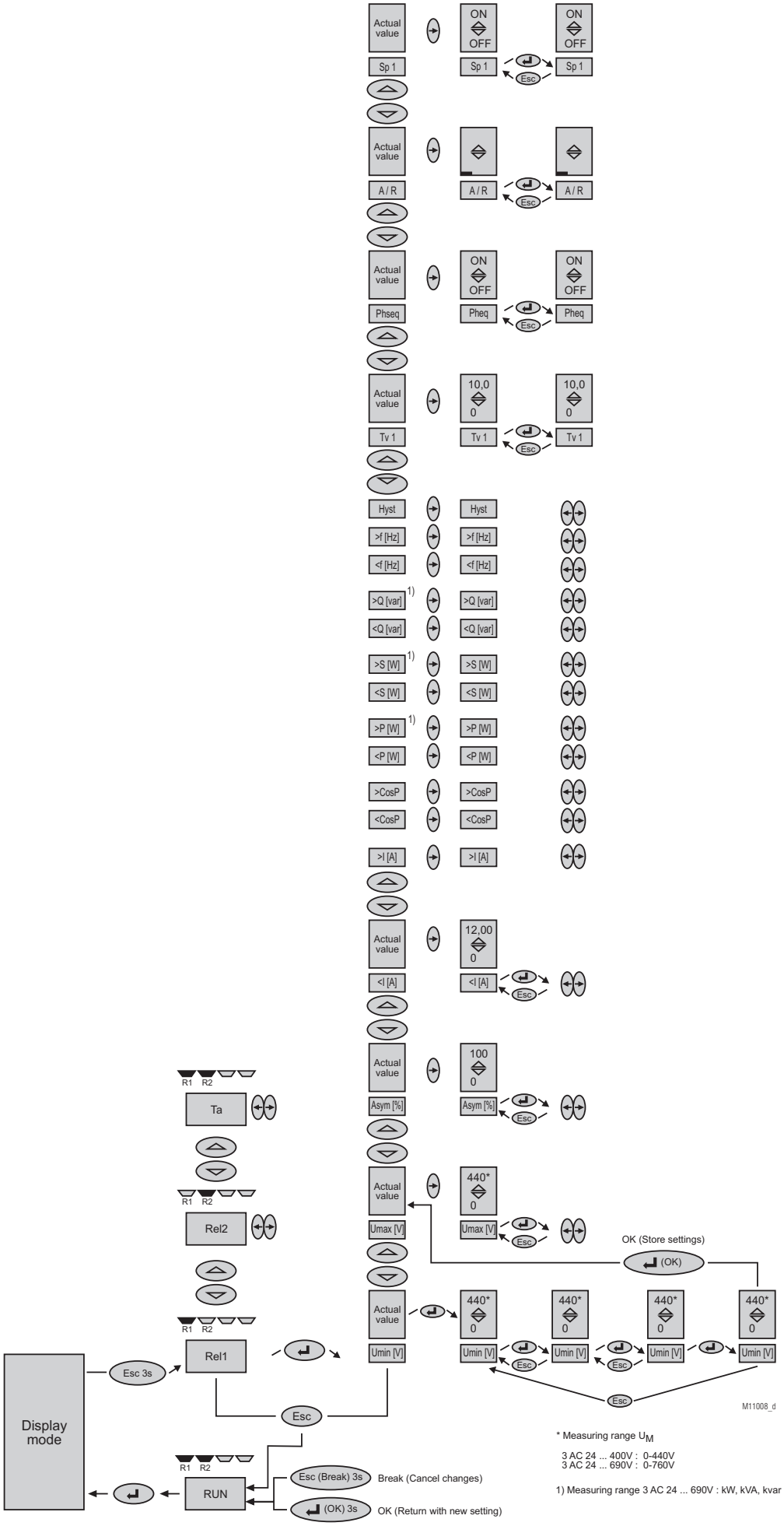
Cursor flashes during on delay tv




1) Measuring range 3 AC 24 ... 690V : kW, kVA, kvar

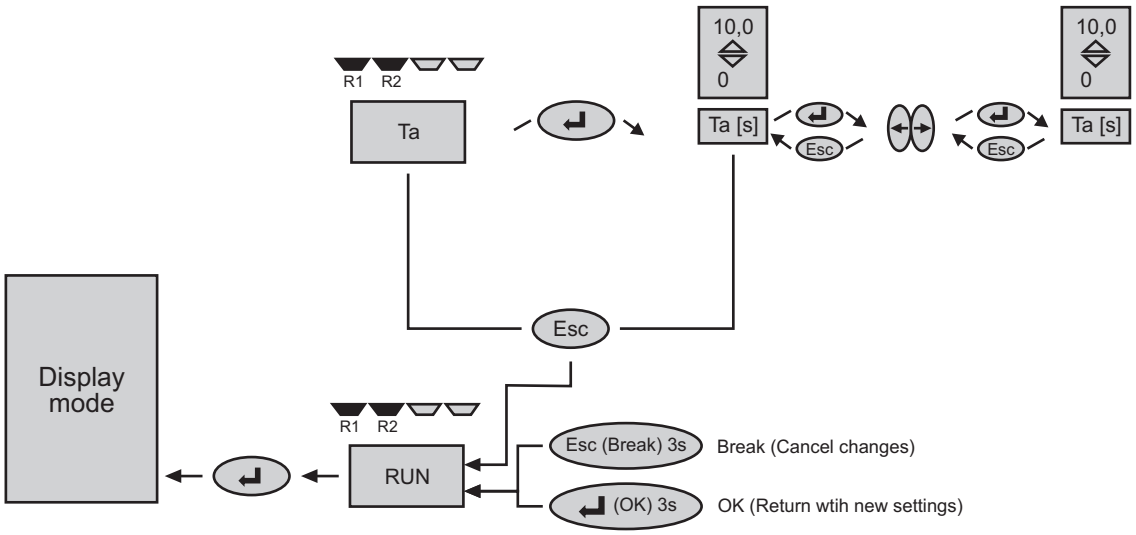
M11002_b

The menu for relay 2 is identically



## Operating - Setting valid for both relays -

Start up time delay $t_a$: 0 ... 10 s in steps of 0.1 s




M11004_a

## Technical Data

**Auxiliary Voltage A1/A2**

| | |
|---|---|
| **Nominal auxiliary voltage $U_H$** | |
| MK 9300N: | DC 24 V (0.9 ... 1.1 x $U_H$) |
| MH 9300: | AC 110, 230 V, 400 V (0.8 ... 1.1 x $U_H$)<br>AC/DC 110 ... 400 V (0.8 ... 1.1 x $U_H$)<br>DC 24 V (0.9 ... 1.1 x $U_H$)V |
| **Nominal frequency:** | 50 / 60 Hz |
| **Frequency range:** | 45 ... 400 Hz |
| **Input current** | |
| at DC 24 V: | 50 mA |
| At AC 230 V: | 15 mA |

**Voltage Measuring Input L1/L2/L3**

| | |
|---|---|
| **MK 9300N:** | |
| **Nominal voltage:** | 3 AC 400 V |
| **Measuring range $U_M$:** | 3 AC 24 ... 400 V<br>(0,8 ... 1,1 x $U_M$) |
| **MH 9300:** | |
| **Nominal voltage:** | 3 AC 400 V / 690 V |
| **Measuring range $U_M$:** | 3 AC 24 ... 400 V, 24 ... 690 V<br>(0,8 ... 1,1 x $U_M$) |
| **Nominal frequency:** | 50 / 60 Hz |
| **Frequency range:** | 1 ... 400 Hz |

## Technical Data

**Current Measuring Input i / k**

| | |
|---|---|
| **Nominal current:** | AC 12 A |
| **Measuring range:** | AC 100 mA ... 12 A |
| **Max. overload** | |
| Continuously: | 16 A |
| Short time < 10 s: | Max. 25 A<br>If current range is overloaded, the LED flashes fast |
| **Nominal frequency:** | 50 / 60 Hz |
| **Frequency range:** | 45 ... 400 Hz |

**Setting Range (absolute, via button and LCD-display)**

| | |
|---|---|
| **Measuring accuracy at nominal frequency** (in % of setting value): | ± 4 % |
| **Hysteresis** (in % of setting value): | 0.2 ... 50 % of response value |
| **Reaction time:** | < 350 ms (f > 10 Hz) |
| **Adjustable on delay $t_v$:** | 0 ... 10 s (in steps of 0.1 s) |
| **Adjustable start up time delay $t_a$:** | 0.2 ... 10 s (in steps of 0.1 s) |

**Output Circuit (Rel1: 11/12/14; Rel2: 21/22/24)**

| | | |
|---|---|---|
| **Contacts:** | | |
| MK 9300N: | 1 changeover contact | |
| MH 9300: | 1 changeover contact (Rel1) and<br>1 changeover contact (Rel2) | |
| **Thermal current $I_{th}$:** | 2 x 4 A | |
| **Switching capacity** | | |
| to AC 15: | | |
| NO contacts: | 3 A / AC 230 V | IEC/EN 60947-5-1 |
| NC contacts: | 1 A / AC 230 V | IEC/EN 60947-5-1 |
| To DC 13 | | |
| NO contacts: | 1 A / DC 24 V | IEC/EN 60947-5-1 |
| NC contacts: | 1 A / DC 24 V | IEC/EN 60947-5-1 |
| **Electrical life** | | |
| to AC 15 at 3 A, AC 230 V: | 2 x $10^5$ switching cycles | |
| **Permissible switching frequency:** | 1800 / h | |
| **Short circuit strength max. fuse rating:** | 4 A gG / gL | IEC/EN 60947-5-1 |
| **Mechanical life:** | 30 x $10^6$ switching cycles | |

## Technical Data

### General Data

| | | |
|---|---|---|
| **Nominal operating mode:** | Continuous operation | |
| **Temperature range** | | |
| Operation: | - 20... + 60 °C<br>(at range 0 ... - 20 °C limited function of the LCD display) | |
| Storage: | - 20... + 70 °C | |
| **Altitude:** | ≤ 2000 m | |
| **Clearance and creepage distance rated impulse voltage / pollution degree** | | |
| Auxiliay voltage / meas. input: | 6 kV / 2 | IEC/EN 60664-1 |
| Auxiliay voltage / contacts: | 6 kV / 2 | IEC/EN 60664-1 |
| Measuring input / contacts: | 6 kV / 2 | IEC/EN 60664-1 |
| Contacts 11,12,14 / 21,22,24: | 4 kV / 2 | IEC/EN 60664-1 |
| Overvoltage category: | III | |
| **EMC** | | |
| Electrostatic discharge (ESD): | 8 kV (air) | IEC/EN 61000-4-2 |
| HF-irradiation | | |
| 80 MHz ... 6 GHz | 10 V / m | IEC/EN 61000-4-3 |
| Fast transients: | 2 kV | IEC/EN 61000-4-4 |
| Surge voltages between | | |
| wires for power supply: | 2 kV | IEC/EN 61000-4-5 |
| Between wire and ground: | 4 kV | IEC/EN 61000-4-5 |
| HF-wire guided: | 10 V | IEC/EN 61000-4-6 |
| Interference suppression: | Limit value class A*)<br>*) The device is designed for the usage under industrial conditions (Class A, EN 55011).<br>When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken. | |
| **Degree of protection** | | |
| Housing: | IP 40 | DIN EN 60529 |
| Terminals: | IP 20 | DIN EN 60529 |
| **Housing:** | Thermoplastic with VO behaviour according to UL Subject 94 | |
| **Vibration resistance:** | Amplitude 0.35 mm, frequency 10 ... 55 Hz | IEC/EN 60068-2-6 |
| **Climate resistance:** | 20 / 060 / 04 | EN 60068-1 |
| **Wire connection** | | DIN 46228-1/-2/-3/-4 |
| **Screw terminal (fixed):** | 1 x 4 mm² solid or<br>1 x 2.5 mm² stranded ferruled (isolated) or<br>2 x 1.5 mm² stranded ferruled (isolated) or<br>2 x 2.5 mm² solid | |
| Insulation of wires or sleeve length: | 8 mm | |
| **Terminal block with screw terminals** | | |
| Max. cross section: | 1 x 2.5 mm² solid or<br>1 x 2.5 mm² stranded ferruled (isolated) | |
| Insulation of wires or sleeve length: | 8 mm | |
| **Terminal block with cage clamp terminals** | | |
| Max. cross section: | 1 x 4 mm² solid or<br>1 x 2.5 mm² stranded ferruled (isolated) | |
| Min. cross section: | 0.5 mm² | |
| Insulation of wires or sleeve length: | 12 $^{\pm 0.5}$ mm | |
| **Wire fixing:** | Plus-minus terminal screws M3,5 box terminals with wire protection or cage clamp terminals | |
| **Fixing torque:** | 0.8 Nm | |
| **Mounting:** | DIN rail | IEC/EN 60715 |
| **Weight:** | | |
| MK 9300N: | Approx. 140 g | |
| MH 9300: | Approx. 250 g | |

### Dimensions

| | |
|---|---|
| **Width x height x depth:** | |
| MK 9300N: | 22.5 x 90 x 97 mm |
| MH 9300: | 45 x 90 x 97 mm |

## DNV-Data

**Tested according to Class Guideline DNV-CG-0339, Edition August 2021**

**Certificate No:** TAA0000155

**Location class**

| | |
|---|---|
| Temperature: | B |
| Humidity: | B |
| Vibration: | A |
| EMC: | A |
| Enclosure: | A |

## Standard Types

MK 9300N.11/022 3 AC 20 ... 440 V AC 12 A DC 24 V

| | |
|---|---|
| Article number: | 0063630 |
| • Measuring voltage: | 3 AC 20 ... 440 V |
| • Measuring current: | AC 12 A |
| • Auxiliary voltage $U_H$: | DC 24 V |
| • Output: | 1 changeover contact |
| • Width: | 22.5 mm |

MH 9300.12/022 3 AC 20 ... 440 V AC 12 A AC 230 V

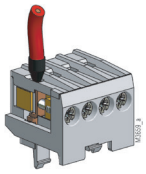
| | |
|---|---|
| Article number: | 0063631 |
| • Measuring voltage: | 3 AC 20 ... 440 V |
| • Measuring current: | AC 12 A |
| • Auxiliary voltage $U_H$: | AC 230 V |
| • Output: | 1 changeover contact (Rel1) and 1 changeover contact (Rel2) |
| • Width: | 45 mm |

## Ordering Example

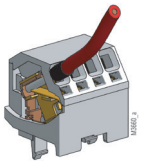
MK 9300N .11 _ _ /022 3 AC 20 ... 440 V AC 12 A DC 24 V

- Auxiliary voltage $U_H$
- Measuring current $U_M$
- Measuring voltage
- Type of terminals
  - Without indication: Terminal blocks fixed with screw terminals
  - PC (plug in cage clamp): Pluggableterminalblocks withcageclampterminals
  - PS (plug in screw): Pluggableterminalblocks with screw terminals
- Contacts
- Type

## Options with Pluggable Terminal Blocks



Screw terminal
(PS/plugin screw)

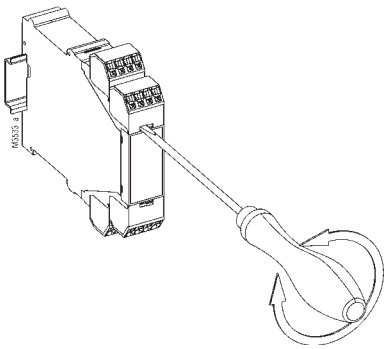


Cage clamp terminal
(PC/plugin cage clamp)

## Notes

Removing the terminal blocks with cage clamp terminals

1. The unit has to be disconnected.
2. Insert a screwdriver in the side recess of the front plate.
3. Turn the screwdriver to the right and left.
4. Please note that the terminal blocks have to be mounted on the belonging plug in terminations.



## Safety notes

**Dangerous voltage.**
**Electric shock will result in death or serious injury.**

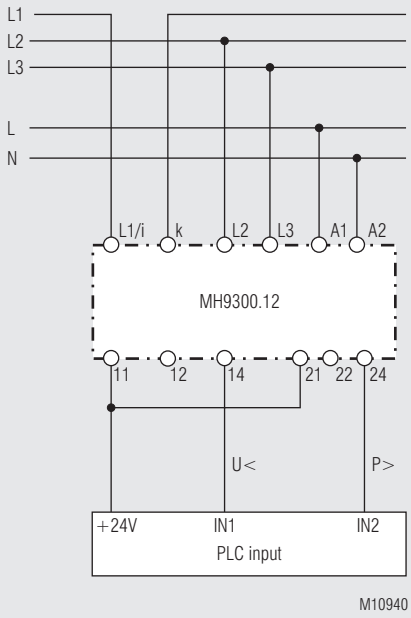
Disconnect all power supplies before servicing equipment.

- Faults must only be removed when the relay is disconnected
- The user has to make sure that the device and corresponding components are installed and wired according to the local rules and law (TUEV, VDE, Health and safety).
- Settings must only be changed by trained staff taking into account the safety regulations. Installation work must only be done when power is disconnected.
- Observe proper grounding of all components

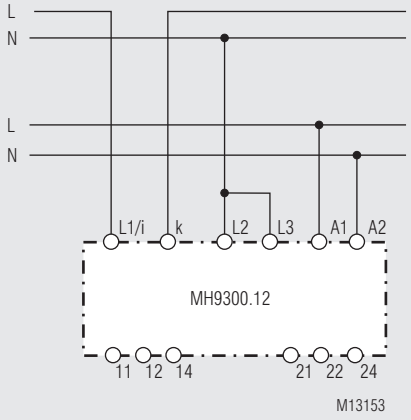
## Set Up Procedure

The connection has to be made according to the connection examples. To connect the current of L1 the Terminals I and k are available. If the current to be measured exceeds the maximum continuous current of the input and external current transformer has to be used. If current is not measured input k remains unconnected.

## Connection Example




For 3-phase connection




For single-phase connection

| | |
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| EN | **Notice** |
| FR | **Note** |