**Monitoring Technique**

**VARIMETER PRO**

**Multifunction Measuring Relay**

**MK 9300N, MH 9300**

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### 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 systems is very simple and without extensive wiring. Because of the menu structure the multifunctional measuring relays can be used easily 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

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### 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 delay, on delay
- Adjustable hysteresis 0.2 ... 50 % of response value
- Manual reset
- LCD for indication of the measuring values

### Monitoring Technique

**VARIMETER PRO**

**Multifunction Measuring Relay**

**MK 9300N, MH 9300**

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### 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 to relay 1 and/or relay 2

### Approvals and Markings

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### 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

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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.
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 \( U_{\text{min}} / U_{\text{max}} \).

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

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### Circuit Diagrams

MK 9300N.11

MH 9300.12

### Connection Terminals

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 (+), A2</td>
<td>Auxiliary voltage AC or DC</td>
</tr>
<tr>
<td>L1/i, L2, L3</td>
<td>Voltage measuring input AC</td>
</tr>
<tr>
<td>L1/i, k</td>
<td>Current measuring path AC</td>
</tr>
<tr>
<td>11, 12, 14</td>
<td>Indicator relay (C/O contact)</td>
</tr>
<tr>
<td>21, 22, 24</td>
<td>Indicator relay (C/O contact)</td>
</tr>
</tbody>
</table>

### Function

After connecting the auxiliary supply to terminals A1-A2 the startup 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 (1) and (2) 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

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.

The fault memory is selectable

With button (3) 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 \( U_{\text{min}} / U_{\text{max}} \).

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

---

### Setting

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>green LED</td>
<td>( U_n ): on, when auxiliary voltage present</td>
</tr>
<tr>
<td>red LED</td>
<td>(flashes) at overload at current path</td>
</tr>
<tr>
<td>orange LED</td>
<td>No measurement, unit in input mode</td>
</tr>
</tbody>
</table>

### Cursor LCD Display

- Active manual reset
  - Manual reset activated: flashes when memory mode is ON and relay in failure state.
  - Reset with button (4)

- Contact state of the output relays
**Limit values for Rel.1 and Rel.2**
Selectable with buttons.

**Factory setting**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umin:</td>
<td>Response value undervoltage, Lowest phase to phase voltage</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>(Undervoltage relay)</td>
<td></td>
</tr>
<tr>
<td>Umax:</td>
<td>Response value overvoltage, Highest phase to phase voltage L1, L2 or L3</td>
<td>440 V</td>
</tr>
<tr>
<td></td>
<td>(Overvoltage relay)</td>
<td></td>
</tr>
<tr>
<td>Asym:</td>
<td>Response value voltage asymmetry, Percentage of highest to lowest phase to</td>
<td>20 %</td>
</tr>
<tr>
<td></td>
<td>phase voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Asymmetry relay)</td>
<td></td>
</tr>
<tr>
<td>I:</td>
<td>Response value current at current path L1</td>
<td>&gt; 8.00 A</td>
</tr>
<tr>
<td></td>
<td>(&lt; under- / &gt; overcurrent)</td>
<td></td>
</tr>
<tr>
<td>Cos-j:</td>
<td>Response value phase displacement between current and voltage</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>(&lt; under- / &gt; overcurrent)</td>
<td></td>
</tr>
<tr>
<td>P:</td>
<td>Response value effective power 3-phase</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>Independent of phase sequence switches at adjusted value also at reverse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>power (&lt; under- / &gt; overload)</td>
<td></td>
</tr>
<tr>
<td>S:</td>
<td>Response value apparent power 3-phase</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>(&lt; &lt; / &gt; )</td>
<td></td>
</tr>
<tr>
<td>Q:</td>
<td>Response value reactive power (&lt; / &gt; )</td>
<td>OFF</td>
</tr>
<tr>
<td>f:</td>
<td>Response value frequency (range 1 ... 400 Hz)</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>(&lt; under- / &gt; overfrequency)</td>
<td></td>
</tr>
<tr>
<td>Hyst:</td>
<td>Hysteresis 0.2 ... 50 % of response value</td>
<td>4.0 %</td>
</tr>
<tr>
<td>tv:</td>
<td>On delay for relays (0 ... 10 sec)</td>
<td>0 s</td>
</tr>
<tr>
<td>Phseq:</td>
<td>Monitoring phase sequence (ON / OFF)</td>
<td>ON</td>
</tr>
<tr>
<td>A / R:</td>
<td>Setting open- / closed circuit operation</td>
<td>R</td>
</tr>
<tr>
<td>Sp:</td>
<td>Error storage (ON / OFF)</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Response values can be deactivated. (OFF)

**Further Setting Parameter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>t:</td>
<td>Start up delay, when auxiliary voltage connected (0.2 ... 10 sec) in steps</td>
<td>0.2 s</td>
</tr>
<tr>
<td></td>
<td>of 0.1 s</td>
<td></td>
</tr>
</tbody>
</table>

**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.
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 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

One character to the left

Back to the Display (Run)-Mode

Press button 3 s OK New values stored

or

Press button 3 s; Break Values unchanged

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

### Display (RUN) Mode

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display inverted when the actual value is in failure state.</td>
<td>Measurement interrupted, relays are in failure state, indicator LED orange color</td>
</tr>
<tr>
<td>Scroll display between the 10 different measuring values.</td>
<td>Chose Rel1, Rel2, T	extsubscript{a}, and RUN As option address for RS485 Bus</td>
</tr>
<tr>
<td>Reset fault memory: Esc</td>
<td>Chose parameter Change and set response values for Rel1 and Rel2.</td>
</tr>
<tr>
<td>For more the 3 sec, change to input mode</td>
<td>Shift cursor to the left</td>
</tr>
<tr>
<td>For more than 3 sec, change to display mode</td>
<td>Shift cursor to the right</td>
</tr>
</tbody>
</table>
The menu for relay 2 is identically...
Operating - Setting valid for both relays -

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

### Technical Data

#### Auxiliary Voltage A1/A2

- **Nominal auxiliary voltage $U_h$:**
  - **MK 9300N:**
    - DC $24$ V $(0.9 ... 1.1 \times U_h)$
    - AC $110, 230$ V, $400$ V $(0.8 ... 1.1 \times U_h)$
    - AC/DC $110 ... 400$ V $(0.8 ... 1.1 \times U_h)$
  - **MH 9300:**
    - DC $24$ V $(0.9 ... 1.1 \times U_h)$

- **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
    - $(0.8 ... 1.1 \times U_m)$
- **MH 9300:**
  - Nominal voltage: $3$ AC $400$ V / $690$ V
  - Measuring range $U_m$: $3$ AC $24 ... 400$ V, $24 ... 690$ V
    - $(0.8 ... 1.1 \times U_m)$

- **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
- **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): $\pm 4\%$
- **Hysteresis** (in % of setting value): $0.2 ... 50\%$ of response value
- **Reaction time:** $< 350$ ms $(f > 10$ Hz)
- **Adjustable on delay $t_o$:** $0 ... 10$ s (in steps of $0.1$ s)
- **Adjustable start up delay $t_s$:** $0.2 ... 10$ 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 1 changeover contact (Rel2)

- **Thermal current $I_{th}:**
  - $2 \times 4$ A

- **Switching capacity** to AC $15$:
  - NO contacts: $3$ A / AC $230$ V
  - NC contacts: $1$ A / AC $230$ V
  - to DC $13$
  - NO contacts: $1$ A / DC $24$ V
  - NC contacts: $1$ A / DC $24$ V

- **Electrical life** to AC $15$ at $3$ A, AC $230$ V:
  - $2 \times 10^5$ switch. cycl.

- **Permissible switching frequency:** $1800 / h$

- **short circuit strength**

- **Max. fuse rating:** $4$ A gG / gL
- **Mechanical life:** $30 \times 10^3$ switching cycles
**Technical Data**

**General Data**

Nominal operating mode: continuous operation

Temperature range

Operation: -20...+60 °C
(at range 0...-20 °C limited function of the LCD display)

Storage: -20...+60 °C

Altitude: <2,000 m

Clearance and creepage distance

rated impulse voltage /
pollution degree

- Auxiliary voltage / meas. input: 6 kV / 2 IEC/EN 60 664-1
- Auxiliary voltage / contacts: 6 kV / 2 IEC/EN 664-1
- Measuring input / contacts: 6 kV / 2 IEC/EN 664-1
- Contacts 11,12,14 / 21,22,24: 4 kV / 2 IEC/EN 664-1

Overvoltage category: III

**EMC**

- Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2
- HF-irradiation, 80 MHz ... 2.7 GHz: 10 V / m IEC/EN 61 000-4-3
- Fast transients: 2 kV IEC/EN 61 000-4-4

**Degree of protection**

- Housing: IP 40 DIN EN 60 529
- Terminals: IP 20 DIN EN 60 529
- Housing: thermoplastic with VO behaviour according to UL Subject 94

**Vibration resistance**

- Amplitude 0.35 mm, frequency 10...55 Hz IEC/EN 60 068-2-6

**Climate resistance**

- 20 / 060 / 04 EN 60 068-1

**Wire connection**

- Screw terminal (fixed): DIN 46 228-1/-2/-3/-4
- Insulation of wires or sleeve length: 8 mm
- Insulation of wires or sleeve: 8 mm
- Terminal block with screw terminals
  - Max. cross section: 1 x 2.5 mm² solid or 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 1 x 2.5 mm² stranded ferruled (isolated)
  - Insulation of wires or sleeve length: 12 ±0.5 mm
- Wire fixing: Plus-minus terminal screws M3,5 box terminals with wire protection or cage clamp terminals
  - 0.8 Nm

**Mounting**

- DIN rail IEC/EN 60 715

**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

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**Standard Types**

**Ordering Example**

- MK 9300N 11_022 3 AC 20...440 V AC 12 A DC 24 V
- MH 9300 12_022 3 AC 20...440 V AC 12 A AC 230 V

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**DNV GL- Data**

Tested according to Class Guideline DNVGL-CG-0339, Edition November 2015

Certificate No: TAA0000155

**Location class**

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

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**Technical Data**

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**Temperature range**

- Operation: -20...+60 °C (at range 0...-20 °C limited function of the LCD display)
- Storage: -20...+60 °C
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**Clearance and creepage distance**

**Rated impulse voltage**

- Auxiliary voltage / meas. input: 6 kV / 2 IEC/EN 60 664-1
- Auxiliary voltage / contacts: 6 kV / 2 IEC/EN 664-1
- Measuring input / contacts: 6 kV / 2 IEC/EN 664-1
- Contacts 11,12,14 / 21,22,24: 4 kV / 2 IEC/EN 664-1

**Overvoltage category:** III

**EMC**

- Electrostatic discharge (ESD): 8 kV (air) IEC/EN 61 000-4-2
- HF-irradiation, 80 MHz ... 2.7 GHz: 10 V / m IEC/EN 61 000-4-3
- Fast transients: 2 kV IEC/EN 61 000-4-4

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- Terminals: IP 20 DIN EN 60 529

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**Dimensions**

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

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.