Monitoring Relays
3-Phase Load Guard
Types DWB01, PWB01

Product Description
DWB01 and PWB01 are precise TRMS power factor monitoring relays for 3-phase balanced systems. They can be used for monitoring the actual load of asynchronous motors and other symmetrical loads, where the power factor is almost proportional to the load.

The relay measures the power factor (\(\cos \phi\)), that is the ratio between the active and the apparent power of a motor.

Start/stop input allows to use a manual switch to start and stop the motor, without the need of an auxiliary device.

The advantage of using the latch function is that the relay can be kept energized even after the end of the alarm condition. Inhibit function can be used to avoid relay operation when not desired (maintenance, transients).

The LED's indicate the state of the alarm and the output relay.

Type Selection

<table>
<thead>
<tr>
<th>Mounting</th>
<th>Output</th>
<th>Supply:</th>
<th>Supply:</th>
<th>Supply:</th>
<th>Supply:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN-rail</td>
<td>SPDT</td>
<td>208 to 240 VAC</td>
<td>380 to 415 VAC</td>
<td>380 to 480 VAC</td>
<td>600 to 690 VAC</td>
</tr>
<tr>
<td>Plug-in</td>
<td>SPDT</td>
<td>DWB01 C M23 10A</td>
<td>DWB01 C M23 10A</td>
<td>DWB01 C M48 10A</td>
<td>DWB01 C M69 10A</td>
</tr>
</tbody>
</table>

Input Specifications

<table>
<thead>
<tr>
<th>Input</th>
<th>Voltage (Own power supply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - phase</td>
<td>DWB01: L1, L2, L3</td>
</tr>
<tr>
<td></td>
<td>5, 6, 7</td>
</tr>
<tr>
<td></td>
<td>208 to 240 VAC ± 15%</td>
</tr>
<tr>
<td></td>
<td>380 to 480 VAC ± 15%</td>
</tr>
<tr>
<td></td>
<td>380 to 415 VAC ± 15%</td>
</tr>
<tr>
<td></td>
<td>600 to 690 VAC ± 15%</td>
</tr>
<tr>
<td></td>
<td>DWB01CM48: L1, L2, L3</td>
</tr>
<tr>
<td></td>
<td>5, 6 (connect pins 6, 7)</td>
</tr>
<tr>
<td></td>
<td>208 to 240 VAC ± 15%</td>
</tr>
<tr>
<td></td>
<td>380 to 480 VAC ± 15%</td>
</tr>
<tr>
<td></td>
<td>380 to 415 VAC ± 15%</td>
</tr>
<tr>
<td></td>
<td>600 to 690 VAC ± 15%</td>
</tr>
<tr>
<td>1 - phase</td>
<td>DWB01CM23: L1, L2, L3</td>
</tr>
<tr>
<td></td>
<td>5, 6 (connect pins 6, 7)</td>
</tr>
<tr>
<td></td>
<td>208 to 240 VAC ± 15%</td>
</tr>
<tr>
<td>Current:</td>
<td>DWB01: 5A, 10A: I1, I2</td>
</tr>
<tr>
<td></td>
<td>Mi... U1, U2</td>
</tr>
<tr>
<td></td>
<td>PWB01: 5A, 10A: 11, 10</td>
</tr>
<tr>
<td></td>
<td>Mi... 9, 8</td>
</tr>
</tbody>
</table>

Measuring ranges

- Power factor (\(\cos \phi\))
- Direct input:
  - 0.5 to 5A: 30A
  - 1 to 10A: 50A
- Standard CT (examples)
  - TADK2 50 A/5 A
  - TAD12 1000 A/5 A
  - TACO200 6000 A/5 A
- AACrms
- Max. curr. (30 s)
  - 0.5 to 5A: 30A
  - 1 to 10A: 50A
  - 5 to 50 A: 60 A
  - 15 to 150 A: 180 A
  - 40 to 400 A: 480 A
  - 100 to 1000 A: 1200 A
  - 600 to 6000 A: 7200 A
- MI CT ranges
  - 10 to 100 A: 325 AAC
  - 50 to 500 A: 1000 AAC

Specifications are subject to change without notice (07.06.10)
### Input Specifications (cont.)

| Note: | The input voltage cannot raise over 300 V AC with respect to ground (PWB01 only). |

<table>
<thead>
<tr>
<th>Contact input</th>
<th>Terminals Z1, U1</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWB01</td>
<td>Terminals 2, 9</td>
</tr>
<tr>
<td>Disabled</td>
<td>&gt; 10 kΩ</td>
</tr>
<tr>
<td>Enabled</td>
<td>&lt; 500 Ω</td>
</tr>
<tr>
<td>Pulse width</td>
<td>&gt; 500 ms</td>
</tr>
</tbody>
</table>

| Hysteresis | PF approx. 0.1 |

### General Specifications

- **Power ON delay**: 1 to 30 s ± 0.5 s
- **Reaction time**: (input signal variation from -20% to +20% or from +20% to -20% of set value)
  - Alarm ON delay: < 200 ms
  - Alarm OFF delay: < 200 ms
- **Accuracy**
  - Temperature drift: ± 1000 ppm/°C
  - Delay ON alarm: ± 10% on set value ± 50 ms
  - Repeatability: ± 0.5% on full-scale
- **Indication for**
  - Power supply ON: LED, green
  - Alarm ON: LED, red (flashing 2 Hz during delay time)
  - Output relay ON: LED, yellow
- **Environment**
  - Degree of protection: IP 20
  - Pollution degree: 3 (DWB01), 2 (PWB01)
  - Operating temperature:
    - Max. voltage, 50 Hz: -20 to 60°C, R.H. < 95%
    - Max. voltage, 60 Hz: -20 to 50°C, R.H. < 95%
  - Storage temperature: -30 to 80°C, R.H. < 95%
- **Housing**
  - Dimensions: DWB01 45 x 80 x 99.5 mm, PWB01 36 x 80 x 94 mm
  - Material: PA66 or Noryl
- **Weight**: Approx. 250 g
- **Screw terminals**
  - Tightening torque: Max. 0.5 Nm, acc. to IEC 60947
- **Product standard**: EN 60255-6
- **Approvals**: UL, CSA
- **EMC Immunity**: According to EN 60525-26, EN 61000-6-2, EN 60525-26, EN 61000-6-3

### Output Specifications

<table>
<thead>
<tr>
<th>Output</th>
<th>SPDT relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated insulation voltage</td>
<td>250 VAC</td>
</tr>
<tr>
<td>Contact ratings (AgSnO₂)</td>
<td>μ</td>
</tr>
<tr>
<td>Resistive loads</td>
<td>8 A @ 250 VAC</td>
</tr>
<tr>
<td>DC 12</td>
<td>5 A @ 24 VDC</td>
</tr>
<tr>
<td>Small inductive loads</td>
<td>2.5 A @ 250 VAC</td>
</tr>
<tr>
<td>DC 13</td>
<td>2.5 A @ 24 VDC</td>
</tr>
</tbody>
</table>

- **Mechanical life**: ≥ 30 x 10⁶ operations
- **Electrical life**: ≥ 10⁵ operations
  - (at 8 A, 250 V, cos ϕ = 1)
- **Operating frequency**: ≤ 7200 operations/h
- **Dielectric strength**
  - Dielectric voltage: According to EN 60947-1
  - Rated impulse withstand volt.: 4 kV (1.2/50 μs)

### Supply Specifications

- **Power supply**
  - Rated operational voltage
    - Through terminals:
      - DWB01: L1, L2, L3
      - PWB01: 5, 6, 7
      - M23: 177 to 276 VAC 45 to 65 Hz
      - M48: 323 to 552 VAC 45 to 65 Hz
      - M69: 510 to 793 VAC 45 to 65 Hz
- **Approvals**: UL, CSA
- **EMC Immunity**: According to EN 60525-26, EN 61000-6-2, EN 60525-26, EN 61000-6-3
- **Emissions**: According to EN 60525-26, EN 61000-6-2

### Mode of Operation

DWB01 and PWB01 can be used for monitoring the actual load of asynchronous motors. The relay measures the absolute value for the power factor of the system PF = Active Power/Apparent Power that is for balanced system with sinus waveforms. As cos ϕ varies with the load of the motor, underload and overload can be indirectly detected by DWB01 and PWB01. The relation between the load and cos ϕ depends on the type of motor. As a guideline to ensure correct working conditions for a motor, the upper level could be set above the cos ϕ marking on the motor, and the lower level under this value. It is anyway recommended to make the adjustment in connection with a practical test. The relay has an adjustable power ON delay in order to avoid overload detection during motor start.

**Example 1**

Latching mode, relay NE
In this application DWB01 or PWB01 are connected to an external current metering transformer, type MI..., (connected between U1 & U2) as...
Mode of Operation (cont.)

well as to a 3-phase asynchronous motor. The relay energizes as soon as the power supply is applied. After the power ON delay, the unit starts measuring \( \cos \phi \). If \( \cos \phi \) is within the setpoints the relay is energized. As soon as the power factor drops below the lower setpoint or exceeds the upper setpoint the output relay releases and the red LED turns on after the set time has expired. To restart the \( \cos \phi \) measurement, connect Z1 and U1 (2 and 9) or interrupt the power supply for at least 1 s.

Example 2
Non-latching mode, relay NE
DWB01 and PWB01 react as described in the previous example 1 except for the automatic reactivation of the relay as soon as \( \cos \phi \) is back within the two setpoints. When the measured \( \cos \phi \) exceeds the set upper level, the red LED starts flashing. The output relay releases after the set time period. When the measured \( \cos \phi \) drops below the set lower level, the red LED starts flashing, and the output relay releases after the set time period. When the output relay releases there will be no LED indication.

Example 3
1-Phase load monitoring
DWB01CM2310A and PWB01CM2310A can be used for monitoring the power factor of a 1-Phase load with 208 to 240 V AC mains voltage. In this case the power supply has to be connected between L1, L2 (or 5, 6), L2 and L3 (or 6 and 7) have to be connected.

Example 4
Start/stop mode, relay NE
In this application DWB01 or PWB01 are directly connected to a 3-phase asynchronous motor. The relay energizes as soon as the power supply is applied and the start/stop contact is closed. After the power ON delay, the unit starts measuring \( \cos \phi \). If \( \cos \phi \) is within the setpoints the relay energizes. As soon as the power factor drops below the lower setpoint or exceeds the upper setpoint the output relay releases and the red LED turns ON after the set time has expired. When the start/stop contact is opened the relay de-energizes immediately. To restart the system just connect the start/stop contact.

Note 1: to use the start/stop function the output relay has to command a contactor connected in series to the load (see last two wiring diagrams).

Note 2: in case of current below the minimum level the alarm is conventionally ON.

Note 3: (3-phase voltage): connect the 3-phase power supply to the terminals L1, L2 and L3 (DWB01) - 5, 6 and 7 (PWB01) taking care of the sequence.

Function/Range/Level/Time Setting

Select the desired function setting the DIP-switches 1 to 4 as shown on the right. To access the DIP-switches open the plastic cover using a screwdriver as shown on the right.

If DIP switch 3 is set to ON (start/stop) the position of DIP-switch 4 does not affect the products working mode.

Centre knobs:
Setting of upper and lower level of \( \cos \phi \) 0.1 to 0.99.

Lower left knob:
Setting of delay on absolute scale: 0.1 to 30 s.

Lower right knob:
Setting of power ON delay on absolute scale: 1 to 30 s.

Notes

1. DIP-switch 3 set ON enables the start/stop function that is managed by the closing-opening of the contact input.
2. DIP-switch 3 set OFF enables the input contact for the latch/inhibit functions: the selection between these is allows by the DIP switch 4.

The following table shows how the input contact manages the mode of operation:

<table>
<thead>
<tr>
<th>Contact input working mode</th>
<th>CLOSED</th>
<th>OPEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATCH</td>
<td>NOT ACTIVE</td>
<td>ACTIVE</td>
</tr>
<tr>
<td>INHIBIT</td>
<td>ACTIVE</td>
<td>NOT ACTIVE</td>
</tr>
<tr>
<td>START/STOP</td>
<td>START</td>
<td>STOP</td>
</tr>
</tbody>
</table>

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### Operation Diagrams

**Latch function - NE relay**
- Power supply
- Latch contact (Closed = latch not active)
  - Upper Level
  - Lower Level
- Relay ON

**Inhibit function - ND relay**
- Power supply
- Inhibit contact (Closed = inhibit active)
  - Upper Level
  - Lower Level
- Relay ON

**Start and stop function - NE relay**
- Power supply
- Start/Stop contact (Closed = Start; Open = Stop)
  - Upper Level
  - Lower Level
- Relay ON

### Wiring Diagrams

**DWB01 - Direct connection**

**PWB01 - Direct connection**
With the start/stop function enabled, it's necessary to use the following wiring diagrams (which are two examples among many others). It is possible for both 3-phase loads and 1-phase loads, either through direct connection or external current metering transformer.
Dimensions

### DIN-rail

- Width: 99.5 mm
- Height: 80 mm
- Depth: 83.5 mm
- Thickness: 28.5 mm

### Plug-in

- Width: 94 mm
- Height: 80 mm
- Depth: 90 mm
- Thickness: 28.5 mm