PROGRAMMABLE HUMIDITY AND TEMPERATURE ON/OFF OR PID CONTROLLER

* Two current inputs 4 ÷ 20 mA:
  - temperature - 0 ÷ 100 °C
  - humidity - 0 ÷ 100 %
* Outputs:
  - four relay outputs for control action (A1, A2, A3, A4)
* Indication:
  - 3-digit LED display for temperature visualization
  - 3-digit LED display for humidity visualization
  - LEDs for relay status
* Mounting:
  - Dimensions - 96 x 96 x 180 mm
  - Panel cutout 92 x 92 mm
  - Power supply 90 ÷ 250V AC/DC

GENERAL DESCRIPTION
The controller is purposed for temperature and humidity measurement. There are two current inputs - one for temperature measurement (0 ÷ 100°C) and one for humidity measurement (0 ÷ 100%). When the measured value on one of the channels is less than the lower limit range "Und" is visualized on the corresponding display. When the measured value exceeds the upper limit range "Ofl" is visualized on the display. In case of input signal failure "Err" is shown on the corresponding display.

The relay outputs of the controller could be configured for ON/OFF, PID or Alarm control action. Relay outputs A1 (LED C1 on the front panel) and A2 (LED C2) are for input channel 1 (temperature). Relay outputs A3 (LED C3) and A4 (LED C4) are for input channel 2 (humidity).

RELAY OUTPUTS DESCRIPTION
The following parameters have to be configured:
- Control action type (Ctx) - On/Off or Alarm control action
- Type of the limit level (L x) - High or Low limit
- Set point (SPx) - the relay output is triggered when the measured value exceeds this set point
- Hysteresis (h x)
- Delay on relay energizing (t x)
For 3-position control action realization configure one of the relay outputs for high alarm action and the other - for low alarm action. Realization of 3-position control action using relay outputs A1 and A2 is shown on the figure 2 below. For humidity 3-position control action use relay outputs A3 and A4.

**3 - POSITION CONTROL ACTION**

**PID control:**
The general logic of the action of the PID control is given by the expression:

$$u(t) = K \left( e_n + \frac{1}{T_i} \int_0^t e(s) ds + T_d \frac{dPV_n}{dt} \right)$$

where:
- $e = SP - PV_c$ - The closed loop error; SP - Set Point, PV - Process Variable;
- $en = e / \text{Range}$ - Normalized error;
- $dPV_n / dt$ - Change of the normalized process variable (not normalized error);
- $K$ - Proportional Constant;
- $Ti$ - Integral Time (Ti);
- $Td$ - Derivative Time (Td);
- $u$ - PID normalized output 0-1.0;

The following parameters have to be set:
- SP - Set Point
- K - Proportional Constant
- Ti - Integral Time
- Td - Derivative Time
Influence of PID parameters to the controlled process:
The influence of the parameters (K, Ti and Td) to the process is graphically shown on the figure below. Simulated transient responses and responses to load disturbance with different PID parameters are shown on the different parts of the figure.

The output from the controller is PWM (Pulse With Modulation). The operator has to set the PWM cycle. The logic of PWM is shown on figure below.

The above figures can be summarized as follows:

<table>
<thead>
<tr>
<th>Action</th>
<th>Rise Time</th>
<th>Overshoot</th>
<th>Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase K</td>
<td>faster</td>
<td>increases</td>
<td>gets worse</td>
</tr>
<tr>
<td>Increase Ti</td>
<td>slower</td>
<td>decreases</td>
<td>improves</td>
</tr>
<tr>
<td>Increase 1/Ti</td>
<td>faster</td>
<td>increases</td>
<td>gets worse</td>
</tr>
</tbody>
</table>

The time Tcycle can be set from the front panel in seconds. The time, in which the relay output is ON, is calculating like \( u(t) \cdot T_{cycle} \) where \( u(t) \) is the PID action output and is from 0 to 1 (or from 0% to 100%).
OVERALL DIMENSIONS

CONNECTIONS DIAGRAM

Note: Input 1 (T °C) and input 2 (RH %) are with common minus.

<table>
<thead>
<tr>
<th>Terminal No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>Input 1 (4 - 20 mA) - temperature</td>
</tr>
<tr>
<td>3, 4</td>
<td>Input 2 (4 - 20 mA) - humidity</td>
</tr>
<tr>
<td>5, 6</td>
<td>Galvanic isolated voltage output 24V DC</td>
</tr>
<tr>
<td>7, 8</td>
<td>Power supply 90-250V AC/DC</td>
</tr>
<tr>
<td>9, 10, 11</td>
<td>Relay output A1</td>
</tr>
<tr>
<td>12, 13, 14</td>
<td>Relay output A2</td>
</tr>
<tr>
<td>15, 16, 17</td>
<td>Relay output A3</td>
</tr>
<tr>
<td>18, 19, 20</td>
<td>Relay output A4</td>
</tr>
</tbody>
</table>