E5CC

QUICK START INSTRUCTION
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Author: T. van Leeuwen
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Introduction
This Quick Start Instruction is designed to set your Omron controller so that you can connect it, parameterize it and get it started quickly. This Quick Start Instruction contains only recommendations and does not substitute thorough study the user manual. It is aimed at technically skilled persons with knowledge of the hazards involved in handling electronic devices in terms of electric shocks and other effects caused by incorrect settings.

A comprehensive guide and data sheet for our controllers is on our web site:

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Preparation
To follow this guide it is important that you have the following hardware.

Hardware
- Temperature control
  - E5CC
  - E5EC
  - E5……..
- Reader
  - Temperature sensor: Pt100 or Thermocouple
  - Sensor with process value 4-20mA or 0-10V
- Heating and/or cooling element
  - control through Relay,
  - control through Solid-state relay
  - control through 4-20mA
PV: Process Value = Actual and measured value.
SV: Set Value = Set and desired value.
Outputs: Activated outputs.
Level button: Level setting selection.
Mode button: Parameter selection.
Shift button: Programmable function button or number scrolling.
UP/Down button: Increase or decrease the value of the selected parameter.
1. Connections & Settings
This chapter discusses the basic settings and connections. Before contacting the help desk, please be sure to go through these.

1.1 Connecting the E5CC
A connection diagram is displayed on the side of each controller. (See Figure 1.) The picture below is an example, the type you purchased may deviate from this. Most connections and numbers are identical, however.

![Connection Diagram](image.png)

Figure 1: Connection diagram.

- Clamps 1 - 2 are the control output for heating / cooling unit
- Clamps 4 - 5 - 6 are for the sensor, such as thermocouple or Pt100
- Clamps 7 - 8 - 9 - 10 are the alarm / help connections
- Clamps 11 - 12 are the power voltage CAUTION! 24V or 100-240V
- Clamps 13 through 18 are for options
1.1.1 Connecting sensor

Pt100
If a Pt100 is used, connect it to clamps 4, 5, & 6. The controller expects a 3-wire Pt100, which generally has 2 identical colors and 1 different color. The identical colors go under clamps 5 and 6, the different color under clamp 4.
If you have a 2-wire Pt100, then connect the reader between 4 and 5, with a bridging wire between connection 5 and 6.

Thermocouple
If you use a thermocouple, connect it to clamps 5 & 6
Caution! A thermocouple has a + and – Incorrect connection may result in a negative or an incorrect value.

4-20 mA or 0-10 V
A process value such as 4-20 mA or 0-10 V may be connected to clamps 4&5 and 5&6, respectively.

For correct operation of the controller, please always indicate which type of sensor is connected.

If this is not done correctly, the controller will display an 5-ERR (sensor-error) message, or the incorrect value.

For the correct settings, please see Chapter 1.2.1

Figure 2: connecting sensor.
1.1.2 Connecting control output

Relay output
If a controller with a relay as control output is used, then this relay will be confirmed if there is a heating demand (or cooling in a cooling installation). The relay can switch a maximum of 3 amps; if more current is demanded, a more powerful relay must be switched.
You may also choose to use a controller with solid-state control output in combination with a solid-state relay with the correct power.
See Figure 4 for connection diagram.

Solid-State Relay
Solid-state relays are extremely suitable for frequent switching of high capacities and PID controls. The solid-state relay is controlled with a voltage of 12 Volts. This voltage is delivered by the controller. So the solid-state relay can be connected directly to the controller. Please note the polarity
See Figure 5 for connection diagram.
Omron has a comprehensive package of solid-state relays

4-20mA
Some processes need to be controlled by a 4-20mA signal. In this case, you also need a controller with this type of control output.

![Diagram of several control outputs](Figure 3: Several control outputs.)
Figure 4: Controlling through relay output.

Figure 5: Controlling through solid-state relay.
1.2 Setting up the controller
For the correct operation of the controller, specific parameters need to be set. The most important settings are discussed in the following chapters.

1.2.1 Determining the sensor type
At the factory, the controller is set to a type-K thermocouple. If you are using a different sensor type (for instance Pt100), you will find the correct setting in the table below (Figure 6). Next to the type number is a number (1 through 29).

<table>
<thead>
<tr>
<th>Temperature inputs</th>
<th>Input type</th>
<th>Input</th>
<th>Setting</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum resistance thermometer</td>
<td>Pt100</td>
<td>0</td>
<td>-200 to 850 (°C) / -300 to 1500 (°F)</td>
<td></td>
</tr>
<tr>
<td>JPt100</td>
<td>1</td>
<td>-199.9 to 500.0 (°C) / -199.9 to 900.0 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.0 to 100.0 (°C) / 0.0 to 210.0 (°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-199.9 to 500.0 (°C) / -199.9 to 900.0 (°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.0 to 100.0 (°C) / 0.0 to 210.0 (°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermocouple</td>
<td>K</td>
<td>5</td>
<td>-200 to 1300 (°C) / -300 to 2300 (°F)</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>6</td>
<td>-20.0 to 500.0 (°C) / 0.0 to 900.0 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>-100 to 850 (°C) / -100 to 1500 (°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>-20.0 to 400.0 (°C) / 0.0 to 750.0 (°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>9</td>
<td>-200 to 400 (°C) / -300 to 700 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>-199.9 to 400.0 (°C) / -199.9 to 700.0 (°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>11</td>
<td>-200 to 600 (°C) / -300 to 1100 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>12</td>
<td>-100 to 850 (°C) / -100 to 1500 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>13</td>
<td>-200 to 400 (°C) / -300 to 700 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>14</td>
<td>-199.9 to 400.0 (°C) / -199.9 to 700.0 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>15</td>
<td>-200 to 1300 (°C) / -300 to 2300 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>16</td>
<td>0 to 1700 (°C) / 0 to 3000 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>17</td>
<td>0 to 1700 (°C) / 0 to 3000 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>18</td>
<td>100 to 1800 (°C) / 300 to 3200 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PL II</td>
<td>19</td>
<td>0 to 2300 (°C) / 0 to 3200 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared Thermosensor ES1B</td>
<td>10 -70°C</td>
<td>21</td>
<td>0 to 90 (°C) / 0 to 190 (°F)</td>
<td></td>
</tr>
<tr>
<td>60 -120°C</td>
<td>22</td>
<td>0 to 120 (°C) / 0 to 240 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115 -165°C</td>
<td>23</td>
<td>0 to 165 (°C) / 0 to 320 (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>140 -260°C</td>
<td>24</td>
<td>0 to 260 (°C) / 0 to 500 (°F)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analog input type</th>
<th>Current input</th>
<th>4 to 20mA</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage input</td>
<td>0 to 20mA</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>1 to 5V</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 5V</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 10V</td>
<td>29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 6: Sensor type and its settings.
1.2.2 Setting the sensor type
To set the sensor type, you need to change the parameter \( \text{iN-t} \) (input-type). Do this as follows:
1. Press the 1st button (level button) at least 3 seconds until \( \text{iN-t} \) is displayed.
2. The set value is indicated green and will default to 5.
3. If you are using a different sensor type, please enter the number next to the type used. Chapter 1.2.1
4. You can change the value with the up / down button.
5. After changing the value, press the level button for 3 seconds again.
If \( \text{s-err} \) is displayed on the controller, then the sensor has not been connected properly, the incorrect type has been selected, or the sensor has a malfunction.

Example: If you are using a Pt100, then you will see in the table on page 9 that you can select either the value 0.1 or 2. The difference between these settings is the range and the decimal point (see also Chapter 1.2.3).

1.2.3 Hide or show decimals
To show or hide decimals, first change the sensor type, see Figure 6 in Chapter 1.2.1. Next to Pt100 in the table is setting 0.1 or 2. If we indicate the number 0, then the range is -200 to 850 degrees WITHOUT decimals; number 1 ranges from -199.9 to 500.0, WITH decimals.
1.3 Selecting PID / ON-OFF
Do you want accurate controls without the temperature overshooting? This is easily achieved by setting your controller as PID instead of ON-OFF. See Chapter 1.3.1 When the controller is set as PID controller, autotune must be run to get the correct PID values. For autotune, see Chapter 1.3.2.

If accurate temperature control is not imperative, then you may set the controller to ON-OFF.

Figure 7 illustrates the results of different regulation algorithms.

Figure 7: PID vs ON-OFF

1.3.1 Setting up as PID controller
To set the controller as PID controller, adjust the \( \text{cntl} \) (control) parameter.
1. Press the 1st button (level button) for 3 seconds until \( \text{cntl} \) is displayed.
2. Then briefly press the 2nd button (mode button) several times until \( \text{cntl} \) is displayed.
3. As you can see, this parameter reads \( \text{onof} \) (ON-OFF). With the arrow up button change this to \( \text{pid} \) (PID).
4. Then press the 1st button again until the controller resets.

The controller is now set as PID controller. We recommend changing the PID values. As mentioned earlier, the simplest way to do this is by using autotune See Chapter 1.3.2.
1.3.2 Run Autotune

For accurate controlling the correct PID parameters are important. These can be calculated by using the autotune function.

1. Using the up and down buttons, set the desired temperature (set value).
2. Press the 1st button briefly until \( R_d \) is displayed
3. Then press the 2nd button until the \( R_L \) parameter is displayed.
4. Using the up button, select \( R_L - 2 \)
5. After a few seconds the tune message lights up. As long as this message is lit, the controller is learning the process to configure the correct parameters.
6. Then briefly press the 1st button again. The temperature will be displayed again and the tune message will remain lit.
7. As long as the tune message is lit, the controller is tuning. During this process the temperature will vary. **Do not interrupt the tuning process.**

When the message is no longer displayed, the parameters have been set correctly and controlling will be stable and economical.

**Caution:** Running autotune may take some time, depending on your process. To guarantee the correct settings, do not interrupt this process.

If autotune still has not completed after 2 hours, please contact the Omron help desk.

During tuning the temperature may rise above the set value. If this is not desirable, then you may also select \( R_L - 1 \). The controller will now commence tuning at 40% of its capacity, which will cause tuning to be slower and less excessive.
1.4 Change alarm type

The E5CC has 3 alarm outputs. These can be used to switch to an output when a specific value is reached.

Some options:
Option 1: Alarm when the temperature rises 5 degrees above the set value.
Option 2: Alarm at fixed value, for instance 150 degrees.

These are two different alarm types. There are 19 alarm types in total, see Figure 8.

For instance, if you want an alarm to activate at a fixed temperature (absolute value), then change the *alarm type*. An absolute upper limit is found at value 8. In Figure 8 all alarm types are organized in a table.

If you wish to change the alarm type, follow these steps:

1. Press and hold the 1st button for 3 seconds until $\text{ALT-}$ is displayed.
2. With the 2nd button scroll through the parameters until you reach $\text{ALT-1}$ (Alarm type 1).
3. Enter a number with the arrow buttons, referring to Figure 8. This will be the desired alarm type.

Caution: You have not set an alarm value yet. This is covered in Chapter 1.4.1
<table>
<thead>
<tr>
<th>Set value</th>
<th>Alarm type</th>
<th>Alarm output operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>When alarm value X is positive</td>
</tr>
<tr>
<td>0</td>
<td>Alarm function OFF</td>
<td>Output OFF</td>
</tr>
<tr>
<td>1</td>
<td>Upper- and lower-limit *1</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>2</td>
<td>Upper-limit</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>3</td>
<td>Lower-limit</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>4</td>
<td>Upper- and lower-limit range *1</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>5</td>
<td>Upper- and lower-limit with standby sequence *1</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>6</td>
<td>Upper-limit with standby sequence</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>7</td>
<td>Lower-limit with standby sequence</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>8</td>
<td>Absolute-value upper-limit</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>9</td>
<td>Absolute-value lower-limit</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>10</td>
<td>Absolute-value upper-limit with standby sequence</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>11</td>
<td>Absolute-value lower-limit with standby sequence</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>12</td>
<td>LBA (alarm 1 type only)</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>13</td>
<td>PV change rate alarm</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>14</td>
<td>SP absolute value upper limit</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>15</td>
<td>SP absolute value lower limit</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>16</td>
<td>MV absolute value upper limit *9</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>17</td>
<td>MV absolute value lower limit *9</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>18</td>
<td>RSP absolute value upper limit *10</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
<tr>
<td>19</td>
<td>RSP absolute value lower limit *10</td>
<td><img src="image" alt="Alarm Output Diagram" /></td>
</tr>
</tbody>
</table>

*Figure 8: Alarm types*
1.4.1 Setting the alarm
In the previous chapter, the type of alarm was discussed. After setting the alarm type, you will set an alarm value. Do this as follows.

1. To set the alarms, press the 2nd button several times until $RL - 1$ is displayed. This is the setting for alarm 1.
2. $RL - 2$ is the setting for alarm 2 (in some controllers $RL - 1$ is not visible. This has already been assigned to a different function)
3. You can change the alarm value with the up and down button.

**Example 1:** On your controller, you want to activate an alarm when the temperature rises 10 degrees above the set value. The alarm type is set to 2. The SV is set to 40 degrees. The value for the alarm output $RL - 1$ then becomes 10. If SV is exceeded by 10 degrees, the alarm output is activated.

**Example 2:** On your controller with factory settings you want to activate an alarm when the temperature rises above 150 degrees. The alarm type is set to 8. The value for the alarm output $RL - 1$ then becomes 150. If SV rises above 150 degrees, the alarm output is activated.
1.5 Setting temperature shift
If the temperature on the controller display deviates from your measured value (for instance due to ageing of the sensor), you can set a temperature shift. Enter the shift using the \( \text{lnS} \) (input shift) parameter.

1. Press the 1st button briefly until \( \text{LAdj} \) is displayed.
2. Then press the second button briefly several times until \( \text{lnS} \) is displayed.
3. The value entered here shifts the temperature up or down. If you enter -10, the measured temperature is decreased by 10 degrees.

1.6 Hysteresis
If the controller is set to ON-OFF, you can change the hysteresis. The hysteresis is a switching point above and under the set point. A higher value limits the number of switches, but leads to less accuracy in temperature readings.

1. Go to the \( HYS \) parameter by briefly pressing the 1st button once until \( \text{LAdj} \) is displayed.
2. Then press and hold the 2nd button until \( HYS \) is displayed.
3. The default value is 1.0. You may increase or decrease this value.

Caution! Hysteresis is not available if the controller is set to PID.

Example: Suppose the desired temperature (set point) is set to 50 degrees. The controller heats to 50 degrees and then stops. The temperature will fall below 50 degrees before the controller switches on again. Suppose the hysteresis is set to 2 degrees; the controller will then switch on at 48 degrees.
2. Advanced features

The Omron E5CC has very powerful and advanced parameters. These are normally hidden, as they may severely disrupt the process. If you wish to change advanced parameters in the advanced setting level, lower the protect level to make them accessible. First follow the instructions in Chapter 2.1 and then Chapter 2.2

2.1 Releasing advanced setting level / Decrease protect level

To decrease the protect level, change the following settings.

1. Press the 1st and 2nd buttons simultaneously for 3 seconds until \( \bar{R}_{PE} \) is displayed.
2. Press the 2nd button once until \( \bar{C}_{PE} \) (Initial Setting Communication Protect) is displayed.
3. The default value is 1. Decrease it to 0
4. Now press the 1st and 2nd buttons again until the main screen reappears. The protect level is now decreased.

The advanced parameters are now accessible. Figure 9 shows the different protect levels. All shielding options are discussed in the manual which you can download from our web site.

![Figure 9: security or protect level](image)
2.1.1 Hiding parameters / Increasing protect level
You can shield parameters from users or operators. In this example, we scroll through the settings so only the temperature can be changed. To increase the protect level, change the following settings.

1. Press the 1st and 2nd buttons simultaneously for 3 seconds until *RPL is displayed.
2. The default value is 0. Increase it to 3.
3. Then press the 2nd button until *P (Initial Setting Communication Protect) is displayed.
4. The default value is 1. Increase it to 2.
5. Now press the 1st and 2nd buttons again until the main screen reappears.

The protect level is now increased. You can only change the set value. Figure 7 shows the different protect levels. Other shielding options are discussed in the manual which you can download from our web site.

2.2 Advanced settings menu
In the initial parameter settings at the * (move to advanced level) parameter, change the value to -169. After a few seconds, the controller automatically changes to the advanced settings level. The value -169 is fixed and cannot be changed.
2.3 Menu structure / Settings level diagram

The following diagram (Figure 10) shows the different levels. In Chapter 2.4 you will find the complete parameter list. You can find a description of all levels and parameters in the manual which you can download from our web site.

**Operation level**: Basic level, desired value, alarm, etc.
**Adjustment level**: Changing P, I, D value, etc.
**Protect level**: Hiding buttons and levels
**Initial level**: Setting the sensor, alarm types, etc.
**Advanced function level**: Advanced settings
**Communications level**: Parameters for data communication

*Figure 10: Settings level diagram*
2.4 Parameter list
A comprehensive description of all levels and parameters is in the manual which you can download from our web site.
3. Q & A

I get the message 5-ERR.
Answer: This is because the reader has been connected incorrectly, the controller has been set incorrectly, or the reader has a malfunction, see Chapter 1.2.1 and Chapter 1.2.2

The temperature varies.
Answer: A controller set to ON-OFF has over and undershoot. If necessary, set the controller to PID, see Chapters 1.3 through 1.3.2

The temperature overshoots.
Answer: A controller set to ON-OFF has over and undershoot. If necessary, set the controller to PID, see Chapters 1.3 through 1.3.2

There is a discrepancy between measured and actual value.
Answer: The reader may not show the correct temperature, possibly due to ageing. This can be resolved by setting a shift, see Chapter 1.5

What is hysteresis and how do I set it?
Answer: Hysteresis is used in an ON-OFF controller, and it ensures that the controller does not “jump” around the set value (SV). For an explanation, see Chapter 1.6

How do I use alarm / help connections? It does not work as expected
Answer: The alarm type may not have been set correctly. The operation of the alarm types is explained in Chapter 1.4

The alarm does not switch to the set value
Answer: The alarm type may not have been set correctly. The operation of the alarm types is explained in Chapter 1.4

I cannot open the advanced settings menu.
Answer: This level is hidden by default. Decrease the protect level, as described in Chapters 2.1 and 2.2
I want to block the buttons, so the controller cannot be operated by everyone.
Answer: At the protect level you can assign user change rights. For an explanation, see Chapter 2.1.1

The user only has a right to change the temperature.
Answer: At the protect level you can assign user change rights. For an explanation, see Chapter 2.1.1

I want to hide or show the decimal values of the temperature.
Answer: You can show or hide decimals by setting the number associated with the reader. See Chapter 1.2.3
4. Abbreviations and names

SV: Set Value is the set and desired temperature

PV: Process Value is the current, measured temperature

MV: Manipulated Variable is the “power” the controller transmits to reach the desired temperature

Set point: Also called set value or SV

Sensor: External temperature measuring device

Pt100: The Pt100 is a frequently used temperature reader. The reader has a resistance value of 100 Ohms at 0 degrees; Pt100s can be tested for continuity, and must have a value of around 106 Ohms at room temperature. For the Pt100 normal extension cables can be used

4-20mA: 4-20mA is a signal that is transmitted from certain sensors (for instance hygrometers), or which is used specifically to control a device, such as a steam valve

Alarm: An output that is switched on at a certain temperature is often referred to as an alarm. An alarm output may also be used for other purposes, depending on its settings.

Heat: This control is used for heating

Cool: This control is used for cooling

Heat/cool: This control is used for heating as well as cooling; therefore, two control outputs are used.

PID: Correct PID parameters ensure accurate and stable control. PID parameters are values that can be changed manually, but are mostly achieved by running Autotune. PID is the abbreviation of Proportional, Integration and Differentiation.
**On-Off:** The default setting of the controller as an ON-OFF controller. This ensures a limited extent of switching on the output, but results in less accurate control. This control does not take disturbances into account and is not “intelligent”

**Thermocouple:** A thermocouple is a sensor that transmits a millivolt signal, which cannot be tested for continuity. Caution: a thermocouple can only be extended by specially designed couple extension cables

**Solid-state relay:** Also called SSR. This relay is specifically developed for frequent switching. It has no moving parts or mechanical contacts but can also break or short-circuit. SSRs are often used in temperature controls set as PIDs.

**Control output:** The control output is the output that controls the process. This output is switched on when temperature needs to be controlled

**Overshoot:** Temperature overshoot occurs when the temperature rises above the set value when the controller stops heating too late. In an ON-OFF control the overshoot will be larger than in a PID controller.

**Undershoot:** Temperature undershoot occurs when the temperature falls below the set value when the controller starts heating too late. In an ON-OFF controller the undershoot will be larger than in a PID controller.

**AT or AutoTune:** Autotune allows you to easily calculate and set the correct P, I, and D parameters. The process is learnt by the controller itself

**Hysteresis:** Hysteresis is the value at which an output must be switched on or off. It is used in alarm contacts and ON-OFF controllers.

**Decimals:** Decimals are the numbers after the decimal point, e.g. 10.8 degrees.
OMRON EUROPE B.V.  Wegalaan 67-69, NL-2132 JD, Hoofddorp, Nederland.
Tel: +31 (0) 23 568 13 00  Fax: +31 (0) 23 568 13 88  industrial.omron.eu

NETHERLANDS
Omron Electronics B.V.
Wegalaan 61,
NL-2132 JD Hoofddorp
Tel: +31 (0) 23 568 11 00
Fax: +31 (0) 23 568 11 88
industrial.omron.nl

BELGIUM
Omron Electronics N.V./S.A.
Stationstraat 24
B-1702 Groot-Bijgaarden
Tel: +32 (0) 2 466 24 80
Fax: +32 (0) 2 466 06 87
industrial.omron.be

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Denmark
Tel: +45 43 44 00 11
industrial.omron.dk

Germany
Tel: +49 (0) 2173 68 00
industrial.omron.de

Finland
Tel: +358 (0) 207 464 200
industrial.omron.fi

France
Tel: +33 (0) 1 56 63 70 00
industrial.omron.fr

Hungary
Tel: +36 1 399 30 50
industrial.omron.hu

Italy
Tel: +39 02 326 81
industrial.omron.it

Norway
Tel: +47 (0) 22 65 75 00
industrial.omron.no

Austria
Tel: +43 (0) 2326 377 800
industrial.omron.at

Poland
Tel: +48 (0) 22 645 78 60
industrial.omron.pl

Portugal
Tel: +351 21 942 94 00
industrial.omron.pt

Russia
Tel: +7 495 648 94 50
industrial.omron.ru

Spain
Tel: +34 913 777 900
industrial.omron.es

Czech Republic
Tel: +420 234 620 602
industrial.omron.cz

Turkey
Tel: +90 216 474 00 40
industrial.omron.com.tr

United Kingdom
Tel: +44 (0) 870 752 08 61
industrial.omron.co.uk

South Africa
Tel: +27 (0) 11 608 3041
industrial.omron.co.za

Sweden
Tel: +46 (0) 8 632 35 00
industrial.omron.se

Switzerland
Tel: +41 (0) 41 748 13 13
industrial.omron.ch

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