Glossary of terms

Analogue thermostat

In a simplified way – an analogue thermostat cannot be programmed. The evaluation of the measured values itself and the switching can take place in various ways – these can be membrane thermostats, bimetallic or even electronic ones – however, the fact that the thermostat isn't programmable remains. The user sets the required value (temperature) on the thermostat; the user needs to act again in order to make any changes. Some analogue thermostats, however, can be equipped with a temperature attenuation function which can replace programming to a limited degree – see **Temperature attenuation**. According to the type of thermostat, the switching on of the contact can be signalled with a light diode.

Digital (programmable) thermostat

Digital thermostats enable the automatic switching on and off of the heating system and simultaneously enable the maintenance of temperature at various values as it suits you best at a given time in a heated room (on a heated floor). The thermostats themselves differ according to how many times a day they can change this temperature (number of temperature changes), whether they can set a different temperature for each change or whether the thermostat only switches between two pre-set temperatures etc. Thermostats can be equipped with other functions, such as PARTY mode, HOLIDAY or e.g. a calculator of hours of operation. **Consider carefully who will be in control of the thermostat and what purpose the thermostat will serve when choosing one**. Some thermostats offer a really wide range of setting options; however, controlling them is more complex. A badly set thermostat can completely degrade the operating parameters of the whole application.

Central regulation

The term Central regulation is very often connected with a system which is used in warm-water systems with a gas boiler where a programmable wall thermostat is placed in the living room which monitors the temperature and switches the gas boiler on and off. The whole building is then heated only according to this one room. Today, however, this is an outdated system with insufficient parameters. Central regulation means the programming and control of temperatures in individual rooms, from one place (centrally); however, completely individual modes can be set for each room, i.e. when and to what temperature the room is to be heated. Central regulation systems for electric heating also usually enable connection with a home PC on which the relevant software is installed. This significantly increases and simplifies the ease of control and makes it possible to monitor current temperatures in the building on-line, make operative alterations to the set programme as well as monitor and count operating hours.

Temperature attenuation

Temperature attenuation is a function thanks to which an analogue thermostat lowers the required (set) temperature –without any intervention of the user - based on a signal from an external regulation element (see regulators for the control of attenuation) by a pre-defined value (usually 5K). For example, if the thermostat is set to maintain a temperature of 22°C in a room and the thermostat receives a signal from the temperature

attenuation regulator, it lowers the temperature in the room by 5K, which is to 17°C. When the next signal is received, it goes back to 22°C. **Please note that thermostats need to be combined with a suitable temperature attenuation regulator in order to be able to use this function**. One temperature attenuation regulator can control several analogue thermostats simultaneously. The temperature attenuation function is used only with analogue thermostats; for digital ones, temperature changes are programmed directly in the thermostat.

Temperature attenuation – how does it work?

Thermostats are used for the measurement of temperature using what are known as thermistors. A thermistor is a tiny component which changes its resistance with increasing temperature. For example, in the case of a floor probe, the thermistor is hidden in a plastic end piece at the end of a sensor. Information about what resistance values correspond to specific temperatures (termed sensor characteristics) is stored in the thermostat and based on this, the thermostat can "recognize" the temperature. If the thermostat is equipped with the temperature attenuation function, another resistance is added into the circuit of the sensor. When a signal is sent from the attenuation regulator, it is passes from the temperature sensor through this resistance. The value of resistance which the regulator now measures is higher and the regulator "thinks" that it measured a higher temperature than there really is in the room (on the floor).

Switching contact

A value in Amperes is given for the switching contact of a thermostat; this value describes how much electric current can flow through the contact. If this value is exceeded, contacts overheat, a discharge (the contact emits a spark) is created during the switching (approximation of contacts), which leads to the burning of contacts and gradually to a complete burn-through of the switching contact.
The amount of flowing current can be determined with the help of the formula: I=P/U
Where I is the amount of the flowing current in Amperes [A], P is the wattage of the connected appliance (heating) in Watts [W] and U is the voltage in the mains [V]
When doing the calculation, it is necessary to remember that the voltage in the mains may fluctuate and the lower the voltage is (undervoltage in the mains), the more current flows through the contact. Therefore, appliances with wattages approximating the maximum value of the switching contact should never be connected to thermostats. In the case of room thermostats, the permitted wattage of the connected appliance may even be limited. For example, the thermostat may have a switching contact of 16A, which corresponds to a wattage of approx 3500 W. However, the instruction manual says that the maximum permitted switched wattage is 2000 W. This is because the contact inside the thermostat produces heat when it is switched on and thus affects the integrated room sensor. The thermostat then shows a higher temperature than there really is in the room. Some thermostats have an algorithm in the programme that makes it possible to set the output of the connected heater; they then adjust the measured temperature accordingly. Despite that, it is better to use a power relay - a contactor – for more powerful heaters and thus avoid problems with the accuracy of the measurement of room temperature and also extend the lifespan of the switching contacts.

Programme back-up

In the case of digital thermostats, it is necessary to arrange the back-up of the set

programme in order to avoid re-setting of the thermostat if there is a short-term power failure. There are usually miniature batteries or rechargeable accumulators in the thermostat, or there can be small capacitors which are charged from the mains and, in the event of a power failure, keep the set programme in the memory. Thermostats usually switch off their light during such power failures and cannot be controlled – this takes place in order to make the batteries last as long as possible. In the case of electric heating, a direct-heating tariff when the power supply of the thermostat is interrupted 4 times a day for 1 hour may be a problem. Standard batteries or capacitors aren't dimensioned for this frequency and their lifespan decreases sharply due to this. Therefore, thermostats with large-capacity capacitors and EEPROM memory, or at least lithium accumulators are more suitable for these applications. Another option in the case of a direct-heating tariff is to switch on the connected heating via a power relay and provide the power supply of the thermostat from a non-blocked (non-heating) circuit – see the **Switching contact**section.

Pulse width modulation (PWM) and fuzzy logic

Analogue thermostats use the simplest control system – i.e. the on/off state. If you set the required temperature on the thermostat, the thermostat will switch on the switching contact and the heating will emit warmth without interruption. As soon as the required temperature is achieved, the thermostat switches off the heating. However, as practically every heating system has a certain inertia and the heating is still hot for some time even though it is switched off, the room is 'overheated'. Programmable thermostats can use the same control system (on/off) as well; however, modern types sometimes have an integrated function which increases the accuracy of the regulation:
pulse width regulation (PWM) – this function is the one that prevents the undesired overheating of rooms. While standard thermostats switch off the heating once the required temperature has been achieved, a thermostat with the PWM function will start to pulse before the desired temperature is achieved – i.e. it will start to switch the heating on and off in alternation. The lengths of the individual pulses change the closer the room temperature is to the temperature required – the room temperature will thus stabilize directly at the required value.

fuzzy logic – thermostats equipped with this function are also called "intelligent" or "self-learning" thermostats. In a simplified manner, the thermostat evaluates the period which the heating system needs to heat the room to a required temperature. It will "learn" gradually that if the room has to be heated to 21°C by 7 o'clock in the morning and cooled down to 18°C overnight, the heating system should switch itself on two hours earlier for the required temperature to be achieved at 7 o'clock. Thermostats which don't have this function will switch on the system at 7 o'clock in the morning when the programme indicates they should start to maintain a higher temperature in the room. In practice, situations arise when the user makes an operative intervention into the programme of the thermostat which leads to the immediate switching on or off of the contact in the case of a standard thermostat. However, in the case of thermostats with fuzzy logic, it may take half a minute or so before the thermostat evaluates the requirement and compares it with its "experience". The situation can lead the user to the wrong conclusion that the thermostat isn't functioning correctly.

Operating modes

Thermostat descriptions name what are termed ‘operating modes’ in which the thermostat can function – **room temperature / floor + room / floor only**. The “**room temperature**” mode is intended for convection and radiant heating, i.e. for systems where it isn’t necessary to monitor the floor temperature.
The “**floor + room**” mode is for floor heating – the thermostat monitors the room temperature as well as the floor temperature. In this mode, the room temperature has a higher priority – i.e. if the required temperature is achieved in the room, the heating will switch itself off even if the floor is cold. Here, the floor probe functions as a limitation probe – it prevents the overheating of the floor. The “**floor only**” mode is intended for supplementary floor heating (sometimes also called floor comfort heating). In this mode, the thermostat doesn’t measure the room temperature but merely monitors the floor temperature and maintains it at a required value. The floor will be warm even if the room is heated by a different source of heat –in an extreme case the room can become overheated.

Number of temperature changes

For digital thermostats, the number of temperature changes is usually stated. This is the number of times for which a temperature change can be programmed. For example, if you programme a thermostat to start heating a room to 22°C at 7 o’clock in the morning, that is the first temperature change. If the thermostat is then supposed to lower the temperature to 18°C at 9 o’clock, that is the second temperature change. The ‘temperature change’ thus means the programmed time when the change of temperature should occur.

Daily and weekly programme

A thermostat with a purely daily programme enables the setting of an almost unlimited number of temperature changes per day – e.g. every 10 minutes. However, this programme is repeated automatically every day and no other programme can be set, e.g. for working days and weekends. This type basically is no longer in use, with the exception of special applications. On the other hand, a digital thermostat with a weekly programme has a limited number of temperature changes per day – usually 4 – 6 changes per day; however, either these changes can be set differently for each day of the week or a week is at least divided into working days and the weekend.

Temperature hysteresis

Temperature hysteresis can also be called temperature delay. In order that a thermostat which is to maintain a certain temperature in a room doesn’t continually switch on the connected heating, temperature hysteresis is set for it, i.e. a value by which the temperature has to drop below the set limit for the thermostat to switch on the system again. If the hysteresis of the thermostat is 0.5K and it is set to 21°C, it will switch off the heating when the set temperature is reached. It will switch it on again when the temperature drops by 0.5K, i.e. to 20.5°C. For most thermostats the set value is fixed, but with some thermostats it can be set by the user. In practice, the optimum hysteresis ranges from 0.5 – 1 K. A lower value has no real benefit while a higher one can already have a negative influence on thermal comfort and heating comfort.