OEM Actuator 5: Proportional (APR)

The OEM Actuator 5: Proportional (APR) is a thermal valve actuator for controlling heating and cooling systems. The actuator is controlled by a 0 – 10 V d.c. signal from a central DDC system or a room thermostat. The main area of application is building management systems.

The actuator without valve stroke recognition has closing point recognition and a fixed stroke.

The OEM actuator of the 5th generation is specially developed for customer-specific use in the OEM business. The modular design offers various differentiation options for customer-specific versions.

1.1 Key features

- Modern OEM design
- Stroke variants 4.0 mm/5.0 mm
- Force ≥ 100 N
- NC version (normally closed)
- 1 watt power consumption
- Activation with a 0–10 V d.c. signal
- Short response times, thus improved control behaviour
- Closing point control and adjustment during operation
- Full compatibility with the Möhlenhoff valve adapter system
- Easy plug-in assembly
- Mechanically and electrically (due to reverse polarity protection) very robust
- Patented 100% protection for leaking valves
- 360° assembly
- FirstOpen function
- Optical adjustment control
- Plug-in connection cable (optional: halogen-free)
- Adjustment guide on the valve
- Compact design, small dimensions
- All-round function indicator
- Silent and maintenance-free
- High functional reliability and long lifespan
- Versions: 24 V a.c., 24 V d.c.
- Certified by TÜV

1.2 Versions

The OEM Actuator 5: Proportional (APR) is supplied in the basic version as follows:

- Without logo
- With plug-in connection cable
- Function display white/white
- Without valve adapter

The following versions are available in the basic version:

Version	VSR	Operating voltage		Control voltage	Stroke	Operating principle	Scope of delivery
APR 40405-00N	No	24 V	a.c.	0–10 V	4.0 mm	NC	• OEM Actuator 5: Proportional (APR) in individual packaging • 1 m connection cable (plug-in), white PVC 3 x 0.22 mm² • Installation manual in 12 languages
APR 40405-01N	No	24 V	a.c.	2–10 V	4.0 mm	NC	
APR 40405-02N	No	24 V	a.c.	10–0 V	4.0 mm	NC	
APR 42405-00N	No	24 V	d.c.	0–10 V	4.0 mm	NC	
APR 40505-00N	No	24 V	a.c.	0–10 V	5.0 mm	NC	
APR 40505-01N	No	24 V	a.c.	2–10 V	5.0 mm	NC	
APR 40505-02N	No	24 V	a.c.	10–0 V	5.0 mm	NC	
APR 42505-00N	No	24 V	d.c.	0–10 V	5.0 mm	NC	

Further variants on request
VSR: Valve stroke recognition

The following optional extensions and customizations to the basic version are available:

Cable lengths	Standard	2 m, PVC in white – 3 x 0.22 mm² (custom lengths: up to 20 m on request)
	Halogen-free	1 m, 2 m, Hal F LiYY 3 x 0.22 mm²/white (custom lengths on request) To fulfil fire protection and environmental requirements.
Packaging		According to requirements: Production of customised printed packaging
Printing on the housing		Laser printing of the brand (e.g., logo) and the individual type
Colour of housing and cable		Homogeneous colouring Colour of the function display or function cap to match the corporate design or product design

Please contact us if you have any further requests.

Accessories

Valve adapter	Precise and simple installation thanks to click mechanism available for almost every valve
Protection cap SK 1004	Protects against theft and vandalism

2 Function

The actuating mechanism of the OEM Actuator 5: Proportional (APR) works with a PTC-heated wax element and a spring.
Compared to a standard on-off actuator, the OEM Actuator 5: Proportional (APR) features a microcontroller with power controller for the PTC on the wax element, an additional high-impedance control input and a wear-free magnetic displacement sensor. The displacement sensor detects the movement of the wax element.

The internal microcontroller regulates the power supply to the wax element depending on the control voltage applied and the travel measurement after the target position has been calculated. The resulting movement is transferred to the plunger and opens/closes the valve. Through the precise control of the power output of the PTC on the wax element, each position is precisely controlled by the microcontroller. If the control voltage changes, the heat supply is immediately adjusted by the control electronics. As a result, no excess energy is stored in the wax element: the actuator reacts quickly.

The microcontroller has two different memories: a volatile memory (RAM) and a non-volatile memory (EEPROM). If the voltage is interrupted, data in the RAM is deleted, data in the EEPROM is retained. During operation, data on the closing point of the valve is saved from the RAM to the EEPROM.

Note: Commissioning should always be carried out on a valve.
The following conditions can temporarily lead to deviating control behaviour (see the installation procedure in section 4, Installationshinweise):
- Operation without valve (no visible driving behaviour)
- Prolonged operation > 8 h without valve
- Conversion of the actuator to another valve with a different closing point
- Adjustment of the valve during operation

The actuator automatically compensates for deviations during operation. This process can take several hours.

To avoid reactions to ripple voltages caused by long cable lengths, the actuator remains in the idle state in the range 0–0.5 V (depending on the model). The closing force of the spring is matched to the closing force of commercially available valves. The spring keeps the valve closed when de-energised.

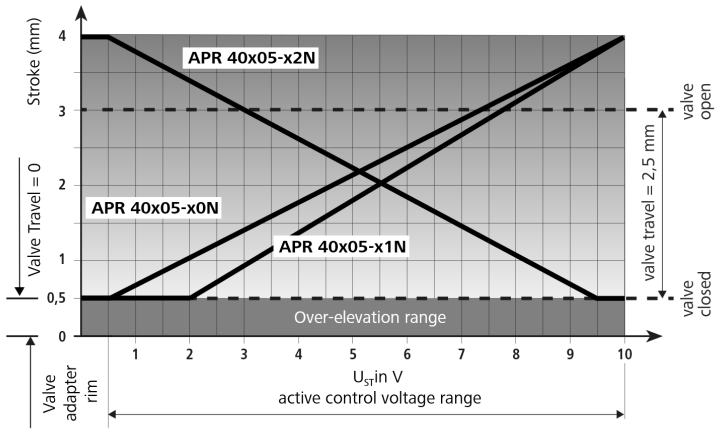
2.1 Starting behaviour OEM Actuator 5: Proportional (APR)

When delivered, the actuator plunger of the OEM Actuator 5: Proportional (APR) is retracted. This state is achieved by the FirstOpen function. After the operating voltage is switched on for the first time, the internal microcontroller checks whether there is a value for the closing point of the valve in the EEPROM. If there is no value for the closing point, the OEM Actuator 5: Proportional (APR) performs the initialisation. The wax element is heated up and the FirstOpen function is unlocked. The heating resistor on the wax element is then switched off, the wax element cools down and the OEM Actuator 5: Proportional (APR) searches for the closing point of the valve. If the sensor system detects no further movement, the valve closing point has been reached. The value is saved in the RAM.

In normal operation, the OEM Actuator 5: Proportional (APR) cyclically measures the active control voltage. If the active control voltage is within the operating range*, the OEM Actuator 5: Proportional (APR) calculates the position based on the preset stroke and the determined closing point. The internal microcontroller switches on the heating resistor on the wax element. The position of the actuator is continuously measured. The internal displacement sensor detects the movement of the wax element. After the delay time has elapsed, the actuator opens the valve evenly. The calculated target position is precisely approached and maintained until a change in the control voltage occurs.

*Example: Operating range type 0 – 10 V = 0.5 – 10 V

Functional diagram:



Note: Re-initialisation is only carried out if the OEM Actuator 5: Proportional (APR) has not been in operation for more than 8 hours. No cyclical calibration runs are performed.

2.2 Functionality of EEPROM

After 8 hours of uninterrupted operation, the value determined for the closing point is written to the non-volatile memory (EEPROM). When switching off after less than 8 hours of operation following initial commissioning, each restart begins with the closing point search. Reason: No valve data is yet stored in the EEPROM.
As soon as valve data is saved in the EEPROM, the OEM Actuator 5: Proportional (APR) immediately switches to normal operation after a power interruption. The stored value for the closing point is used.

The closing point of the valve is checked during operation. Deviations are adjusted. After 8 hours of operation, the new value is saved in the EEPROM. This value is discarded if the voltage supply is switched off before 8 hours of operation have elapsed. When switching on again, the OEM Actuator 5: Proportional (APR) uses the last value saved in the EEPROM.

New valves or adjustments must first be trained in to the OEM Actuator 5: Proportional (APR). Training takes place during operation. The incorrect position is compensated for by the thermostat until the actuator has detected the new valve.

2.3 Behaviour when the valve stroke is changed

The closing point can change for various reasons: the valve's default settings can be changed or the actuator can be set to a new valve. If there is a change in the closing point, control is initially based on the value stored in the OEM Actuator 5: Proportional (APR) for the closing point. End positions may not be reached.

To balance these deviating positions, the value determined for the closing point is checked and corrected during operation. The correct closing point is determined by continuously comparing the stored and determined values. When a new closing point is recognised, the new value is saved in the RAM. Depending on the extent of the deviation, this process can take several hours. During this process, deviations are only noticeable at a maximum through increased control oscillation. The thermostat corrects a deviating position.

For information on the process of saving a new value, see section 2.2 Functionality of EEPROM.

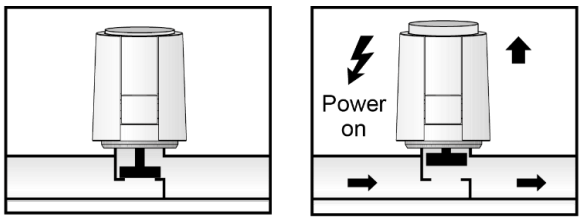
The behaviour when the valve stroke changes applies in particular when commissioning the OEM Actuator 5: Proportional (APR) without a valve. The closing point is far from a realistic position.

Note:

- Manual acceleration of the detection of a new closing point, prerequisite: existing mounting on a valve
  - Actuator with **positive** characteristic curve (e.g., 0 - 10 V): Supply OEM Actuator 5: Proportional (APR) for 1 h with a control voltage of 0 V, then for 1 h with 10 V
  - Actuator with **negative** characteristic curve (e.g., 10 - 0 V): Supply OEM Actuator 5: Proportional (APR) for 1 h with a control voltage of 10 V, then for 1 h with 0 V
- Leave the OEM Actuator 5: Proportional (APR) in operation for 8 h after this procedure so that the valve data is saved in the EEPROM!

2.4 Function display

Thanks to the function display (all-round function indicator) of the OEM actuator, it is clear at a glance and in the dark whether the valve is opened or closed.



NC version: Function display moves out when the valve opens.

2.5 FirstOpen function

In its delivered state, the OEM Actuator 5: Proportional (APR) is opened de-energised by the FirstOpen function: Heating operation is possible during the shell construction phase, even if the electrical wiring of the single room temperature control system has not yet been completed. During subsequent commissioning, the FirstOpen function is automatically unlocked by applying the operating voltage during the initialisation phase. The initialisation process takes up to 25 minutes. The FirstOpen function is unlocked after 6 minutes, closing point recognition is completed after 19 minutes. After completion, the OEM Actuator 5: Proportional (APR) is ready for operation.

3 Technical data

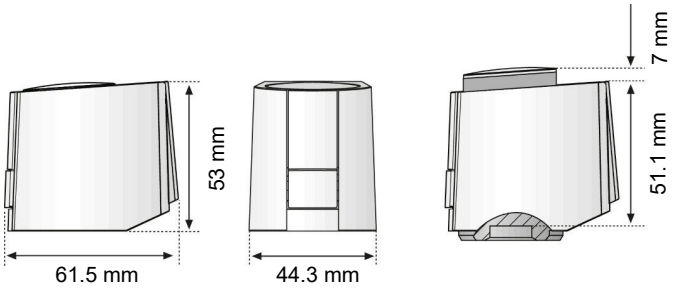
Voltage (depending on version)		24 V a.c., -10% to +20%, 50–60 Hz 24 V d.c., -20% to +20%
Control voltage range		0 V to 10 V
Inrush current max.		< 320 mA for max. 2 min.
Operating power[1]		1 W ± 15%
Control voltage input resistor		100 kΩ
Stroke		4.0 mm/5.0 mm
Force		100 N +10%
Fluid temperature[2]		0°C to +100°C
Storage temperature		-25 °C to +60 °C
Ambient temperature		0°C to +60 °C
Protection type[3]		IP54
Protection class		III
CE conformity according to		EN 60730
Housing	Material	Polyamide
	Colour	White
Connection cable	Type	3 x 0.22 mm² PVC
	Colour	White
	Length	1 m
Weight with connection cable (1 m)		111 g
Overvoltage protection according to EN 60730-1		1 kV

[1] measured with True-RMS precision power meter LMG95 in steady state at still air and 25°C ambient temperature

[2] may also be higher depending on the adapter

[3] in all mounting positions

3.1 Dimensions



Dimensions

Installation height

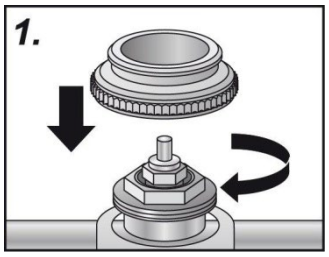
3.2 Certificates

The OEM Actuator 5: Proportional (APR) is certified by TÜV Süd

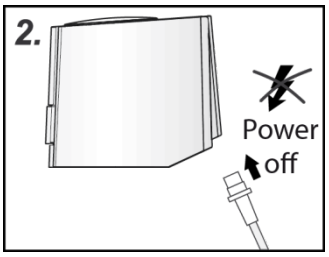
4 Installation instructions

4.1 Assembly with valve adapter

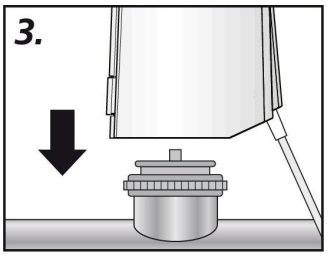
The valve adapter range ensures the actuator perfectly adapts to virtually all valve bottoms and heating manifolds on the market. The OEM Actuator 5: Proportional (APR) can be easily fastened on the manually pre-installed valve adapter by means of plug-in assembly.



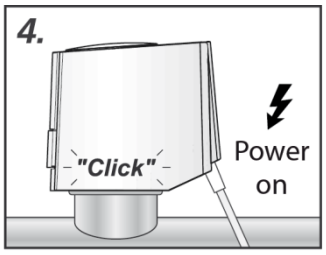
Manually screw the valve adapter onto the valve.



Connect the cable to the OEM actuator.

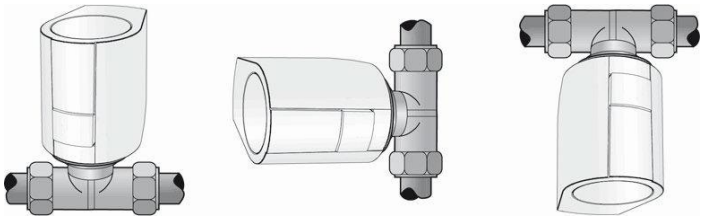


Manually position the OEM actuator vertically on the valve adapter.



With manual, vertical pressure, engage the OEM actuator easily and audibly on the valve adapter.

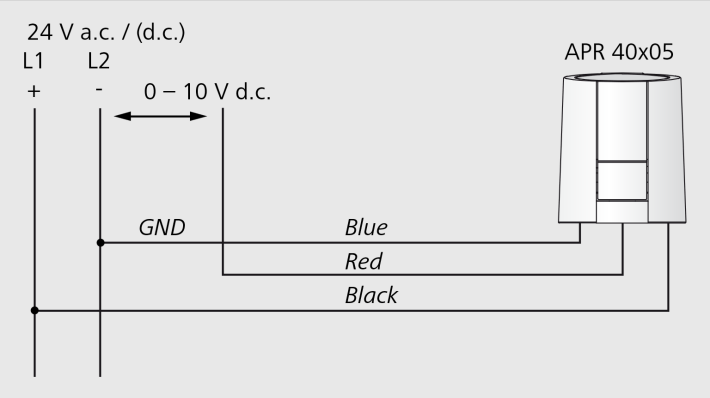
4.2 Assembly position



vertical horizontal "upside down"

The OEM Actuator 5: Proportional (APR) should preferably be installed in a vertical or horizontal assembly position. In the case of “upside down” assembly, specific circumstances (e.g., dirty water) may reduce the service life.

4.3 Electrical connection



Cable
The following cable lengths are recommended for the installation of a 24 V system:

Cable	Cross section / diameter	Length
Standard DDC cable	0.22 mm²	20 m
NYM/NYIF	1.5 mm²	136 m

Transformer/power supply unit
- for a.c. variant: Safety transformer according to EN 61558-2-6
- for d.c. variant: Switching power supply according to EN 61558-2-16

The dimensioning of the safety transformer/switching power supply is determined by the switch-on power of the OEM actuators:

Rule of thumb: $P_{transformer}$ = 6 W x n
n = Number of OEM actuators