Energy-autonomous thermostatic radiator valve aces field testing

Micropelt's thermostatic radiator valve equipped with its thin-film thermogenerator and EnOcean wireless technology confirms its high performance in a long-term test.

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Testing conditions

- Two family house (duplex) building with insulated outside walls and central heating system
- Network of EnOcean sensors and room control managed by "MyHomeControl" Software
- Micropelt battery-free thermostatic radiator valve (iTRV) integrated in regular building operation
- Low inlet temperature in transition period in autumn to challenge thermal harvesting performance
- Time controlled switching between comfort temperature 20°C and economy setting of 17°C

Testing targets

- Evaluation of the energy balance of the iTRV under stringent conditions and for a longer period. (Balance of energy harvested from the inlet temperature minus consumption of motor and radio operation)
- Evaluation of a typical valve control and operation scenario: Number of actuating movements and travel distance
- Regulation quality and control functionality compared to battery-powered iTRVs

Testing results

- Micropelt's energy-autonomous radiator valve does not show any differences in room temperature control quality and dynamic performance compared to battery-driven TRVs.
- Even short heating periods per day with low inlet temperatures (32°C) are sufficient to scavenge the required energy for actuating and radio communication.
- This harvesting based iTRV is an adequate alternative to every conventional or battery-driven radiator valve actuator.

In spring 2013, Micropelt presented a fully batteryless and wireless, motor-driven thermostatic radiator valve with EnOcean wireless technology at ISH, the world's leading trade show for heating technology. The valve has now passed the final test required for mass production. In an extensive field trial lasting several weeks, it was thoroughly tested during operation of a heating system in a two family house (duplex). The test was aimed at demonstrating the valve's unlimited functionality and performance in a real-life environment. Special attention was paid to typical, low inlet temperatures during the transitional period in autumn.

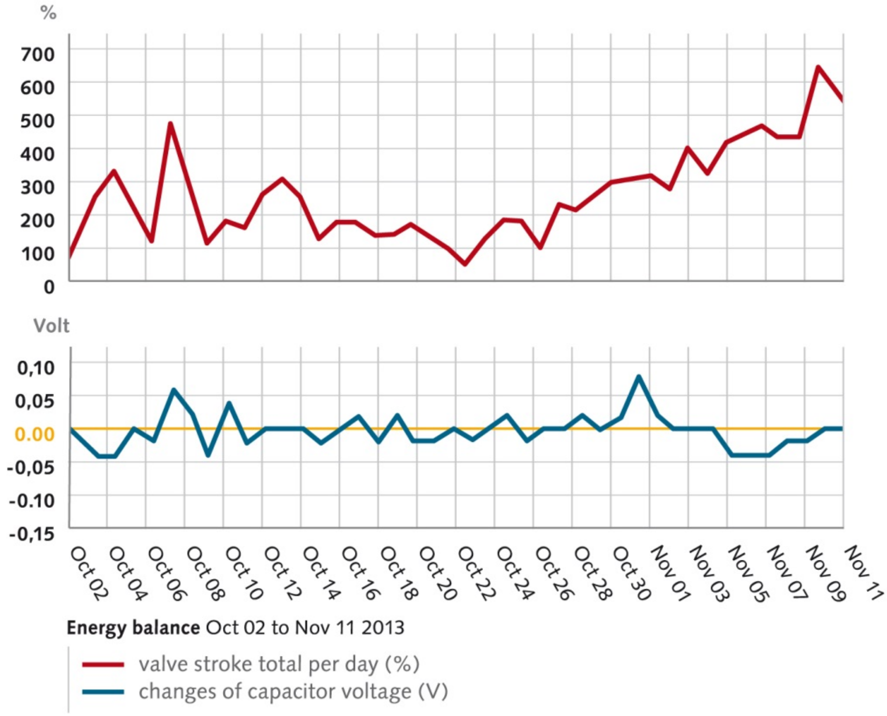
A gas-fired condensing boiler (23 KW nominal power) heats all rooms (200 sqm) in the duplex, built in the 1950s, using panel radiators that are equipped for single room temperature control with battery-operated wireless TRVs (thermostatic radiator valves). Communication with the bidirectional EnOcean wireless protocol makes it possible to confirm the valve position, which is used to control the inlet temperature, depending on the actual demand for heat in the rooms. Compared to conventional outdoor temperature-driven or reference room-driven controllers, this approach permits more efficient operation with optimized burner times.

Testing the energy-autonomous thermostatic radiator valve in a duplex with insulated walls

For the field test, a battery-driven thermostatic radiator valve was replaced by a new valve with a Micropelt thermogenerator, which generates electrical energy from the difference between the inlet temperature and the room temperature. A commercial PC with myHomeControl software manages the individual room functions within the system. This software controls all EnOcean sensors and actuators and records all relevant data.

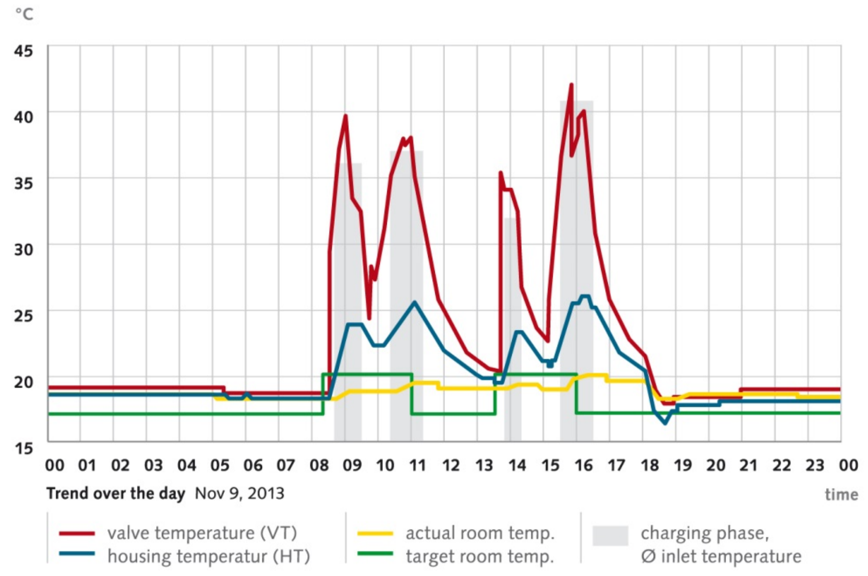
Even small temperature differences during the transitional period yield sufficient energy

The harvesting valve had to meet strict standards, since demand-driven control results in a heavily fluctuating inlet temperature that is lower on average. The phases in which the thermogenerator can generate the required electrical energy become shorter. In addition, the night economy setting was activated. The field trial took place in October and November, when outdoor temperatures exceeded 10°C on many days, causing the maximum inlet temperature to rise to only slightly above 40°C. In principle, the question was whether the thermogenerator could generate enough energy to power the motor as well as provide activation and wireless communication. After all, flawless operation without sacrificing comfort or control functionality under stringent conditions is necessary to ensure that the new technology is suitable for general deployment.



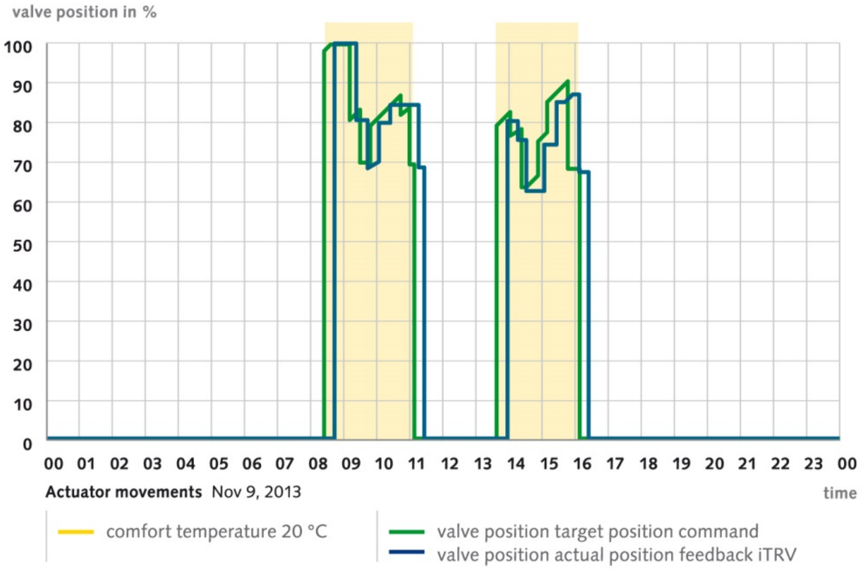
The battery-free iTRV (intelligent thermostatic radiator valve) operates reliably even under stringent conditions

During the test period, the capacitor voltage, which was detected once a day, moved constantly between 3.02 V and 3.16 V, which means that the energy generated and consumed reached a more or less equal balance. The average daily inlet temperature fluctuated between 24°C and 33°C at a comfortable temperature of 20°C during the day and a setback temperature of17°C. The phases with inlet temperatures above 32°C suitable for energy harvesting lasted between 0.5 and 5 hours. The energy consumed by the motor and wireless electronics, which were activated constantly every 10 minutes, had to be generated and stored during this period.



Energy-autonomous valve handles up to 40 actuating movements per day

In total, the motor had to execute between 10 and 40 actuating movements per day and cover a valve stroke distance of 1.5 mm one to seven times. The majority of the movements (72%) involved a relative travel distance between 0% and 10%, constituting only small corrections of the controller. Greater distances had to be covered only with reference travel and at temperature set point changes in the morning and evening. Due to the not particularly low outdoor temperatures and the outer wall insulation, the controller response was relatively sluggish and the room temperature targets were easily reached.



In summary, the field test shows that the energy-autonomous thermostatic radiator valve performs reliably even under the most stringent conditions—a relatively low and fluctuating inlet temperature typical for modern heating systems, a well-insulated house and the relatively warm outdoor temperatures in the transitional autumn months—and is fully equal to the battery-driven valves when it comes to convenient control.