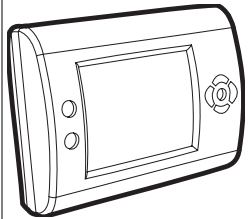


Product Overview

thermoSmart is an after-market home heating system that creates **temperature zones** in single zone homes.

Our main goal is to increase the **efficiency** of forced hot-air home heating systems while simultaneously improving the **comfort** of the users.

The Parts

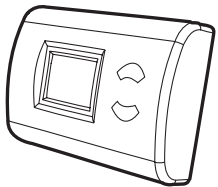
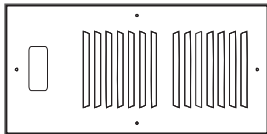


Coordinator

The Coordinator syncs all smartGrates and smartTemps in the user's home in a central location.

smartGrate

The louvers of the smartGrate automatically adjust to increase or decrease airflow into a room.

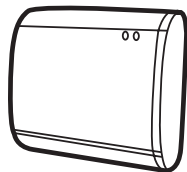


smartTemp

The smartTemp allows a user to adjust their desired temperature within a room.

HVAC Controller

The HVAC Controller interfaces with the furnace and signals the furnace to turn on or off.



Orange Team

Team Members:

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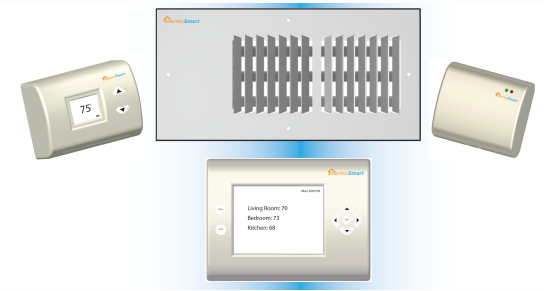
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Saving energy does not require
sacrifices in comfort!



2.009 Orange Team Final Presentation 12/8/2008



General Product Overview

Key Design Considerations

Energy Savings

- ✓ Simulation of thermoSmart system in a full-sized home led to **15% energy savings**
- ✓ Scheduling function on Coordinator adds an **extra 7% in energy savings**.
- ✓ Algorithm determines optimum louver position

Room by Room Temperature Control

- ✓ smartGrate's louvers adjust air flow into each room
- ✓ smartTemps measure temperature changes in each room
 - current room temperature
 - change in room temperature
 - desired temperature of the room

DIY Installation

- ✓ Easy and quick installation
- ✓ Coordinator GUI designed for quick configuration

Aesthetics

- ✓ Controls hidden behind smartGrate
- ✓ Ergonomic design of Coordinator

Safe Addition to HVAC System

- ✓ Simulation confirms that change in furnace trunk pressure is not enough to damage the HVAC system

Control Algorithm

Our control algorithm allows a home to **reduce heat-up time by up to 15%!**

Optimum positions of the smartGrate's louvers are determined from:

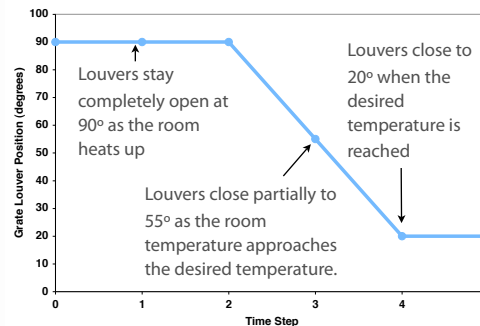
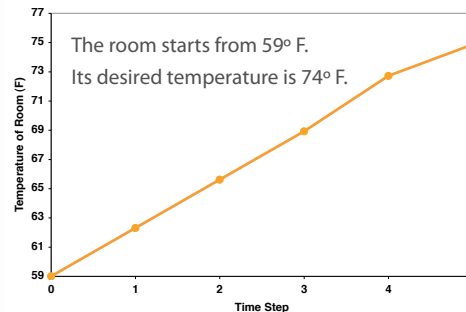
- current room temperature
- change in room temperature
- desired temperature of the room

Louvers have three possible opening positions: 20°, 55°, and 90°

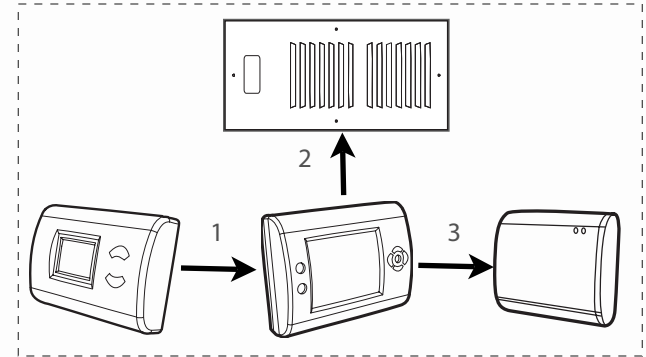
The Algorithm:

- If $T_{\text{desired}} - T_{\text{current}} > T_{\text{current}} - T_{\text{past}}$, then $\theta = 90^\circ$
- If $T_{\text{desired}} - T_{\text{current}} < 0$, then $\theta = 20^\circ$
- In all other cases, $\theta = 55^\circ$

Simulation of Room Temperature



Communications



The four components of the thermoSmart system communicate wirelessly using the SMAC standard.

1. Each smartTemp sends the current and desired temperature of their room to the Coordinator.
2. The Coordinator calculates the optimum grate louver position and sends this value to the smartGrate servo.
3. When all rooms have reached desired temperature, the Coordinator sends a signal to the HVAC Controller to turn the furnace off.

Pricing

Basic Pack 2 smartGrates, 2 smartTemps, 1 Coordinator	\$179.99
HVAC Controller 1 HVAC Controller	\$34.99
Expansion Pack 1 smartGrate, 1 smartTemp	\$58.99
Premium Pack 5 smartGrates, 5 smartTemps, 1 Coordinator	\$389.99