

HVAC Switch

The HVAC switch contains a physical switch that physically shorts the four wires from the wall with two thermostats also attached to it. The second function of this device is to determine if the heater, fan, or AC is on. With two sets of sensors, the mote is able to determine which thermostat is shorting which signal, regardless of which position the switch is in.

The switch together with the sensors enables us to perform three tasks:

- (1) Monitor the actual electrical connection of the HVAC relay mote before it is hooked up to the house's HVAC system for testing purposes.
- (2) Monitor the usage pattern of the existing thermostat.
- (3) Once the testing phase is over, we can still monitor which signal the HVAC relay mote is sending to the HVAC system. The switch enables a fallback to the old thermostat in case something goes wrong.



Figure 1 HVAC Switch

The HVAC switch contains three sets of four-jack compression terminals. The terminal in the center is to be connected directly to the HVAC system through the four wires coming through the wall. The terminal that's pointed by the USB connector (pictured on the left in Figure 1) is to be connected to the HVAC relay mote. The last terminal (pictured on the right in Figure 1) is to be connected to the original thermostat. The switch located in the center top of Figure 1 is a standard four pole / double throw switch. If the switch is switched to the left (called position 1 from now on), the HVAC system will be controlled by the thermostat on the left; if the switch is switched to the right (called position 2 from now on), the system will be controlled by the thermostat connected by the terminal to the right.

Device Input / Output

The main IO, as described above, consists of the two thermostats and the switch as inputs, and the terminal going out to the wall as the output. In addition to these physical IO connections, the device also outputs the HVAC status through the Telos mote using radio. As the raw sensor data can vary from system to system for the same state, it is difficult to determine the system state for a system based just on raw sensor data. Therefore, instead

of calculating and sending the system state, this device sends the raw data from the six sensors and lets the receiving side do the conversions.

Table 1

	<i>LOW</i>	<i>HIGH</i>	<i>4095</i>	<i>FLOAT</i>
711.value	Heater On	-	Heater Off	-
712.value	Fan On	-	Fan Off	-
713.value	AC On	-	AC Off	-
714.value	Heater Relay On *	Heater Relay Off *	Heater Relay On **	Heater Relay Off **
715.value	Fan Relay On *	Fan Relay Off *	Fan Relay On **	Fan Relay Off **
716.value	AC Relay On *	AC Relay Off *	AC Relay On **	Fan Relay Off **

* Indicates the switch is in position 1

** Indicates the switch is in position 2

The Telos mote is sampling six points on the circuit, with sensors IDs of [711,716]. The table above summarizes the possible outputs from the device. Depending on the particular HVAC system, a different LOW / HIGH threshold may be required. From the initial device testing, a LOW range of < 100 and a HIGH range of > 3000 seem to work. The message structure of the data packet that this mote sends out follows the standard DR structure for seven sensors, the six listed above and one for reporting the internal battery voltage.

NOTE:

This device would NOT work with the plastic house. It is NOT able to handle the 14 amps of current.