Automatic Low Cost Thermostat

National Semiconductor
Application Brief 22
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Ths application brief describes the use of the NMC9346 (64 x 16) serial EEPROM. With the advent of the inexpensive COPS™ family from National Semiconductor, heretofore ''expensive'' applications can now be realized inexpensively. Such an application is a low cost thermostat. Typical features of such a device are:

1) Ability to interface to local and remote temperature sensors,
2) Ability to hold changeable settings,
3) Digital display of present temperature,
4) Inexpensive in high volume.

CIRCUIT DESCRIPTION

The basis of the thermostat is the COP410 microcontroller. This, with the addition of 2 ADC0854 A/D converters, an NMC9346 EEPROM and some logic for LED display, comprise an extremely versatile, yet low cost, system. The ADC0854 allows 4 channels of temperature sensors, 1 local and 3 remote. Temperature sensors used are LM34 (for readings in °F) or LM35 (for readings in °C).

While there are several possible choices for A/D converters that are MICROWIRE™ compatible, the ADC0854 was chosen because of its ''settability''. By presetting the ''cold'' temperature (i.e., when the cooling unit should come on—say 80°F) all the microcomputer has to do is to multiplex the inputs and read the data in line. Similarly, the ''hot'' A/D can be preset to the temperature where the furnace should come on (e.g., 60°F) and scanned in a like manner. Since the microcomputer is also keeping time of day, selecting an A/D with more ''smarts'' (as in the ADC0854) the software can be kept manageable and an external real time clock chip is not needed.

The EEPROM (NMC9346) holds the presettable temperature ranges (high and low settings) by day of the week. Since data is in EEPROM rather than in mask ROM, it can be changed.

The LED display is multiplexed by the microcomputer. Depending on the type of display selected, external drivers may be necessary.

Input power is typically 24 VAC. Using a linear regulator would cause too much heat to be dissipated, which would upset the local temperature sensors. Thus, a switch mode regulator must be used. Fortunately, National Semiconductor has provided a solution to the problem with the LM3578, a switching regulator in an 8-pin mini-DIP, providing more than enough current for the application, using only a minimum of external components.

SOFTWARE DESCRIPTION

Since a real time clock is implemented in software, all routines must execute the same number of cycles independent of the input. Because of the flexibility of the COPS family instruction set, this is not as difficult a problem as it first appears. Since the EEPROM contains the settings that are periodically sent to the A/D converters, the COPS program merely fetches data from one source and dumps it to another while monitoring the output. Even the SET and MODE keys can be acted upon in a predictable manner IF the software designer carefully plans the program flow BEFORE writing code.

Note: Also see App Brief 15.

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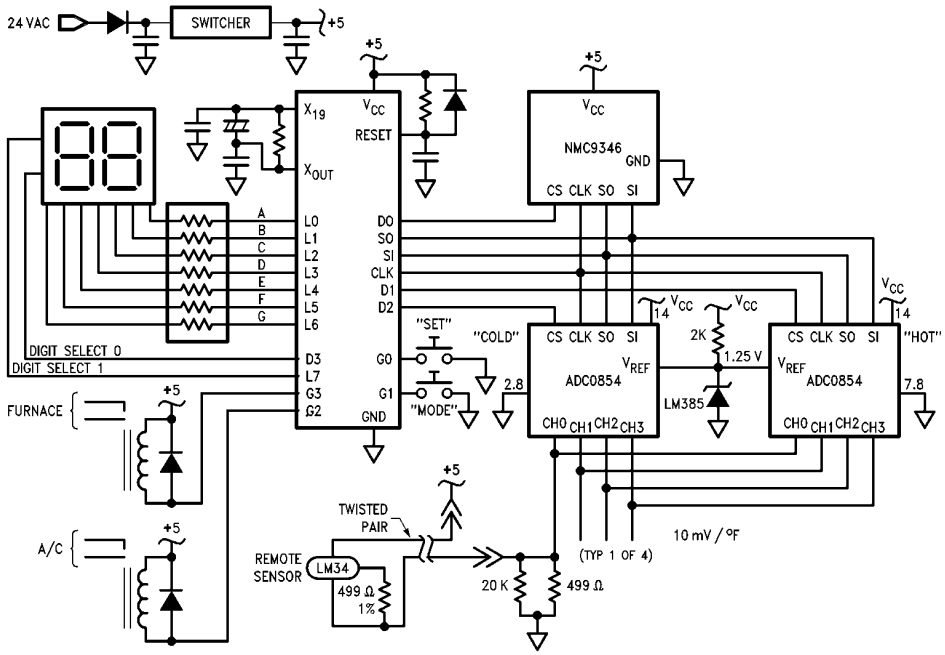

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FIGURE 1

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