
Multi-Zone Temperature Monitoring with the TCN75 Thermal Sensor

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INTRODUCTION

This Technical Brief presents an example of a simple, multi-zone thermal monitoring system using the Hardware mode of the Master Synchronous Serial Port (MSSP) module of a PICmicro[®] microcontroller. The design uses several TCN75 thermal sensors and the PIC16LF872 microcontroller.

Typical applications where this design may be implemented include power supplies, aquariums, personal computers, work stations, ovens, hot-swappable thermal sensing systems, office electronics, and electronic test equipment. This type of system design is also optimum for monitoring temperatures in the electronic systems of various home appliances, such as microwave ovens, blenders, toasters, refrigerators, washers, dryers, vacuum cleaners, and mixers.

SENSOR OVERVIEW

The TCN75 is a solid state, serially programmable digital temperature sensor. Environment temperature is output as a 9-bit, 2's complement serial digital signal. The device has an operating range of -55°C to +125°C (represented as 192h to 0FAh), with a typical resolution of 0.5°C.

The TCN75 has the ability to notify the host controller when a temperature measurement exceeds a user programmable set-point through its interrupt feature. It also incorporates a comparator function that can be used in place of the interrupt. These two functions are multiplexed through the same pin (INT/CPL) on the chip. Selectable addressing is implemented by pulling the three address pins to either VDD (binary 1), or ground (binary 0), providing for a total of eight devices that can be addressed on the same two-wire serial bus.

The device is available in MSOP and SOIC packaging, which also makes it an ideal choice for low cost/low profile thermal management systems.

CIRCUIT OVERVIEW

Figure 1 shows the overall design of the system. The circuit is divided into two sections: the remote sensors and the microprocessor board. The thermal sensing

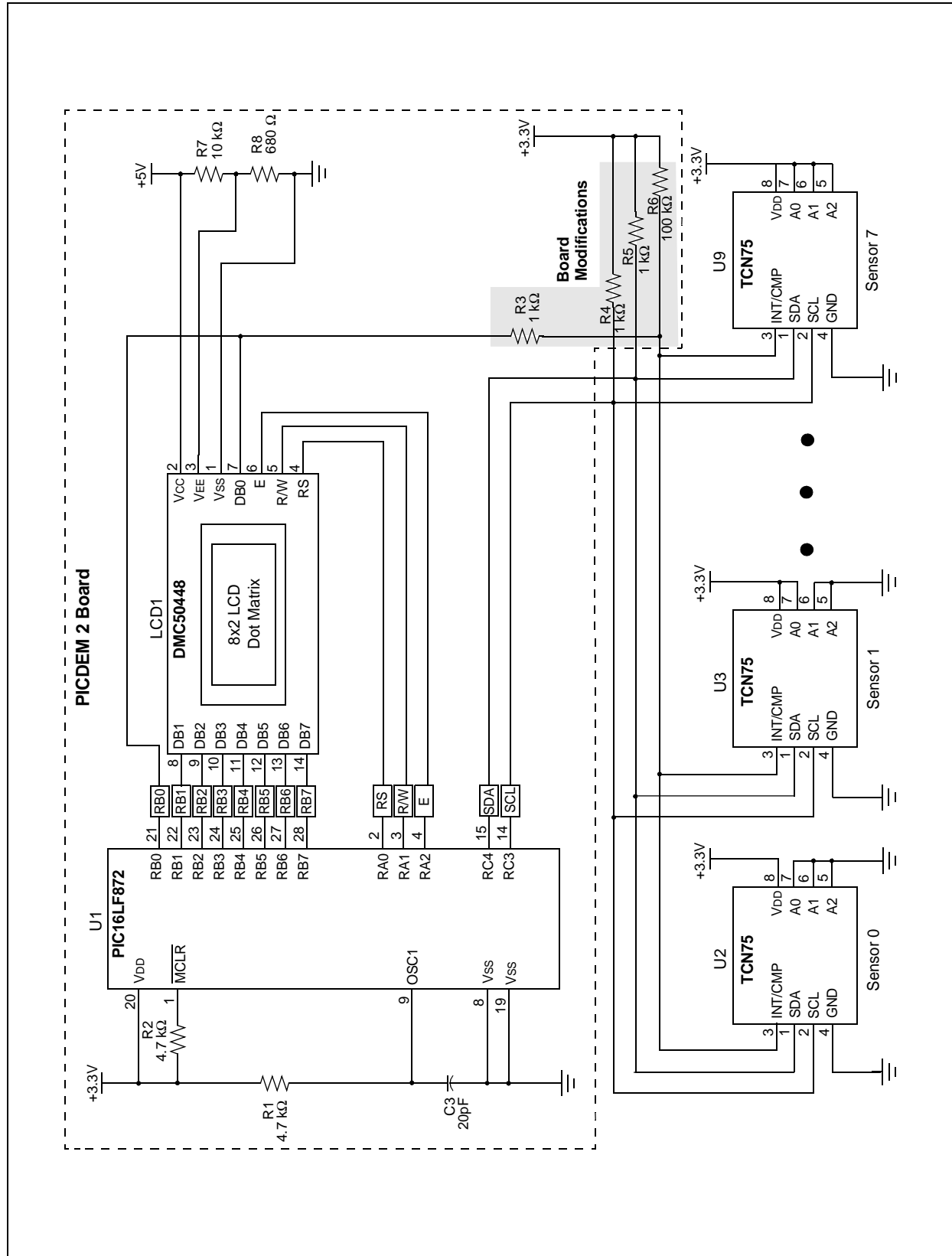
nodes are connected to the host processor through an I²C[™] interface. Only three TCN75 sensors are shown, to demonstrate the binary addressing scheme using pins A0 through A2.

Since the original design was prototyped using Microchip's PICDEM[™] 2 Demonstration Board, some minor changes to the board were required to accommodate the 3.3V power supply and the additional resistors (noted in the shaded areas of Figure 1). When RB0 is communicating with the LCD, the pin needs to be isolated from the sensors, regardless of the state of INT/CMP. For this reason, R3 was designed into the circuit as an isolation resistor. R4 and R5 are typical pull-up resistors for the I²C bus, while R6 is a weak pull-up when RB0 is configured as an input waiting for INT/CMP to change state. The circuitry for implementing over-temperature conditions is shown using R3 through R6 (this feature is not included in the firmware, however). Users who also wish to use the demonstration board as a basis for their designs are advised to review the overall schematic, which may be downloaded from the Microchip corporate website.

To create a more economical design, the PIC16LF872 oscillator is configured for RC mode. Because I²C bus timing is critical, and to accommodate minimum and maximum clock rate specifications that may be compromised due to running the processor in RC mode, the I²C clock rate was derated to 49 kHz. (This is compared to the maximum 100 kHz clock rate for the controller port running in this I²C mode.)

After powering up and completing its initialization sequence, the microcontroller enters the main software routine where I²C addresses are continuously polled based on a timer interrupt and a counter. Detecting the sensors at various addresses is accomplished by sending address bytes to slave addresses, then testing the Acknowledge status bit in the MSSP module. When a slave acknowledges, the system identifies the device at the address as a TCN75 and interrogates it for temperature data. Once collected, the data is processed and displayed on the LCD. Each sensor is polled for data, approximately every 1 to 2 seconds; if the sensor acknowledges the master, its data is sequentially displayed on the LCD. Polling and display frequencies are controlled by a delay loop in the firmware.

FIGURE 1: CIRCUIT DIAGRAM FOR THE TEMPERATURE SENSOR



APPENDIX A: SOFTWARE DISCUSSED IN THIS TECHNICAL BRIEF

The source code for the design discussed in this Technical Brief is not provided here. The firmware for this design is available as a single WinZip archive file. The archive may be downloaded from the Microchip corporate Web site at

www.microchip.com

NOTES:

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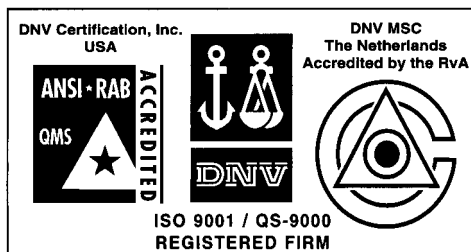
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