Monitor alarm and indicator display multiple deviation boundaries

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A low-cost monitor can visually indicate a process problem, such as a failed cabinet fan or other high- or low-temperature characteristic. The microcontroller-based circuit in **Figure 1** provided a simple visual indication of both the direction and the magnitude of the temperature's deviation from a user-set mean in a solder pot. Using a Microchip (www.microchip.com) 12F675 controller, the coded sequences allow the user to both set the mean and scale the range of the monitored variation. The application uses the controller's internal clock and

two of the controller's four ADCs.

Asserting switch S_1 on Pin 4 copies the input voltage under test from Pin 7, which becomes the mean value. The code then evaluates the input-voltage deviation from the mean and applies scaled boundaries to a corresponding display format. The processor monitors both the input under test and a second analog level, on Pin 6, to scale the internal deviation/boundary tables. It then schedules as many as four sequences of one or both LEDs. The monitor also asserts an output on Pin 5 when the measured variation exceeds the third tabled boundary.

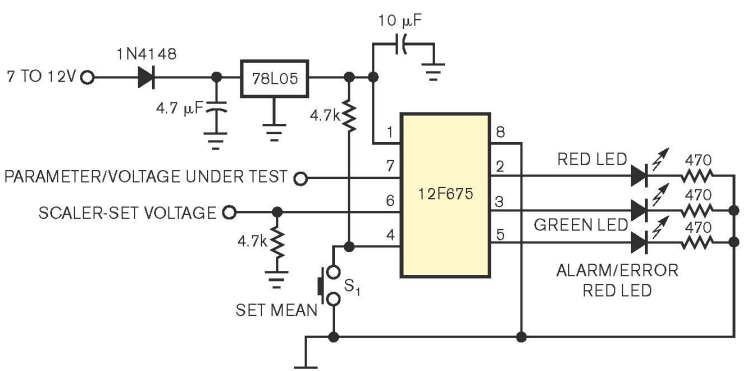

Figure 1 This microcontroller-based circuit provides a simple visual indication of both the direction and the magnitude of the temperature's deviation from a user-set mean in a solder pot.

The circuit provides independent positive- and negative-deviation tables and multiplies the ranges by interpreting the voltage on Pin 6, resulting in the application of a multiple from one to eight on the boundary limits. You configure the converter reference to use the controller's V_{DD} voltage. Using only 8 bits of the controller's 10-bit ADC, the deviation can be as small as one step or $1/256 \times V_{DD}$, the drain-to-drain voltage. For a 5V reference, this voltage is approximately 9 mV.

Figure 2 shows the boundaries and their possible spans, which Pin 6 and corresponding display-format numbers set (**Table 1**). Using the provided minimum value of the deviation/boundary table, neglecting the error that results from the use of the 78L05 as a reference, and assuming the scal-

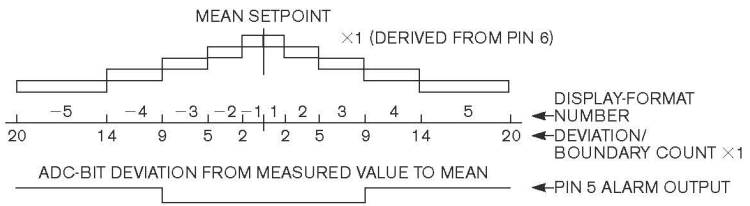

Figure 2 Pin 6 and the corresponding display-format numbers set the boundaries and their possible spans.

ing derived from Pin 6 result in ×1, the first display-format step, in this application, which occurs when the measured input deviates more than the deviation/boundary-table value times the scale derived from Pin 6 times 1/256 times the drain-to-drain voltage equals 2×5/256×1, or 39 mV.

You can change the display-sequence formats for the five positive boundaries, beginning in a green-LED flash, and five negative boundaries, beginning in a red-LED flash, to suit simpler go or no/go applications or other needs. The circuit may also find a use in airflow or other physical-parameter monitors.

Using the controller's ADC, you can monitor any parameter that you can represent with a voltage. You can modify the code-based tables to accommodate a variety of other display sequences, parameter nonlinearities, or error distributions.

You can download **Listing 1**, code for the error monitor, from www.edn.com/100422dic. EDN

TABLE 1 DISPLAY-FORMAT NUMBERS AND TABLE-BASED SEQUENCE

Display-format number	Sequence
>5	Green, red/green, red/green, red/green
5	Green, green, green/red, green/red
4	Green, red, green/red
3	Green, green, green, red
2	Green, green, red
1	Green
−1	Red
−2	Red, red, green
−3	Red, red, red, green
−4	Red, green, red/green
−5	Red, red, red/green, red/green
≤5	Red, red/green, red/greeen, red/green