Title: **Color Mark Sensor Calibration System for Timing Devices with a Seven-Segment LCD**

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Abstract

Abstract: A patent pending calibration system for timing devices with a seven-segment liquid crystal display (LCD) is presented in this paper. The prototype calibration system uses a color mark sensor, a gate controller, a toggle switch, and dual counters. It operates by directing the light spot of the color mark sensor onto an identified segment of the seven-segment LCD. When the device under test is running, the signal output from the color mark sensor, depending on the state of the chosen segment, will trigger the toggle switch to start or stop the counters to count the pulses of the 1 kHz reference frequency. By means of the toggle switch, the first counter will stop counting when the second counter starts counting, and vice versa, without halting the counting processes; thus, eliminating the elapsed time between the measurement readouts reported by the dual counters. The experimental results and bilateral comparisons showed that the new calibration system based on this technique has a measurement uncertainty of 6.8×10^{-8}.