Low-cost programmable key lock uses a PC-hardward monitor IC
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pg. 88

ing sequence of ones and zeroes at a nominal frequency of 650 kHz. The D-type flip-flop (U5) divides this frequency by two, producing a nominal 325-kHz spread-spectrum clock signal to the switching regulator.

Bench measurements show a 15-dB reduction in peak power density at about 300 kHz. Except for 9 mA of extra current drawn by the PN generator, the regulator's efficiency remains unchanged. (The efficiency is 94% while delivering 0.5 A with a 3.6-V input and a 5-V output.) Ripple amplitude in the time domain also remains unchanged. Output spectra demonstrate that a conventional fixed-frequency clock *(Fig. 3)* produces considerably more noise than does the spread-spectrum technique *(Fig. 4)*.

Low-Cost Programmable Key Lock Uses A PC-Hardware Monitor IC

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Simplicity is the key to a good security system design. The following is a simple yet powerful security system employing an ADM-1024 PC-hardware monitor as the key's decoder.

The ADM1024 was designed to monitor the local temperature, the die temperature of up to two Pentium processors, and the speed of up to two fans. This device monitors up to seven supply voltages and a 5-bit VID code. It also includes a 10-bit digital-to-analog converter (DAC). In this application, the ADM1024 is used to monitor seven voltages provided by a digital key as well as to open a lock if the correct key is inserted.

The basic principle of this lock decoder is the division of a voltage into seven specific levels that can be measured by the ADM1024. The voltage dividers are embedded in a key that can be inserted into the lock, as shown in the figure. For simplicity, only details relating to the ADM1024 and the key are given in this diagram.

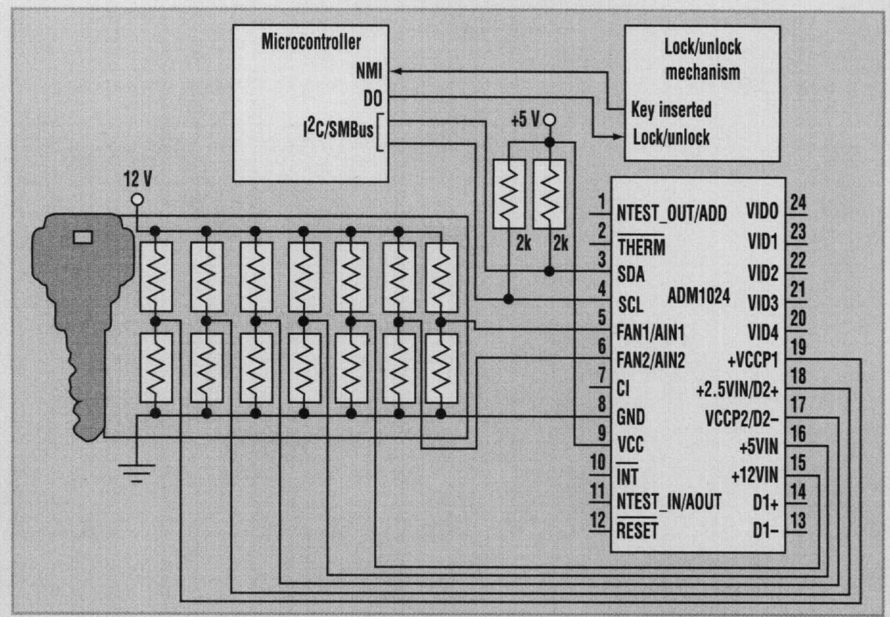
The seven voltage-input channels are each capable of measuring a voltage with 10-bit resolution. However, only eight bits of data are available on the serial bus. Hence, the theoretical maximum number of key combinations is

7.2×10^{16}! The number of different keys is limited to 4.4×10^{12} by practical concerns, the given standard 1% resistor values, and the allowance of a 16-LSB measurement span for each key combination. This is still a very secure system.

In production, keys could be created by vapor deposition of resistive material directly onto a circuit board. Absolute accuracy is not critical since the resistors are used in a voltage divider. Resistors created in a batch will match well, so their ratios can be precisely defined.

The on-board temperature sensor can be used to measure the ambient temperature. This enables the calculation of voltage changes caused by resistor-temperature drift if desired.

This system has several advantages. Only two signal wires are required to communicate with the lock. The first enables the lock to tell the microcontroller that a key has been inserted. The second allows the microcontroller to tell the lock to lock or unlock. The microcontroller can easily process all of the combinations to determine that the correct key was inserted. Keys can be manufactured at a relatively low cost and can be authenticated in milliseconds. The enormous number of possible combinations makes this key decoder very secure.



The ADM1024 finds an unusual use for its power-supply-monitor inputs in the detection of the seven analog voltages produced by the low-cost key.

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