

TEMPERATURE SENSOR IN STANDARD CMOS TECHNOLOGY

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ABSTRACT In this work, a Temperature Sensor and Switch is designed with Standard CMOS technology. It has no diode or diode-connected BJT, so that it can easily be incorporated into another IC such as μ -controller. Instead of using bandgap-reference as a temperature sensor core, it uses a threshold voltage extractor. Since the threshold voltage V_{tp} linearly depends on temperature, it can be used as a temperature sensitive element. In comparison with a reference voltage variable by external resistor, this temperature sensor works as a temperature switch.

BACKGROUND Temperature sensors/switches are key element in digital system for measuring die temperature to prevent reducing the performance by over-heating of chip. In order to accuracy measure IC temperature, an evident approach is to build temperature sensors into all VLSI chips, with the appropriate circuitry providing easy read-out. This in-chip solution is obviously more suitable than the use of individually packaged temperature sensor chip. However to incorporate temperature sensors/switches into another IC it is essential both circuits can built in same technology. Even though realized with parasitic vertical PNPs can be use instead of using diode, it still not enough to built in standard digital CMOS process. The goal of the work was realizing an accuracy and small area occupied temperature sensor/switch in standard digital process.

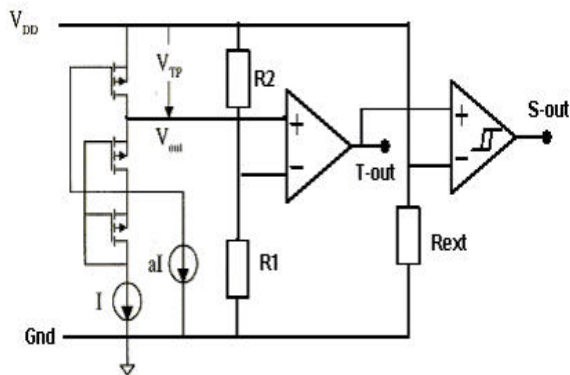


Fig. 1 Temperature sensor and switch principle circuit

WORK DONE The principle schematic of the temperature sensor/switch is shown in Figure 1. The half of this circuit is the temperature sensor circuit, which uses a p channel threshold voltage extractor. The rightmost part of this circuit is a voltage comparator, which creates the output signal of the temperature switch. This proposed temperature sensor/switch built in SOI 0.35 μ m CMOS technology. It occupied only an area of 0.03mm². It needs a single 3.3V supply voltage.

RESULTS The simulation of the temperature sensor and switch is presented in Figure 2 showing a switching turning point at 70°C with 12K Ω external resistor. The output of the temperature sensor is linear between -20°C ~ 80°C with 4.4mV/°C as shown in Figure 3.

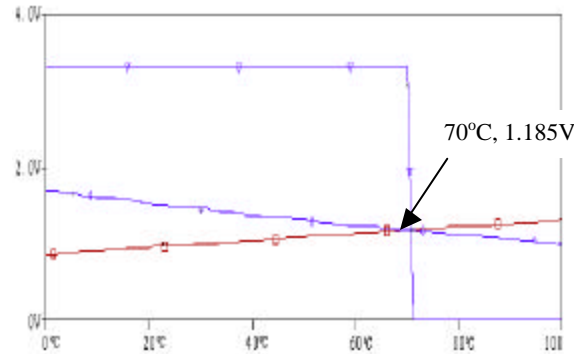


Fig.2 output of the temperature switch

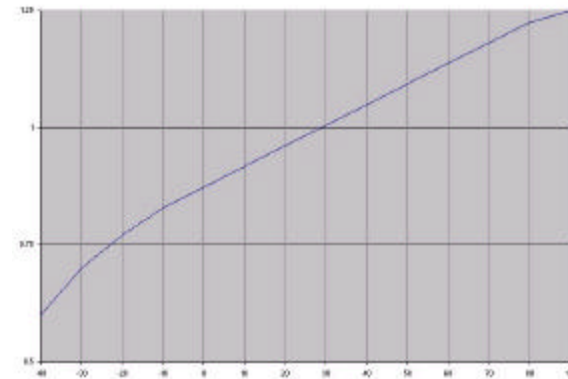


Fig. 3 Output of the temperature sensor

FUTURE WORK The next challenge is to fabricate the temperature sensor that outputs a clock signal.