THE QUALITY ASSURANCE TESTS OF THE MCM TEMPERATURE SENSORS FOR THE PHENIX MULTIPLICITY VERTEX DETECTOR

Sangkoo Hahn, LANL Guanghua Xu, UC Riverside
for the PHENIX MVD Group

1. Introduction

The temperature sensors incorporated in the PHENIX Multiplicity Vertex Detector (MVD) will monitor the temperature on the electronics in the multi-chip modules(MCM) and on the motherboards. Each MCM has one temperature sensor. The bare die sensors manufactured by Analog Devices are 39×58 mils chips (see Fig.1) and idealy have the current/temperature ratio of 1.0 $\mu A/^{\circ}K$ as specified by the manufacturer. To assure measurement accuracy, we tested 299 sensors with a probe station. Only those sensors with less than $2^{\circ}K$ difference between the measured and true temperatures were accepted for use in the MCMs.

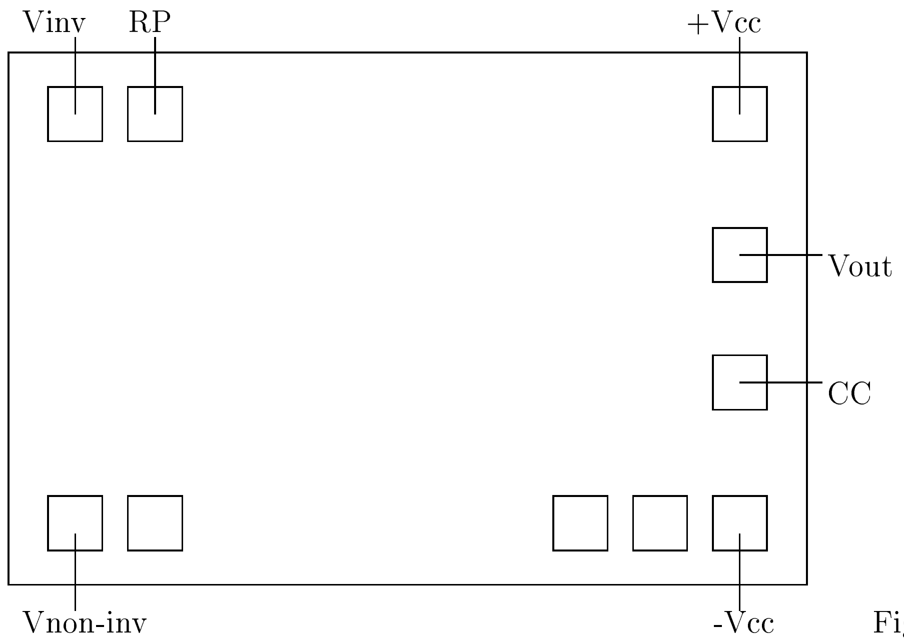

Fig.1: T-Sensor.

2. The Test Setup

The test circuit is shown in Fig.2. The setup is the same as the circuit used in the real MCM. A $5V$ DC is used for biasing the sensors. $5V$ was selected to have enough head room for the sensor to operate in the linear region.

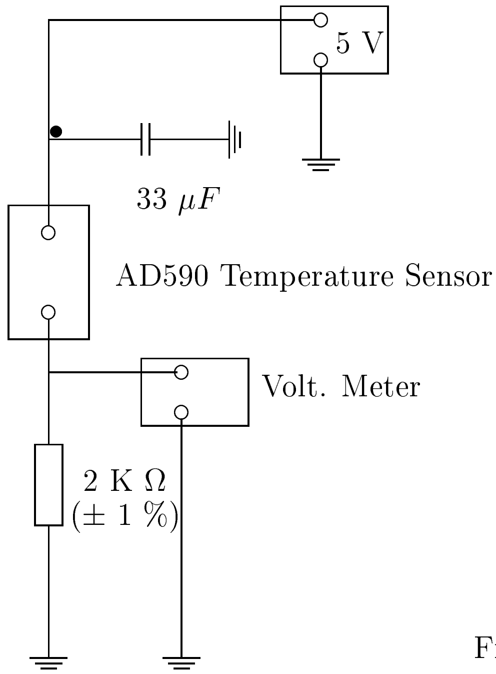

Fig.2: Test Setup.

The 33 μF is used as a by-pass capacitor. The 2 $K\Omega$ precission resistor has a tolerance of less than 1%. We used an HP 3458A Multimeter, which has five effective digits, to measure the voltage across the 2 $K\Omega$ resistor. We also used an OMEGA HH82 thermometer to the voltage acrossing the 2 $K\Omega$ resistor. To obtain accurate temperature readings, we put the sensor as close to the thermometer as possible.

3. The Test Results

For an ideal temperature sensor with a current/temperature rate of 1.0 $\mu A/^\circ K$, the voltage developing across the 2 $K\Omega$ resistor at temperatue T should be given by,

$$V = 2K\,\Omega \times 1\mu A/^\circ K \times T \tag{1}$$

At room temperature of $\sim 300^\circ K$, it is very close to $0.6V$ The differences ΔV between the measured voltages $V_{meas.}$ and the expected voltage V_{exp} at the same temperature is the error voltage. For our requirement of $\Delta T < 2^\circ K$, it corresponds to $\Delta V < 4mV$.

The details of the test results are located in MVD Silicon Detector Logbook 3. Some of the test results are shown in the following table and Fig.3.

Sensors	Temp.(K)	V_{input}(V)	$V_{meas.}$(V)	$\Delta V(mV)$
1	293.75	5.002	0.58856	1.06
2	293.91	5.000	0.58931	1.49
3	293.86	5.001	0.58944	1.72
4	293.89	5.001	2.1008	5.86
5	293.95	5.001	0.58953	1.75
6	295.45	5.002	0.59029	-0.61
7	295.55	5.001	0.59113	0.03
8	295.55	5.001	0.59098	-0.12
9	295.35	5.002	0.59080	0.1
10	295.45	5.002	0.59139	0.49
11	294.25	5.002	0.58846	-0.04
12	294.15	5.001	0.58833	0.03
13	294.25	5.001	0.58888	0.38
14	294.25	5.000	0.59064	2.14
15	294.35	5.001	0.59000	1.3
16	294.35	5.001	0.58872	0.02
17	294.35	5.000	0.58907	0.37
18	294.45	5.000	0.58940	0.5
19	294.45	5.000	0.58935	0.45
20	294.45	5.001	0.58942	0.52

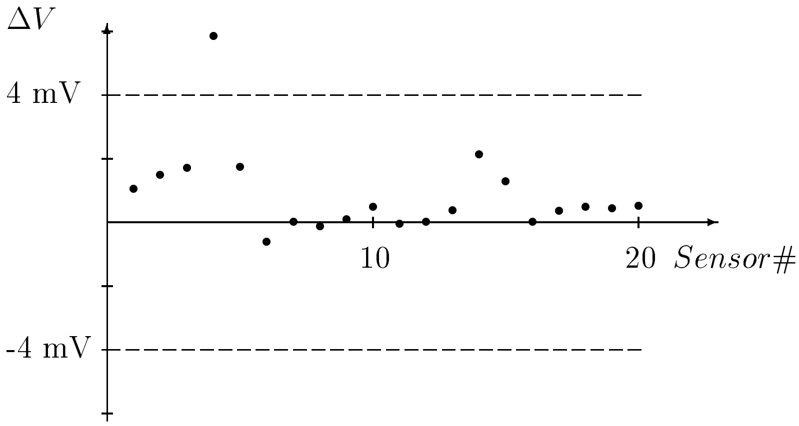

Fig.3: ΔV vs $Sensor\#$

Among the 20 sensors shown above, Sensor 4 does not pass our test since its ΔV is larger than 4 mV.

In conclusion, 299 temperature sensors were tested by the above method and 289 sensors satisfied our QA specification. Those 291 sensors will be used in the MCM's.