**ABSTRACT**

IC design is more and more important in the chip production and for each chip, engineers need to provide a supply or certain voltage to the other blocks, which means each chip needs a reference voltage block. Even though bandgap reference circuit is already widely used in industry production to be a voltage reference, it still has some characteristics to be explored and some methods to be found to improve its performance, especially for the voltage variation across the certain temperature range. In this paper, the second order coefficient of the voltage reference is to be introduced to show the characteristics of curvature of the voltage reference and compare several kinds of the bandgap reference circuits structure that most used in the production. The comparisons show that even though the structure of these reference circuit are different, the actual voltage variation of each one is same under the same condition. Furthermore, most of the traditional bandgap reference circuit are made of PN junctions, other technologies like MOSFET is to be used but still the same structure of the reference circuit to replace the original diode or bipolar. Since the subthreshold region operation of the MOSFET is much like with the diode, MOSFET was set to work in the subthreshold region to do the mathematics’ analysis and simulation to compare with the same structure that use the PN junctions. In theory, the MOSFET works better than the traditional bandgap reference circuit with PN junctions.

Key word: second order coefficient, bandgap reference circuit, PN junction, MO