Bandgap Voltage reference using OP-AMP architecture.

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Abstract

A CMOS architecture which is used to generate a constant voltage with respect to any change in temperature, supply changes and process variations. Bandgap reference circuit is used in Low drop out regulators and other DC to DC converters to compare any signal with the constant reference voltage which is supplied by the bandgap reference circuit. A bandgap voltage reference can produce a voltage of 1.1V to 1.3V depending on the values of the resistors designed. The output voltage is usually around 1.2V which is close to the bandgap energy as that of silicon. A dual stage fully CMOS operational amplifier helps in matching the voltages of inverting terminal and non-inverting terminal as it is in negative feedback.

1 Circuit Details

A bandgap voltage reference is a circuit which produces a constant voltage of 1.1V to 1.3V with respect to any change in temperature, supply changes of plus or minus 10 percent and process variations. A constant current is pumped into a diode, the voltage across the diode decreases with respect to increase in temperature. This is called complementary to absolute temperature, CTAT. This is obtained using pumping a constant current through a diode connected pnp or npn transistor. The slope of the CTAT voltage is around 26mV per C When the voltage difference between the two CTAT voltages is taken we get Proportional to absolute temperature, PTAT voltage. PTAT voltages varies linearly with the increase in the temperature. The slope of the PTAT is around 86uV per C. This PTAT voltage is obtained by taking the difference of the CTAT voltages produced by two independent diodes. The current from the first diode is copied using a current mirror or an operational amplifier used in negative feedback. The op amp in the negative feedback makes the voltages of non inverting terminal and inverting terminal equal and the potential difference between the two CTAT voltages is taken using a designed resistor. The CTAT and PTAT currents are being added and are being dumped into a resistor to obtain constant reference voltage. To avoid the zero biased conditions at the transient a start up circuit is designed to keep the mosfets in saturation region.

2 Implemented Circuit

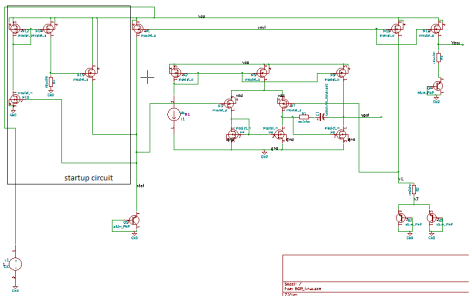

Figure 1: Implemented circuit diagram.

3 Implemented Waveforms

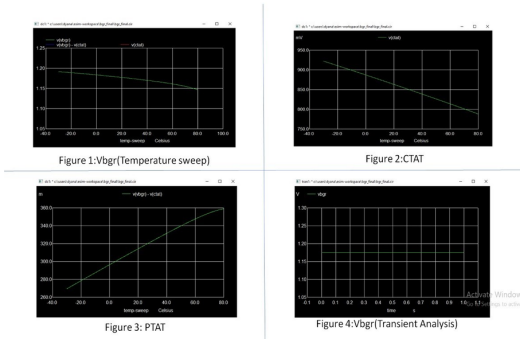

Figure 2: Implemented waveform.

References

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