

8 Bit Dual Slope ADC Using eSim

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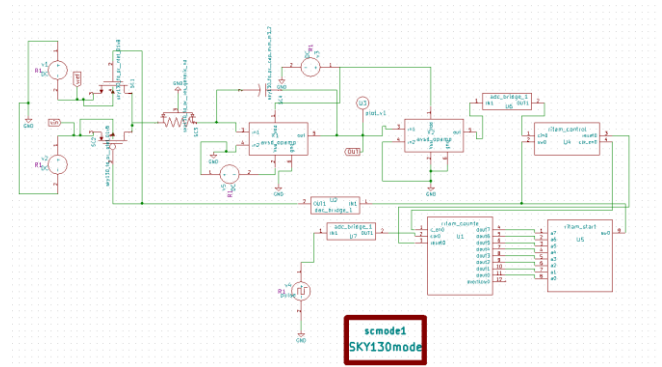
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Abstract

In this paper I have explained an 8-bit dual slope ADC (analog to digital converter) circuit which I have designed. A dual slope ADC produces an equivalent digital output for a corresponding analog input by using two (dual) slope technique. The dual slope ADC mainly consists of 5 blocks: Integrator, Comparator, Clock signal generator, Control logic and Counter.

Final Circuit

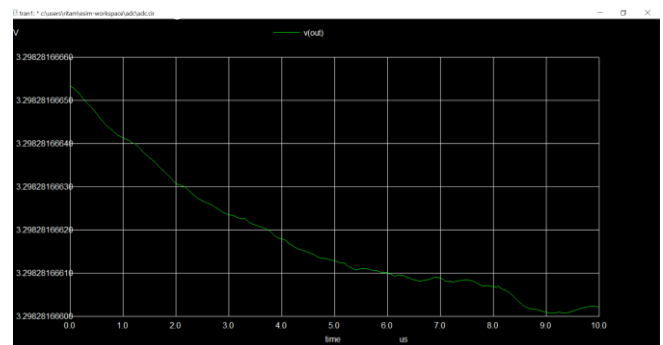


Reference Circuit Details

The input signal is applied to an integrator; at the same time a counter is started, counting clock pulses. After a predetermined amount of time (T), a reference voltage having opposite polarity is applied to the integrator. At that instant, the accumulated charge on the integrating capacitor is proportional to the average value of the input over the interval T. The integral of the reference is an opposite-going ramp having a slope of V_{REF}/RC . At the same time, the counter is again counting from zero. When the integrator output reaches zero, the count is stopped, and the analog circuitry is reset. Since the charge gained is proportional to $V_{IN} \times T$, and the equal amount of charge lost is proportional to $V_{REF} \times t_x$, then the number of counts relative to the full-scale count is proportional to t_x/T , or V_{IN}/V_{REF} . If the output of the counter is a binary number, it will therefore be a binary representation of the input voltage. The charge on the capacitor at time t_1 is proportional to the average value of V_x times t_1 . This is equal to the charge lost by the capacitor during time $t_2 - t_1$, while being discharged by the reference voltage, proportional to V_r times $(t_2 - t_1)$. Hence $(t_2 - t_1)/t_1$ is proportional to V_x/V_r . The output binary count for the time interval $(t_2 - t_1)$ is thus proportional to V_x , the input voltage. With appropriate circuitry, bipolar voltages can also be measured.

Dual-slope integration has many advantages. Conversion accuracy is independent of both the capacitance and the clock frequency, because they affect both the up-slope and the down-slope by the same ratio.

Final Circuit Waveforms



References

- (1) Dual Slope Converters, Hank Zumbahlen, with the engineering staff of Analog Devices, in Linear Circuit Design Handbook, 2008
- (2) Analog/Digital Conversions, Howard Austerlitz, in Data Acquisition Techniques Using PCs (Second Edition), 2003