Zero Drift Latching Comparator

I was recently working on a very low signal level, battery powered design that called for latching comparator, so I turned to the trusty MAX9011. When reviewing the datasheet, I noticed two glaring problems with this device (and all off-the-shelf solutions). First, the power supply swing is 4.5V - 5.5V. Second the voltage offset, Vos, is ±5mV. On a design that needs to latch on a 15mV change in signal, 5mV uncertainty is unacceptable.

After a relatively exhaustive search for a suitable component, it became clear that I was going to have to design it to my specifications.

*Desired Specifications:*

1. Low power operation (<100uA)
2. Zero Drift voltage offset (<10uV)
3. Low voltage operation (2.7V - 5.5V)
4. Low voltage noise (en < 10nV/rtHz)
5. Latching output
6. Reset line

The first 4 specifications can be achieved by careful selection of an operational amplifier. The remaining specifications present the challenge.

*Design considerations:*

1. A comparator is just an op-amp configuration that takes advantage of the large open-loop gain
2. A switch will be needed to ‘latch’ and ‘reset’ the circuit

The output of the comparator should swing from rail-to-rail per the equation below, based on the voltage at the two input pins

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INSERT COMPARATOR IMAGE

We need a solution to latch the output. To keep the design simple let’s try using a transistor as a switch. From the equation above, we can use the transition from the output swinging high to low to control the transistor. Putting the transistor in the comparator feedback loop will allow us to manipulate the comparator output. To keep the polarity correct, the device for the job is a P-Ch MOSFET or PNP BJT.

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