Application Brief

Reducing System Complexity With Self-Latching Comparators

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Introduction

For voltage and current fault signals, it is often advantageous to latch the detection signal into the fault state until the system controller takes action to fix the faults. Latching maintains that the fault condition is acknowledged and addressed by the system controller before the latch is deliberately released. The latching functionality of comparators is typically implemented with a comparator and other discrete components. Designing and controlling a discrete latching comparator takes up board space, as well as introduces complexity to the design. This application brief explains the advantages of using TI's self-latching comparator family over discrete latching comparators.

Discrete Latching Comparator

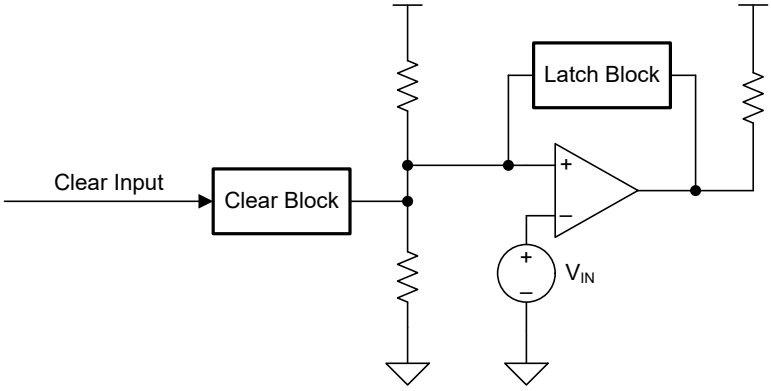

Figure 1. Block Diagram Implementation of a Latching Comparator

A discrete latching comparator is implemented with two functional blocks: a latch block and a clear block. The latch block serves to latch the output of the comparator after a fault condition is detected. The clear block serves to clear the latch to put the comparator back into an armed state for the next detection of the fault. Below is an example of a discrete implementation for an inverting comparator that latches low.

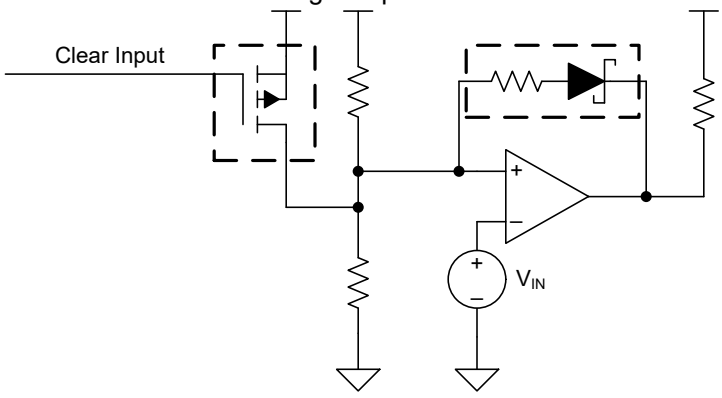

Figure 2. Example Discrete Implementation of a Latching Comparator

The latch block is implemented by a Schottky diode and a resistor. During output low, the diode is forward biased and conducts to pull the non-inverting input of the comparator low. This action latches the comparator, as the non-inverting input is now a low voltage such that the inverting input can no longer cross the non-inverting input to cause an output high state. The clear function is implemented with an enhancement-mode PMOS that clears the latch on active low. The PMOS pulls the non-inverting input of the comparator up to the supply voltage to assert an output high to clear the latch.

Discrete implementations of a latching comparator add complexity to the system. Designer must account for the electrical characteristics of the latch block and the clear block. When using discrete components, such as the series resistor and Schottky diode in Figure 2, there are additional considerations to take into account to establish functionality. For example, the designer must select an appropriate resistor and Schottky diode to effectively pull the non-inverting input to a lower voltage than the input voltage at the inverting terminal. Additionally, the designer must choose and drive the pull-up PMOS to overcome the series resistor and Schottky diode to release the latch. The addition of the discrete components also affects the power dissipation of the circuit and the amount of board space the design occupies.

Integrated Self-Latching Comparator

TI's TLV902xL family offers integrated self-latching comparators. The latching and clear functionality are integrated into the device, so the comparator does not need discrete components to implement latch and clear blocks. The discrete implementation above can be substituted with TLV9020L without the need for the discrete PMOS, Schottky diode, and extra resistor.

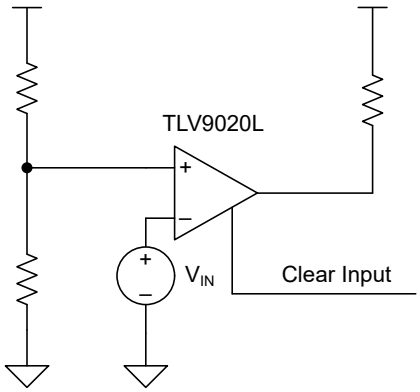

Figure 3. Self-latching Comparator Implementation Using TLV9020L

TLV9020L is an open-drain, self-latching comparator that latches low. The output of the comparator stays latched low on the first high-to-low transition until the device is manually cleared by a negative edge clear signal.

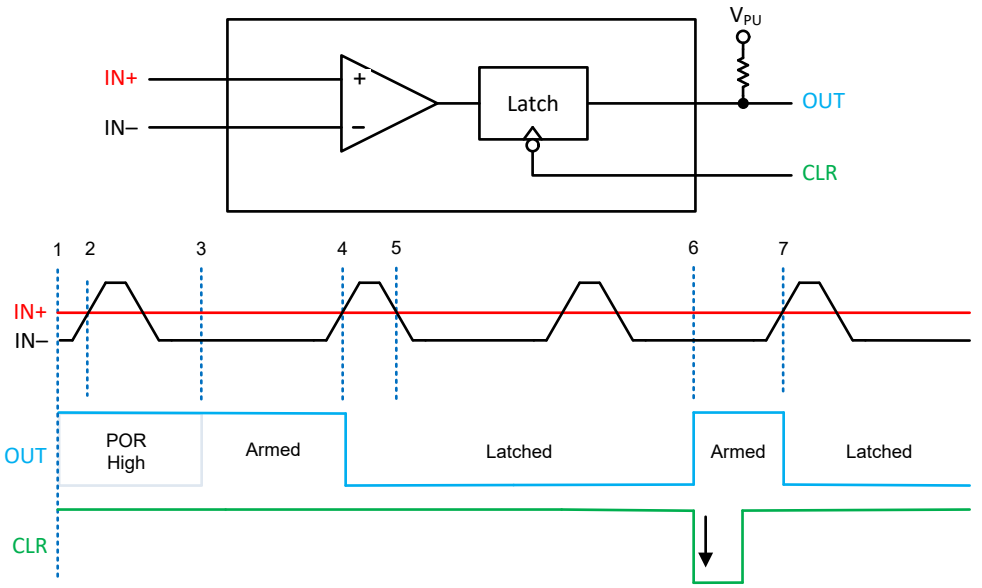

Figure 4. Timing Diagram for TLV9020L

TLV9020L integration of the latch and clear functions simplify the design and control of the latching comparator. The lack of additional discrete components reduces the overall board space this circuit occupies. There are fewer considerations for the latch and clear, as the latch is handled internally to the TLV9020L, and the clear is a digital signal with an input low level of 0.6V and an input high level 1.2V. TLV9020L has an edge-triggered clear that offers advantages over level-triggered clears. Fault conditions can cause the clear signal to short to ground or the supply voltage, inadvertently causing the comparators to constantly be in a clear state and fail to detect fault conditions. This failure is mitigated by the TLV9020L negative edge-triggered clear signal. Overall, the TL902xL family offers improvement in functionality and design simplicity when compared to discrete latching comparators.

The TLV902xL and TLV903xL family have several power-on options differentiated by *L1* and *L2* options, depending on whether the user wants the self-latching comparator to power on in a latched or unlatched state.

Table 1. Power-On Options

Device	Output Type	Output State During POR	Output State After POR	Armed Output Latches On	Output Latch Condition
TLV902xL1	Open-Drain	High	Armed	H → L	Low
TLV902xL1-Q1					
TLV902xL2	Open-Drain	Low	Latched Low	H → L	Low
TLV902xL2-Q1					
TLV903xL1	Push-Pull	Hi-Z	Armed	L → H	High
TLV903xL1-Q1					
TLV903xL2	Push-Pull	High	Latched High	L → H	High
TLV903xL2-Q1					

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