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AnalogDialogue

RAQ Issue 215: Is There Such a Thing as a True Glitch-Free Voltage Supervisor IC?

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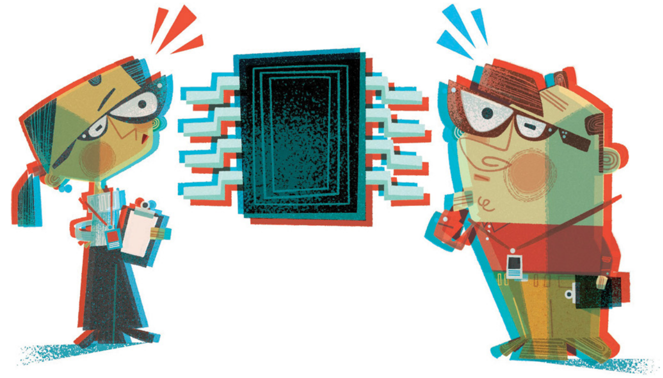
Question

Does a true glitch-free voltage supervisor IC exist or is it just a concept?



Answer

Yes, a true glitch-free supervisor IC exists. The MAX16161/MAX16162 are examples of ICs that can generate a reliable reset signal even at zero supply voltage, allowing them to monitor low voltage electronics with less than 1 V.

A reliable supervisor IC is always an industry need as it adds system reliability and improves system performance over voltage transients and power failures. Semiconductor manufacturers are constantly enhancing the performance of voltage supervisor ICs. All that the supervisor IC requires is a minimum voltage called power-on reset (V_{POR}) before generating a clean or reliable reset signal. Before the minimum supply voltage, the state of the reset signal is undetermined. Generally, we called this glitch on reset.

There are predominantly two different topologies used for the RESET pin: open-drain and push-pull (Figure 1). Both topologies use NMOS as a pull-down MOSFET.

During power-up, if the supply voltage is below V_{POR}, there is not enough voltage for the internal circuitry driving the output MOSFET to operate, so the output MOSFET is off. The supervisor has no way to control the output reset voltage. Reset will rise in proportion to the pull-up voltage (V_{PULLUP}), and once the supply voltage is above V_{POR} voltage, the internal MOSFET will drive the RESET pin to a valid state.

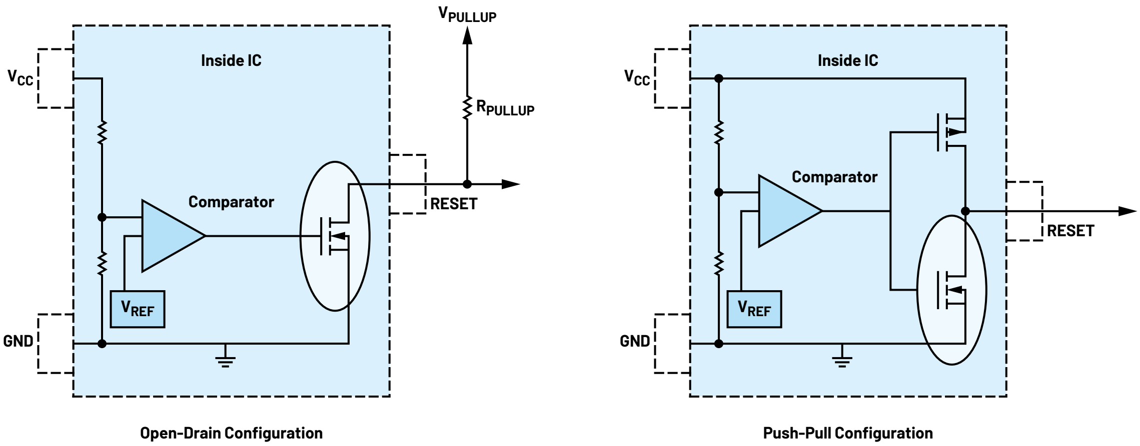


Figure 1. An open-drain configuration and a push-pull configuration for reset topologies.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{CC}	Operating range	1.7		5.5	V
		Reset output is guaranteed to be at known state	1.5			

POR Voltage in Data Sheet EC Table

Figure 2. The POR spec in data sheet EC table.

A voltage supervisor can be used to monitor the low voltage rails for FPGAs, ASICs, or digital signal processors, where the voltage can be as low as 1 V. In low voltage processors, the I/O logic levels are very sensitive and the V_{IH} can be as low as 0.5 V, as shown in Figure 3.

During power-up, an FPGA, an ASIC, or a digital signal processor needs to be in the RESET state until all the supply rails are stable. Since RESET may have a glitch when V_{CC} is below V_{POR}, this glitch can trigger an unknown state of an FPGA. Once V_{CC} is above V_{POR} voltage, the internal MOSFET turns on, connects RESET to GND, and causes RESET to output the correct low logic level.

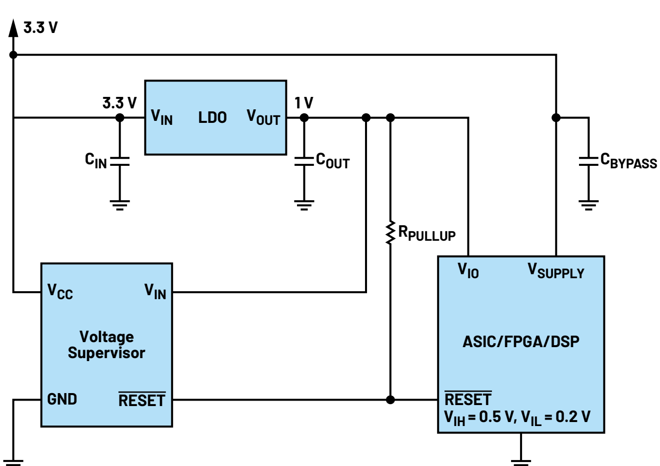


Figure 3. The interfacing of a supervisor with a low voltage ASIC, FPGA, or digital signal processor.

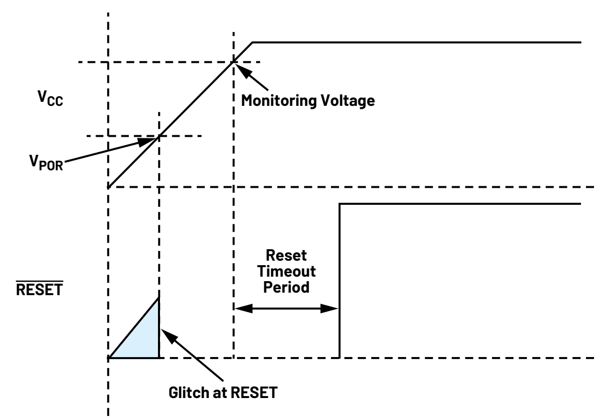


Figure 4. The power-on sequence with a glitch on reset.

As the electronic industry moves toward low voltage semiconductors, analog chip manufacturers are also working to deliver glitch-free reset with a conventional supervisor. Manufacturers can only reduce the V_{POR} voltage by improving the process, but a true glitch-free supervisor needs a new architecture.

Currently, system engineers use an external circuit with a conventional supervisor to mimic the glitch-free feature of the supervisor shown in Figure 5. By adding a standard JFET configured in a source-follower configuration, the voltage at the source will follow the voltage at VG minus the threshold voltage of the JFET. The threshold of the JFET causes approximately a 1 V drop between VG and V_{OUT} and eliminates the voltage potential rise on the output until the internal circuitry becomes operational.

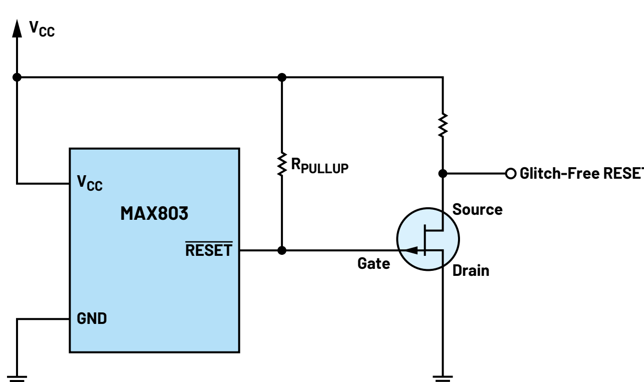
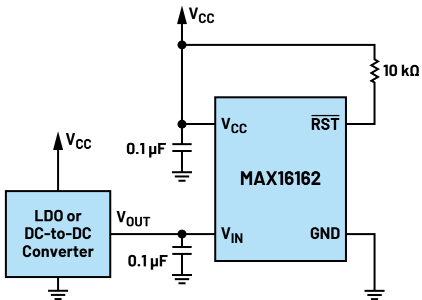


Figure 5. A conventional supervisor with an external P type JFET for glitch-free operation.

True glitch-free supervisors can sink the current through a reset, which forces reset to a ground potential even at zero V_{CC}. Figure 6 shows an example of a true glitch-free supervisor in a circuit. The MAX16161/MAX16162 do not require any external components for their glitch-free operation, which makes them tiny and cost-effective.

Conclusion

A true glitch-free supervisor IC is no longer just a concept. Designers now have a supervisor IC that generates a reliable reset signal at zero supply voltage to enable system engineers to use the IC to monitor low voltage (less than 1 V) electronics. The MAX16161/MAX16162 are tiny, nanopower ICs that use just 825 nA of quiescent current to help extend system battery life.



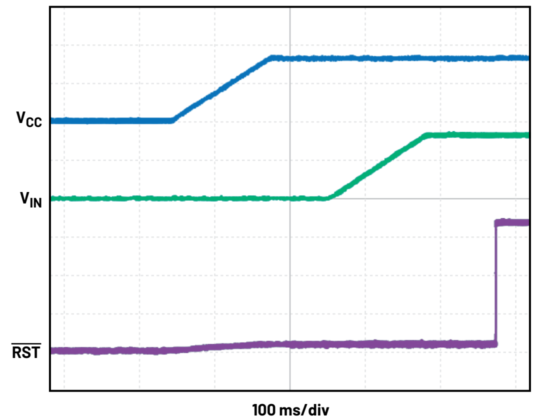


Figure 6. An application diagram of the MAX16162 and a corresponding timing diagram.

About the Author

Suryash Rai has been working at Analog Devices as an applications engineer since 2016, where he supports the protection IC portfolio. He received his master's degree in communications engineering from the National Institute of Technology Karnataka, Surathkal. Suryash currently lives in San Jose, California, and enjoys cooking, traveling, and meeting new friends.