Technical Article

Selecting Voltage Detectors, Supervisors, and Reset ICs for System Safety: Part 2

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In the first installment of this series, I defined voltage detectors and supervisors/reset ICs and explained different output types, along with some basic devices. As designs become more complex, more advanced devices may be required to successfully monitor a voltage. In this installment, I'll highlight various features found in voltage detectors and supervisors/reset ICs to help designers select the right one.

Programmable Output Delay

Voltage supervisors, unlike voltage detectors, usually have a programmable output delay using an external capacitor, making them extremely flexible. They are useful for the proper sequencing of multiple supplies, such as in field-programmable gate array (FPGA) applications or to prevent system glitches. When the supply voltage rises above the voltage threshold (plus the hysteresis, if applicable), this would normally trigger the device to "unflag" the reset signal and return the system from a reset condition. Since there is a delay created by the delay capacitor (C_D), however, the voltage must remain above the voltage threshold plus hysteresis for the specified time delay before the reset signal unflags. This prevents the system from returning from a reset condition prematurely.

Programmable output delay is sometimes referred to as a programmable reset timeout period. A ceramic chip capacitor connected directly to the delay pin (sometimes named CD or SRT) is usually sufficient for a stable, well-defined output delay. The LM8365, shown in Figure 1, has a programmable output delay.

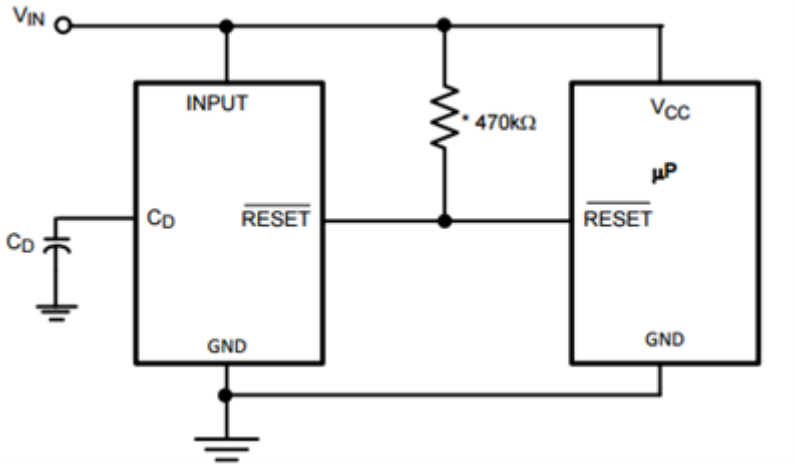

Figure 1. LM8365 Typical Application Circuit with Programmable Output Delay

When the input voltage drops below the reset threshold, the reset pins drops low. When the input voltage rises above the threshold, there is a delay before the reset pin comes back up. By increasing the capacitor (C_D), the delay increases. See the timing diagram for the LM8365 in Figure 2.

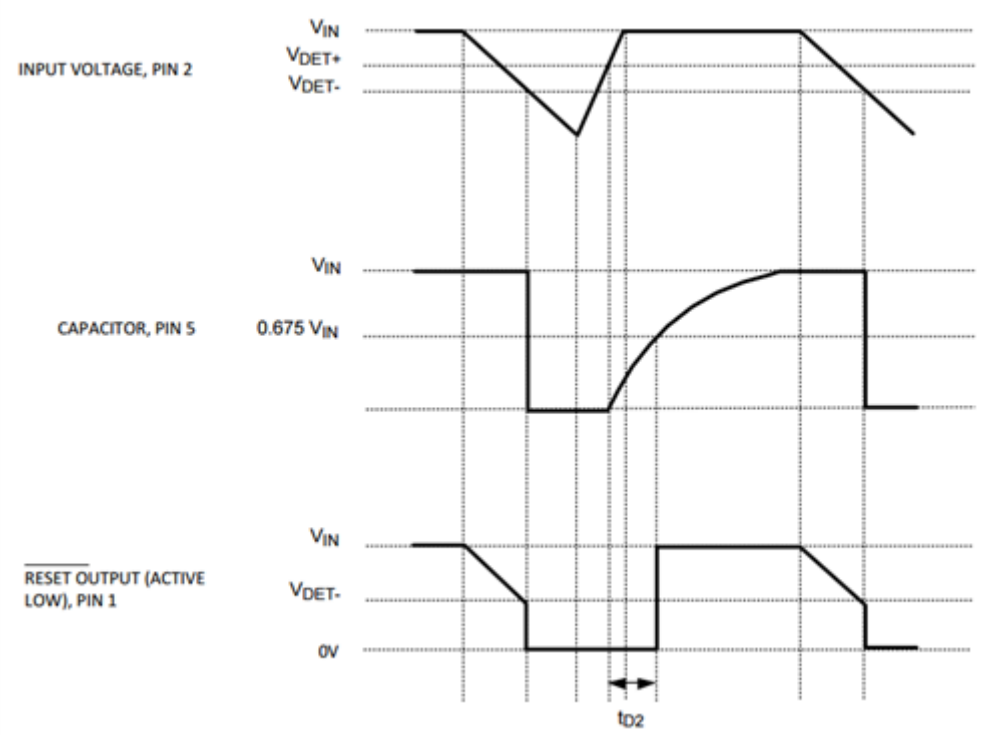

Figure 2. Timing Diagram for the LM8365

Manual Reset

A manual reset input forces a reset when the manual reset (MR) pin is lower than the manual reset threshold (V_{MRT}) for a specific duration, usually on the order of microseconds. The reset pin remains active as long as the MR pin is held low. The pin releases once the reset timeout period expires after MR rises above the V_{MRT}. This feature is useful for microprocessor applications when the user needs to reset. It's also useful in applications that need to reset when detecting a low voltage other than the main supply voltage. Manual reset gives you full control over the reset rather than having only a low supply-voltage trigger.

Power-fail Input

Some voltage detectors and supervisors/reset ICs have an additional input for a power-fail warning to monitor a power supply other than the main supply. This additional input can be useful in systems that want to detect if the power is failing before it actually fails. The threshold can vary with different devices, but a typical threshold value is 1.225V from an internal reference. If the power-fail input (PFI) pin is lower than the power-fail voltage threshold (V_{PFT}), the power-fail output (PFO) drops low.

Typically, the power-fail comparator, driven by a voltage divider connected to the main supply, signals a falling power supply. A voltage at PFI that drops below V_{PFT} several milliseconds before the main supply voltage drops below the reset threshold provides advanced warning of a brownout. The PFI pin can also connect to the MR pin to force a low output signal for voltage detectors or a reset for supervisors/reset ICs.

Watchdog Timer

Voltage detectors and supervisors/reset ICs with watchdog timers wait for signal activity on the watchdog input (WDI) pin. A reset triggers if the supervisor does not detect a signal within the watchdog window. You can program this window using an external capacitor, making the watchdog window more flexible.

A watchdog timer is usually for safety-critical applications or for processor monitoring that requires a reset if the microprocessor is not active for a certain duration. This feature prevents the system from continuing to run if the microprocessor is not functioning properly.

Low-line Output

This early power-failure warning indicator goes low when the supply voltage drops to a value higher than the reset threshold. The indicator triggers about 2% above the reset threshold to indicate low power without causing a reset.

Figure 3 shows an example application circuit for the LM3710, while Figure 4 shows an example timing diagram with examples of the features I've reviewed so far.

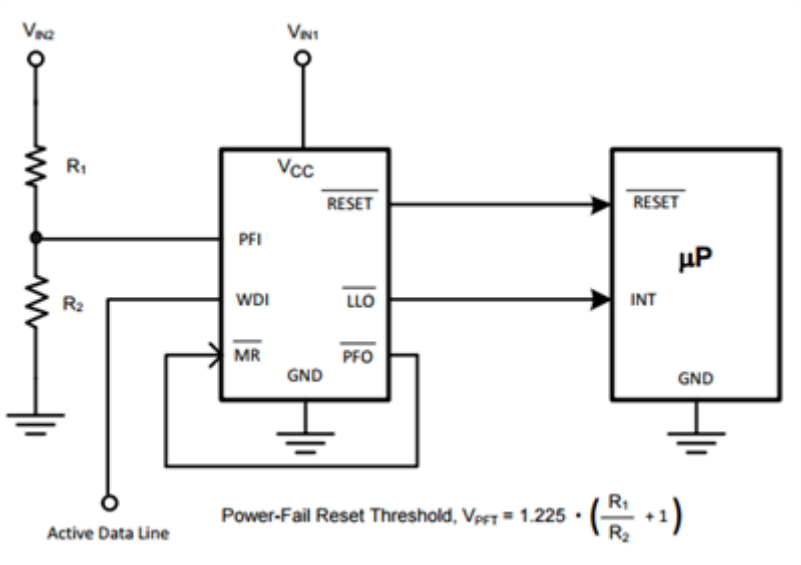

Figure 3. LM3710 Application Circuit

In addition to the standard reset, the LM3710 has a manual reset, power-fail input, watchdog timer and low-line output, making it a very flexible device for many applications. The application circuit shown in Figure 3 above uses R1 and R2 as a voltage divider connected to V_{IN2} to set the power-fail reset threshold in order to monitor a second power supply. If the second power supply drops below the power-fail reset threshold, the PFI pin will be low, so the PFO pin will also drop low. Since this pin is connected to the MR pin, a reset will trigger.

A reset will also occur if no activity is detected within the watchdog window on the WDI pin. The WDI pin can connect to the microprocessor to detect if it is still operating correctly by having the microprocessor send an intermittent pulse. The low-line output (LLO) pin will drop low if the supply voltage at V_{CC} drops to within about 2% of the reset voltage threshold. The LLO pin, for example, can connect to a microprocessor for detection. When the LLO pin goes active, a signal sent to the microprocessor can cause some other action to occur such as sending a signal to another device or a flashing LED or some other alert to the user.

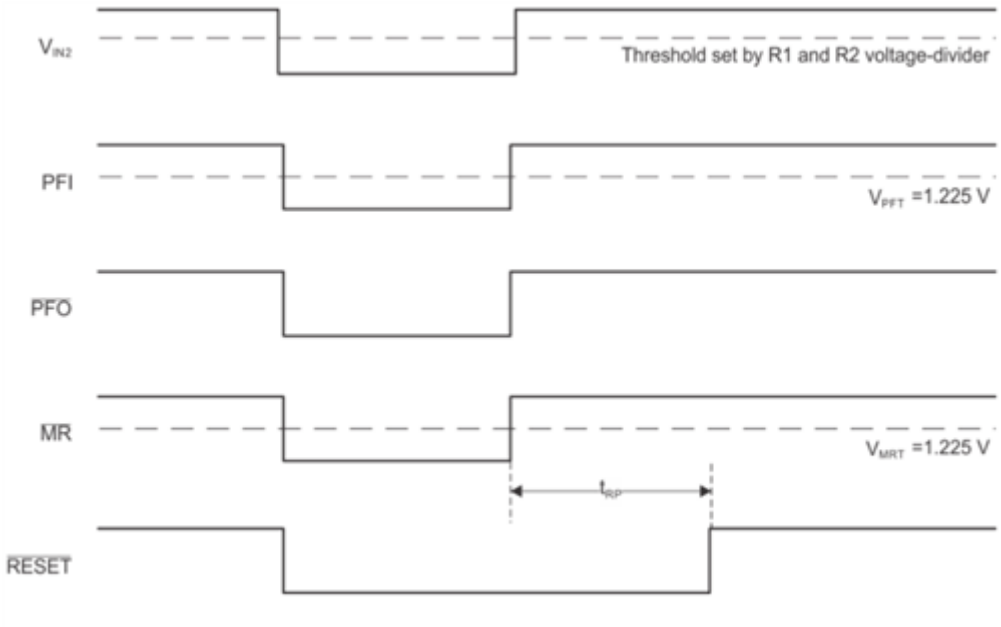

Figure 4. Example Timing Diagram for Power-fail and Manual Resets of the LM3710

The timing diagram in Figure 4 shows an example of monitoring a second voltage input (V_{IN2}). When the V_{IN2} connected to the PFI pin goes low, the PFO pin drops low, causing the MR pin to drop low, which then triggers a reset. There are many ways to use the power-fail and manual reset features, so it is up to you to decide what you need for your application.

After reading Part 1 and Part 2 of this blog series, you should be aware of the subtle difference between voltage detectors and voltage supervisors/reset ICs along with the various features that are available. There are countless applications that require detecting a supply voltage beyond a set voltage threshold and it is up to the designer to determine what happens next. When your battery is low, for example, do you want your system to flash a light or turn on a speaker or turn off some other device in your circuit? Do you want the user to be able to press a button to trigger this same condition or some other condition? Do you want to be able to monitor multiple voltages at different thresholds? When choosing a voltage detector or supervisor/reset IC, first determine what you are trying to do and what features you need then you can narrow down the devices by the specific specs, package, cost, etc. To see all of the voltage detectors and supervisors/reset ICs offered by Texas Instruments, see the voltage detector and supervisor/reset IC selection guide website.

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