Power Supply Supervision Using Programmable Window Comparators With DACx3608

Protection circuits are a necessary overhead in products designed for robustness. Achieving such protection with least amount of trade-off is always the goal of a product developer. The DACx3608 family of DACs offer a solution to one such challenge of circuit protection by enabling efficient power supply voltage and current supervision.

Power supply supervision is a circuit that is present in almost all applications that need power supply rails shared across boards and modules. This circuit is often seen as an overhead as it ensures the protection of various components in case of a fault, rather than directly aiding the application. Therefore, implementing a robust power supply supervision circuit in a cost effective way is a challenge for any designer. The application space for this circuit includes Communications equipment, Battery Test System, Automated Test Equipment, and others. In this application note, we will discuss methods of implementing a robust power supply supervision circuit using precision DACs.

Power Supply Supervision with Precision DACs

Figure 1 provides a high-level block diagram of how power supply voltage and current supervision is implemented. A precision DAC sets the threshold voltages for a window comparator and the measured voltage or current is compared with these thresholds. The comparator subsequently triggers a processor in case the measured values move outside the programmed band. We will focus on only voltage supervision in the rest of the document.

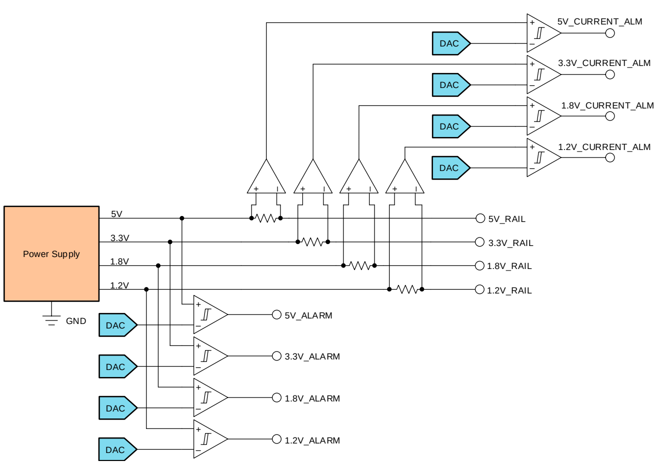

Figure 1. Block Diagram of Power Supply Supervision

Power Supply Supervision Inside A Control Loop

A common approach towards power supply supervision is to detect the direction of the failure so that the power supply source can be regulated accordingly. This topology requires two trigger outputs from every supervisory circuit as shown in Figure 2. Two DAC channels are used to generate the high- and low-threshold voltages independently. The resistors R_A and R_B bring the nominal value of monitored voltage (V_{IN}) in the range of the DAC. Usually open-drain comparators are preferred in order to generate trigger signals at the IO voltage level of the processing circuit. When the attenuated input voltage increases beyond V_{TH-HI}, the output $V_{ALARM-HI}$ goes LOW. $V_{ALARM-LO}$ goes LOW in a similar manner when the voltage decreases below V_{TH-LO}. The outputs are pulled HIGH otherwise. Figure 3 shows the waveforms at different nodes of this circuit. TLV1701 dual comparator was used for simulating the circuit.

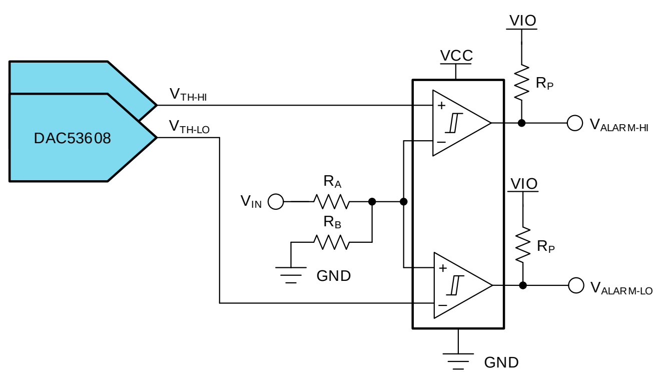

Figure 2. Window Comparator for Control Loop

Supervision for Fault Indication (Open Loop)

The circuit in Figure 2 is very useful but requires two trigger pins per monitoring channel. In applications where only fault indication is required, this circuit can be further simplified. Figure 4 shows a method to generate a single trigger output by combining the open-drain comparator outputs. This trigger output goes LOW in case at least one of the comparator output is LOW. Note that this circuit cannot be used inside a control loop as the output only conveys a fault condition, not the type of fault.

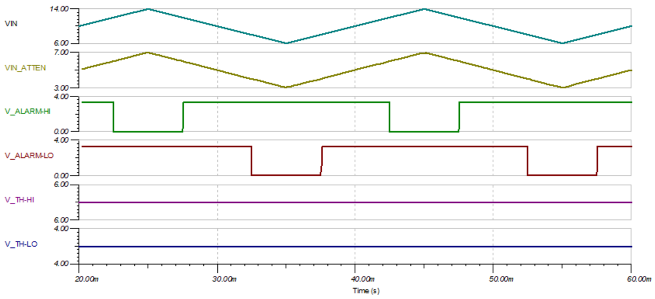

Figure 3. Dual Output Waveform

Figure 5 shows the corresponding waveform for the fault indication circuit. It can be seen that trigger output is LOW whenever there is a fault.

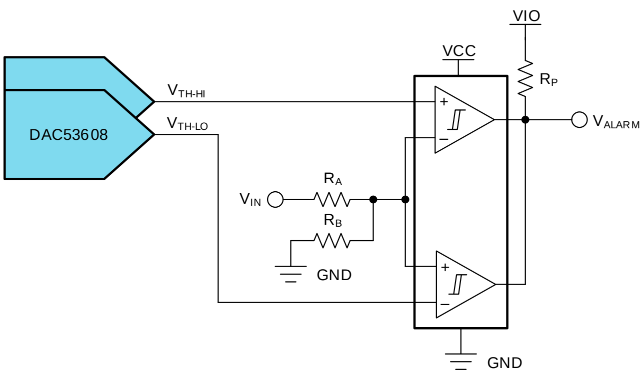

Figure 4. Window Comparator for Fault Indication

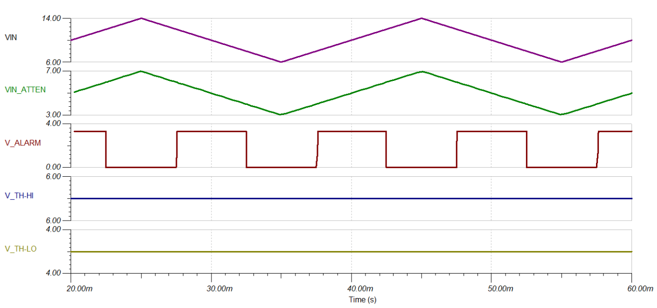

Figure 5. Fault Indication Waveform

Resource Optimized Open Loop Supervision

It can be observed in circuits shown in Figure 2 and Figure 4 that two DAC channels are required for every monitoring channel in order to provide full programmability over the threshold voltage levels. However, in some applications the ratio between the high- and low-threshold voltages can be fixed and a DAC is required only for programming the nominal voltage. For such applications, the number of DAC channels required can be reduced by half. Figure 6 depicts such a topology. The DAC sets the high-threshold voltage while the low-threshold voltage is defined by the resistor ratio as shown by the equation.

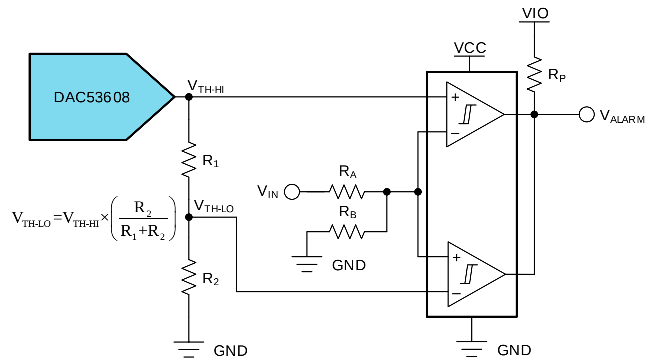

Figure 6. Resource Optimized Fault Indication

DACx3608 Family of Precision DACs

The DACx3608 family of DACs is an 8-channel buffered voltage output DAC with a tiny 3x3 QFN package. It has a single supply operation and comes in 8-bit and 10-bit pin-compatible versions. The DAC provides an I2C interface whose device address can be configured to four different values using a single hardware pin. This will allow use of 32 channels without using any I2C buffer. All these features combined with tiny footprint makes DAC53608 an excellent choice for power supply supervision.

Discussion

Power supply supervision is a necessary overhead in many applications. In this application note, we discussed how this overhead circuit can be made simpler and robust using a precision DAC53608. When used with the circuits described above, DAC53608 family can provide both closed-loop and open-loop circuit functionality for both voltage and current supervision.

Related End Equipment

- Communication Equipment
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