LINEAR TECHNOLOGY

DESIGN NOTES

Power Supply Sequencing Made Simple – Design Note 401

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Introduction

System designers face a number of problems when it comes to controlling multiple power supplies. Turn-on and turn-off characteristics, supply monitoring, fault management and reset generation are a few issues that affect both the short term system performance and long-term reliability. Design is further complicated by a process that often puts final decisions about supply requirements at the end of the design phase. So, a good supervisor/control solution allows for easy design and adjustment anywhere in the design process.

Firmware solutions place a daunting hurdle directly in the critical path of the design. Every change involves software engineers, a load of testing and worst of all, waiting. Loading code during production is time consuming and costly.

A better solution uses hardware, but easy-to-change, relatively inexpensive hardware. How about generic reusable circuit blocks that are added early in the system design with little regard to the final specific power requirements? The existing blocks are left unfinished, simply waiting for passive component values to be determined. When final decisions about the power supplies' operating specifications are determined, calculate the values for a few passive components and populate the empty spaces in the circuit. Fortunately, such a solution exists.

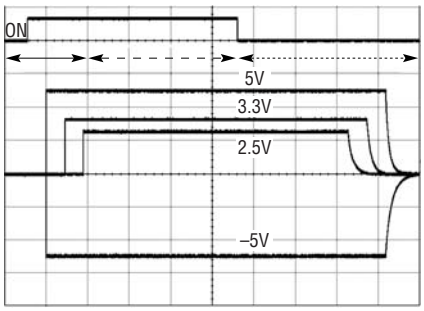

Figure 1. Sequencing Application Waveforms

The LTC2928 is a 4-channel cascadable power supply sequencer and high accuracy supervisor. Multiple LTC2928s can be easily connected to sequence an unlimited number of power supplies. Cascade action is via a single pin connection and is functional during sequence-up and sequence-down operations. Sequencing thresholds, order and timing are configured with just a few external components, eliminating the need for PC board layout or software changes during system development. Sequence outputs control supply enable pins or N-channel pass gates. Precision input comparators with individual outputs monitor power supply voltages to 1.5% accuracy. Supervisory functions include under and overvoltage monitoring and reporting as well as reset generation. The reset output may be forced high to complement margin testing.

Application faults, whether generated by the LTC2928 or communicated by a host, can shut down all controlled supplies. The type and source of faults are reported for diagnosis. Individual channel controls are available to independently exercise enable outputs and supervisory functions. A high voltage input allows the LTC2928 to be powered from voltages as high as 16.5V. A buffered reference output permits negative power supply sequencing and monitoring operations.

Three Phases of the Power Management Cycle

A complete power management cycle is divided into three phases as shown in Figure 1. The sequence-up phase initiates by transitioning the ON pin above threshold with a logic signal or power supply. The controlled supplies sequence-up with user configured order and timing. All supplies must exceed a user defined sequence-up threshold within the configured "power-good" time. If any supply fails to turn on properly, a sequence fault occurs and all controlled supplies are shut down. Once all supplies reach their sequence-up threshold, the supply monitor phase begins.

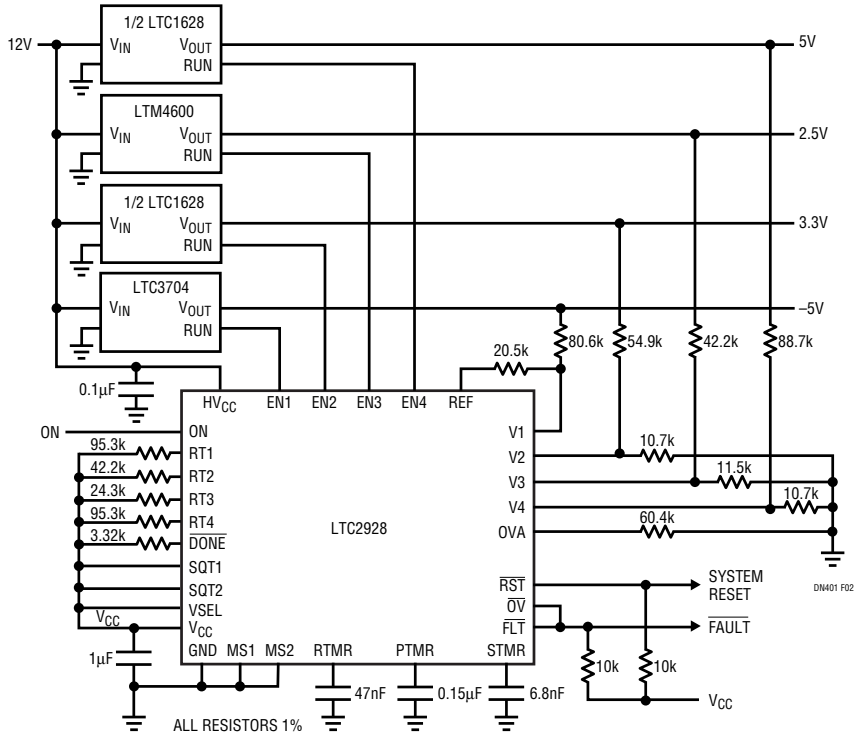

Figure 2. LTC2928 Application Schematic (component values calculated with the LTC2928 Configurator Tool)

During the supply monitor phase, the input signals are continuously compared against user configured undervoltage and overvoltage thresholds. The comparators filter out minor glitches coupled to their inputs. If any supply is out of compliance with sufficient magnitude and duration, the reset output ($\overline{RST}$) and/or overvoltage output ($\overline{OV}$) pulls low. Once all inputs are within compliance, the respective monitor output pulls high after the user defined reset delay. Users may select whether or not a fault is generated on the basis of under or overvoltage events. A generated fault shuts down all controlled supplies. Shutting down upon an undervoltage fault is often a critical operation. For example, consider a temporary short on one supply due to a probe slip. Once the short is removed, the supply may recover, but it might do so out of sequence if the other supplies are unaffected. A reset fault shuts off all the supplies, allowing for a new in-sequence start-up procedure.

The sequence-down phase initiates by transitioning the ON pin below threshold with a logic signal or power supply. The controlled supplies sequence-down with user configured order and timing. All supplies must fall below the user defined sequence-down threshold within the configured "power-good" time. If any supply fails to turn off properly, a sequence fault occurs and all controlled supplies are shut down.

LTC2928 Configuration Software Designs It for You

To make life truly simple, Linear Technology offers free configuration software that calculates all resistor values, capacitor values and required logic connections. The tool also generates schematics and a passive element bill-of-materials. All you need to know are your supply parameters and sequence order. Contact Linear Technology for details.

Conclusion

The LTC2928 greatly reduces the time and cost of power management design by eliminating the need to develop, verify and load firmware at back end test. System control issues such as sequence order, timing, reset generation, supply monitoring and fault management are all handled with the LTC2928.

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