The challenges in designing a multiple power supply multiply with each additional supply rail. The designer must consider the dynamic environment of coordinated power supply sequencing and timing, generating power-on reset, monitoring for faults and responding appropriately to protect the system. An experienced designer recognizes that flexibility is key to successfully navigating the ebb and flow as a project moves from prototype to production. The ideal solution minimizes the number of hardware and software changes during development.

The ideal multisupply design tool is a single IC that resides in a design from beginning to end, requiring no wiring changes through the life cycle of the product. It autonomously supervises and sequences multiple power rails, cooperating with other ICs to seamlessly supervise many power regulators in the system, and provides fault and reset management. The designer can use powerful PC-based software to configure, visualize and debug system behavior in real time when connected to an I²C bus.

The LTC®-2937 fits this bill. It is a 6-channel voltage sequencer and high-accuracy supervisor with EEPROM. Each of the six channels has two dedicated comparators to accurately monitor over- and undervoltage conditions to within ±0.75%. The comparator thresholds are individually programmable over a range of 0.2V to 6V with 8-bit resolution. The comparators are fast, with deglitched propagation delays of 19μs. Each sequencer channel has an enable output that can control an external regulator, or the gate of a pass FET. All aspects of supervisor voltage and sequencer timing are individually configurable, including up- and down-sequence order, sequence timing parameters, and fault response. The built-in EEPROM makes the part completely autonomous and able to power-up in the correct state to control the system. In addition, multiple LTC2937s can cooperate to autonomously sequence up to 300 supplies in a system, all using a single-wire communication bus.

Power supply faults are controllable, visible and manageable through the LTC2937’s autonomous fault response behaviors, and through debug registers. The LTC2937 automatically detects fault conditions and can power down the system in a coordinated manner. It can remain off, or attempt to resquence the supplies after the fault. In a system with a microcontroller and an I²C/SMBus, the LTC2937 provides detailed information regarding the type and cause of the fault, and the state of the system. The microcontroller can make decisions about how to respond, or allow the LTC2937 to respond on its own.

Three Steps of Power Supply Control
A power supply cycle has three operating steps: sequence-up, monitoring and sequence-down. Figure 2 shows these phases for a typical system. During up-sequencing, each power supply must wait its turn, and then power up to the correct voltage in a designated amount of time. During the monitoring phase each power supply must remain within designated over- and undervoltage
Each of the LTC2937’s six channels has two dedicated comparators to accurately monitor over- and undervoltage conditions to within ±0.75%. The comparator thresholds are individually programmable over a range of 0.2V to 6V with 8-bit resolution.

Table 1. Programmable 6-channel sequencer and supervisors with EEPROM

<table>
<thead>
<tr>
<th>Feature</th>
<th>LTC2933</th>
<th>LTC2936</th>
<th>LTC2937</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequencer</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Comparator Outputs</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Threshold Range</td>
<td>1V to 13.9V (1×) 0.2V to 5.8V (5×)</td>
<td>0.2V to 5.8V (6×)</td>
<td>0.2V to 6V (6×)</td>
</tr>
<tr>
<td>Threshold Accuracy</td>
<td>±1%</td>
<td>±1%</td>
<td>±0.75%</td>
</tr>
<tr>
<td>Power Supply</td>
<td>3.4V to 13.9V</td>
<td>3.13V to 13.9V</td>
<td>2.9V to 16.5V</td>
</tr>
<tr>
<td>Package (mm × mm)</td>
<td>5×4 DFN-16, SSOP-16</td>
<td>4×5 QFN-24, SSOP-24</td>
<td>5×6 QFN-28</td>
</tr>
</tbody>
</table>
The LTC2937’s extensive register set is powerful, yet mastering it is simple. The LTpowerPlay graphical user interface (GUI) displays all of the status and debug register information in one convenient interface.

again to bring the supplies down, but all of the sequence-down parameters are independent from the sequence-up parameters. Channels can sequence down in any order, and multiple LTC2937 chips coordinate sequencing of all controlled supplies. During the down-sequence, each supply must fall below its discharge threshold within its configured time limit, or trigger a sequencing fault. The LTC2937 can pull down on the supply with an optional current source to actively discharge slow moving supplies.

The sequence position clock enforces event-based sequence order, with each event waiting for preceding events before it can continue. The LTC2937 also allows time-based sequencing, and can participate in systems that enable supply rails at predetermined time points.

Reconfigurable registers function in either time-based or event-based mode.

LTpowerPlay Makes it Simple

The LTC2937’s extensive register set is powerful, yet mastering it is simple. The LTpowerPlay® graphical user interface (GUI) displays all of the status and debug register information in one convenient interface. The GUI communicates with any Linear Technology power system management IC (including the LTC2937) on the I2C/ SMBus. Configuring one or more LTC2937s is as simple as a few clicks of the mouse.

LTpowerPlay saves settings on the PC, and can write them into the LTC2937 EEPROM. The GUI also shows all of the debug information for system malfunctions. LTpowerPlay can show when any supply is over- or undervoltage, or if a supply has failed sequence timing. After a fault, the GUI allows complete control over restarting the system. In every stage of the design—start-up, configuration, debug, and operation—LTpowerPlay is an indispensable window into system performance.

Conclusion

The LTC2937 simplifies power system sequencing and supervision. It requires very little board real estate for a complete system. It is flexible and reconfigurable, yet autonomous through its EEPROM memory. It can operate on its own, or in concert with other chips in a large system, seamlessly orchestrating the operations of up to 300 power supplies.
The LTC2937 simplifies power system sequencing and supervision. It requires very little board real estate for a complete system. It is flexible and reconfigurable, yet autonomous through its EEPROM memory. It can operate on its own, or in concert with other chips in a large system, seamlessly orchestrating the operations of up to 300 power supplies.

Figure 4. LTpowerPlay graphical user interface (GUI) displays all of the status and debug register information in one convenient interface. Configuring one or more LTC2937s is as simple as a few clicks of the mouse. LTpowerPlay saves settings on the PC, and can write them into the LTC2937 EEPROM.