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System Safety & Reliability Issues in SBS Implementations

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System Safety Concept

- Overview SBS Safety Concept
- SBS and Multichemistry
- SBS and Interchangeability
- System Example
- Note: Specific Battery, Charger, and Selector safety issues will be presented in other sections

SBS Safety Concept

- Issuing alarm messages
  - SBS provisions for alarms for unsafe condition such as over-temperature or over-voltage
- Bus error detection
  - Slave does not issued an acknowledge, causing a premature termination of the command code
  - Signals Host that data transfer did not occur properly

SBS Safety Concept (cont'd.)

- Alert signals
  - Signal host through a hardware pin of status changes or problems
  - Host services hardware interrupt by interrogating slaves
- SBS device should protect against irregular system operation
  - All SBS components should default to a "safe" condition

SBS Safety Concept (cont'd.)

- Host failure
  - Charging may be conducted between Smart Battery and Level 2/3 charger without host intervention
  - Host response to Alarm conditions varies with system architecture
- Charger failure
  - Battery pack should provide protection against charger failure
    - PTC, thermal fuses, etc.

SBS Safety Concept (cont'd.)

- Battery failure
  - Charger restores defaults after message timeout period
  - Thermistor is required in ALL SBS batteries
    - Thermistor is the key fail-safe temperature monitor for the charger
  - Charger may apply wake-up current if thermistor is within valid range
  - "Battery-removed" default charge is no greater than 10mA

SBS Safety Concept (cont'd.)

- Bus locked
  - Host master may attempt to clear bus with a START/STOP (design recommendation)
  - All slave devices must time out when any clock is held low for longer than $T_{timeout}$ maximum
  - SBS systems have a minimum clock frequency of 10KHz and a clock extend of 10ms for Master and 25ms Slave devices

Alarm Messages

- Host
  - Designed to receive alarm messages from various components
  - Cannot disable this function; i.e., Charger Broadcast disable from Smart Battery does not inhibit alarm messages to Host
  - Broadcast Alarm messages every 10 seconds until the condition causing the alarm is removed
  - All SMBus hosts should be capable of receiving alarm messages

Alarm Messages (cont'd.)

- Error detection
  - Slave determines an error has occurred (unsupported command code or data unavailable, etc.)
  - Responds by not acknowledging the byte transfer
  - Host responds by issuing a STOP, and checking the device status for error codes
  - Lack of an error code signals Host of bad data transfer

SBS & Multichemistry

- SBS allows for *any* rechargeable chemistry
  - Theoretically, primary batteries are possible
- Smart Battery is responsible for providing charge current/voltage information
  - Level 3 charger may utilize other charge current/voltage combinations

SBS & Interchangeability

- Different chemistry batteries and manufacturers may/can co-exist in same system
- SBS flexibility allows adaptation to battery-specific criteria
  - Critical for Smart Battery to follow SBS procedures for safe operation
  - Should tolerate latencies of up to Smart Charger time-out with damage

System Example