Intel® RAID Smart Battery AXXRSBBU7

Technical Product Specification

Revision History

Date	Revision Number	Modifications
June 2009	1.0	Initial Release

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1.   Overview

This document describes the key hardware components, firmware, and software utility requirements for the Intel® RAID Smart Battery AXXRSBBU7. It provides data integrity for the RAID (Redundant Array of Inexpensive Disks) solution by ensuring that the data passing through the cache is protected during a power outage until written to the hard drives.

The Intel® RAID Smart Battery AXXRSBBU7 is available as an accessory for some Intel® RAID Controller models.

The Intel® RAID Smart Battery AXXRSBBU7 contains the following components:

- Board-to-board connector: The Intel® RAID Smart Battery AXXRSBBU7 can connect to the base RAID controller through this connector, as a daughter card to the base RAID controller.

- 20-pin remote battery connector: The Intel® RAID Smart Battery AXXRSBBU7 can remotely connect to the Remote Extender Board (REB) component through this connector.

- Remote Extender Board (REB): The REB component is used to connect to the base controller through the board-to-board connector, as a daughter card to the base controller, so as to provide a 20-pin inline connector for remote battery installation support.

- Remote battery connecting cable: A 20-inch 20-pin connector cable is provided to connect the REB card to the battery.

- The Smart Battery Module which includes the following components:

  - Smart Battery circuit board: This ensures that the battery is maintained at optimal performance and charge levels. This circuit is based on the Texas Instruments bq2060A SBS v1.1-compliant gas gauge IC*.

  - Battery pack: The battery pack is mounted on the circuit board. It includes a separate internal circuit logic board and Li-Ion (Lithium Ion) batteries. The logic board provides sensing and management logic to support battery charge, discharge, and monitoring.

  - 5-pin battery pack connecting cable: The connector is used for communicating between the Smart Refresh circuit board and the battery pack.

- Monitoring / notification software: Monitoring is accomplished through the Intel® RAID BIOS Console 2, Intel® RAID Web Console 2, or Intel® RAID Command Line Utility 2 utilities. The software notifies the user of failures or corrective actions.
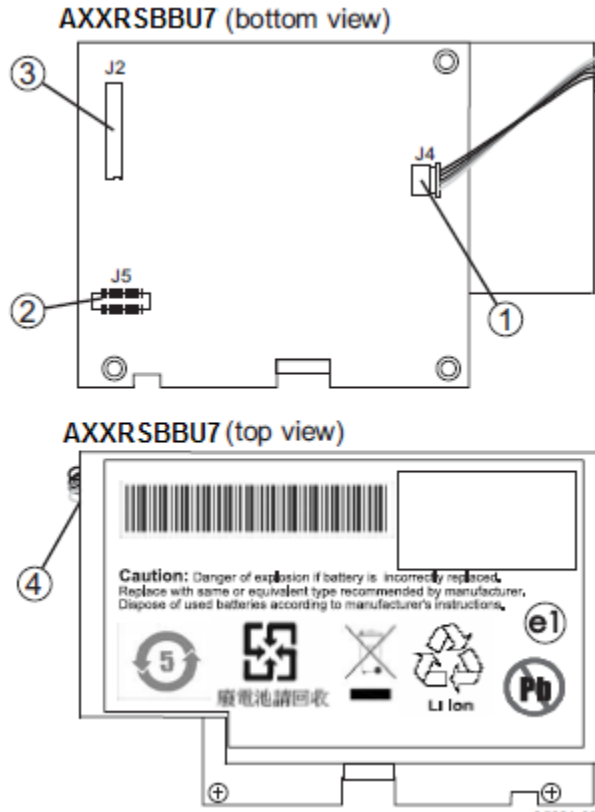
1.	J4 Battery Pack Harness Connector
2.	J5 Board-to-board Connector
3.	J2 Remote BBU Connector
4.	Battery Pack Harness

Figure 1. Intel® RAID Smart Battery AXXRSBBU7

The battery pack charges automatically and communicates battery status information, such as voltage, temperature, and current to the host computer system.

During RAID controller operation, a "write back cache" option is available where data is first written to the RAID controller cache memory and held in memory until the disk is available for the write to complete. This improves write performance as it is faster to write data to the RAID adapter's cache memory than it is to write it directly to a storage device. These write operations are completed quickly at the software application level. The RAID controller then writes the cached data to the storage device when it is available to accept the write.

This method of writing data carries a risk. Cached data on the RAID controller can be lost if the AC power fails before the data is written to the storage device. The Intel® RAID Smart Battery AXXRSBBU7 mitigates this risk by providing battery power to the RAID controller if the AC power fails.

The Intel® RAID Smart Battery AXXRSBBU7 monitors the voltage level of the DRAM modules on the RAID controller. If the voltage drops below a predefined level, the Smart Battery switches the memory power source from the RAID controller to the battery pack. The battery pack provides power for the memory until the voltage returns to an acceptable level, at which time the Smart Battery circuit board switches the power source back to the RAID controller. Cached data is then written to the storage devices with no loss of data. The Smart Battery provides additional fault tolerance when used with an UPS.

The battery pack cache memory hold time depends on the size and configuration of the RAID controller memory. Retention time depends on memory capacity and the number of memory components on the DIMM to support the capacity. An estimated battery backup retention time is 72 hours (three days).

2.   Hardware

2.1   Electrical and Mechanical Details

Table 1. Electrical and Mechanical Details

Feature	Description
Data retention	Up to 72 hours
Chemistry	Lithium-Ion (Li-Ion)
Dimensions	3.160 inches x 2.122 inches (battery extends over PCB)
Weight	51 grams
Operating temperature	10 to 44.5° C dry bulb temperature (the maximum dry bulb temperature is derated by 3.3° C per 1000 m above 500 m)
Operating humidity	20% - 80 %, non-condensing
Storage temperature	Depends on the storage time: ▪ Greater than 90 days at 0 to 30° C ▪ 30 to 90 days at 0 to 40° C ▪ Less than 30 days at 0 to 50° C
Storage humidity	20% to 80 %, non-condensing
Battery capacity	1350 mAH
Voltages	Nominal OCV: 3.7 V
Fast charge rate	500 mAH
Battery voltage conditioning	Less than 3.0 V
Battery charge time	Typical: Approximate 4 hours
Date retention times	72 hours for 512 MB, using five 64M x 16 parts DDR
MTBF (electrical components)	▪ 3,257,965 hours at 40 °C (AXXRSBBU07) ▪ 20,408,163 hours at 40 °C (Remote Extender Board)
Battery shelf life	One year
Battery operational life	500 recharges cycles **Note**: Intel recommends replacing the battery yearly.

2.2   Functional Block Diagram
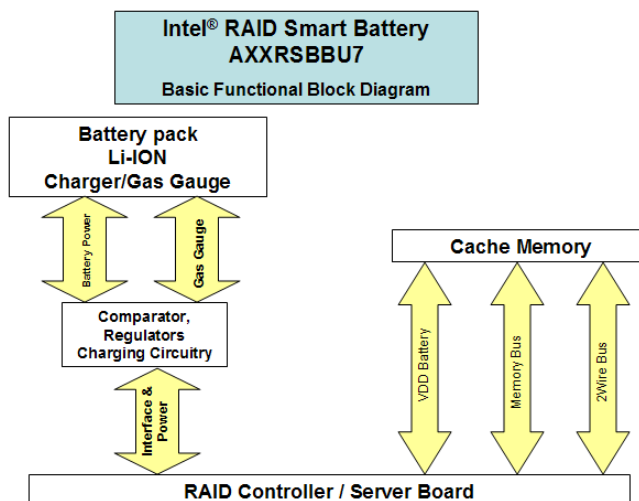
Figure 2. Block Diagram

2.3   Board-to-board connector

The Intel® RAID Smart Battery AXXRSBBU7 can be connected through the board-to-board connector J5.

Table 2. Board-to-Board Interface Connector Pin-out

Pin	Signal Name	Signal Type
1	VBB_DDR_MEM	Output
2	GND	GND
3	+12 V	Input
4	GND	GND
5	PFAIL#	Output
6	BBEN	Input
7	+1.8V	Input
8	BBU_DET	Output
9	3.3v_AUX	Input
10	GND	GND
11	GND	GND
12	+3.3V	Input
13	SCL	Input / output
14	GND	GND
15	SDA	Input / output
16	BBSTATUS	Output
17	GND	GND
18	BBSTROBE	Input
19	GND	Input
20	VBB_DRR_MEM	Output

2.4   Remote Extender Board (REB)

The REB component is designed to mount to the base controller through the board-to-board connector J2, as a daughter card to the base controller. The REB provides a 20-pin remote battery connector J1 for remote battery installation support.
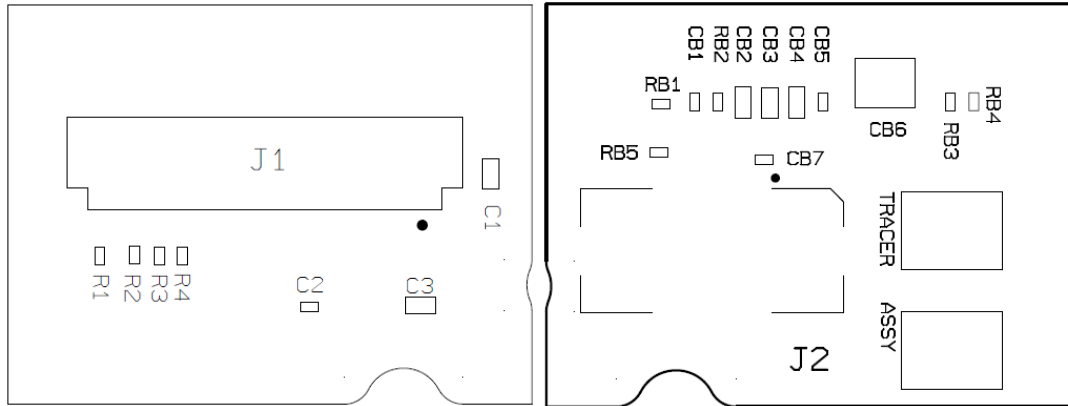

Figure 3. Remote Extender Board

2.5   Remote Battery Connecting Cables

The AXXRSBBU7 supports remote connectivity to a RAID controller via a 20 pin cable. Remotely connecting the battery to some RAID controllers may also require the use of the Remote Extender Board (REB). To remotely connect the Intel® RAID Smart Battery AXXRSBBU7 to a RAID controller, connect the 20-pin cable to J2 on the battery and the other end of the cable to the REB J1 connector, or to a 20 pin connector on the RAID controller if available. If using a REB, the REB should then be mounted as a daughter card to the RAID controller through the J2 connector on the REB.

Table 3. Cable Compatibility

Intel® RAID Controller or Server System	20-inch Cable
Intel® RAID Controller RS2BL080	X (Requires REB)
Intel® RAID Controller RS2BL040	X (Requires REB)
Intel® RAID Controller RS2PI008	X

Table 4. Interface Connector Pin-out

Pin	Signal Name	Signal Type
1	+12 V	Input
2	GND	GND
3	SPARE	N/A
4	GND	GND
5	VREG_DDR (1.8 V / 2.5 V)	Input

Pin	Signal Name	Signal Type
6	GND	GND
7	+3.3 V	Input
8	GND	GND
9	DDR – Rail (2.5 V – 1.8 V)	In power / out power, depending on mode
10	GND	GND
11	AUXPWR_3.3V	Input
12	GND	GND
13	SCL	Input / output
14	GND	GND
15	SDA	Input / output
16	PFAIL#	Output
17	SPARE	N/A
18	XD0-BBE	Input
19	BBSTROBE	Output
20	BBSTATUS	Output

2.6   Battery Module

The battery module includes components and states of operation as described below.

2.6.1   Internal Connecting Cable

Within the battery module, a 5-pin connector cable connects the battery pack to the Smart Battery circuit board.

Table 5. Interface Connector Pin-out

Pin	Signal Name	I/O	Description
1	VBATP	Input	Battery positive terminal
2	THERMISTOR SENSE	Output	Sense contact of the thermistor
3	GND	Input	Battery negative terminal
4	SCL	Output	I^2C Clock for pack monitoring
5	SDA	Input	I^2C Data for pack monitoring

2.6.2   Circuit Logic Board

The Intel® RAID Smart Battery AXXRSBBU7 is based on the Texas Instruments bq2060A SBS v1.1-compliant Gas Gauge IC*. The SBS v1.1 IC maintains an accurate record of the available charge. It monitors the amount of charge input into or removed from the Intel® RAID Smart Battery AXXRSBBU7 to determine the battery capacity.

The bq2060A measures battery voltage, temperature, and current; estimates battery self-discharge and monitors the battery for low-voltage thresholds. It measures charge and discharge activity by monitoring the voltage across a small-value series sense resistor between the battery's negative terminal and the negative terminal of the battery pack. The battery charge

Intel order number E70473-001

is determined by monitoring this voltage and correcting the measurement for environmental and operating conditions.

For more information about the Texas Instruments bq2060A SBS v1.1-compliant Gas Gauge IC*, refer to the Texas Instruments web site at http://www.ti.com/.

The Intel® RAID Smart Battery offers the following features:

- The Smart Battery circuit integrated into the battery pack
- Provides reduced host CPU intervention
- Shares I^{2}C bus with the on-board EEPROM (Electronically Erasable Programmable Read-Only Memory) for memory
- Provides real-time battery status information
- Displays a low charge warning
- Provides instantaneous voltage, current, and temperature warnings
- Provides remaining battery charge percentage and at-rate information
- Broadcasts event alarms to the host:
  - Out-of-temperature
  - Terminate charge
  - Terminate discharge
  - Low capacity
- Displays manufacturing information
- Provides Smart Charger Protocol for improved battery maintenance, calibration, and charging performance

2.6.3   Battery Pack - Life and Data Retention Time

The Intel® RAID Smart Battery software utilities use a counter to show the number of times the battery has been recharged. When replacing the Intel® RAID Smart Battery AXXRSBBU7, the Intel® RAID BIOS Console 2 utility can be used to reset the counter to zero for the new battery.

Intel recommends that you replace the Intel® RAID Smart Battery AXXRSBBU7 once a year or after 500 recharging cycles, whichever comes first. The Smart Battery has a one-year warranty.

The Smart Battery can retain data for about 72 hours (three days). This is approximate and can vary due to several factors, including charge level of the battery pack, the battery load, the ambient temperature, the age of the battery, and the number of discharge cycles associated with the battery.

2.6.4   Battery States

The battery pack includes sensing logic that checks the battery voltage levels and recognizes the battery state.

2.6.4.1   Initialized State

The battery is in the initialized state during a normal power-up sequence. In the RAID firmware, there are two levels of initialization:

- During boot loader execution
- During a RAID firmware boot

2.6.4.2   Discharging State

The battery voltage is drained as part of a relearn cycle.

2.6.4.3   Fully-charged State

Battery voltage level is monitored to determine the level of charge. Charging begins when the battery's sensing logic detects low voltage.

Once a new battery is fully charged, a relearn cycle is initiated. Relearn is the process of taking a fully charged battery through the discharge-charge cycle to update the gas gauge capacity parameters. The relearn cycle takes up to 24 hours to fully discharge and recharge the battery pack. After the relearn cycle is completed, information from the battery accurately provides the state of charge, capacity, and other parameters.

These parameters determine the health of the battery; a relearn should be performed periodically to recalibrate these parameters:

- The relearn cycle can be set at a user-defined interval. The default is one month (30 days).
- A relearn cycle is initiated when a new battery is inserted, even if the battery was fully charged previously.
- Some applications can start a relearn, or a relearn can be manually started.

2.6.4.4   Fully-discharged State

The fully-discharged state is detected as a very low voltage parameter. The charger detects a fully-discharged battery state and starts charging the cells when sufficient power is available, and when the firmware has completed initializing the pack.

3.   RAID Firmware Interaction

The RAID firmware detects the battery status and logs the following events:

- Battery is present
- Battery is not present
- A new battery is detected
- Battery has been replaced
- Battery temperature is high
- Battery voltage is low
- Battery is charging
- Battery is discharging
- Battery voltage is normal
- Battery needs replacement: SOH is bad
- Battery needs replacement: Battery is three years old
- Battery needs replacement: Charger is not working
- Relearn has started
- Relearn is in progress
- Relearn completed
- Relearn timed out
- Relearn pending: Battery is under charge.
- Relearn postponed
- Relearn will start in four days
- Relearn will start in two days
- Relearn will start in one day
- Relearn will start in five hours

4.   Software

4.1   Intel® RAID BIOS Console 2

The system BIOS loads the RAID option ROM that resides on the Intel® RAID controller flash. To use this utility, press <Ctrl> + <G> when prompted during POST (Power-on Self Test). The option ROM checks for the presence of the battery and informs the user if the battery is missing or not fully charged. The Intel® RAID BIOS Console 2 utility can be used to monitor charge cycle count and voltage levels. For more information on the Intel® RAID BIOS Console 2 utility, see the *Intel® RAID Software User's Guide*.

4.2   Intel® RAID Web Console 2

The Intel® RAID Web Console 2 utility is an operating system-based utility for supported Microsoft Windows* and Linux* operating systems. This utility can monitor battery status, charge level, and so on. For more information on the Intel® RAID Web Console 2 utility, see the *Intel® RAID Software User's Guide*.

4.3   Intel® RAID Command Line Utility 2

The Intel® RAID Command Line Utility 2 is a text-based command-line utility (CLU) for DOS*, UEFI*, Microsoft Windows* and Linux* operating systems. It shows battery status and can be used to initiate a relearn. For a list of all command line options, see the *Intel® RAID Controller Command Line Tool 2 User Guide*.

5.   Product Regulatory Compliance

5.1   Intended Application

This product was evaluated as a component for use with Information Technology Equipment (ITE), which may be installed in offices, schools, computer rooms, and similar commercial type locations. The suitability of this product for other product categories and environments (such as: medical, industrial, telecommunications, NEBS, residential, alarm systems, test equipment, and so on.), other than an ITE application, may require further evaluation.

5.2   Safety

This BBU complies and has been certified by UL to UL60950.

5.3   Environmental Compliance

This BBU complies with:

- European Directive 2002/95/EC and it's updates
    - Restriction of Hazardous Substances (RoHS) - Threshold limits and banned substances are noted below the following:
        - Quantity limit of 0.1% by mass (1000 PPM) for:
          Lead, Mercury, Hexavalent Chromium, Polybrominated Biphenyls Diphenyl Ethers (PBB/PBDE)
        - Quantity limit of 0.01% by mass (100 PPM) for:
          Cadmium
- MII Measure 39 (China RoHS) -
  EFUP of 5-10 yrs, based on the technology
- European Battery Directive 2006/66/EC and it's updates
- UN38.3 Air Transportation Regulation
- IATA, ADR Transportation Requirements

Glossary

This appendix contains important terms used in the preceding sections.

Word / Acronym	Definition
BBU	Battery Backup Unit
BIOS	Basic Input/Output System
CLU	Command-line Utility
DIMM	Dual In-line Memory Module
Gb	Gigabit
GB	Gigabyte
Kb	Kilobit
KB	Kilobyte
Mb	Megabit
MB	Megabyte
PCB	Printed Circuit Board
POST	Power-on Self Test
RAID	Redundant Array of Independent Disks
ROM	Read-only Memory
SAS	Serial Attached SCSI
SCSI	Small Computer Systems Interface
SOH	State of Health

Reference Documents

See the following documents for additional information:

- *Intel® RAID Smart Battery AXXRSBBU7 User's Guide* (Document number: E70472-00x)
- *Intel® RAID Software User's Guide* (Document number: D29305-0xx)
- *Intel® RAID Controller Command Line Tool 2 User Guide* (Document number: E36092-00x)