A Simpler Multiple Battery Architecture for Notebooks

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Abstract

The IBA (intelligent battery architecture) multiple battery architecture is simpler and less expensive than an SBS version 1.1 multiple battery implementation. Selector, charger, charge balance, fuel gauge, and protector are all within the pack. Each battery has an individual address on the SM-Buss allowing up to eight batteries in a system.

Three years ago, Compaq developed a new battery architecture (Figure 1) optimized for multiple battery configurations. Top priority during development was cost and flexibility to use all major cell suppliers. An additional point to mention is that optional battery cost was of much lower priority. This resulted in a design with internal charger, selector, protector, and fuel gauge.

Key Points of the Architecture:

- Two power FET's within the pack perform multiple functions
- Two FET's in the system allow external sources like and AC adapter to mimic a battery
- Each battery has its own SMBUS address as determined by a system side location resistor
- Batteries in expansion devices look the same as those in system
- One power and data bus for all batteries
- The MASTER battery is picked by the host controller
- MASTER battery drives a signal MBAT high
- Removal of MASTER battery causes MBAT to go low forcing all sources to a diode "or" state.
- Possible for battery to charge directly from AC adapter
- Load sharing accomplished by modulating MBAT when adapter current exceeds threshold.

Two power FET's within the pack satisfy the functionality of a selector, protector, and DC/DC charger. The charge FET provides a level of over charge protection, isolation from charge current during selection, and is also the pass switch in a step down converter. Over-current protection and isolation from discharge current during selection are both conveyed from the discharge FET.

Similarly, two power FET's in the system perform the same function as the two in the battery. This makes an external source look like a battery with one exception. Sources with voltages above 17.5 volts can be used as a charging source. Sources between 10 and 17.5 can then be treated like any other battery. This also provides another function, that of disallowing charge when connecting to aircraft power (15 – 16 volts).

A resistor on the system side of each battery connector is used to indicate the location of that battery and correlate the address of that battery on the SMBUS. A micro-controller in the pack measures the value and assigns itself and address. Up to eight batteries/addresses can be derived in the present definition.

All batteries are connected together through a common power and data bus. This allows for a simple connection through a system connector into an expansion device with additional batteries. Each additional battery requires no additional system hardware.

Common with each battery is a signal called MBAT. When "high" a source has been defined as the master and becomes the sole source of power. When "low" all sources are diode or'd onto the power bus. Once the battery manager has assigned a source as master it drives MBAT high. In this manor, all other sources will immediately diode "or" onto the bus when the master is removed.

Since the charger, protector, and controller are within the pack, it is a simple matter to charge through a connection directly from an adapter. This can save cost if an external charging method is required.

A simple adapter current sense circuit drops MBAT whenever current exceeds a limit. When

MBAT drops "low", charging stops. Charging resumes at a slightly lower current. See Figure 2. This repeats until the charging current has reduced to a level that limits adapter power to its rated limit.

Conclusion

This architecture has proven to be simpler and lower cost than an SBS equivalent. Compaq is also proposing that this architecture be included in future SBS specifications to standardize on a more optimized solution. For your benefit, you may wish to consider this for your next notebook power system.

Acknowledgement

1. Smart battery 1.1 specifications; http://www.sbs-forum.org/specs/index.html

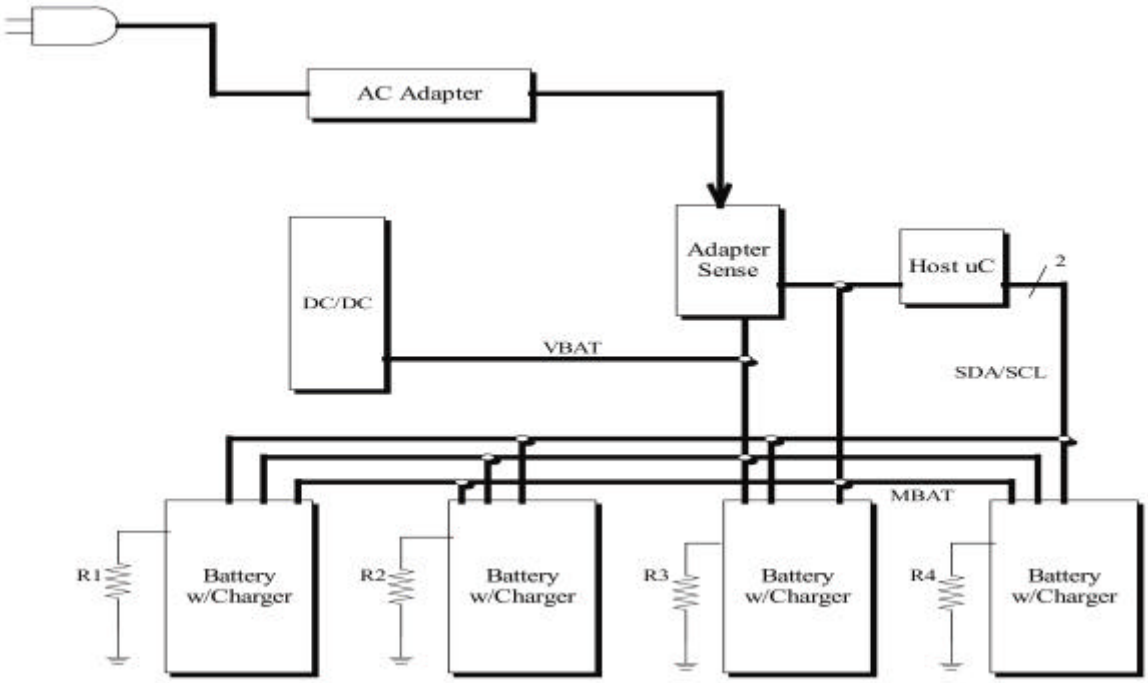

Figure 1: IBA Block Diagram

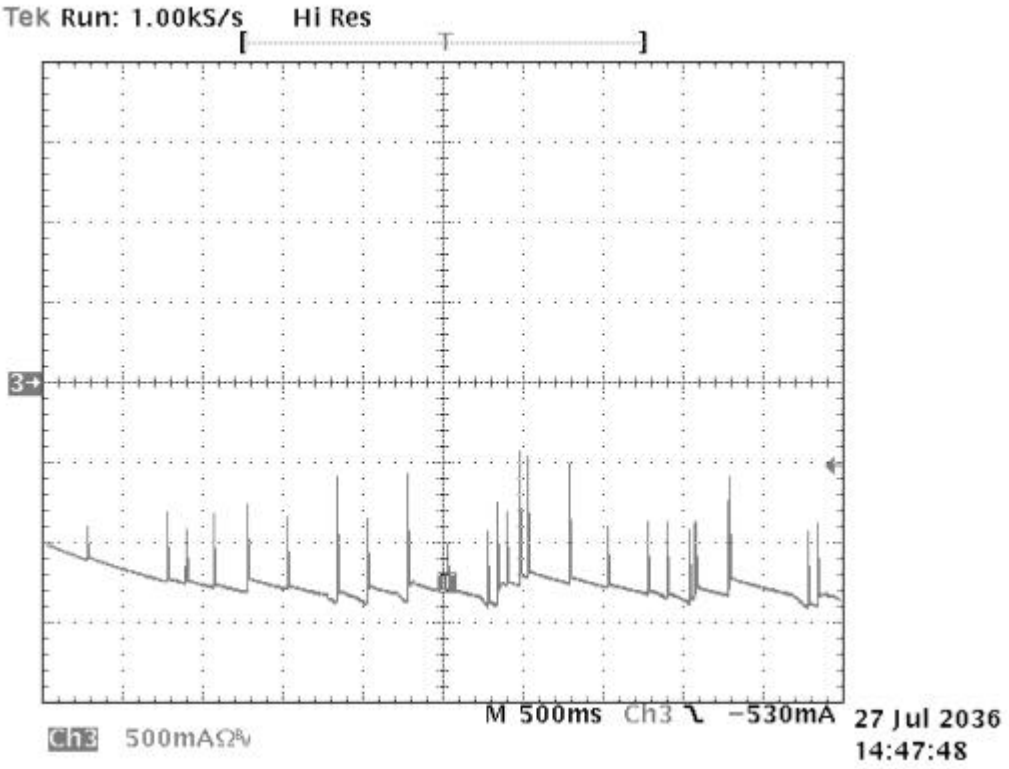

Figure 2: Battery Current During Load Sharing