Battery Specification

Document Number

DS214A20

Description

Rechargeable Smart Lithium Ion Battery Pack.

Inspired Energy Part Number For Battery

NC2560A20

Statement Of Confidentiality

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1. REVISION HISTORY

Revision	Release Date	Revisions	Issued By	Approved By
0.1	12/8/06	Discussion Only…	RAH	
0.2	2/21/07	Changed safety OT.	RAH	
1.0	6/19/07	Released	RAH	DB
1.1	9/14/07	Corrected “Pack Configuration”	RAH	

2. INTRODUCTION

2.1. Scope

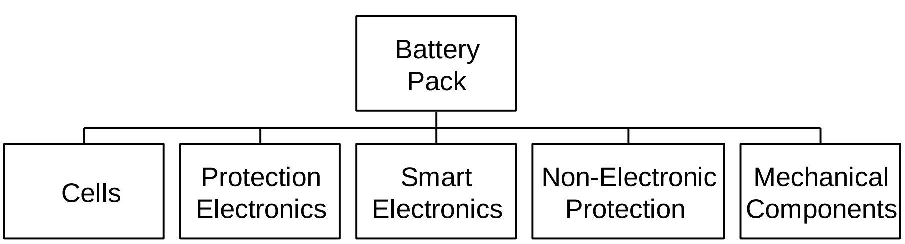
This specification describes the physical, functional and electrical characteristics of a rechargeable Lithium Ion battery pack supplied by Inspired Energy. This specification is the interface document between Inspired Energy and it’s customer. It is understood that the customer may create their own internal specification. However, this specification is the master that defines the battery’s operation. Battery packs produced will meet this specification.

2.2. Battery Pack Overview

This specification describes the physical, functional and electrical requirements for the NC2560A20 Smart Battery including a rechargeable Lithium Ion battery and a Battery Management Module. The battery consists of (3) Lithium Ion rechargeable cells of 103450 size, assembled in a 3 series / 1 parallel (3S 1P) configuration. Each cell has an average voltage of 3.6V and a typical capacity of 2.0Ah giving a battery pack of 10.8V and 2.0Ah typical.

The electronics are to be capable of communicating with the host or charger through the System Management Bus (SMBus) and comply fully with SMBus and SBDS Revision 1.1 (w/ PEC). Protection is provided for over-charge, over-discharge and short circuit. For redundancy, passive safety devices will be integrated into the battery pack to protect against over-current and over-temperature.

The battery pack comprises the individual elements as shown below.



2.3. General Precautions

2.3.1. Handling

- Avoid shorting the battery
- Do not immerse in water.
- Do not disassemble or deform the battery
- Do not expose to, or dispose of the battery in fire.
- Avoid excessive physical shock or vibration.
- Keep out of the reach of children.
- Never use a battery that appears to have suffered abuse.

2.3.2. Charge & Discharge

- Battery must be charged in appropriate charger only.
- Never use a modified or damaged charger.
- Specified product use only.

2.3.3. Storage

- Store in a cool, dry and well-ventilated area.

2.3.4. Disposal

- Regulations vary for different countries. Dispose of in accordance with local regulations.

3. REQUIREMENTS

3.1. General Requirements

3.1.1. Nominal Voltage

The battery nominal operating voltage is 10.8V.

3.1.2. Rated Capacity

The initial capacity is ≥ 1850mAh (based on a CV charge of 12.6V ± 50mV with a current limit of 1.33A and a 380mA discharge to 8.25V @ 25C, within 1 hour of charge).

3.1.3. Initial Impedance

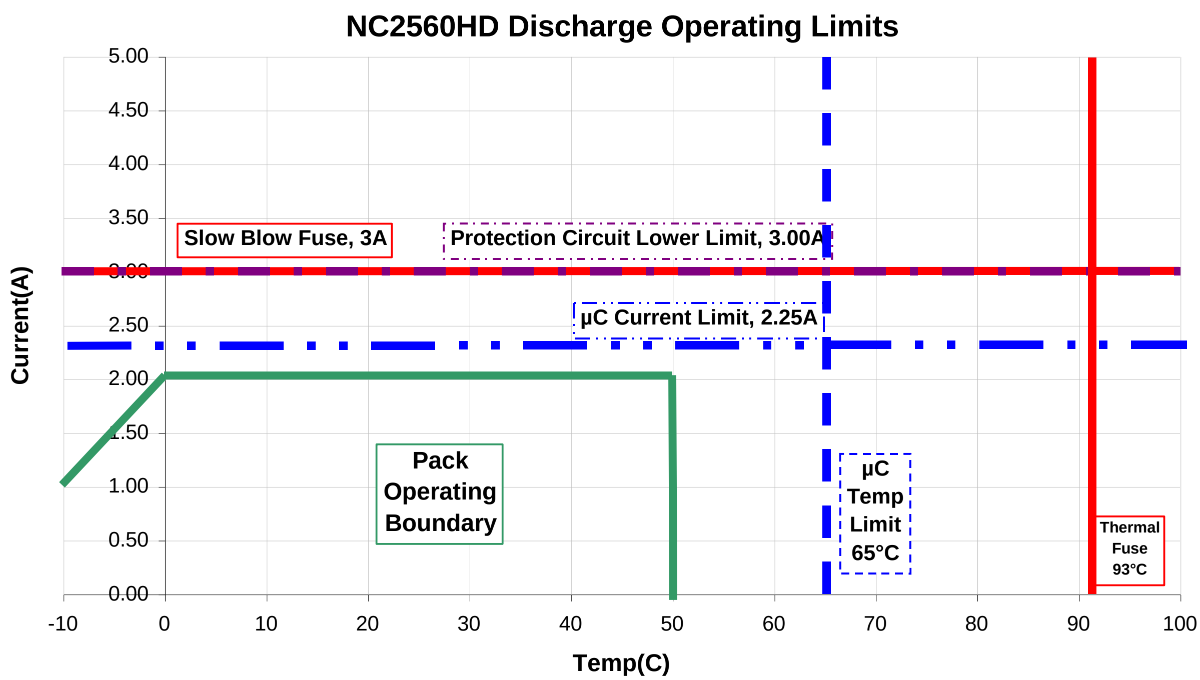
The internal impedance of a fully charged battery shall be < 400mΩ when measured across the positive and negative battery terminals at 1kHz at 20°C.

3.1.4. Discharge

Discharge Temperature Limits: -10°C to 50°C, ≤ 80%RH

The battery shall be capable of continuous discharge within the Pack Operating Boundary as shown in the graph below.

Host devices should be designed for a controlled shutdown following battery notification of termination by the battery sending TERMINATE_DISCHARGE alarm, prior to protection circuit cut-off.

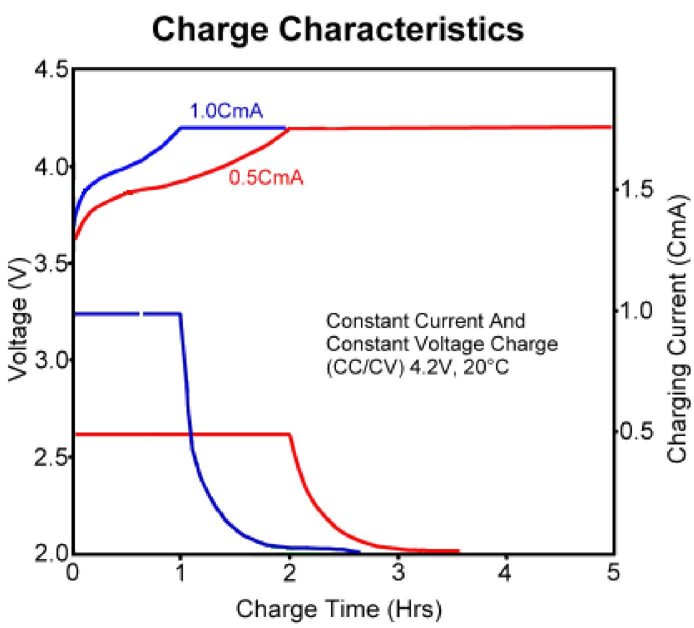


3.1.5. Charge

Charge Temperature Limits: 0°C to 45°C, ≤ 80%RH

The battery shall be capable of continuous charge at 12.6V, 1.33A across the entire charge temperature range. A dedicated level II or level III smart battery charger is required to charge the battery. Using this type of charger, the battery will request appropriate charging Voltage and Current from the smart battery charger. The battery will request 0mA (off), 240ma (pre-charge) OR 1330mA (fast-charge).

The FULLY_CHARGED bit in the BatteryStatus() will be set when the charging current tapers down under 66mA while charging at 12.6V.



3.1.6. Storage

Storage Temperature Limits: -20°C to 60°C, ≤ 80%RH

The battery packs should be stored in an environment with low humidity, free from corrosive gas at a recommended temperature range <21°C. Extended exposure to temperatures above 45°C could degrade battery performance and life.

3.1.7. Terminal Specifications

See Mechanical Drawing for orientation of contacts J1-1,5

Terminal	Legend	Description
1	(+)	Positive side of battery
2	(C)	SMBus Clock. Internally a 1MΩ resistor is connected between (C) and (-).
3	(D)	SMBus Data. Internally a 1MΩ resistor is connected between (D) and (-).
4	(T)	300Ω ±5% resistor connected between (T) and (-).
5	(-)	Negative Side Of Battery

- A key slot is also present on each pack for mechanical alignment adjacent to the positive terminal.
- The SMBus Clock and data lines require separate pull-ups to system logic voltage, NOT the battery voltage. Typically a 15KΩ pull-up resistor is used, but please refer to the SMBus Specification for additional information.

3.2. Fuel-Gauge Electronics

The electronics are capable of communicating with host or the charger through the System Management Bus (SMBus) and comply fully with SMBus and SBDS Revision 1.1 (with PEC). A bq2063 is used to process the core algorithms and perform operations required for battery monitoring. Charge and discharge current, cell and pack voltages, and pack temperature are all measured by the Fuel-gauge circuit.

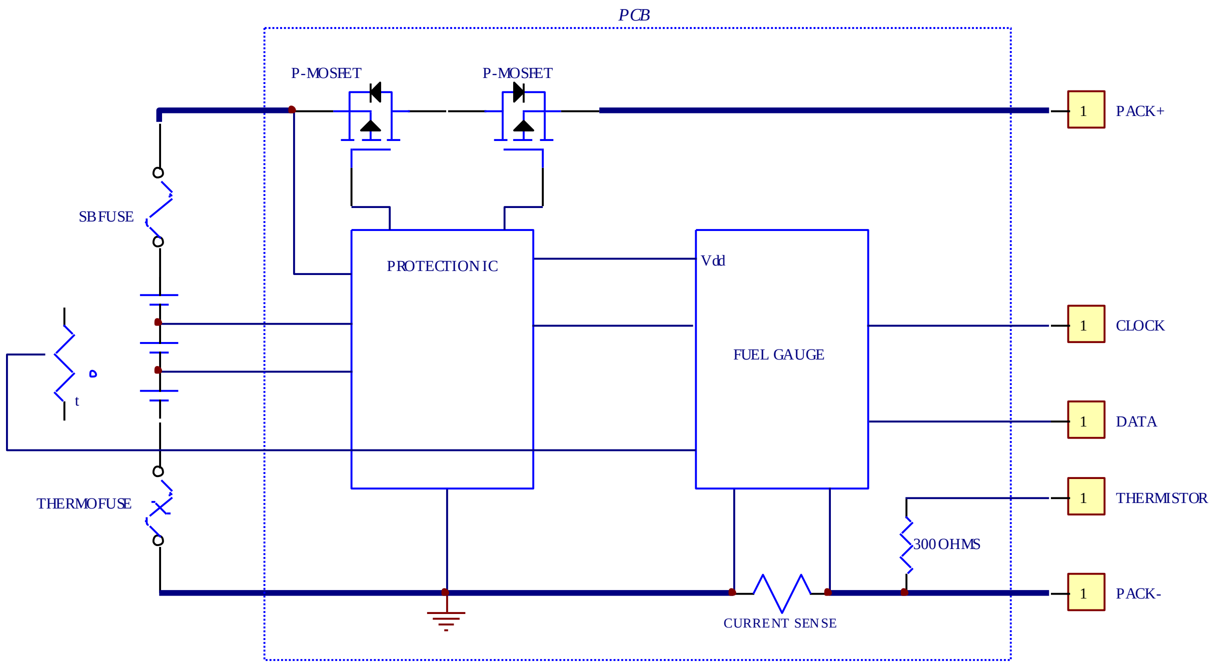
Protection circuits for over-charge, over-discharge and short-circuit are also included. In addition, an external thermal fuse & slow blow fuse will be fitted in series with cell stack to protect the battery from abuse.

The electronics use a system level approach to optimize the performance of the battery. Its primary functions are to provide fuel gauging and software based charge control, and to ensure safe operation throughout the life cycle of the battery.

The fuel gauge determines the State-Of-Charge (SOC) by integrating the input and output current of the attached battery. To achieve the desired fuel-gauging accuracy, compensation factors are continually applied to account for battery non-linearity and environmental conditions. This approach provides the user a meaningful and repeatable capacity measure with minimal risk of overstating run time.

Charge control is used to provide optimal and safe charging requests to a SMBus level II or level III charger.

The electronics have three modes of operation: Active, Low Power Storage and Shutdown. Active mode is the condition of normal operation. While in this mode, battery parameters continue to be monitored at regular intervals to compensate for self-discharge capacity losses. Low Power Storage mode is entered when the system receives an SMBus command instructing it to do so. Shutdown mode occurs when the lowest cell voltage drops below 2.4V. In this mode, parasitic current is reduced to a minimum by shutting down the fuel-gauge IC and all associated circuitry. If this should happen, the battery will require an initial low current charge to bring the battery voltage back up before normal operation will resume.



3.2.1. DC Specifications

Parameter	Limits	Remarks
Maximum input voltage	12.6V	Not to exceed 12.6V for all operations.
Active mode current consumption	<355µA	At all other times.
Low Power Storage mode current consumption	<130µA	When Instructed via SMBus command.
Shutdown mode current consumption	<1µA	Lowest cell voltage falls below 2.4V. Normal operation resumes when the battery has experienced a “wake-up” charge.

3.2.2. Measurement Accuracy (After Calibration)

3.2.2.1. Voltage

The voltage measurements are to have a resolution of 1mV. The absolute accuracy of the reading is ±0.65% over the operating range. Note that measurements are made at the cell stack (not the pack connector). Therefore internal resistance drops due to the shunt, safety components, and contact resistance are not taken into consideration.

3.2.2.2. Temperature

The internal pack temperature is to be measured by an NTC thermistor attached to the cell stack. Temperature readings are to have a resolution of 0.1°K. The absolute accuracy is ±1.5°K @ 25°C.

3.2.2.3.Current

The current measurements are to have a resolution of 1mA. The absolute accuracy of the reading is ±1.3%. A guard band has been imposed around zero current (-5mA to +5mA).

3.2.3. LED Indication

The battery can directly display the capacity information. The battery capacity is displayed as the relative SOC. Each LED segment represents 25 percent of the full charge capacity. The LED pattern definition is given in the table below. If the battery voltage is below 2.4V/parallel-cell-group, there will be no LED indication.

Capacity	LED Indicators #				Note
	1	2	3	4	
At or below 10%	■				Blinks 3 times.
10% - 25%	■				**Lit for 5 seconds.**
26% - 50%	■	■			**Lit for 5 seconds.**
51% - 75%	■	■	■		**Lit for 5 seconds.**
76% - 100%	■	■	■	■	**Lit for 5 seconds.**

3.3. SMBus and SBD Parameters

3.3.1. Overview of Operations

The electronics is fitted with a bq2063 and associated circuitry for communication with an external host device and/or smart battery charger. Reference should be made to the following specifications when reading this section:

- System Management Bus Specification (Rev 1.1, Dec 11, 1998)
- Smart Battery Data Specification (Rev 1.1, Dec 15, 1998)
- Smart battery Charger Specification (Rev 1.0, June 27, 1996)

3.3.2. SMBus Logic Levels

Symbol	Parameter	Limits		Units
		Min	Max	
Vil	Data/Clock input low voltage		0.8	V
Vih	Data/Clock input high voltage	1.7	6.0	V
Vol			0.4	V

3.3.3. Communication Protocol

SMBus Interface complies with SBS Specification Version 1.1. The battery pack includes a simple bi-directional serial data interface. A host processor uses the interface to access various battery pack registers.

3.3.4. Initialization Procedure

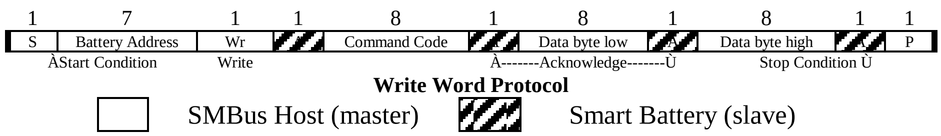
The interface uses a command-based protocol, where the host processor sends the battery address command byte to the battery pack. The command directs the battery pack to either store the next data received to a register specified command byte or output the data specified by the command byte.

The Bus Host communicates with the battery pack using one of three protocols:

- Write Word
- Read Word
- Read Block

3.3.4.1.Write Word

The first byte of a Write Word access is the command code. The next two Bytes are the data to be written. In this example the master asserts the slave device address followed by the write bit. The device acknowledges and the master delivers the command code. The slave again acknowledges before the master sends the data word (low byte first). The slave acknowledges each byte according to the I²C specification, and the entire transaction is finished with a stop condition.

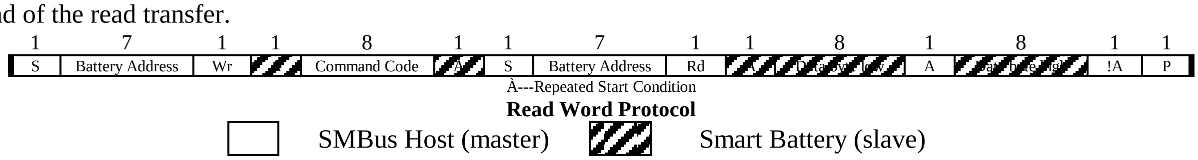


Write Word Protocol

3.3.4.2.Read Word

Reading data is slightly more complex than writing data. First the host must write a command to the slave device. Then it must follow that command with a repeated start condition to denote a read from that device's address. The slave then returns two bytes of data.

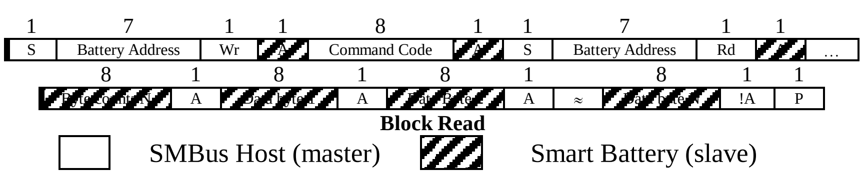
Note that there is not a stop condition before the repeated start condition, and that a "Not Acknowledge" signifies the end of the read transfer.



Read Word Protocol

3.3.4.3.Block Read

The Block Read begins with a slave address and a write condition. Then it must follow that command with a repeated start condition to denote a read from that device's address. After the repeated start the slave issues a byte count that describes how many data bytes will follow in the message. If a slave had 20 bytes to send, the first byte would be the number 20 (14h), followed by the 20 bytes of data. The byte count may not be 0. A Block Read can transfer a maximum of 32 bytes.



Block Read

3.3.5. Communicating with the Host

A message destined for the host could appear from an unknown device in an unknown format. To prevent possible confusion on the host part, only one method of communication is allowed -- a modified Write Word. This protocol is used when an SMBus device becomes a master to communicate with the SMBus host acting as a slave.

Device to Host communication will begin with the host address. The message's Command Code will actually be the initiating device's address. The host now knows the origin of the following 16 bits of device status.

1	7	1	1	8	1	8	1	8	1	1
S	Charger Address	Wr	A	Command Code	A	Data byte low	A	Data byte high	A	P

Battery Originated Messages for the Charger

☐ Smart Battery (master) ▨ Smart Battery Charger (slave)

Note : For the detail and the latest information, please refer to the Web Site address : "www.sbs-forum.org"

3.3.6. Host To Battery Message (Slave Mode)

The Host acting in the role of a bus master, uses the read word, write word, and read block protocols to communicate with the battery, operating in slave mode.

Host-to-Battery Messages

Function	Command Code	Description	Unit	Access	Default (POR)
ManufacturerAccess()	0x00			r/w	
RemainingCapacityAlarm()	0x01	Remaining Capacity Alarm Threshold .	mAh	r/w	200
RemainingTimeAlarm()	0x02	Remaining Time Alarm Threshold.	minutes	r/w	10
BatteryMode()	0x03	Battery Operational Modes.	Bit flags	r/w	0x6080
AtRate()	0x04	This function is the first half of a two-function call-set used to set the AtRate value used in calculations made by the AtRateTimeToFull(), AtRateTimeToEmpty(), and AtRateOK() functions.	mA	r/w	0
AtRateTimeToFull()	0x05	Returns the predicted remaining time to fully charge the battery at the AtRate() value.	minutes	r	65535
AtRateTimeToEmpty()	0x06	Returns the predicted remaining operating time if the battery is discharged at the AtRate() value.	minutes	r	65535
AtRateOK()	0x07	Returns a Boolean value that indicates whether or not the battery can deliver the AtRate value of additional energy for 10 seconds. If the AtRate() value is zero or positive, the AtRateOK() function will ALWAYS return TRUE.	boolean	r	1
Temperature()	0x08	Returns the pack's internal temperature.	$0.1\,^{o}K$	r	
Voltage()	0x09	Returns the battery's voltage (measured at the cell stack)	mV	r	
Current()	0x0a	Returns the current being supplied (or accepted) through the battery's terminals.	mA	r	0
AverageCurrent()	0x0b	Returns a rolling average based upon the last 64 samples of current.	mA	r	0
MaxError()	0x0c	Returns the expected margin of error.	percent	r	100
RelativeStateOfCharge()	0x0d	Returns the predicted remaining battery capacity expressed as a percentage of FullChargeCapacity().	percent	r	0
AbsoluteStateOfCharge()	0x0e	Returns the predicted remaining battery capacity expressed as a percentage of DesignCapacity().	percent	r	0
RemainingCapacity()	0x0f	Returns the predicted remaining battery capacity.	mAh	r	0
FullChargeCapacity()	0x10	Returns the predicted battery capacity when fully charged.	mAh	r	1900
RunTimeToEmpty()	0x11	Returns the predicted remaining battery life at the present rate of discharge.	minutes	r	65535
AverageTimeToEmpty()	0x12	Returns the rolling average of the predicted remaining battery life.	minutes	r	65535
AverageTimeToFull()	0x13	Returns the rolling average of the predicted remaining time until the battery reaches full charge.	minutes	r	65535
ChargingCurrent()	0x14	Returns the battery's desired charging rate.	mA	r	1330
ChargingVoltage()	0x15	Returns the battery's desired charging voltage.	mV	r	12600
BatteryStatus()	0x16	Returns the battery's status word.	Bit flags	r	0x0AD0
CycleCount()	0x17	Returns the number of charge/discharge cycles the battery has experienced. A charge/discharge cycle is defined as: an amount of discharge approximately equal to the value of DesignCapacity.	cycles	r	0
DesignCapacity()	0x18	Returns the theoretical capacity of the new battery.	mAh	r	2000
DesignVoltage()	0x19	Returns the theoretical voltage of a new battery.	mV	r	10800
SpecificationInfo()	0x1a	Returns the version number of the SBDS the battery pack supports, as well as voltage and current scaling information.	Formatted word	r	0x0031
ManufacturerDate()	0x1b	Returns the date the electronics was manufactured.	Formatted word	r	
SerialNumber()	0x1c	Returns the electronics serial number.	number	r	
Reserved	0x1d - 0x1f			r	
ManufacturerName()	0x20	Returns a character array containing the manufacture's name.	string	r	INSPIREDE
DeviceName()	0x21	Returns a character array that contains the battery's name.	string	r	NC2560
DeviceChemistry()	0x22	Returns a character array that contains the battery's chemistry.	string	r	LION
ManufacturerData()	0x23	Returns data specific to the manufacture.		r	

3.3.7. Battery To Charger Messages (Master Mode)

The battery, acting in the role of a bus master, uses the write word protocol to communicate with the charger, operating in slave mode. If the CHARGER_MODE bit in BatteryMode() is clear, the Battery will broadcast Charger request information at 15-second intervals.

Battery-to-Charger Messages

Function	Command Code	Description	Unit	Access
ChargingCurrent()	0x14	Sends the desired charging rate to the battery charger	mA	W
ChargingVoltage()	0x15	Sends the desired charging voltage to the battery charger	mV	W

3.3.8. Critical Messages (Master Mode)

If the ALARM_MODE bit in BatteryMode() is clear and the Battery detects a critical condition, it takes the role of a bus master and sends AlarmWarning() message to the Host and/ or Charger. The Battery broadcasts the AlarmWarning() message at 10 second intervals until the critical condition(s) has been corrected.

Battery Critical Messages

Function	Command Code	Description	Unit	Access
AlarmWarning()	0x16	This message is to the host and/or charger to notify them that one or more alarm conditions exist.	Formatted word	W

Alarm Bit Definitions

Hex	Battery Status	Status	Definition
8000	OVER_CHARGD_ALARM	ON	Battery is being charged beyond the Maximum Overcharge limit.
		OFF	Battery is no longer charged.
4000	TERMINATE_CHARGE_ALARM	ON	One or more of the battery's charging parameters are out of range or when the bq2063 detects a primary charge termination.
		OFF	When the battery's parameters fall back into the allowable range, the termination condition ceases or the bq2063 detects that the battery is no longer being charged.
1000	OVER_TEMP_ALARM	ON	If Temperature() ≥ MaxT
		OFF	If Temperature() ≤ (MaxT-5°C) or Temperature() ≤ 43°C
800	TERMINATE_DISCHARGE_ALARM	ON	During discharge when pack voltage is below EDV0 or when lowest cell voltage drops below CVUV.
		OFF	When either condition is removed.
200	REMAINING_CAPACITY_ALARM (User settable)	ON	Battery detects that its RemainingCapacity() is less than that set by the RemainingCapacityAlarm()
		OFF	Either the value set by the RemainingCapacityAlarm() is lower than the RemainingCapacity() OR when the RemainingCapacity() in increases by charging the battery.
100	REMAINING_TIME_ALARM (User settable)	ON	Battery detects that the estimated remaining time at the present discharge rate is less than that set by the RemainingTimeAlarm()
		OFF	Either the value set by the RemainingTimeAlarm() is lower than the AverageTimeToEmpty() OR when the AverageTimeToEmpty() in increases by charging the battery.

Status Bit Definitions

80	INITIALIZED	ON	When the bq2063 has detected a valid load of EEPROM
		OFF	When the bq2063 detects an improper EEPROM load
40	DISCHARGING	ON	Battery "Current()" is not positive
		OFF	Battery "Current()" is positive
20	FULLY_CHARGED	ON	When the battery is bq2063 detects a primary charge termination or an overcharged condition.
		OFF	When the "RelativeStateOfCharge" of the battery is ≤ the "FULLY_CHARGED Clear %".
10	FULLY_DISCHARGED	ON	When "Voltage()" or VCELL drops below EDV2** and "Current()" < "OverloadCurrent" or when "RelativeStateOfCharge()" < "Battery Low %".
		OFF	"RelativeStateOfCharge()" ≥ 20%.

Note:
** The host device should initiate a 'Save-To-Disk' action when the battery broadcasts the TERMINATE_DISCHARGE Alarm during discharge.

3.3.9. Definition Of Valid Calibration Cycle

Calibration is the process whereby the fuel gauge is adjusted to maintain an acceptable level of accuracy. This may be necessary if a battery has aged or has been subjected to an unusual usage pattern. A battery can be calibrated by performing the following procedure:

1. Discharge the battery until the TERMINATE_DISCHARGE_ALARM in the BatteryStatus() is set (pack voltage drops below EDV0 or when the lowest cell voltage drops below CVUV).

2. Charge the battery at 12.6 measured across the battery terminals) and with a current limit no greater than 1330mA. Charge the battery until the TERMINATE_CHARGE_ALARM in the BatteryStatus() is set (Current()<=66mA). Repeat step 1.

Note, Calibration is invalid if:

- Packs lowest cell Voltage goes below 2.4V.
- Pack Temperature drops below the low temperature thresholds programmed in MaxT_LowT or 12°C during discharge period.
- More than 256 mAH of self-discharge, battery load estimation, and/or light discharge estimation occurs.
- Battery Voltage does not reach the EDV2 threshold during the discharge period and the voltage was not less than the EDV2 threshold minus 256 mV when the bq2063 detected EDV2.

Notes On Calibration And Maximum Error:

Accurate correction factors are to be applied to the fuel gauge capacity to compensate for the effects of time, temperature, usage patterns and charge/discharge rates, although it is inevitable that the fuel gauge accuracy will drift with time.

The smart electronics only know the actual capacity at two reference points: 'empty' and 'fully charged'. When either of these two points is reached, the predicted capacity is compared with the known capacity and an error factor is calculated (Max Error). It is recommended that the application software recommend to the user that the battery should be calibrated when a pre-determined max error limit is reached (10% for example).

At the completion of the calibration cycle, the CONDITION_FLAG in the BatteryMode() register will be reset.

3.4. Protection Electronics

3.4.1. Overview Of Operation

Electronic circuitry will be permanently connected within the battery pack to prevent damage if either the charger or host device fails to function correctly. The circuitry also protects the battery if an illegal current source is placed across the battery terminals, or an illegal load is connected. The circuit has a stand-alone protection chip.

3.4.2. Over-Charge Protection

The protection circuit will prevent the battery from charging at a voltage of 4.35 ±0.025V or more per parallel-cell group. Then, once the battery voltage is lowered by 0.15 ±0.05V, it will allow charging again.

The bq2063 also provides a secondary level of protection against cell over-voltage (4384mV), pack over-voltage (12808mV) and over-temperature (50°C).

3.4.3. Over-Discharge Protection

The protection circuit will prevent the battery from being further discharged once any cell voltage reaches 2.4±0.08V or less per parallel-cell-group. Then, once the battery voltage has risen by 0.2±0.1V by charging, it will allow the battery to discharge again.

The bq2063 also provides a secondary level of protection against cell under-voltage (2496mV).

3.4.4. Over-Current Protection

The protection circuit will prohibit the discharge of the battery if a short-circuit or an excessive in-rush demand is placed across the battery + / - terminals. Once in the over-current mode, the load will have to be removed to reset the fault condition (automatically reset). There are two levels of over-current protection provided by the protection IC:

1) When the discharge current becomes higher than the specified limit (6A<I2trip) and the state continues for longer than the delay time (1.5mS<T2delay<4mS), the protection circuit will enter the over-current mode and shutdown discharge.

2) When the discharge current becomes higher than the specified limit (3A<I1trip<6A) and the state continues for longer than the delay time (5mS<T1delay<15mS), the protection circuit will enter the over-current mode and shutdown discharge.

The bq2063 also provides continuous over-current protection and will prevent the battery from discharging at average currents =>2000mA and charge currents =>1330mA+256mA. In either case, the over-current condition is cleared when the average current magnitude drops below 256mA or the current changes in polarity.

3.5. Passive Safety Protection

3.5.1. Overview Of Operation

The battery pack will be fitted with additional components to protect it against abusive charge and discharge conditions. These are in addition to the electronic protection module.

3.5.2. Slow-Blow Current Fuse

A current slow-blow fuse is assembled in series with the battery pack to protect the battery pack against abusive over current over-load. The hold current is rated at 3A for 4 hours (minimum). The fuse is non-re-settable rendering the battery pack non-functional.

3.5.3. Thermal Fuse

A Thermal Fuse is fitted in series with the charge/ discharge path to protect the battery from over temperature. This device goes open circuit if the cell case temperature reaches the fuse's temperature rating of 93°C (+0°C, -5°C). The fuse is non-re-settable rendering the battery pack non-functional.

3.6. Mechanical Specifications

3.6.1. Weight

Approximately 0.18 Kg.

3.6.2. Mating Connector

The recommended interconnection mating connector is AMP P/N 5787422-1 or 5787446-1.

3.6.3. Date Code/Serial Number

A date code and the serial number is stamped on each pack (reference the mechanical drawing).

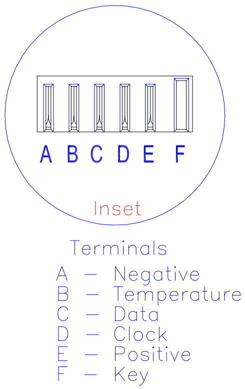
Manufacturing Date (Calendar Year & Week) _____↓
Manufacturing Site____↓ ↓____Pack Revision

IE YYWW XX
S/N XXXXX
Serial Number_____↑

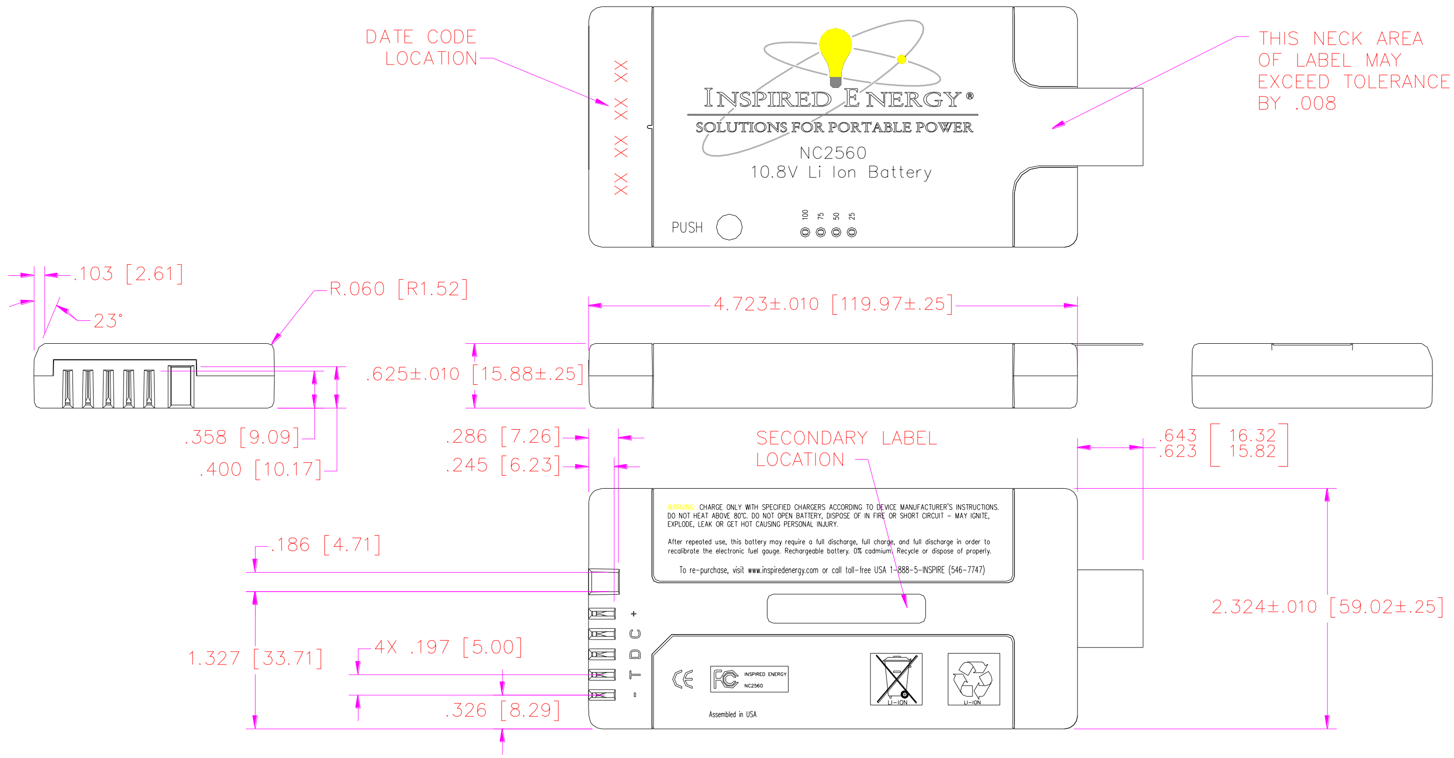
3.6.4. Packaging

TBD.

3.6.5. Mechanical Drawing



Specification Number	DS214A20
Specification Revision	1.1
Prepared By	RAH
Issue date	6/19/07



3.7. Environmental/Safety Specifications

3.7.1. EMC And Safety

The battery complies with the following:

- EMC Directive 89/336/EEC
- Low Voltage Directive 73/23/EEC
- Toxic Chemicals Directive 91/157/EEC
- “RoHS“ directive 02/95/EC

The battery has been tested in accordance with the UN Manual of tests and Criteria part III subsection 38.3 (ST/SG/AC.10/11/Rev.3) - more commonly known as the UN T1-T8 Transportation tests; and has been found to comply with the stated criteria. [USDOT-E7052].

The battery has the following approvals and the pack is labeled accordingly:

- FCC
- CE

3.8. Pack configuration using BQ2063

3.8.1. Calibration

Board level calibration is required. (Calibration will change some values in EEPROM)

3.8.2. EEPROM

The EEPROM is to be programmed with these initial values.
See Table below:

EEPROM Address		Name	Value		Hex Values Msb	Lsb
0x02	0x03	Remaining Time Alarm	10	mins	00	0A
0x04	0x05	Remaining Capacity Alarm	200	mAh	00	C8
0x06		EDV C1 Factor	0	%/1kCC		00
0x07		EDV TC Factor	0			00
0x08		Safety OverTemperature	70	C		F5
0x0a	0x0b	Charging Voltage	12600	mV	31	38
0x0e	0x0f	Cycle Count	0		00	00
0x12	0x13	Design Voltage	10800	mV	2A	30
0x14	0x15	Specification Information	V1.1/PEC		00	31
0x16	0x17	Manufacture Date	dd/mm/yyyy		NNNN	
0x18	0x19	Serial Number	nnnnn		00	00
0x1a	0x1b	Fast Charging Current	1330	mA	05	32
0x1c		Pack Load Estimate	0.245	mA		59
0x1d		Maint Charging Current	0	mA		00
0x1e		Pre-Charge Current	200	mA		19
0x1f		Safety Overvoltage	13056	mV		8C
0x20		Manufacturer Str Length	9			09
0x21 - 0x2b		Manufacturer Name	INSPIREDE		ASCII CODE	
0x2e	0x2f	Maximum Overcharge	200	mAh	FF	42
0x30		Device Name Length	6			06
0x31 - 0x37		Device Name	NC2560		ASCII CODE	
0x38	0x39	Last Measured Dschg	1900	mAh	07	6C
0x3a	0x3b	Pack Capacity	2000	mAh	07	D0
0x3c	0x3d	Cycle Count Threshold	2000	mAh	F8	30
0x3f		Pack Configuration	A4	(Hex)		A4
0x40		Device Chem Str Length	4			04
0x41 - 0x44		Device Chemistry	LION		ASCII CODE	
0x45		MaxT/LowT	50/0	(Hex)		CO
0x46	0x47	Overload Current	2250	mA	08	CA
0x48		Overvoltage Margin	304	mV		13
0x49		Overcurrent Margin	256	mA		20
0x4a		Cell Under/Over Voltage	2496/4384	mV		79
0x4b		Fast Charge Termination %	100	%		FF
0x4c		Fully Charged Clear %	95	%		A1

EEPROM Address		Name	Value		Hex Values Msb	Lsb
0x4d		Charge Efficiency	100	%		FF
0x4e		Current Taper Threshold	66	mA		02
0x4f		Current Taper Qual Volt	208	mV		68
0x50		Mfg Data Str Length	7			07
0x51		Control Mode	0A	(Hex)		0A
0x52		Digital Filter	100	µV		16
0x53		Self Discharge Rate	0.21	%/Day		05
0x54		Battery Low %	7	%		12
0x55		Near Full	100	mAh		32
0x5e	0x5f	VFC Offset	0		00	00
0x60		VFC Offset	0			00
0x61		Temperature Offset	0	°C		00
0x62		ADC Offset	0			00
0x63		Pack Programming	0x19			19
0x64		Light Load estimate	0	mA		00
0x66	0x67	ADC Voltage Gain	5:1		30	D4
0x68	0x69	ADC SenseResistorGain	0.020	Ω		
0x6a	0x6b	VFC SenseResistorGain	0.020	Ω		
0x6c	0x6d	VOC25	11169	mV	D4	5E
0x6e	0x6f	VOC50	11370	mV	D3	96
0x70	0x71	VOC75	11730	mV	D2	2E
0x72	0x73	EDVF/EDV0	2900	mV	0B	54
0x74	0x75	EMF/ EDV1	3000	mV	0B	B8
0x76	0x77	EDV TO Factor	0	mV		00
0x78	0x79	EDV CO Factor/ EDV2	3050	mV	0B	EA
0x7a	0x7b	EDV R0 Factor	0		00	00
0x7c	0x7d	EDV R1 Factor	0		00	00

3.9. Reliability

3.9.1. Life Expectancy

Given normal storage & usage, user can expect the battery to deliver 80% or more of it's initial capacity after 300 charge/discharge cycles where the charge phase is CC/CV 1330mA, 12.6±0.05V and the discharge is 380mA down to 2.9V/Cell at 25°C.

3.9.2. Warranty

A high quality standard is maintained by Inspired Energy. All products are warranted against defects in workmanship, material and construction. The warranty period is one (1) year from the date of shipment from Inspired Energy.

3.9.3. Shelf Life

The batteries are shipped from Inspired Energy with between 30% and 50% rated capacity and this provides a minimum of 6 months shelf life, when stored at 25°C. If the storage temperature exceeds 25°C over the 4-month period then the shelf life will be reduced and provisions should be made to recharge the battery periodically.

In order to prevent parasitic drain on the battery, the electronics will go into a shutdown mode at 2.4±0.08V/parallel-cell-group. If this should happen, the battery pack will require an initial low charge to activate the electronics prior to the implementation of the normal charge. Any SMBus version 1.0, or higher, compatible charger is capable of providing this initial pre-charge.