TITLE: BATTERY PACK, LI-ION, ROSSINI

REVISION PAGE

ISSUE	MEMO	ORIGINATOR	SIGNATURE	REASON FOR CHANGE	DATE
T1		YB Ng		Initial Draft (Items in **Blue** are not yet finalize)	28 Apr 2003
T2		YB Ng		Change Thermistor from 10K to 47K. Change Discharge Operating temp from -10degC to -20degC. Updated 5.2.1. Updated 5.2.2.2. Updated 5.2.8. and 5.2.9. Update 5.2.13. (Items in **Blue** are not yet finalize)	04 June 2003
T3		YB Ng		Change Discharge Operating temp from -20degC to -10degC. Updated 5.2.8, over load shutdown current from 6.5A to 5.5A.	02 July 2003
T4		YB Ng		Updated format as per Frodo 60R Included DC impedance Updated 5.2.8, over load shutdown current from 5.5A to 6.5A. Updated sec 3.2. Added sec 5.1.2.3.	28 July 2003

CONTENTS

TITLE: BATTERY PACK, LI-ION, ROSSINI

1.0 PURPOSE AND SCOPE

This document contains general Motorola requirements, qualification requirements, and those specific electrical and mechanical requirements for this part.

2.0 DESCRIPTION AND APPLICATION

2.1 DESCRIPTION

This battery pack is a 3.6-volt nominal lithium ion secondary battery assembly for use as a power source. This battery contains terminals for the DC output connections and for recharging the battery. It contains an internal Thermistor for measuring internal ambient cell pack temperatures, an internal safety circuit that will open the current path when excessive voltage is supplied or excessive voltage or current is drained, and an ID terminal for battery identification.

2.2 APPLICATION

The battery pack is designed for use in subscriber portable cellular telephone applications.

3.0 APPLICABLE DOCUMENTS

3.1 ASSEMBLY DRAWINGS:

01DXXXXXX	**Assembly Drawing, Li-ion, ROSSINI**

3.2 MOTOROLA DOCUMENTS:

12G13933A01	Motorola Receiving Bar Code Specification
12G13933A97,Class B	Motorola Cosmetic Specification For Handheld Product
12M02897W18	Motorola Controlled, Restricted, and Reportable Materials Disclosure
12M04103T83	Battery Design Verification/ Qualification Process Specification
12M09166A21	Date Coding of Cellular Telephone Batteries
12M09167A69	Motorola Intermediate Packaging Bar Code Label Specification
12M09170A79	Abrasion Resistance of Coatings/Printings
12M09189A47	Labeling Guidelines For User-Replaceable Cellular Phone Batteries
12M80967A78	Motorola Inc. Supplier Material Quality Control
12S10601A	Packaging Requirements for Inbound Shipments to Motorola
12S11055A	General Requirements for a Supplier Quality Assurance Program

4.0 APPROVED SOURCES

Refer to battery assembly drawing listed in 3.1

5.0 COMPONENT REQUIREMENTS

5.1 GENERAL REQUIREMENTS

5.1.1 Critical Parameters

This symbol "[X]" shall apply to all parameters identified as critical by Engineering. Critical parameters shall be collected per 7.1. Motorola may add additional critical parameters later if the need arises.

5.1.2 Operating Temperature Range

5.1.2.1. Charging: 0°C to +45°C

5.1.2.2. Discharging: -10°C to +60°C

5.1.2.3. Safety circuit: -20°C to +60°C

5.1.3 Reference Condition

Electrical parameters shall be corrected to applicable reference conditions: temperature of 23°C ± 2°C, relative humidity of 40% ± 10%, and barometric pressure of 28 to 30 inches of mercury.

5.1.4 Storage Temperature (Reference capacity is per section 5.2.1)

The percentage of allowable permanent capacity loss from Initial Capacity as received shall be in accordance with Table 1.

Table 1: Percentage Allowable Permanent Capacity Loss From Initial Capacity as Received.

Temperature	Duration	Permanent Loss (Max)
+60°C	1 week	10%
+25°C	3 months	5%
+25°C	1 year	10%

The percentage of allowable permanent capacity loss from Initial Capacity at 100% charged shall be in accordance with Table 2.

Table 2: Percentage Allowable Permanent Capacity Loss from Initial Capacity @ 100% Charge.

Temperature	Duration	Permanent Loss (Max)
+60°C	1 week	15%
+25°C	3 months	10%
+25°C	1 year	20%

Up to 3 charges, discharge cycles are allowed to condition the cell. Capacity measurements shall be taken by charging and discharging according to section 5.2.5 and 5.2.6.1 respectively.

5.1.5 Safety Circuit

The battery pack shall exhibit fail-safe characteristics, which is to be verified and documented by written safety approval from the manufacturer.

5.1.6 Component Documentation

Batteries containing protection circuit module must have performance qualification data (i.e., qualification package) confirming the circuit performance meets or exceeds Motorola requirements on file at CSS Component Engineering.

5.2 ELECTRICAL REQUIREMENTS (At Ta=23°C ± 2°C unless otherwise noted)

5.2.1 Capacity of Individual Battery (Nominal and minimum):

For a discharge per section 5.2.6.1 to a 3 Volt cutoff, the average battery capacity of any random sample of batteries shall be the nominal rated capacity. No battery capacity can be below the minimum rated capacity. Charging shall be performed in accordance with section 5.2.5. Minimum discharge capacity per 5.2.6.2 must be met from the 4^{th} through the 10^{th} cycles. Refer to the battery assembly drawing listed in section 3.1 for individual kit capacity rating.

5.2.2 Self Discharge:

5.2.2.1. Capacity shall be greater than 80% of initial capacity after 28 days at 25°C.
Battery capacity shall be greater than 90% of initial capacity when stored for 24hours at 25°C after battery has been cycled per 5.2.7.

5.2.2.2. Protection Circuitry
The battery protection circuit shall not draw more than 20μA at normal operating condition and shall not draw more than 6μA at power down mode. (i.e. during under voltage condition.)

5.2.3 Shipping Capacity

For best storage performance, the cell vendor shall determine the shipping capacity.

5.2.4 Internal AC and DC Impedance:

5.2.4.1. AC Impedance
The initial AC impedance of the battery pack shall not exceed **170mOhm** at 1kHz measurement frequency. This measurement shall be done on a new pack at full capacity and at 10% of initial capacity. The AC impedance (at 1kHz frequency) shall not exceed **230mOhm** at the end of life (80% of initial battery capacity) as defined in Section 5.2.7.

5.2.4.2. DC Impedance (Tested at Design Verification stage only):
The initial DC impedance of the battery pack shall not exceed **220mOhm**. This measurement shall be done with the discharge profile per figure 1, on a new pack at full capacity and at 10% of initial capacity. The internal DC impedance shall not exceed **300mOhm** at the end of life (80% of initial battery capacity) as defined in Section 5.2.7.

5.2.5 Charge Characteristics

5.2.5.1. Optimal Charge Voltage: 4.2V

5.2.5.2. Optimal Fast Charge Rate: 1C

5.2.5.3. Optimal Current Cutoff Rate: 20mA

5.2.6 Discharge Characteristics:

5.2.6.1. Discharge Rate Vs Capacity: (Based on below discharge profile)
100% of minimum capacity shall be achieved with the following discharge profiles. Discharge is complete when the battery voltage reaches End of Discharge Voltage at 3.0V.

5.2.6.1.1 Analog 0.2C discharge. A 1C discharge rate is defined as the discharge current needed to discharge the battery in 1 hour.

5.2.6.1.2 A pulsed GSM type drain as identified in Figure 1 and Table 3.

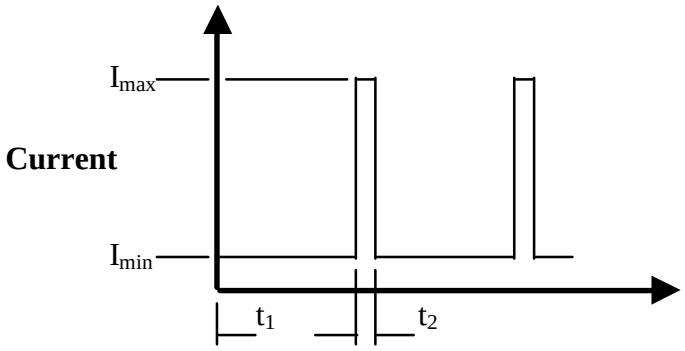


Table 3

I_{max}	1.34 A
I_{min}	164 mA
t_1	4.05 mS
t_2	550 µS
Slew rate	1.6A / 28 µS

Figure 1: GSM Profile

5.2.6.2. Capacity vs. Temperature:
Percentage of minimum capacity when discharged per 5.2.6.1 at the temperatures listed in Table 4 below.

Table 4:

Temp (± 2°C)	+60°C	+25°C	+0°C	-10°C
Min. Capacity (GSM)	90%	100%	50%	30%

5.2.7 Life Cycle:
At least 80% of minimum capacity shall be retained after 400 full charge cycles (as defined in 5.2.5) and discharge cycles (as defined in 5.2.6.1).

5.2.8 Overload Current Limit:

The internal safety circuit must not open from -10°C to 60°C with discharge profile as defined in section 5.2.6.1. The internal safety switch shall not open with a single 2.0A, 1 millisecond pulse current in temperatures from –10°C to +60°C. It shall open with a **6.5** Amps within 30msec. When a load is placed across the terminals of the battery to trip the overload current protection and then the load is removed from the battery terminals, all battery functionality shall return to the pack without having to place it into a charger. At no time shall this assembly be subjected to sufficient stresses to cause a fire hazard.

5.2.9 Under Voltage Protection:

If cell voltage reaches the under voltage threshold of 2.35V ± 120mV, the protection circuit shall open the discharge path and put the battery in power down mode. The battery pack shall be recoverable from power down mode when placed in any approved Motorola charger.

5.2.10 Over Voltage Protection: (Dual Protection)

If cell voltage reaches the over voltage threshold of 4.35V –55mV/+40mV then the battery pack protection circuitry shall open the charge pathway, preventing the battery from accepting charge current.

5.2.11 Internal Thermistor:

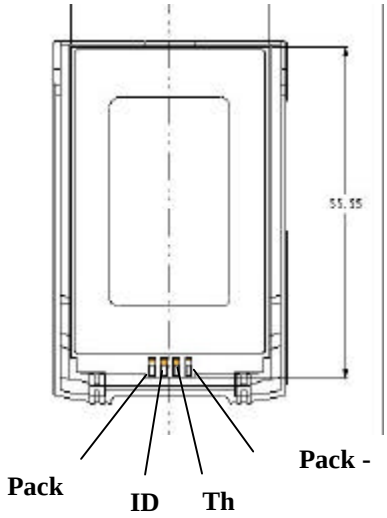
A negative coefficient Thermistor shall be secured internal to the cell pack in order to measure ambient temperature during charging.

Table 5:

Temp & Tolerance (°C)	R min. (KO)	R typical (KO)	R max. (KO)
0°C ± 0.5	144.92	158.21	172.29
+25 °C ± 0.3	44.65	47.00	49.35
+40 °C ± 0.5	22.91	24.59	26.33
+45 °C ± 0.6	18.56	20.05	21.60

5.2.12 Critical Electrical Parameters: (100% Tested at ESG Battery EOL)

Figure 2 – Contact Side



	TERMINALS	SPECIFICATION
[X]	Pack+ to Pack-	> 3.6 Volts, open circuit, within 12weeks upon received. (Storage temperature must within criteria of 25°C ± 2°C)

5.2.13 Identification:
The battery must contain ID terminal, which is tied to a 27kΩ +/-5% resistor and allows the charger to detect the presence of the battery pack.

5.2 MECHANICAL REQUIREMENTS

Refer to assembly drawings listed in section 3.1

5.3 PACKAGING AND SHIPMENT

5.4.1 Components must be sealed prior to shipment so as to prevent contamination and damage while in route to Motorola. All intermediate packaging materials shall be sulfur and chloride free to preserve solderability. Damaged containers will be documented by Motorola Receiving and follow up action with the carrier or supplier will occur when appropriate. Packaged containers shall comply with the Motorola specification 12M09167A69 and 12G13933A01 Bar Coding requirements as well as the shipping label placement per Motorola Standard 12S10601A. Refer to 56R09042J01 for specific packaging requirements.

5.4.2 Any data should be correlated to the material received and enclosed with the parts inside the packing container. When multiple packing containers are shipped as one lot, the container with the data should be marked "DATA IN THIS CONTAINER".

5.4 MANUFACTURER'S LIABILITY LIMITATION

The manufacturer warrants the service life of the battery for a 12-month period. The battery is considered defective if:
(1) It fails to deliver capacity specified in 5.2.1,
(2) Fails to meet the self discharge requirements in section 5.2.2,
(3) Fails to meet impedance as specified in section 5.2.4,
(4) Fails to meet the rated lifecycle in Section 5.2.7, or
(5) It develops visually apparent leakage of electrolyte.

5.5 PEDROS

Internal battery construction document and 3 pedros shall be supplied to Motorola Cellular Subscriber Engineering and to SQC. Drawing and pedros shall be approved "in writing" prior to production lots.

5.6 WARRANTY

The supplier shall comply with the warranty as specified on the Motorola Purchase Order. The stated warranty period is one year upon the date of receipt of parts to Motorola. In the event that the warranty is not specified on the purchase order, the warranty period shall be one year from the date of receipt.

6.0 SUPPLIER REQUIREMENTS

6.1 SPECIFICATION ACCEPTANCE

For all initial specification details and revisions to this specification, the supplier must complete and return a signed “Print Acceptance Form” (PAF) back to Motorola. The PAF (form #3942-89) is as identified in Motorola specification 12M80967A78, Section 3.1. Any production grade product shipped to Motorola that does not have this formed signed will DEFAULT into AUTOMATIC SPECIFICATION ACCEPTANCE as written. Any production part deviation to this specification can result in product rejection.

6.2 EXCEPTIONS

After product qualification, any supplier exceptions to this specification for any reason must be documented by special waiver supplied by the Motorola Cellular Purchasing Department and approved by the Motorola Cellular Development Engineering and Quality Departments. Supplier must complete “Waiver of Specification” (form #3943-89) as identified in Motorola specification 12M80967A78, Section 3.2.

6.3 CHANGES

6.3.1 No major change (affecting reliability or performance) shall be allowed on production material, process, or manufacturing locations, regardless of whether such changes affect characteristics specified, without prior explicit written approvals by the Motorola Cellular Development Engineering, Quality Department, and Purchasing Departments. Supplier must complete a “Request for Engineering Change Approval Form” (form #3976-89) as identified in Motorola specification 12M80967A78, Section 3.3.

6.3.2 Process Change Notification: The supplier must notify Motorola Purchasing, Component Engineering, and the user design group at least 90 days prior to implementation of any major or critical change. These changes may affect the performance, quality, reliability, interchangeability, or ESD sensitivity of the device. Such changes shall not be allowed without prior written approval by Motorola Cellular Purchasing Department.

6.4 QUALITY CONTROL REQUIREMENTS

6.4.1 The supplier must submit a “Supplier Quality Plan” per Motorola Supplier Quality Control Plan specification 12M80967A78 as part of the overall part qualification package. No production lots should be shipped to Motorola prior to approval of the “Supplier Quality Plan” per Supplier Quality Engineering Department.

6.4.2 First piece parts must be submitted with data as outlined in Motorola specification 12M80967A78. First piece tooled parts must be approved by Motorola Cellular Subscriber Sector Mechanical Engineering Department before proceeding with production run.

6.4.3 Production lot data as described in Motorola specification 12M80967A78, Section 6, should be supplied with the production lots until 3 consecutive lots demonstration a Cpk of 1.5 or greater for all critical parameters has been achieved. Future lots will no longer require data shipment with the supplied material. However, the supplier must continue to generate the data and maintain it on file for a minimum period of 2 years.

6.4.4 If the Cpk value on any defined critical parameter should fall below 1.5 at any time during the manufacture of the part, then the supplier must 100% SCREEN all those parts to the specified parameters until a corrective action has been implemented to re-establish a consistent Cpk value of 1.5 or greater. Motorola Supplier Quality Engineering is to be notified if such a condition exists. This should be done through the use of a Corrective Action Response form using the 8D format. An initial notification should be submitted no more than 12 hours after the problem has been identified, stating the immediate containment action. After analysis of the root cause of discrepancy, a plan defining permanent corrective action shall be submitted with samples and supporting data to Motorola Quality Engineering for approval.

6.4.5 If a 100% screen is being used, the screen must either be tracked by Cp process capability analysis or by the Escaping Defect Rate (EDR). The interval for these must be established by statistical methods.

7.0 QUALITY TESTING PROVISIONS

7.1 QUALIFICATION REQUIREMENTS

SPC data from representative production samples of all critical parameters identified must be submitted initially for PART QUALIFICATION and again at any time at Motorola’s request. All electrical and mechanical parameters identified by the symbol "[X]" require statistical quality control data that demonstrate a capability of Cpk of 1.5 or greater. For qualification, this information must supplement the minimum test data requirements in Section 7.2.

Production samples used for qualification testing should be randomly chosen.

The environmental test equipment and the types of test fixtures used for the component qualification are left to the discretion of the supplier.

7.2 QUALIFICATION TESTS

All components must conform to the environmental test program as detailed in Motorola Specification 12M04103T83 Battery Design Verification. Part marking must remain legible after testing. Cell failures are acceptable when batteries are subjected to temperatures beyond the –20°C to +60°C range. Any cell leakage shall have the root cause determined. Cell leakage due to battery pack workmanship defects is unacceptable; any other forms of leakage are not considered a failure. Requirements are subject to verification at any time. Requirements are subject to verification at any time.