X. FB Lithium Carbon-monofluoride Batteries

Rayovac FB batteries consist of two Lithium Carbon-monofluoride coin cells encapsulated within a glass filled polyester molded housing. The FB series of batteries are configured to allow for series or parallel interconnection between the cells.

FB batteries utilize Rayovac BR Lithium Carbon-monofluoride technology to assure the greatest reliability at very wide temperatures and the lowest self-discharge rate.

A. Features

- Meets or exceeds typical hermetically sealed battery shelf life vs. temperature capability
  Operating Temperature Range:
  -40°C to + -100°C (-40°F to +212°F)
- PCB mountable, wave solderable, and process tolerant
- Inherently safe chemistry
- Application flexibility
- Robotically placeable

B. Typical Applications

- Time/data protection
- Industrial control
- Communication equipment
- Portable Instruments

C. Specification Table

Part Number	*Nominal Voltage (volts)*	*Nominal Capacity (mAh)*	*Nominal Pulse Capability (mA*)*	*Dimensions*				
				Width	*Length*	*Height***	*Weight*	*Volume*
FB1225H2	3.0 Parallel 6.0 Series	100 Parallel 50 Series	16 Parallel 8 Series	15.9 mm (0.625")	15.9 mm (0.625")	10.3 mm (0.405")	4.2 g (0.15 oz.)	2.00 cc (6.12 in^3)
FB2325H2	3.0 Parallel 6.0 Series	360 Parallel 180 Series	20 Parallel 10 Series	25.4 mm (1.000")	25.4 mm (1.000")	10.8 mm (0.425")	11.9 g 0.42 oz.)	6.14 cc (0.375 in^3)

* Consult Rayovac OEM Engineering Division for assistance in determining pulse capability for your application.

** Height above circuit board.
NEDA and IEC numbers have not been assigned to FB products.

D. Typical Discharge Curves

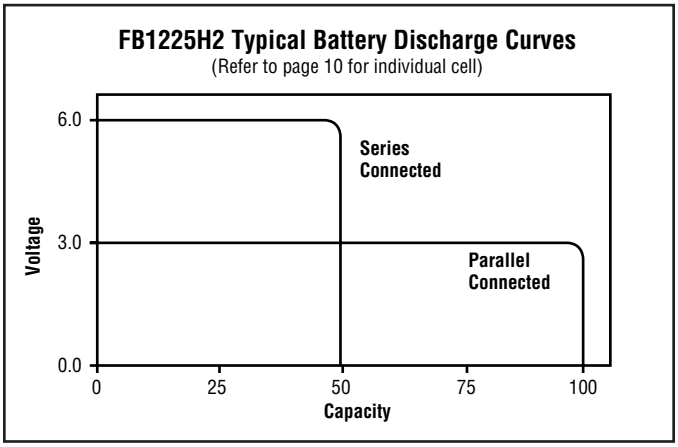


Figure 65

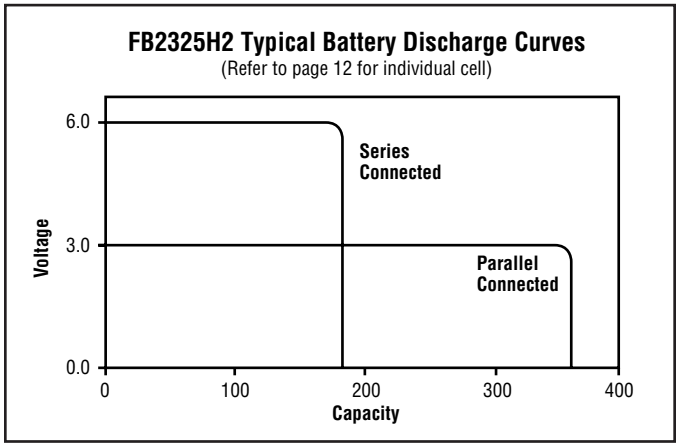


Figure 66

E. Dimensional Drawing

For illustration only. Contact Rayovac for complete specs.

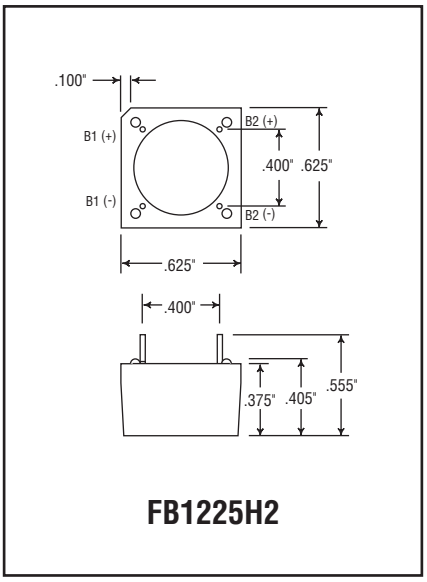


Figure 67

Conversion Chart

INCHES	MILLIMETERS
.100	2.5
.375	9.5
.395	10.0
.400	10.2
.405	10.3
.425	10.8
.555	14.1
.575	14.6
.625	15.9
.700	17.8
1.000	25.4

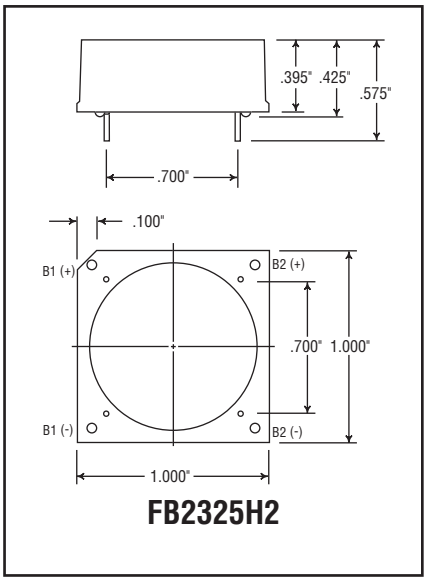
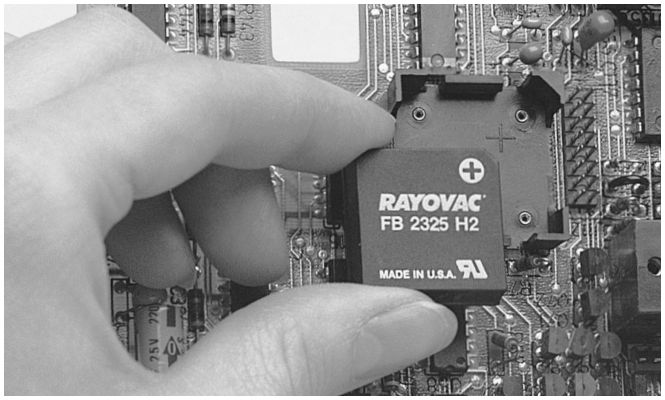


Figure 68

XI. Relex™ Socket



The Relex RH23H2 is a printed circuit board mountable battery socket for use with Rayovac's FB2325H2 battery. This device provides excellent component retention and a gas tight, reliable electrical contact. Its self-orienting design assures proper polarity installation without desoldering or the use of special tools.

A. Features

- Improved contact reliability over conventional holders
- Printed Circuit Board (PCB) mountable, wave solderable, and process tolerant
- Molded in standoff for thorough post reflow cleaning
- Excellent battery retention in shock and vibration
- Tin on tin, gas-tight spring contacts

B. Dimensional Drawings

For illustration only. Contact Rayovac for complete specs.

Relex™ Socket RH23H2

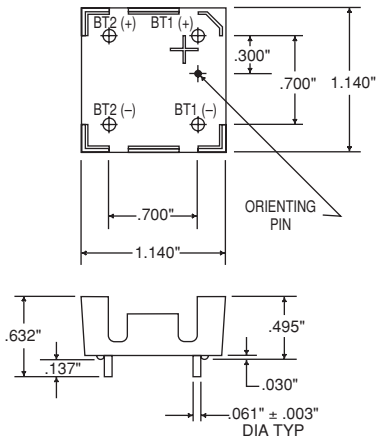


Figure 69

Conversion Chart

INCHES	MILLIMETERS
.003	0.1
.030	0.8
.061	1.5
.137	3.5
.220	5.6
.300	7.6
.495	12.6
.632	16.1
.700	17.8
1.140	28.9

PCB Layout

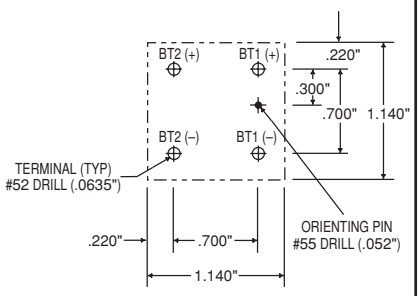


Figure 70

XII. Recommended Storage, Handling and Disposal Procedures

A. Storage and Date Codes

BR Lithium cells and FB Lithium batteries are electrochemical devices which depend upon internal chemical reactions to produce electrical power. These reactions are accelerated by high temperatures and retarded by low temperatures. Therefore, to minimize power loss during storage, batteries should be stored at ambient temperature, 21°C (70°F). Storage at lower temperatures is not necessary nor recommended due to the possibility of shorting from moisture condensation.

To maximize battery power, the following storage procedures should be observed:

1. Rotate inventory. Maintain a first in, first out method of stock storage and usage. The manufacture date of Rayovac cells and batteries are identified by a date code stamped on the individual products.

2. Avoid storage in high temperature areas. Make sure that cells and batteries are stored away from hot air vents, radiators, motors, and equipment that generates heat. Avoid storage near windows or skylights where the sun can generate heat.

B. General Precautions

- BR Lithium cells and FB Lithium batteries should not be inserted improperly, recharged, or disposed of in fire
- Take precautions to insure correct polarity of the battery in the device
- Recharging of batteries may cause leakage
- Never short-circuit, disassemble, or subject batteries to excessive heat
- Never expose Lithium to moisture
- Do not solder directly to battery case
- Improper welding can damage internal components and impair battery performance
- Damaged or penetrated batteries could present a fire hazard. Handle all damaged batteries with this caution in mind.

C. Handling and Shipping

Batteries are vulnerable to short circuiting if not handled, packaged, or transported properly. Cell types which have their positive and negative terminations in close proximity to each other, or tabbed cells, are particularly susceptible to short circuiting if not handled properly. In prototyping and assembly operations, care should be taken to avoid placing these products on conductive antistatic mats.

To avoid potential short circuit and shipping damage situations:

1. Always store the batteries in the trays and/or cartons in which they were shipped. Whenever possible, reship the batteries in undamaged original trays and/or cartons.

2. Rayovac offers individually packaged cells and batteries, designated by a "-1" suffix on the part number. This allows for the safe handling and transport of batteries in smaller quantities.

3. Never place or dump batteries on conducting surfaces such as metal tables or shelves. Do not co-mingle batteries.

4. Never ship batteries or completed circuit boards with installed batteries in anti-static bags as the bags are conductive and will short out the battery.

5. Use caution with measuring equipment. Insulate metal micrometers and calipers with tape to avoid short circuiting batteries during dimensional checks.

6. Make sure batteries installed in equipment are securely or permanently installed prior to packaging.

D. Transportation Regulations

Transportation of Lithium batteries is regulated by the U.S. Department of Transportation (DOT), the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA). For BR and FB solid cathode Lithium coinc cells and batteries, the quantity of Lithium metal is one of two key determinants that defines the applicable regulations and requirements.

All of Rayovac's BR Lithium cells and FB Lithium batteries meet the following requirements:

1. U.S. D.O.T. Title 49 Code of Federal Regulations (49 CFR 173.185F)

   Rayovac BR Lithium coin cells contain less than 0.5 gram of Lithium metal and Rayovac FB Lithium batteries contain less than 1.0 gram of Lithium metal. They are authorized for all modes of transportation when packaged in strong containers that separate the batteries to prevent shorting, or if all provisions of USDOT and IATA regulations are in compliance.

2. ICAO and IATA Special Provision A45

   Rayovac BR Lithium solid cathode coin cells contain less than 0.5 gram of Lithium metal and Rayovac FB Lithium solid cathode batteries contain less than 2.0 grams of Lithium metal. They are authorized for transportation on passenger and cargo aircraft when all conditions of IATA Special Provision A45, A88, and A99 are in compliance.

The table below summarizes the specific requirements for each agency.

Transportation Regulations

	United States	*International*
Regulatory Agency	U.S. Department of Transportation (DOT)	1. International Civil Aviation Organization (ICAO) 2. International Air Transport Association (IATA)
Regulation	Title 49 CFR 173.185F	IATA Dangerous Goods Regulations 44th ed. (DGR), Special Provision (SP) A45, SPA88, and SP A99 and Packaging Instruction (PI) 903, PI 912, and PI 918.
Authorized Modes of Transportation	All	Passenger and Cargo Aircraft
Special Packaging	See IATA DGR, SP A45(d) & PI 903.	IATA DGR SP A45 and PI 903 for batteries. OEM's see also SP A45 and SP A48 along with PI 912 if installed in equipment and PI 918 if shipped uninstalled with equipment.
Hazard Class and Required Shipping Name	None Note: IATA DGR SP A45(c) Testing program is underway.	None Note: IATA DGR SP A45(c) Testing program is underway.
Special Labels Required	IATA DGR SP A45(e)(i)	IATA DGR SP A45(c)
Lithium Metal Limits	Cells: 0.5 gram Batteries: 1.0 gram Note: Not automatically class 9. Testing in A45(f) is the final determinant of hazard class (if any). All labels, marking, and communication requirements apply regardless of Lithium (or Lithium equivalent) content.	Cells: 0.5 gram Batteries: 2.0 grams

E. Disposal

This statement is provided as a service to those who may want information concerning the safe disposal of waste Rayovac BR and FB (Lithium Carbon-monofluoride) battery products for the USA. These products may be distinguished from other battery products by the presence of the letters BR or FB in the product designation, and are manufactured in a disk or "coin" shape and square modules.

This information does not apply to any other Lithium chemistry or Lithium Carbon-monofluoride products in other form factors.

Note: Where regulations regarding management of spent/waste Lithium batteries exist outside of the USA, they generally differ significantly from United States regulations. For information regarding recommended disposal and management practices in regions or countries other than the USA, please contact Rayovac at 1-800-237-7000 within the USA, or 608-275-3340 if outside the USA and ask for Tim Anderson.

Regarding Rayovac BR Lithium cells and FB Lithium battery waste battery management in the USA:

Waste BR Lithium cells and FB Lithium batteriess are neither listed nor exempted from the USEPA hazardous waste regulations. Waste BR and FB Lithium products can be considered reactive hazardous waste if there is a significant amount of unreacted, or unconsumed Lithium remaining. This potential problem may be avoided by discharging waste cells and batteries prior to disposal. One tested method for doing this is to place small quantities of BR Lithium cells or FB Lithium batteries into a metal container with sufficient graphite to cover and surround the individual cells. This procedure will discharge the cells in approximately two weeks to the point where no reactive Lithium remains. The cells may then be disposed of as nonhazardous waste in an ordinary landfill under Federal regulations. The graphite can be reused many times, as needed, or can be disposed of as nonhazardous waste.

Other Disposal Methods

For a list of facilities with demonstrated ability to manage waste BR Lithium cells and FB Lithium battery products as hazardous waste, please click here. The list is not guaranteed to be all inclusive, nor does it seek to exclude potential service suppliers. Rayovac provides it as a customer service to assist the customer in determining what their management options could be. Always review your choice of firm before sending wastes.

Cautions

Under United States Federal law, waste generators are responsible for their wastes. Be sure to check your regional, national, or local regulations as they may differ significantly. Always remember that waste battery products may still have considerable energy remaining in them. Handle such products with care and in accordance with applicable USDOT, IATA, or ICAO regulations.

F. Soldering

Rayovac's BR and FB component class Lithium batteries are suitable for direct soldering onto printed circuit boards (PCB). A welded tab or pin soldered to a PCB will ensure the highest contact reliability available. Observe these precautions to assure life-of-product reliability:

1. Hand Soldering

Never solder directly to cell cases. The resultant heat will cause permanent internal damage to the cell. Soldering of tabbed batteries should be accomplished with a low wattage soldering iron by applying heat just long enough to achieve a good connection.

2. Wave Soldering

During the period when the battery tabs or pins are in the solder bath, the battery is short circuited. If this period is kept to under 5 seconds the battery capacity loss will be minimized. Following a short circuit the battery voltage will recover to above 2.5 volts almost immediately while full recovery to its final working voltage may take hours or even days. This characteristic must be taken into account when making electrical measurements on recovering batteries or when establishing manufacturing pass/fail points.

3.Surface Mount Technology

Rayovac offers a full line of surface mount Lithium cells configurations. These cells are indicated by the suffix "SM" or "SR" in the stock number. The surface mount batteries have configurations that allow for easy board mounting.

Current BR and FB Lithium products are not compatible with Surface Mount Technology (SMT) soldering processes due to the extreme temperatures required for reflow. Batteries should be added as a secondary operation. Mixed technology boards that utilize both SMT and traditional through-hole components have been successfully fabricated.

G. Washing

It is important that PCB wash techniques are compatible with Rayovac's Lithium BR and FBbatteries. The seals of these batteries are polypropylene and solvents that attack this material should be avoided. The most common freon types and deionized water have shown to be acceptable cleaning solvents. Rayovac should be consulted if there is any possibility of process related battery damage.

XIII. U.L. Component Recognition

Rayovac BR Lithium batteries have been accepted by Underwriters Laboratories under their Component Recognition Program and carries U.L. File Number MH 12542. All recognized Lithium batteries can be identified by the symbol located on the data sheet.

For use in UL listed devices, these Lithium batteries must be used in accordance to the following U.L. conditions of acceptability.

A. Conditions of Acceptability

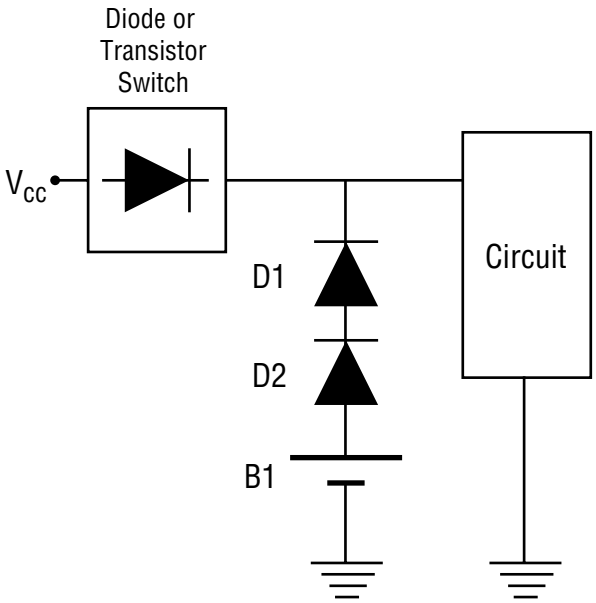
The use of these cells may be considered generally acceptable under the conditions given below:

1. The cells are identified with producer's name and model designation on the cell.
2. These cells are intended for use as components in devices where servicing of the circuitry involving the cells and replacement of the Lithium cells will be done by a trained technician.
3. These cells are intended for use at ordinary temperatures where anticipated high temperature excursions are not expected to exceed 100°C (212°F).
4. These cells can be used in series up to a maximum of four cells of the same model number. When used in series, they should all be replaced at the same time using fresh cells only. These cells should not be connected in series with any other (other than the allowed number of cells in series) power source that would increase the forward current through the cells.

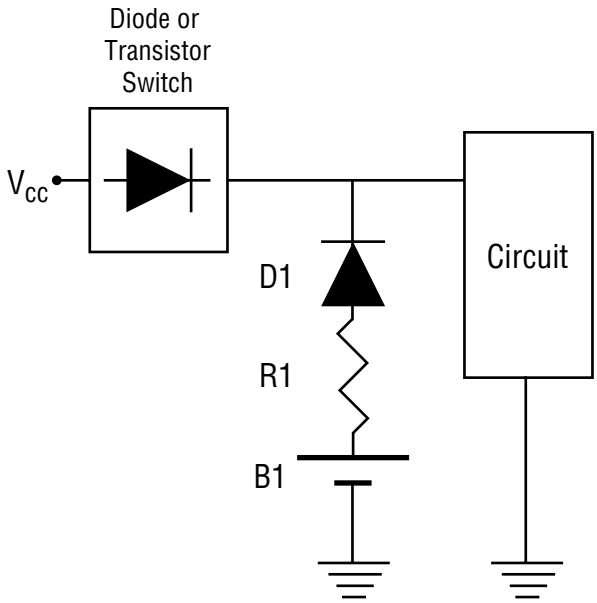
B. Protective Battery Circuits

For D1/D2 use Silicon diodes. Do not use low power Schottky diodes.

Protective Redundant Diodes



Protective Diode and Limiting Resistor



5. The circuit for these cells should include one of the following:

   A. Two suitable diodes or the equivalent in series with the cells to prevent any reverse (charging) current. The second diode is used to provide protection in the event that one should fail. Quality control, or equivalent procedures shall be established by the device's manufacturer to insure the diode polarity is correct for each unit.

   – or –

   B. A blocking diode or equivalent to prevent reverse (charging) current, and in the event of diode failure, the cell shall be further protected against reverse (charging) current in excess of the values shown in chart to the right. The measurement of this current shall include appropriate abnormal tests.

Maximum Reverse Charging Currents for Rayovac BR Lithium Coin Cells

Cell Models	Maximum Current (mA)
BR1225	3.0
BR1632	3.0
BR2032	4.0
BR2325	5.0
BR2335	5.0
FB1225	3.0
FB2325	5.0

Notice

This publication is furnished only as a guide. It is the user's responsibility to determine suitability of the products described for the user's purpose (even if the use is described herein) and to take precautions for protection against any hazards attendant to the handling and use of the products. Rayovac recommends prospective users test each application.

The battery products and arrangements described herein may be covered by patents owned by Rayovac or others. Neither this disclosure nor the sale of products by Rayovac conveys any license under patent claims covering combinations of battery products with other elements or devices. Rayovac does not assume liability for patent infringement arising from any use of the products by the purchaser.

The technical data contained herein are not designed to be the basis for specifications. Rayovac's OEM Engineering Division can furnish data that can serve as the basis for specifications.

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