Application Notes & Product Data Sheet

Lifexä Lithium Coin Cells & FB Encapsulated Lithium Coin Cells - Part 4

X. Product Availability & Cross Reference Table

Stock Number	Description	Inter-changeable Numbers	Figure Number	Packaging	Units per Card	Quan.	Weight (lbs)	Cubic Feet
BR1225	3.0-volt, 50 mAh LIFEX™ cell	BR1225	31	Carded	3	18	22	..01
BR1225-B	3.0-volt, 50 mAh LIFEX cell	BR1225	31	Bulk	-	4,640	13.85	.58
BR1225H2R-B	BR1225 with 2 Tabs	-	32	Bulk	-	800	4.00	.30
BR1225MT2-B	BR1225	-	33	Bulk	-	2,700	7.50	.30
BR1225RT2-B	BR1225R with 2 Short Tabs	-	34	Bulk	-	2,700	7.50	.30
BR1225R18-B	BR1225	-	35	Bulk	-	1,540	4.76	.30
BR1225SM-B	BR1225 Surface Mount	-	36	Bulk	-	2,700	7.68	.30
BR1225SM2-B	BR1225 Surface Mount	-	37	Bulk	-	1,650	5.65	.30
BR1225SR2-B	BR1225	-	38	Bulk	-	1,540	4.76	.30
BR1225T2-1	BR1225 with 2 Tabs	BR1225-1HB	39	Carded	1	100	1.83	.14
BR1225T2-B	BR1225 with 2 Tabs	BR1225-1HB	39	Bulk	-	800	4.00	.30
BR1225-1VB	BR1225 with 2 Tabs - Vertical Mount	BR1225T2V-1	40	Carded	1	100	1.83	.14
BR1225T2V-B	BR1225 with 2 Tabs - Vertical Mount	BR1225-1VB	40	Bulk	-	2,340	7.45	.30
BR1225T3H-B	BR1225 with 2 Tabs , 3 Stands - Horozontal Mount	-	41	Bulk	-	800	4.00	.30
BR1632-B	3.0-volt, 130 mAh LIFEX™ cell	-	42	Bulk	-	3,520	16.24	.58
BR1632DK2-B	BR1632	-	43	Bulk	-	720	6.25	.30
BR1632T2-B	BR1632 with 2 Tabs	-	44	Bulk	-	750	5.11	.49
BR1632T3L-B	BR1632 with 2 Tabs, 3 Stands	-	45	Bulk	-	800	5.57	.49
BR2016	3.0-volt, 70 mAh LIFEX™ cell	BR2016	46	Carded	3	18	.22	.01
BR2016-B	3.0-volt, 70 mAh LIFEX™ cell	BR2016	46	Bulk	-	2,000	10.00	.50
BR2032-B	3.0-volt,195 mAh LIFEX cell	BR2032	47	Bulk	-	2,560	17.00	.58
BR2032T2-B	BR2032 with 2 Tabs	BR2032-1HE1	48	Bulk	-	750	7.73	.49
BR2032T2K-B	BR2032 with 2 Tabs	BR2032-1HSE	49	Bulk	1	800	7.33	.58
BR1225T2-B	BR2032 with 2 Tabs, 3 Stands	BR2032-1GS	50	Bulk	-	750	7.92	.49
BR1225-1VB	BR2032 with 3 Stands - Vertical	BR2032-1GV	51	Bulk	1	750	8.07	.48

*Suffix "-B" designates bulk packaged.
**Height difference - closest equivalent

Stock Number	Description	Inter-changeable Numbers	Figure Number	Packaging	Units per Card	Quan.	Weight (lbs)	Cubic Feet
BR2325	3.0-volt, 180 mAh LIFEX cell	BR2325	52	Carded	3	18	.22	.01
BR2325-B	3.0-volt, 180 mAh LIFEX cell	BR2325	52	Bulk	-	2,000	18.00	.50
BR2325P2-B	BR2325 with 2 Pins		53	Bulk	-	750	8.50	.49
BR2325T2-1	BR2325 with 2 Tabs	BR2325-1HB, BR2325-1HB	54	Carded	1	100	2.10	.18
BR2325T2-B	BR2325 with 2 Tabs	BR2325-1HB, BR2325-1HB	54	Bulk	-	750	8.50	.49
BR1225R18-B	BR2325 with 2 Tabs, 3 Stands	-	55	Bulk	-	750	8.25	.49
BR1225SM-B	BR2325 with 2 Tabs - Vertical	BR2325-1VG	56	Bulk	-	840	8.75	.47
BR2335	3.0-volt, 300 mAh LIFEX cell	BR2330	57	Carded	3	18	.22	.01
BR2335-B	3.0-volt, 300 mAh LIFEX cell	BR2330	57	Bulk	-	2,800	24.28	.58
BR2335SM-B	BR2335 Surface Mount	-	58	Bulk	-	800	8.48	.30
BR2335T2-1	BR2335 with 2 Tabs	BR2330-1HE	59	Carded	1	100	2.10	.18
BR2335T2-B	BR2335 with 2 Tabs	BR2330-1HE	59	Bulk	-	750	9.35	.49
BR2335T3L-1	BR2335 with 2 Tabs, 3 Stands	BR2330-1GU	60	Carded	1	100	2.22	.18
BR2335T3L-B	BR2335 with 2 Tabs , 3 Stands	BR2330-1GU	60	Bulk	-	750	9.35	.49
BR2335T3V-1	BR2335 with 2 Tabs - Vertical	BR2330-1VG	61	Carded	1	100	1.44	.14
BR2335T3V-B	BR2335 with 2 Tabs - Vertical	BR2330-1VG	61	Bulk	-	735	8.62	.47

*Suffix "-B" designates bulk packaged.

X. Lifex FB™ Lithium Batteries

Rayovac Lifex 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.

Lifex FB batteries utilize Rayovac Lifex™ 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 Capacity (mA*)	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 gm (0.15 oz.)	2.00 cc (6.12 in_)
FB2325H2	3.0rallel 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_)

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

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

D. Typical Discharge Curves

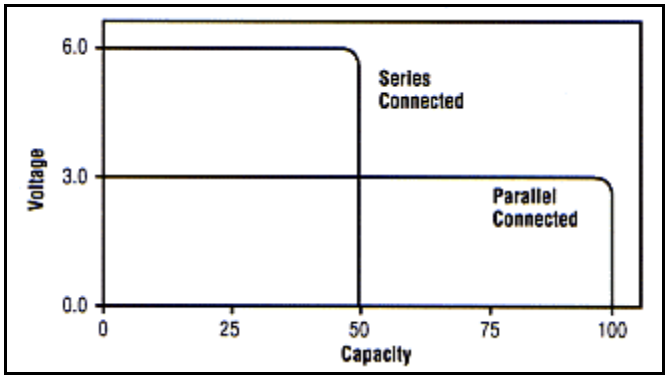


Figure 70

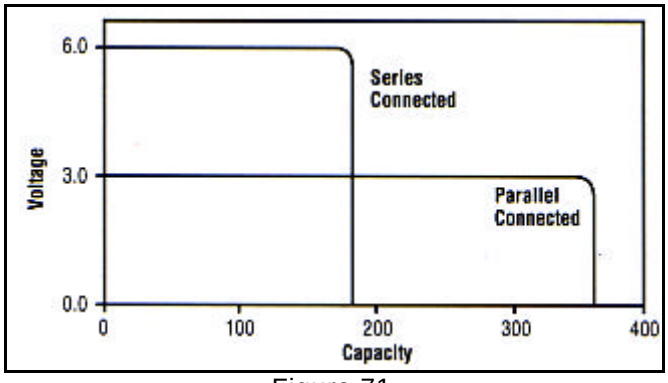


Figure 71

E. Dimensional Drawing

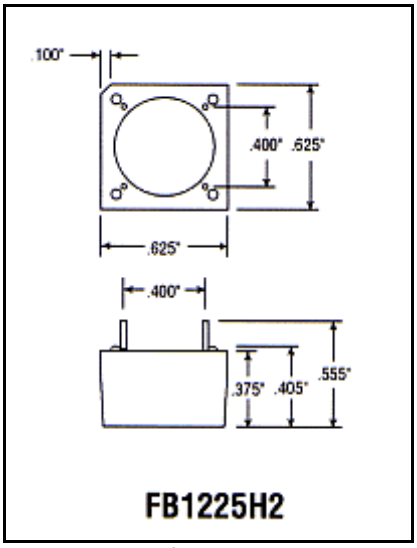


Figure 72

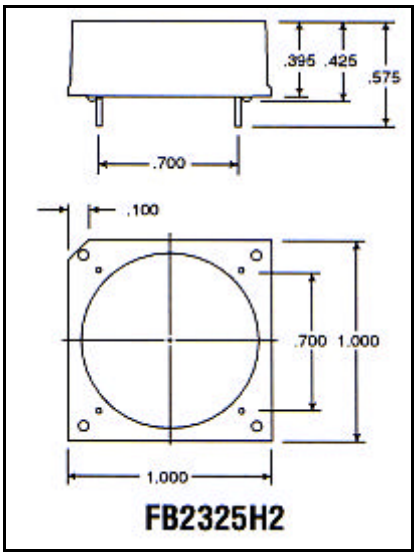


Figure 73

Conversion Chart

INCHES	MILLIMETERS
.100	2.5
.395	10.0
.375	9.5
.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

IX. 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

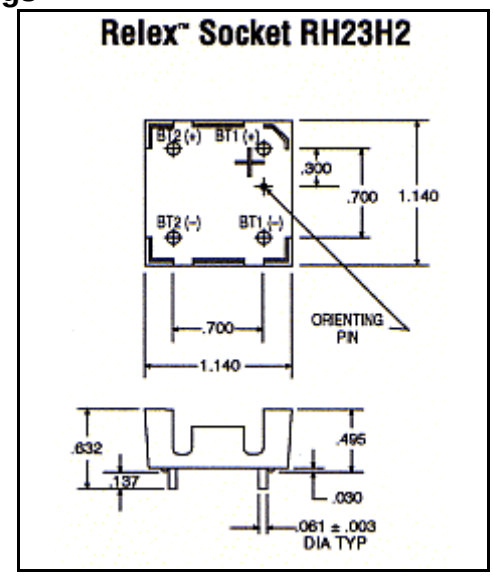


Figure 74

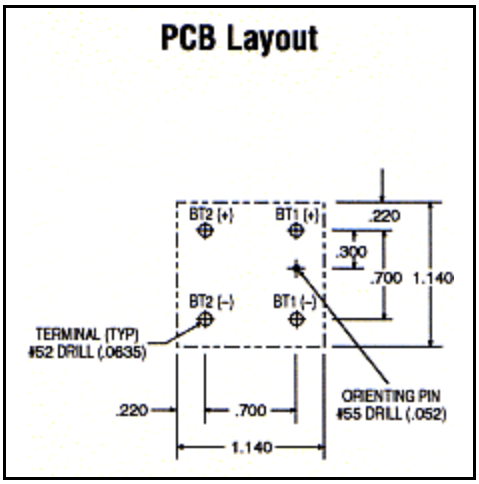


Figure 75

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

XII. Recommended Storage, Handling and Disposal Procedures

A. Storage and Date Codes

Lifex coin cells and Lifex FB 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 four digit Julian 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

- Lifex coin cells and Lifex FB 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

C. Handling and Shipping

Batteries are vulnerable to short circuiting if not handled 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. Rayovac packaging engineers design all packaging to assure that Rayovac batteries can be shipped and stored in their original cartons without damage.

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 theiroriginal 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 parts in smaller quantities.

3. Never place or dump batteries on conducting surfaces such as metal tables or shelves.

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.

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 Lifex™ solid cathode lithium batteries, the quantity of lithium metal is the key determinant that defines the applicable regulations and requirements.

All of Rayovac's Lifex lithium coin cells meet the following requirements:

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

Rayovac Lifex lithium coin cells contain no more than 0.5 gram of lithium metal and Rayovac Lifex FB™ lithium batteries contain no more 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 when the batteries are installed in electronic equipment.

2. ICAO and IATA Special Provision A45

Rayovac Lifex lithium solid cathode coin cells contain no more than 0.5 gram of lithium metal and Rayovac Lifex FB lithium solid cathode batteries contain no more than 2.0 grams of lithium metal. They are authorized for transportation on passenger and cargo aircraft when packaged in strong containers that separate the batteries to prevent shorting, or when the batteries are installed in electronic equipment.

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 **Authorized Modes of Transportation**	Title 49 CFR 173.185F All	Special Provision A45 Passenger and Cargo Aircraft
Special Packaging	Individual cells and batteries to be separated to prevent short circuiting or be installed in electronic equipment.	Individual cells and batteries to be separated to prevent short circuiting or be installed in electronic equipment.
Hazard Class and Required Shipping Name	None	None
Special Labels Required	None	None
Lithium Metal Limits	Cells: 0.5 gram Batteries: 1.0 gram	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 Lifex (lithium/carbon-monofluoride) battery products. 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 squaremodules.

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

United States Environmental Protection Agency (USEPA):

Waste Lifex™ coin cells are neither listed nor exempted from the USEPA hazardous waste regulations. Waste Lifex 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 good method for doing this is to place small quantities of Lifex coin cells into a metal container with sufficient graphite to cover and surround the individual cells. This procedure will discharge the cells in two weeks to the point where no reactive lithium remains. The cells and the graphite may then be disposed of as nonhazardous waste in an ordinary landfill under Federal regulations.

Exemption for Lifex FB™ Products

Rayovac's Lifex FB battery series are two coin cells which are encapsulated into an epoxy-sealed unit. There is a USEPA exemption available from hazardous waste regulations for these products. USEPA Office of Solid Waste and Emergency Response Directive 9443.05 (83) provides that such batteries manufactured to prevent disintegration after disposal need only pass a 30-day salt-water immersion test. If no evidence of leakage exists after 30 days, they are considered non-hazardous waste and may be disposed with ordinary waste.

Other Disposal Methods

If the waste generator elects to manage the waste Lifex or Lifex FB battery product as hazardous waste, one licensed facility known for treating and disposing of lithium battery hazardous waste is BDT, Inc., Clarence, New York. Rayovac's Applications Engineering can provide assistance with BDT's waste documentation forms.

Cautions

Under Federal law, waste generators are responsible for their wastes. Be sure to check your state and local regulations to be sure that they are not more restrictive than the Federal regulations. Always remember that waste battery products may still have considerable energy remaining in them. Handle such products with care and in accordance with applicable DOT and IATA regulations.

F. Soldering

Lifex 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 justlong 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.

Refer to Short Circuit Recovery.

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 Lifex™ 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 Lifex batteries. 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 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.

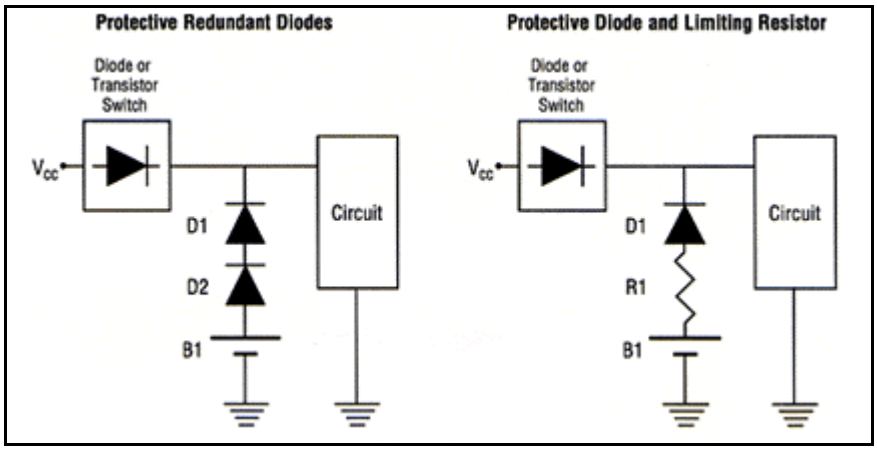
5. The circuit for these cells should include one of the following:

   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.

B. Protective Battery Circuits

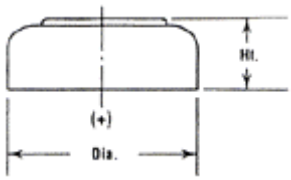


Maximum Reverse Charging Currents for Rayovac Lifex Cells

Cell Models	Maximum Current (mA)
BR1225	3.0
BR1632	3.0
BR2016	4.0
BR2032	4.0
BR2325	5.0
BR2335	5.0
FB2325	5.0

Silver-Oxide Cells

Rayovac offers a complete line of silver-oxide cells that are made in the U.S.A.



Silver Oxide Cells

Rayovac Model Number	ANSI/ NEDA	IEC	Drain	Rated Load KΩ	Nominal Capacity (mAh)	App. Vol. (cm3)	Maximum Dimension Millimeters dia. x ht.	Maximum Dimensions Inches dia. x ht.	App. Weight (grams)
361	1173SO	SR58	high	30	22	.10	7.9x2.1	.311x.083	.44
396	1163SO	SR59	high	45	35	.13	7.9x2.7	.311x.106	.56
392	1135SO	SR41	high	15	35	.17	7.8x3.6	.307x.142	.61
312G	1179SO	SR41	ultra high	1.5	38	.17	7.8x3.6	.307x.142	.61
393	1137SO	SR48	high	15	90	.26	7.8x5.4	.307x.212	1.04
13G	1181SO	SR48	ultra high	1.5	85	.26	7.8x5.4	.307x.212	1.04
370	1188SO	SR69	high	45	35	.15	9.5x2.1	.374x.083	.60
399	1165SO	SR57	high	20	53	.19	9.5x2.7	.374x.106	.79
391	1160SO	SR55	high	15	43	.22	11.6x2.1	.457x.083	.83
389	1138SO	SR54	high	15	85	.32	11.6x3.0	.457x.118	1.21
386	1133SO	SR43	high	6.5	120	.44	11.6x4.2	.457x.165	1.56
357	1131SO	SR44	high	6.5	190	.57	11.6x5.35	.457x.211	2.22
675G	1184SO	SR44	ultra high	.62	190	.57	11.6x5.35	.457x.211	2.22
317	1185SO	NA	low	70	11	.04	5.8x1.65	.228x.065	.18
379	1191SO	NA	low	70	14	.06	5.8x2.15	.228x.085	.23
319	1186SO	NA	low	70	16	.07	5.8x2.7	.228x.106	.26
321	1174SO	SR65	low	70	14	.06	6.8x1.65	.268x.065	.24
364	1175SO	SR60	low	70	19	.08	6.8x2.15	.268x.085	.33
377	1176SO	SR66	low	45	26	.09	6.8x2.6	.268x.102	.40
315	1187SO	SR67	low	70	16	.08	7.9x1.65	.311x.065	.32
362	1158SO	SR68	low	70	22	.10	7.9x2.1	.311x.083	.44
397	1164SO	SR59	low	45	35	.13	7.9x2.7	.311x.106	.56
329	NA	NA	low	20	36	.15	7.9x3.1	.311x.122	.60
384	1134SO	SR41	low	15	35	.17	7.8x3.6	.307x.142	.61
373	1172SO	SR68	low	45	24	.12	9.5x1.65	.374x.065	.44
371	1171SO	SR69	low	45	35	.15	9.5x2.1	.374x.083	.61
395	1162SO	SR57	low	20	53	.19	9.5x2.7	.374x.106	.81
394	1161SO	SR45	low	15	64	.26	9.5x3.6	.374x.142	.96
381	1170SO	SR55	low	20	43	.22	11.6x2.1	.457x.083	.80
390	1159SO	SR54	low	15	85	.32	11.6x3.0	.457x.118	1.21
344	1139SO	SR42	low	15	105	.38	11.6x3.6	.457x142	1.35

*Rayovac's silver cells meet ANSI and IEC specifications.

XIV. Additional Technical Products from Rayovac

Computer Clock Batteries

Rayovac's alkaline computer clock batteries are optimized for low current, long life applications. They are specifically designed as high reliability, low cost batteries for 80286, 80386, and 80486 system real time clock back-up. Rayovac's computer clock batteries are specified by over 40 microcomputer system builders.

- Economical solution for real time clock back-up
- Compatible with major types of PC chipsets
- Shelf life consistent with service life
- Non-hazardous materials _ meet EC'92 regulations
- Inherently charge tolerant (with 5.0 volt supply)
- Velcro mount for easy installation
- Gold contacts for greatest reliability

Stock No.	Description
844	4.5 Volt with 4 Pin Connector. For IBM®PC-AT and compatibles; 1200 mAh of capacity
840	4.5 Volt with 4 Pin Connector. For when space is limited; 600 mAh of capacity

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RENEWAL® Reusable Alkaline™ Batteries

Rayovac's patented RENEWAL batteries combine the high performance attributes of alkaline manganese with the cost and environmental benefits of a reusable system. RENEWAL is available in bulk and carded.

- Reusable 25 times or more with Rayovac POWER STATION® Charger
- Hold their charge in storage up to five years
- Come precharged and ready to use
- No memory problems
- Better for the environment

Stock No.	Description
713-2	RENEWAL Reusable Alkaline D Size Carded 2 Pack
714-2	RENEWAL Reusable Alkaline C Size Carded 2 Pack
715-4	RENEWAL Reusable Alkaline AA Size Carded 4 Pack
724-4	RENEWAL Reusable Alkaline AAA Size Carded 4 Pack
PS1	RENEWAL POWER STATION 4 Position AA/AAA
PS2	RENEWAL POWER STATION 8 Position AA/AAA/C/D

Alkaline Batteries

Rayovac offers a complete line of high performance zero mercury added alkaline batteries that are made in the U.S.A. Rayovac alkaline batteries are available in both carded and multi-pack.

Stock No.	Description
813	1.5 Volt D Size
814	1.5 Volt C Size
815	1.5 Volt AA Size
824	1.5 Volt AAA Size
A1604	9 Volt Size

Notice

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