Contents
VARTA Program — Lithium-Batteries

Any statements and data in this catalogue are for general information purposes. They represent the latest technical status at the time of printing. We reserve the right to change the data in this catalogue without prior notice. The engineering data are typical values. The technical informations are given in a descriptive way and do not guarantee any properties or enlarge the warranty services given in our terms of delivery. The obtainable values in each individual case — which depend on the application — will be given upon request. For printing errors we take no liability.

Unless stated otherwise, values are related to room temperature (+ 20 °C ± 5 °C).

Further information on the VARTA portable battery program can be obtained from the following catalogues:

- Portable and Micro Batteries Type Range — 40 107 e
- Sealed NC-Accumulators/Sales Program and Technical Handbook — 40 121 e
- Sealed NC-Batteries/ Battery Assemblies — 40 312 e
- Maintenance-free Lead Acid Batteries "accu CF" range — 41 302 e

1. General Information

VARTA is in a position to provide solutions for virtually all battery applications. Due to our extensive range of products VARTA is able to offer batteries constructed from various sizes of lithium cylindrical and button cells.

Lithium ist still a magic word in battery technology. For electronic applications which have long life expectancy high capacity, wide temperature range, high cell voltage, low self discharge and high energy density are a distinct advantage.

Intensive development within VARTA has achieved our new manganese dioxide/lithium system. For applications for low drain requirements, VARTA leads the way with regard to capacity, providing stable voltage for long periods of discharge. For instance, in the modern age of microelectronics, real time clock and memory back-up applications this new VARTA lithium battery is a high performance component capable of storing energy for long life expectancy and high reliability.

VARTA has also introduced further sizes in the button cell range to satisfy future market requirements.

Energy Density of Primary Systems
(related to volume)

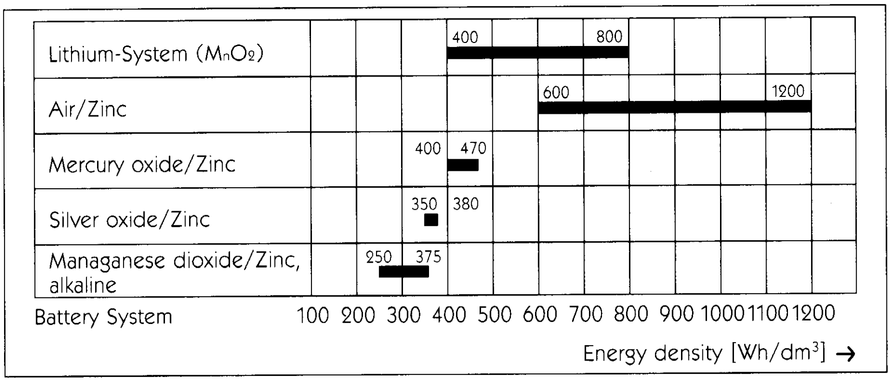


Fig. 1

Typical Discharge Curves of Various Primary Systems

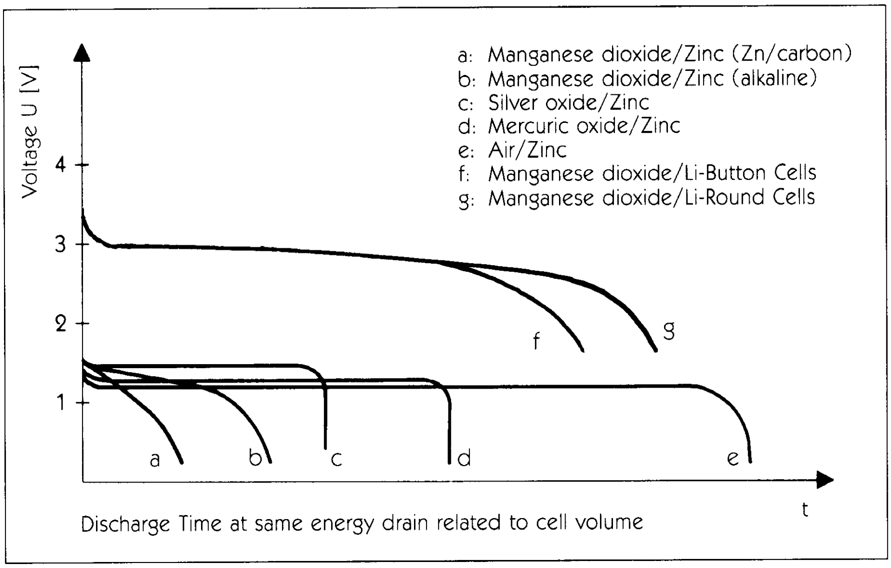


Fig. 2

2. Construction of the Lithium-Cells

Most primary electrochemical couples in production today contain zinc as the anode material and potassium hydroxide as the electrolyte. Battery systems that have improved life characteristics and energy density use lithium in place of zinc as the anode material.

Lithium is the lightest metal in the periodical table in terms of weight; it has only half the specific weight of water.

VARTA lithium batteries use organic non-aggressive, non creeping electrolyte and solid cathode material manganese dioxide.

Lithium Cylindrical Cells

The cylindrical cells CR... A(A) have 1 – 4 MnO_2 rings as positive electrodes depending on the cell length. A separator ist used to separate the negative lithium electrode from the positive manganese dioxide electrode. The outer case is made from stainless steel. The manganese dioxide rings and the separator retain the electrolyte. A stainless steel nail is used as the negative contact. Double synthetic gaskets with a minimum surface area, long diffusion paths and laser welding gives the VARTA lithium CR ... A(A) cells an extremely good sealing characteristic.

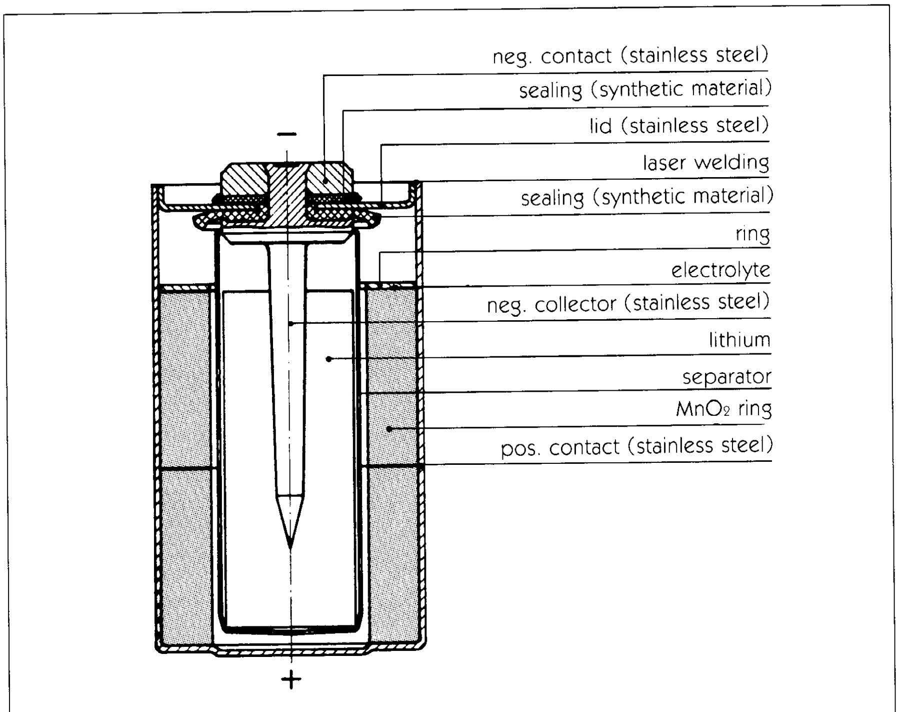


Fig. 3: Schematic construction of a Li/MnO_2-cylindrical cell (CR 1/2 AA)

Lithium Button Cells

VARTA button cells are also based on the well established Li/MnO_2 system. Between the electrodes is a separator and the organic electrolyte.

The stainless steel case is closed to keep under high tension the synthetic seal.

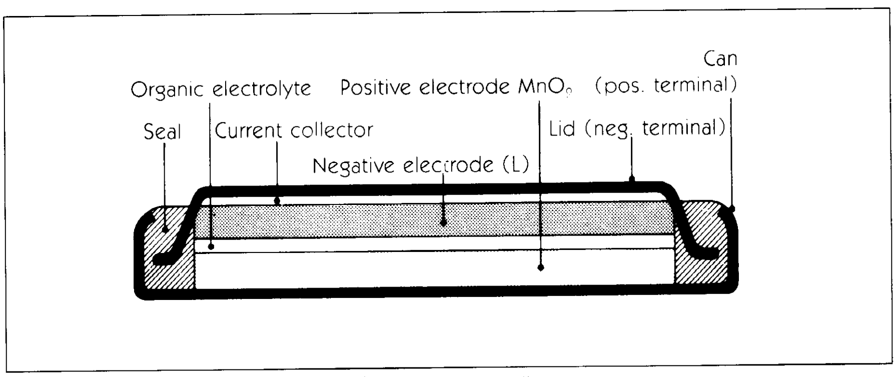


Fig. 4: Schematic construction of a Li/MnO_2-button cell

3. Characteristics and Applications

3.1 Main Characteristics

- Long life expectancy and long operational life
- Low self discharge rate
- High energy density
- High cell voltage (3 V)
- Wide temperature range
- High operating safety
- High reliability
- Resistance to corrosion with full stainless steel case and lid, laser welded
- No leakage problems with an organic non-corrosive electrolyte.

Series	CR-cylindrical cells	CR-button cells
System	Li/MnO_2	Li/MnO_2
Practical energy density	400 – 800 Wh/dm^3	360 – 660 Wh/dm^3
Normal voltage	3.0 V	3.0 V
Open circuit voltage	3.2 V	3.2 V
Available capacity range	400 – 2000 mAh	25 – 500 mAh
Storage properties	≥ 10 years 1)	≥ 5 years
Self discharge $\delta = 20$ °C	< 1 % p.a.	< 1 % p.a.
Operating temperature	– 30 ... + 75 °C 2)4)	– 20 ... + 65 °C
Maximum temperature range (short term) 3)	– 40 ... + 85 °C 4)	– 40 ... + 85 °C
Storage temperature	– 55 ... + 75 °C	– 55 ... + 65 °C

1) CR 123 A, 2 CR 5, CR P2 (> 5 years), 2) CR 123 A, CR 2 NP (– 20 ... + 70 °C), 3) max. about 2 weeks, 4) µA-range

Table 1: System properties of VARTA Lithium cells

3.2 Main Applications

Both the mechanical and electrical properties, together with reliability, ensure that VARTA lithium batteries meet the requirements of modern electronics. They are therefore ideally suited as power sources for the long term supply of micro-electronic circuitry.

For very high reliability, maximum capacity and operational life of up to over 10 years* chose Li/MnO_2 cylindrical cells.

For consumer and other appliances demanding up to 5 years* Li/MnO_2 button cells and small Li/MnO_2 cylindrical cells are recommended.

Depending on the type of equipment being powered, two different battery types, with many types of welded tags or connectors, are available. The VARTA-lithium system with both cylindrical and button cells is the optimal solution for many applications/questions.

The decisive advantage of this VARTA-lithium system over conventional aqueous battery systems is the combination of low self discharge with high practical energy density.

Consult a VARTA battery expert to discuss your application.

VARTA can offer you a suitable battery for all your special applications.

* dependent on application

3.3 List of Applications

- **TELECOM**
  - Credit Card Phones
  - Intercom Systems
  - Mobile Phones
  - Modems
  - Multiplexers
  - PABX's
  - Paging Systems
  - Smart Telephones
  - Switchboards
  - Teletext, BTX
  - Telex Machines
  - Fax Machines

- **PROCESS CONTROL/AUTOMATION**
  - Container Temperature Loggers
  - Crash Recorder
  - Data Transponders
  - Electronic Monitoring
  - Electronic Parking Meters
  - Electronic Traffic Chart Recorders
  - Identification Transponders
  - Intelligent Tags (CIM)
  - Mileage Counters
  - Mobile Data Carriers
  - Navigation Equipment
  - Onboard Computers
  - Taximeters
  - Temperature Controllers
  - Traffic Light Control
  - Traffic Volume Control
  - Programmable Controllers

- **OFFICE AUTOMATION**
  - Address Printers
  - Coin and Banknote Testing Machines
  - Copy Machines
  - Electronic Cash Points (Bank Till)
  - Electronic Weighing Machines
  - Franking Machines
  - Intelligent Interfaces
  - PC Real Time Clock (RTC) and Memory Back-Up (MBU)
  - Point-of-Sale
  - Ticket Vending Machines
  - Typewriters
  - Vending Machines

- **INSTRUMENTATION/METERING**
  - Automatic Weather and Pollution Monitoring Systems
  - Biotelemetry
  - Data Acquisition Systems
  - Event Counters
  - Industrial Clocks
  - Remote Data Logging

- **UTILITY METERS**
  - Calory Meters
  - Electricity Tariff Meters
  - Gas Meters
  - Heat Distribution Meters
  - Water Meters

- **HOUSEHOLD APPLIANCES**
  - Burgler Alarm Systems
  - Electronic Doorlockers
  - Intelligent Heat Control
  - Smoke and other Sensors

- **END CONSUMER**
  - Car Radios
  - Electronic Altimeters
  - HiFi Receivers
  - Marine Electronics
  - Scuba Diving Meters
  - Video Games
  - Video Recorders

4. Applications Instructions and Recommendations

- VARTA Lithium batteries are most suitable as a standby power source for supply of electronic memory (RAM) and Real-Time-Clock (RTC) devices in case of loss of V_{CC} due to mains power failure or any other reason.

The Lithium batteries are blocked from the power supply by means of a diode to prevent discharge of the battery into the DC supply during shut down.

The voltage drop across D1 should be taken into account as the minimum voltage of the load has to be maintained under all circumstances.

Blocking diode D2 prevents the battery from being charged through the power supply. The amount of accumulated reverse current (I_R) must not exeed 1% of the cells typical capacity during it's standby life time (see table 2).

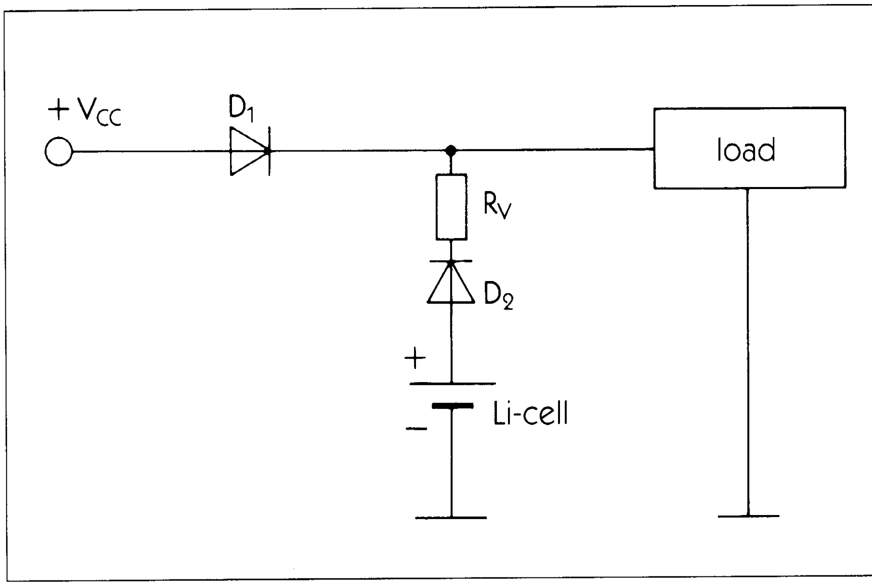


Fig. 5 Blocking circuit with current limiting resistor R_V in case of D_2-failure

In the absence of a DC supply voltage, the Lithium battery supplies the load with the necessary power.

As diodes fail at low current levels by an alloy-effect causing a severe reduction in impedance, an additional safety device must be incorporated.

"UL" requires eihter an additional diode, or a resistor, limiting the current to a safe level of 4 mA (for all cylindrical CR...A (A) Lithium cells).

It should be noted, that the value of the resistor has to be calculated using the higher power supply voltage – not the battery voltage.

The supply voltage to the load can be calculated by the battery voltage drop across the diode and the resistor.

Type	1 Year	3 Years	5 Years	10 Years
CR 1/4 AA	411	137	82	41
CR 1/2 AA	1084	361	217	108
CR 2/3 AA	1541	514	308	154
CR AA	2283	761	457	228
CR 2/3 A	1541	514	308	154

Table 2: Maximum Reverse Current in Nano-Amps

Calculation Example

GIVEN QUANTITIES

Supply Voltage (V_{CC}) : 5V

Load Voltage: 5V, +/– 10%

Load Current (Operation): 1 mA

Load Current (Standby): 10 µA

OPERATION MODE:

Load Voltage:

a) Voltage drop across D_1 = Schottky 0.3V
Load Voltage: 5V – 0.3V = 4.7V

b) Voltage drop across D_1 = Silicon 0.7V
Load Voltage: 5V – 0.7V = 4.3V

In this case, D_1 has to be a Schottky Diode.

Calculation of R_V:

V_{CC} 5V – voltage drop 0.3V = 4.7V
4.7V/4 mA = 1,175 Ohm ≙ 1.2 kOhm resistor.

STANDBY-MODE:

Load Voltage:

10µA × 1.2 kOhm = 0.012V

Voltage drop across D_2 = Silicon 0.3V (0.3V instead 0.7V. as diode operates at 10µA at the lower voltage fold back)

Battery voltage at 10µA = 3.1V

Load voltage: 3.1V – 0.312V = 2.788V

Printed Circuit Board Mounting

VARTA lithium batteries, with solder tags, are suitable for PCB soldering in automatic flow soldering baths.

Solder temperature: Approx. 265 °C
Solder time max.:Approx. 10 secs.

During the solder process, an immeasureable amount of capacity is lost, due to the short circuiting of the battery in the solder bath.

Short Circuit

In table 3 is the temperature at short circuit at an ambient temperature of 20 °C, 40 °C and 70 °C listed. Figure 6 represent the temperature of the CR 1/2 AA at short circuit at 20 °C, 40 °C and 70 °C. The short circuit current of the CR 1/2 AA shows figure 7.

Ambient temperature	CR 1/4 AA	CR 1/2 AA	CR 2/3 AA	CR AA
20 °C	25 °C	24 °C	28 °C	24 °C
40 °C	48 °C	50 °C	50 °C	47 °C
70 °C	80 °C	80 °C	84 °C	77 °C

Table 3: Temperature at short circuit

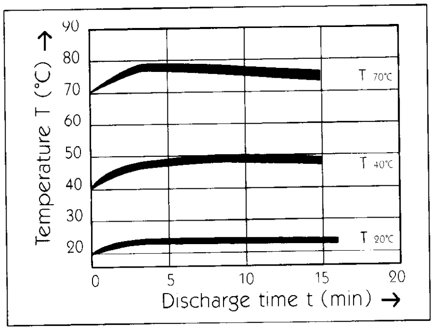


Fig. 6 Temperature at short circuit (CR 1/2 AA)

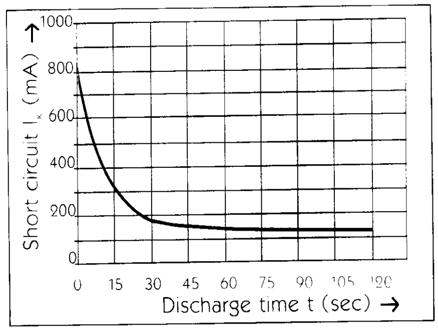


Fig. 7 Short circuit current (CR 1/2 AA)

UL-Recognition

The following VARTA lithium cells/batteries are recognized by Underwriters Laboratories Inc. under UL-file number **MH 13654 (N)** :

Cylindrical cells/batteries	**Button cells**
CR 1/4 AA	CR 2016
CR 1/2 AA	CR 2025
CR 2/3 AA	CR 2032
CR AA	CR 2430
CR 2/3 A	
CR 123 A	
CR-P2	

The cells are marked with the Recognized Component Mark.

Underwriters Laboratories requires for lithium cells/batteries a circuit, which must contain a protective component to prevent charging (see application instructions and recommendations, page 7). In case of diode failure a current limiting resistor must be chosen according to the following guidelines:

Type	max. safe reverse current acc. to UL
CR 1/4 AA	4 mA
CR 1/2 AA	4 mA
CR 2/3 AA	4 mA
CR AA	4 mA
CR 2/3 A	4 mA
CR 123 A	10 mA
CR-P2	10 mA
CR 2016	2,5 mA
CR 2025	5 mA
CR 2032	5 mA
CR 2430	5 mA

Table 4:
VARTA recommends to choose 10 × higher reverse current in failure mode as average discharge current as a maximum safe value, provided this value is below the max. UL rating.

Please pay also attention to the Safety Guidelines on page 35.

Safety tests*

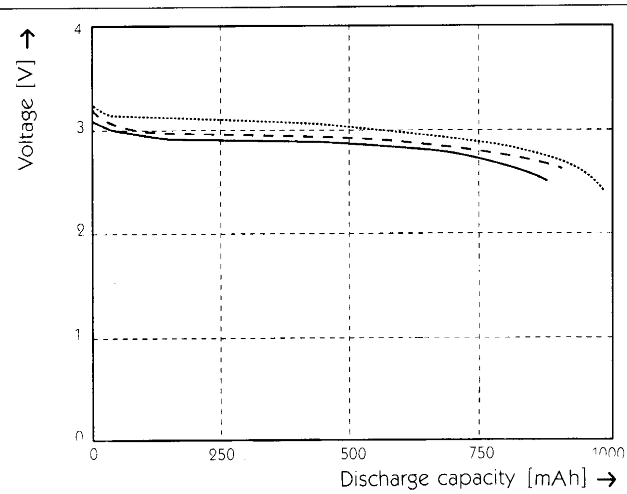
Test	Results
— Compression test Cell compression	— no significant electrolyte loss — no rupturing
— Puncture test total penetration of the cell by a nail Ø 3 mm	— no splashing or pressurized electrolyte loss — no rupturing
— In short circuit condition 24 h 0.1 Ohm	— after 24 h the bottom of the cell is curved by only 0.1 mm; diameter unchanged — no electrolyte creepage or loss — no rupturing
— Test at 150 °C for 2 hours	— open circuit voltage almost unchanged at 3.2 V — the cell base bowed, causing cell height to increase by 1 mm, diameter unchanged — no electrolyte creepage or loss — no rupturing

* For safety aspects please consult VARTA before performing these extreme tests.

Vibration test

Test	Results
— Frequency area: 5 Hz → 55 Hz → 500 Hz → 55 Hz → 5 Hz — Amplitude at frequency area 5 Hz to 55 Hz: ± 0.75 mm — Acceleration at frequency area 55 Hz to 500 Hz: 100 m/s² — Cycle duration: 15 min — Oscillation time of each main axis: 3 h	Without changing of the electrical values the following Li-cells can be exposed to this vibration test: — CR 1/4 AA — CR 1/2 AA — CR 2/3 AA — CR AA

Temperature characteristics



CR 1/2 AA

conditions:
20 h/20 °C 1.5 kΩ
4 h/at various temp. 270 kΩ
discharge: 270 kΩ
.... 75 °C
– – – – – 20 °C
———— −30 °C

5. Selection Guide

To enable battery selection the following is required:

- discharge current and maximum discharge time → capacity
- operation temperature range → self discharge → surplus capacity requirement
- cell size

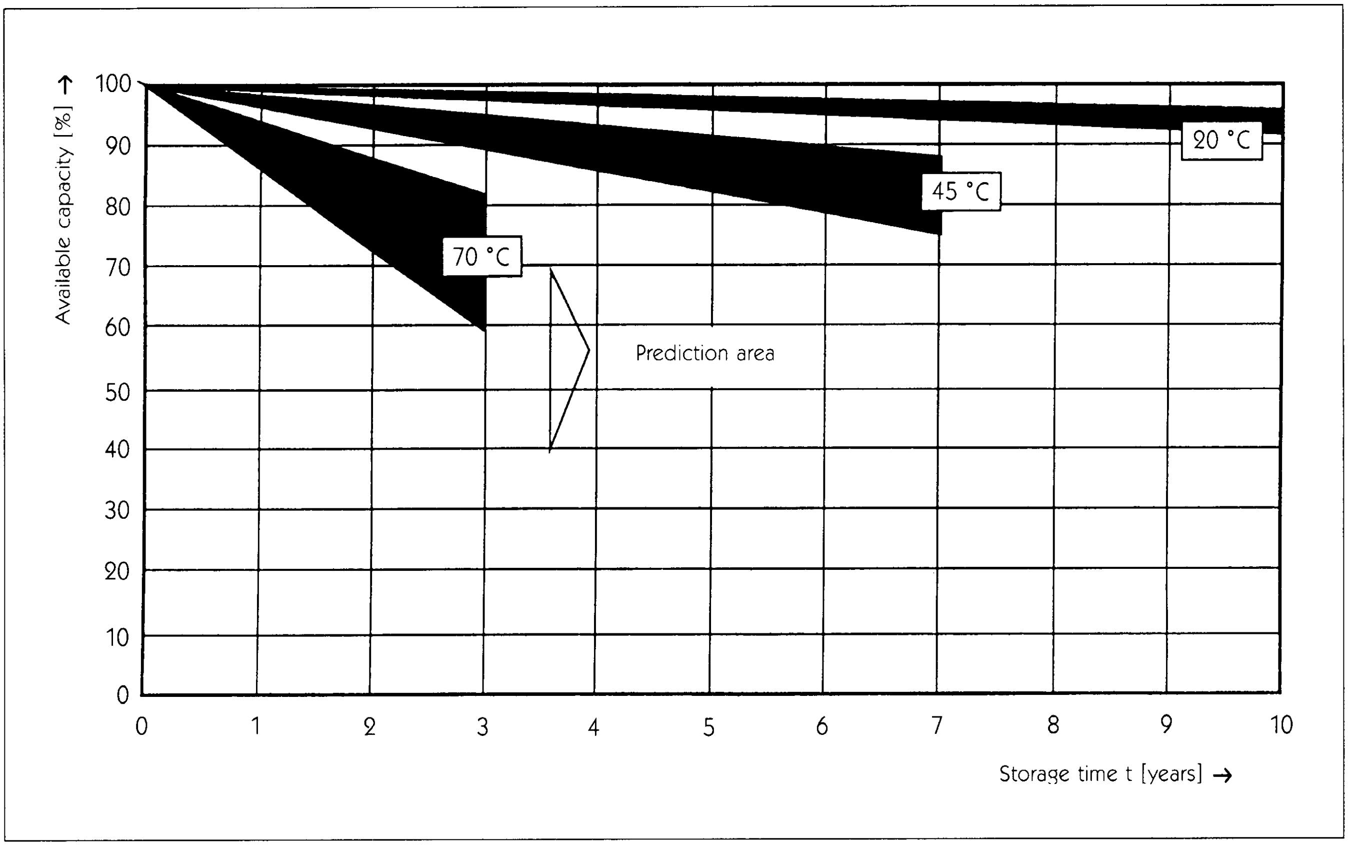


Fig. 8
Charge retention characteristics of VARTA-lithium cells

CR 123 A, 2 CR 5, CR-P2 and button cells CR... (up to approx. 5 years)
Cylindrical cells CR...AA,CR...A and CR 2 NP (up to approx. 10 years)

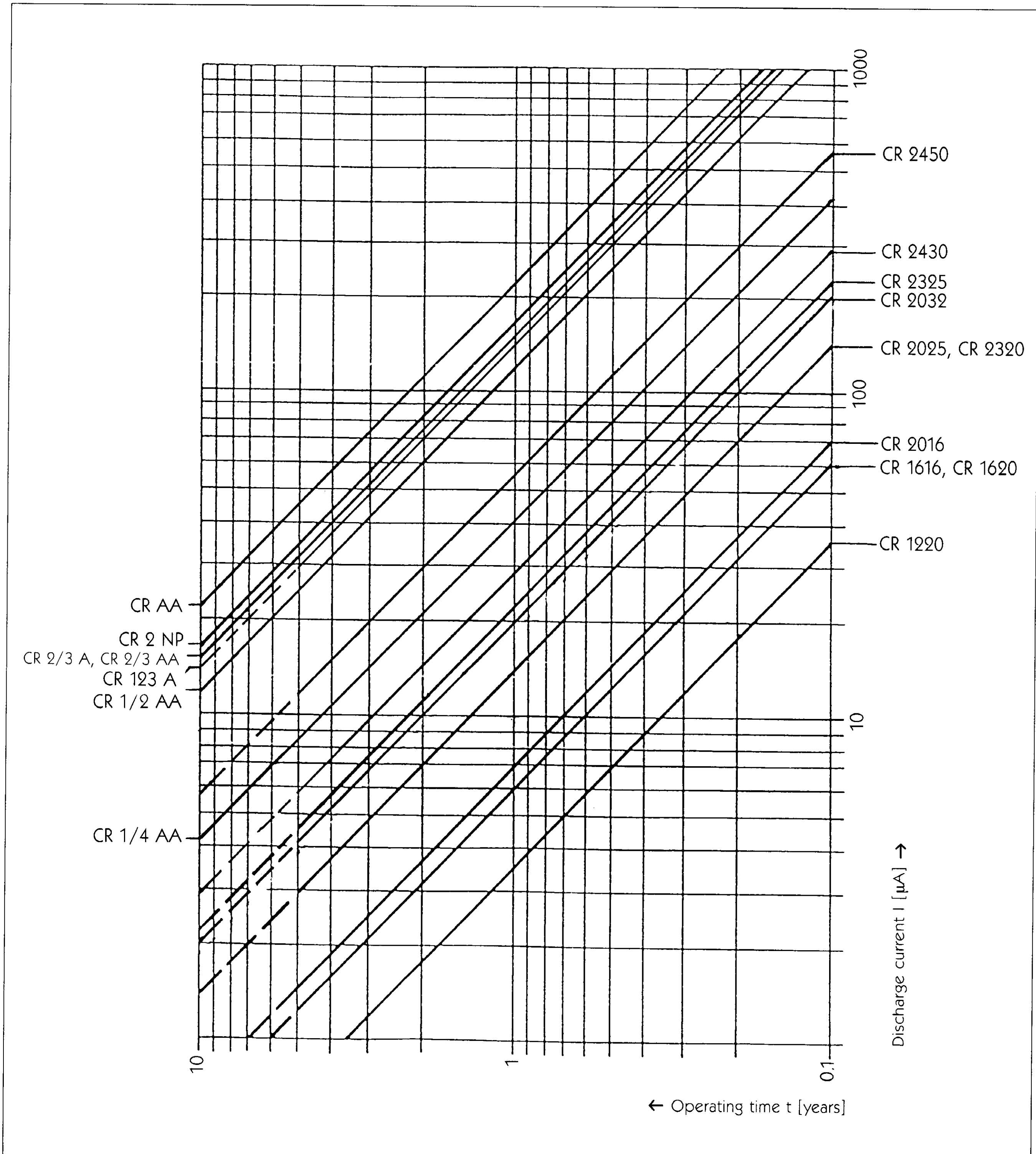
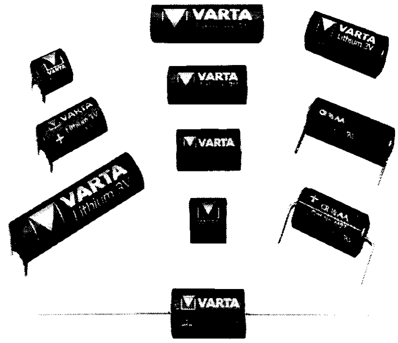


Fig. 9 Discharge current/Operating time
Battery selection diagramme

6. Lithium Cylindrical Cells CR...

6.1 Technical Data



Type	CR 1/4 AA	CR 1/2 AA	CR 2/3 AA	CR AA	CR 2/3 A	CR 123 A	CR 2 NP
Order-No.	6147101501	6127101501	6237101501	6117101501	6238101501	6205101401[2]	6202101501
Nominal voltage	3 V	3 V	3 V	3 V	3 V	3 V	3 V
Typical capacity at 20°C, down to 2.0 V, load	400 mAh 2,0 kΩ	950 mAh 5,6 kΩ	1,350 mAh 1,0 kΩ	2,000 mAh 1,0 kΩ	1,350 mAh 1,0 kΩ	1,300 mAh 200 Ω	1,400 mAh 1,0 kΩ
max. continuous discharge current	5 mA	10 mA	15 mA	20 mA	15 mA	250 mA	15 mA[1]
Weight	6 g	11,5 g	15 g	21,5 g	17 g	16 g	13 g

Table 5:

[1] Current value for obtaining 50% nominal capacity, [2] in blister card (1pc)

Type	Order No.	Dimensions (mm) A	B	C	D	E	F	G	H	I	K	L	M	Fig. No.	Remarks
CR 1/4 AA	6147101501	$14.75_{-0.3}$	$14.0_{-0.4}$	–	–	–	–	–	–	–	–	$7.0_{\pm0.2}$	$0.6_{\pm0.1}$	10	
CR 1/4 AA SLF	6147201501	$14.75_{-0.3}$	$14.0_{-0.4}$	$10.0_{\pm0.15}$	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$14.2_{\pm0.2}$	–	3.0	$5.0_{\pm0.25}$	–		11	
CR 1/4 AA LF	6147301501	$14.75_{-0.3}$	$14.0_{-0.4}$	10.0	–	$3.5_{\pm0.1}$	2.1	$14.2_{\pm0.2}$	2.5	–	–	–	–	12	
CR 1/4 AA CD	6147501501	$14.75_{-0.3}$	$14.0_{-0.4}$	45.0	–	–	–	–	–	–	–	–	–	19	
CR 1/4 AA SLF single pin	6147701501	$14.75_{-0.3}$	$14.0_{-0.4}$	–	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$14.2_{\pm0.2}$	–	3.0	–	–	–	14	
CR 1/2 AA	6127101501	$14.75_{-0.3}$	$25.1_{-0.2}$	–	–	–	–	–	–	–	–	$7.0_{\pm0.2}$	$0.6_{\pm0.1}$	10	
CR 1/2 AA SLF	6127201501	$14.75_{-0.3}$	$25.1_{-0.2}$	$10.0_{\pm0.15}$	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$25.4_{\pm0.1}$	–	3.0	$5.0_{\pm0.25}$	–	–	11	
CR 1/2 AA LF	6127301501	$14.75_{-0.3}$	$25.1_{-0.2}$	10.0	–	$3.5_{\pm0.1}$	2.1	$25.4_{\pm0.1}$	2.5	–	–	–	–	12	
CR 1/2 AA CD	6127501501	$14.75_{-0.3}$	$25.1_{-0.2}$	45.0	–	–	–	–	–	–	–	–	–	19	
CR 1/2 AA CD (90°)	6127601501	$14.75_{-0.3}$	$25.1_{-0.2}$	$7.5_{\pm1.5}$	–	–	–	$33.5_{-1.5}$	–	–	–	–	–	18	
CR 1/2 AA SLF single pin	6127701501	$14.75_{-0.3}$	$25.1_{-0.2}$	–	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$25.5_{\pm0.1}$	–	3.0	–	–	–	14	
CR 1/2 AA LF (180°)	6127801501	$14.75_{-0.3}$	$25.1_{-0.2}$	14.5	–	3.0	–	$25.3_{\pm0.1}$	–	–	–	–	–	16	Tag: 0.15 mm
CR 1/2 AA SLF single short pin	6127901501	$14.75_{-0.3}$	$25.1_{-0.2}$	–	–	$1.0_{\pm0.1}$	–	$25.5_{\pm0.1}$	–	3.0	–	–	–	15	Tag: 0.25 mm
CR 2/3 AA	6237101501	$14.75_{-0.3}$	$33.5_{-0.4}$	–	–	–	–	–	–	–	–	$7.0_{\pm0.2}$	$0.6_{\pm0.1}$	10	
CR 2/3 AA SLF	6237201501	$14.75_{-0.3}$	$33.5_{-0.4}$	$10.0_{\pm0.15}$	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$33.7_{\pm0.2}$	–	3.0	$5.0_{\pm0.25}$	–	–	11	
CR 2/3 AA LF	6237301501	$14.75_{-0.3}$	$33.5_{-0.4}$	10.0	–	$3.5_{\pm0.1}$	2.1	$33.7_{\pm0.2}$	2.5	–	–	–	–	12	
CR 2/3 AA CD	6237501501	$14.75_{-0.3}$	$33.5_{-0.4}$	45.0	–	–	–	–	–	–	–	–	–	19	
CR 2/3 AA SLF single pin	6237701501	$14.75_{-0.3}$	$33.5_{-0.4}$	–	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$33.7_{\pm0.2}$	–	3.0	–	–	–	14	
CR AA	6117101501	$14.75_{-0.3}$	50.5_{-1}	–	–	–	–	–	–	–	–	$7.0_{\pm0.2}$	$0.6_{\pm0.1}$	10	
CR AA SLF	6117201501	$14.75_{-0.3}$	50.5_{-1}	$10.0_{\pm0.15}$	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$50.4_{\pm0.3}$	–	3.0	$5.0_{\pm0.25}$	–	–	11	
CR AA LF	6117301501	$14.75_{-0.3}$	50.5_{-1}	10.0	–	$3.5_{\pm0.1}$	2.1	$50.4_{\pm0.3}$	2.5	–	–	–	–	12	
CR AA CD	6117501501	$14.75_{-0.3}$	50.5_{-1}	45.0	–	–	–	–	–	–	–	–	–	19	
CR AA SLF single pin	6117701501	$14.75_{-0.3}$	50.5_{-1}	–	$1.0_{\pm0.5}$	$1.0_{\pm0.1}$	–	$50.4_{\pm0.3}$	–	3.0	–	–	–	14	
CR 2/3 A	6238101501	$17.0_{-0.5}$	$33.5_{-0.4}$	–	–	–	–	–	–	–	–	$7.0_{\pm0.2}$	$0.4_{\pm0.1}$	7	
CR 2/3 A LF	6238301501	$17.0_{-0.5}$	$33.5_{-0.4}$	10.0	–	$3.5_{\pm0.1}$	2.1	$33.7_{\pm0.2}$	2.5	–	–	–	–	9	
CR 2/3 A CD	6238501501	$17.0_{-0.5}$	$33.5_{-0.4}$	45.0	–	–	–	–	–	–	–	–	–	16	
CR 123 A	6205101501	17.0_{-1}	$34.5_{-2.5}$	–	–	–	–	–	–	–	–	6.25	0.5 minimum	10	
CR 2 NP	6202101501	$11.6_{-0.4}$	60_{-1}	–	–	–	–	–	–	–	–	3	1.5	10	
CR 2 NP SLF	6202201501	$11.6_{-0.4}$	60_{-1}	$10.0_{\pm0.15}$	pos.: $0.5_{\pm0.2}$ neg.: $0.7_{\pm0.2}$	1.0	–	$58.8_{\pm0.3}$	–	3.0	$5.0_{\pm0.25}$	–	–	17	
CR 2 NP LF	6202301501	$11.6_{-0.4}$	60_{-1}	pos. 11 neg. 10	–	4.0	–	$58.8_{\pm0.3}$	–	–	–	–	–	13	

Table 6:

Tag

Material: nickel plated sheet-steel

Tag thickness: 0.2 mm

In case of higher quantities special customer cell assemblies are possible.

Fig. 10 **without tags**

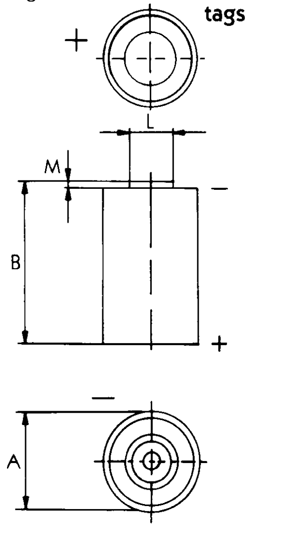


Fig. 11 **SLF**

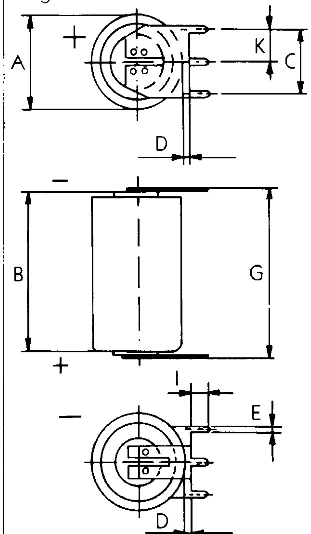


Fig. 12 **LF**

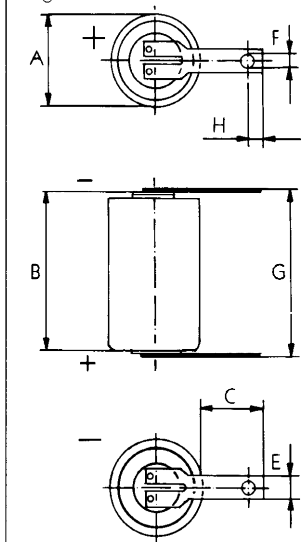


Fig. 13 **LF**

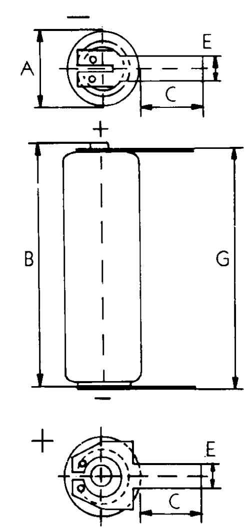


Fig. 14 **SLF single pin**

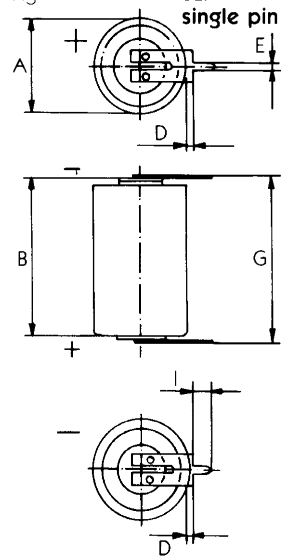


Fig. 15 **SLF single pin short**

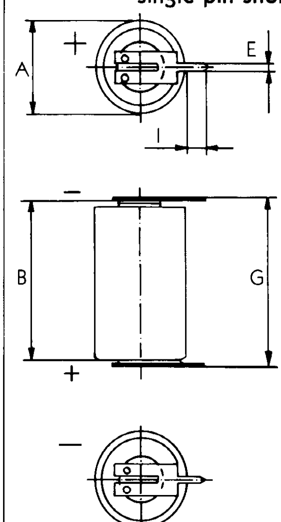


Fig. 16 **LF 180°**

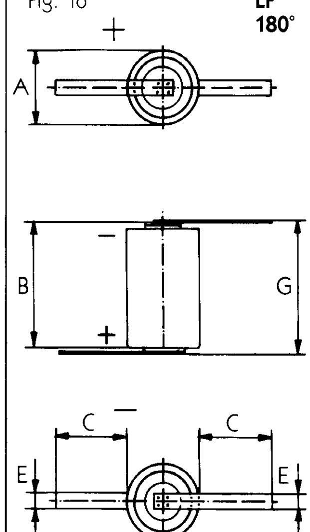


Fig. 17 **SLF**

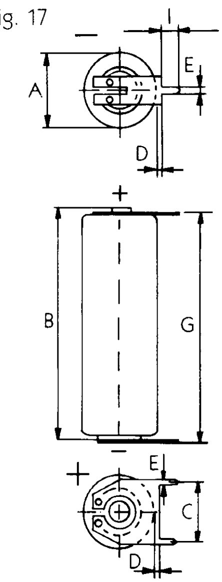


Fig. 18 **CD 90°**

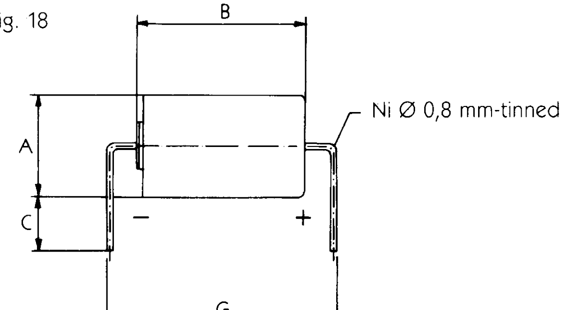
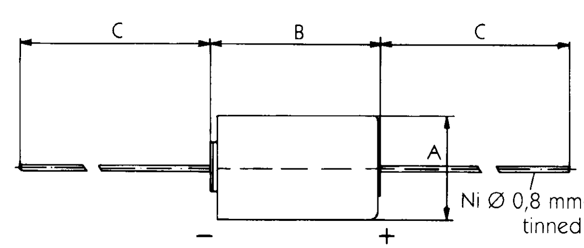


Fig. 19 **CD**



6.3 Discharge data

Fig. 20
CR 1/4 AA
Load: cont. 2 kΩ:U_b
Impuls-load: 2s/2h 510 Ω:U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 510Ω and T_t = 2s
Temperature: δ = 20 °C

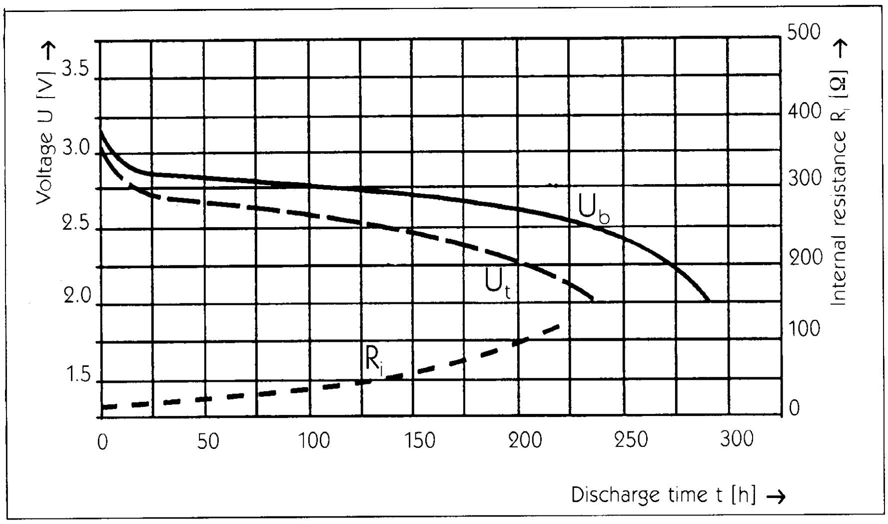


Fig. 21
CR 1/2 AA
Load: cont. 1 kΩ:U_b
Impuls-load: 2s/1h 200 Ω:U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 200Ω and T_t = 2s
Temperature: δ = 20 °C

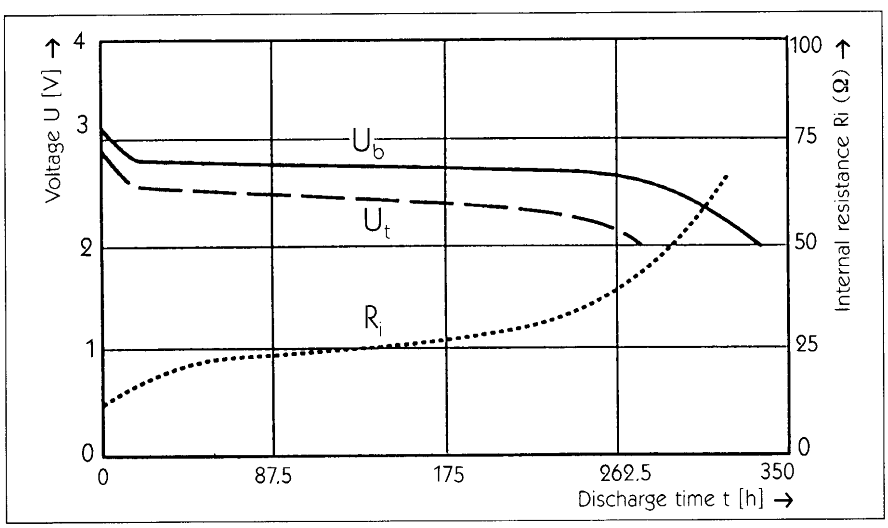
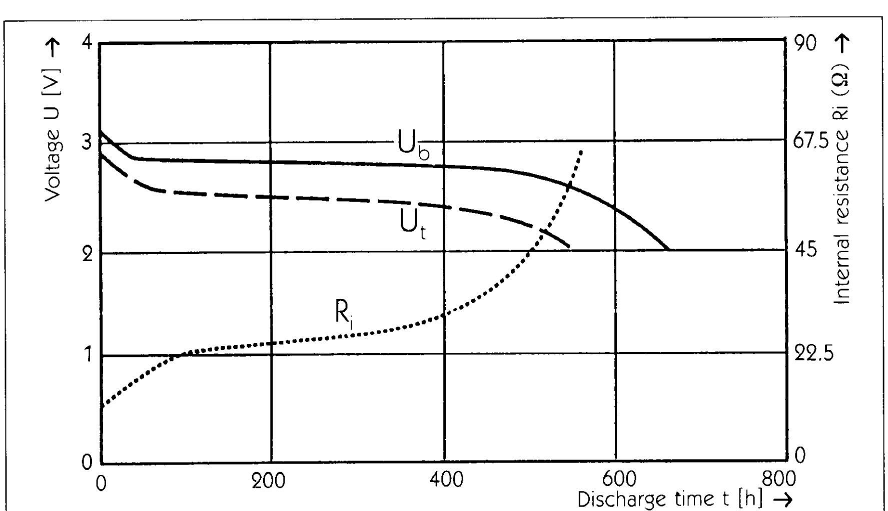


Fig. 22
CR 1/2 AA
Load: cont. 2 kΩ:U_b
Impuls-load: 2s/1h 200 Ω:U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 200Ω and T_t = 2s
Temperature: δ = 20 °C



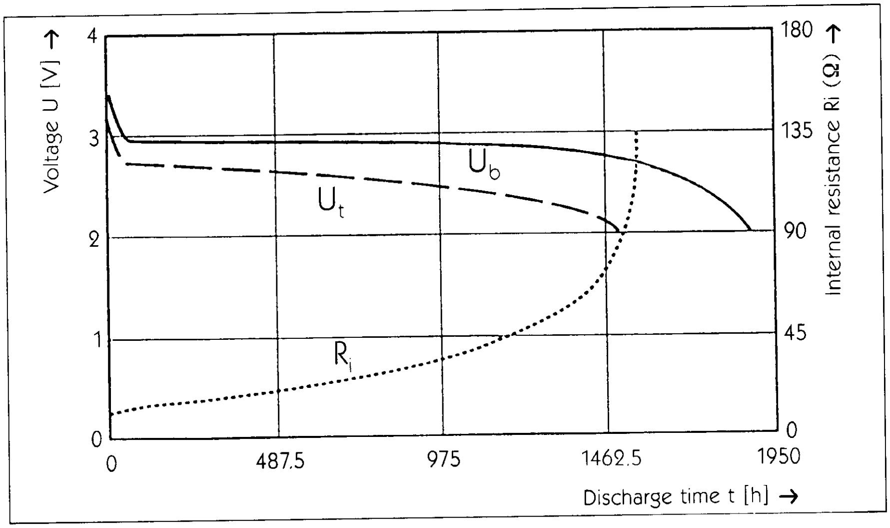


Fig. 23
CR 1/2 AA
Load: cont. 5.6 kΩ:U_b
Impuls-load: 2s/1h 200 Ω:U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 200Ω and T_t = 2s
Temperature: δ = 20 °C

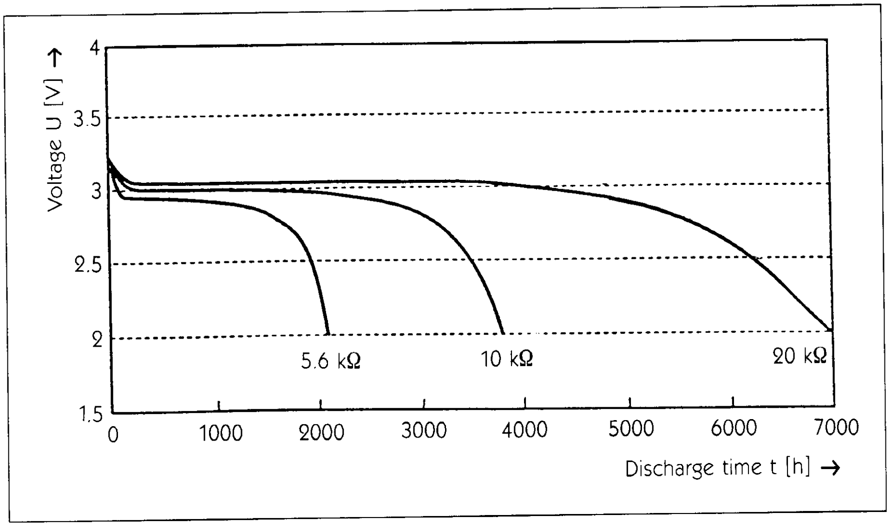


Fig. 24
CR 1/2 AA
Load: R_1 = 5.6 kΩ
R_2 = 10 kΩ
R_3 = 20 kΩ
Mean discharge current:
I_1 = 0.5 mA
I_2 = 0.3 mA
I_3 = 0.15 mA
Temperature: δ = 20 °C

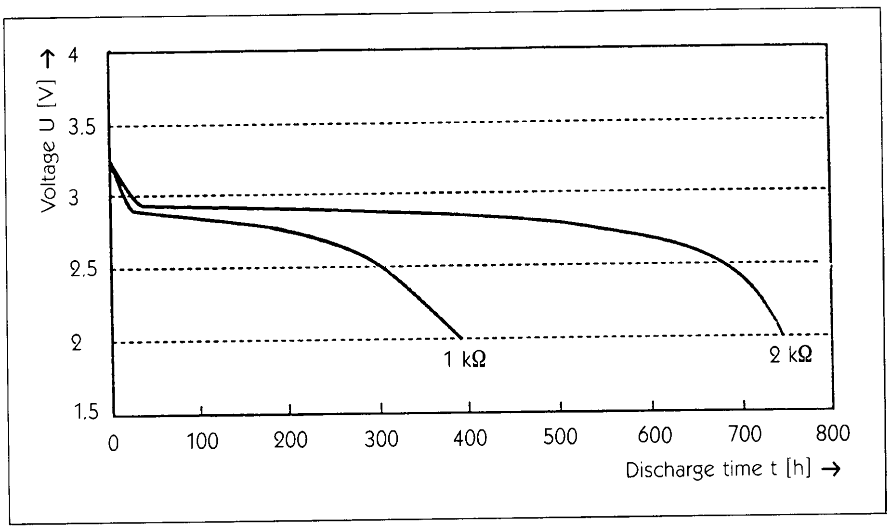


Fig. 25
CR 1/2 AA
Load: R_1 = 1 kΩ
R_2 = 2 kΩ
Mean discharge current:
I_1 = 2.6 mA
I_2 = 1.4 mA
Temperature: δ = 20 °C

Fig. 26

CR 2/3 AA, CR 2/3 A

Load: cont. 1 kΩ:U_b
Impuls-load: 2s/2h 200 Ω:U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 200Ω and T_t = 2s

Temperature: δ = 20 °C

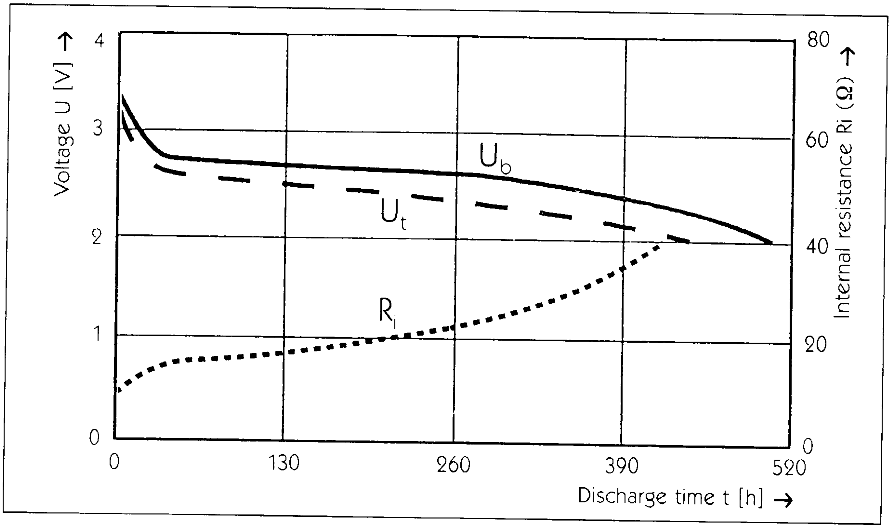


Fig. 27

CR AA

Load: cont. 620 Ω:U_b
Impuls-load: 2s/1h 200 Ω:U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 200Ω and T_t = 2s

Temperature: δ = 20 °C

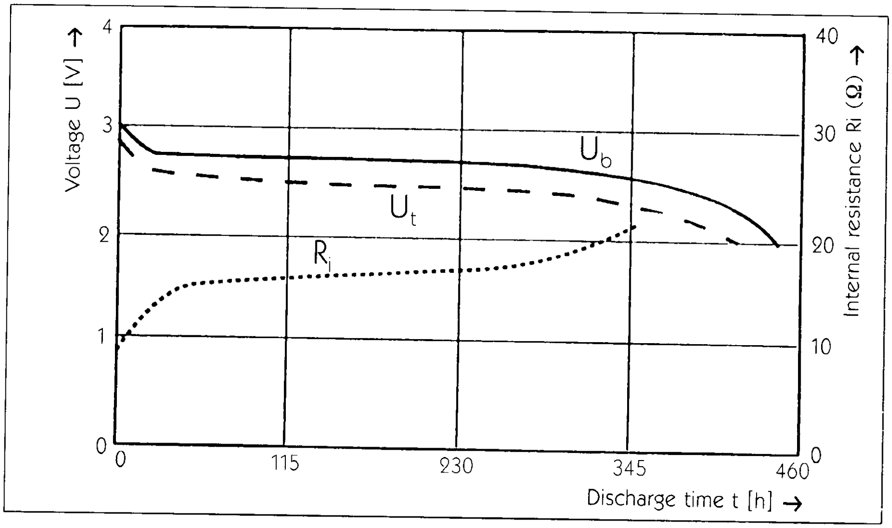


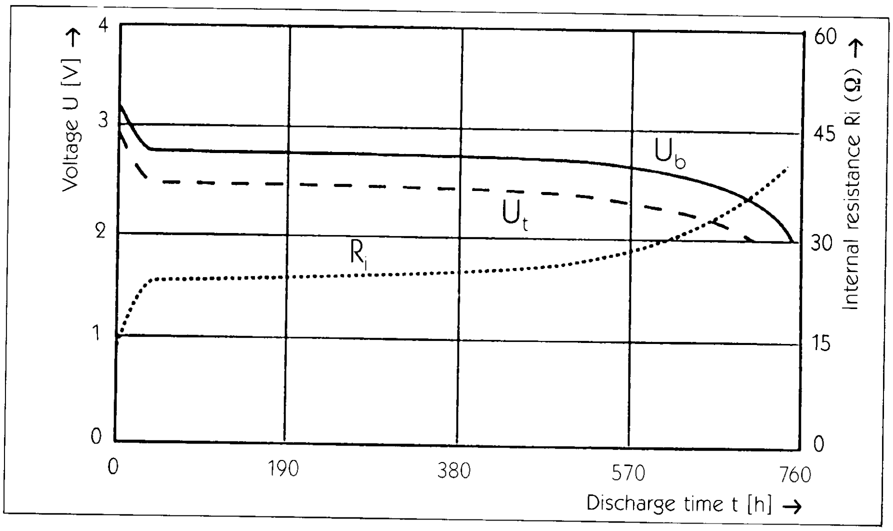
Fig. 28

CR AA

Load: cont. 1 KΩ:U_b
Impuls-load: 2s/1h 200 Ω:U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 200Ω and T_t = 2s

Temperature: δ = 20 °C



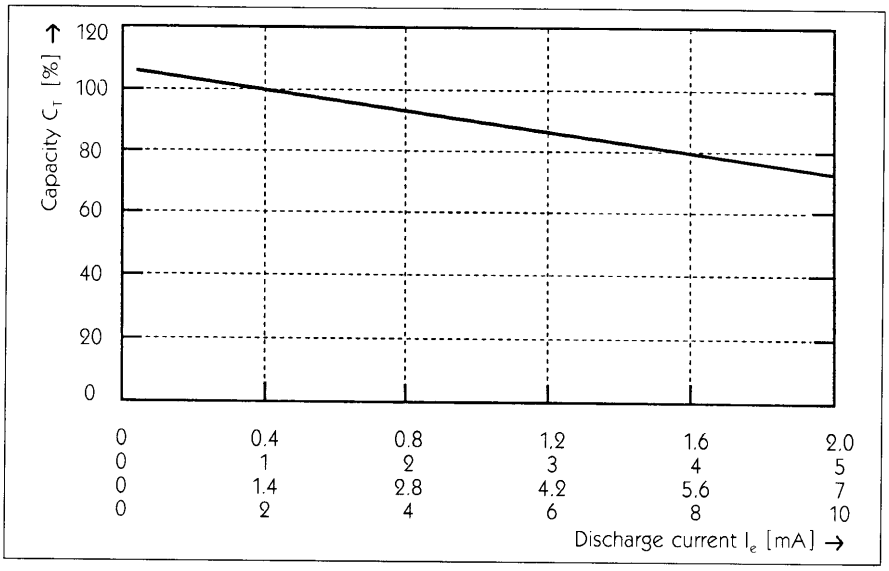


Fig. 29

CR 1/4 AA
CR 1/2 AA
CR 2/3 AA, CR 2/3 A
CR AA

Dependance of cpacity/load

CR 1/4 AA: C_T = 400 mAh
CR 1/2 AA: C_T = 950 mAh
CR 2/3 A, CR 2/3 AA: C_T = 1350 mAh
CR AA : C_T = 2000 mAh

Temperature: $\delta = 20$ °C

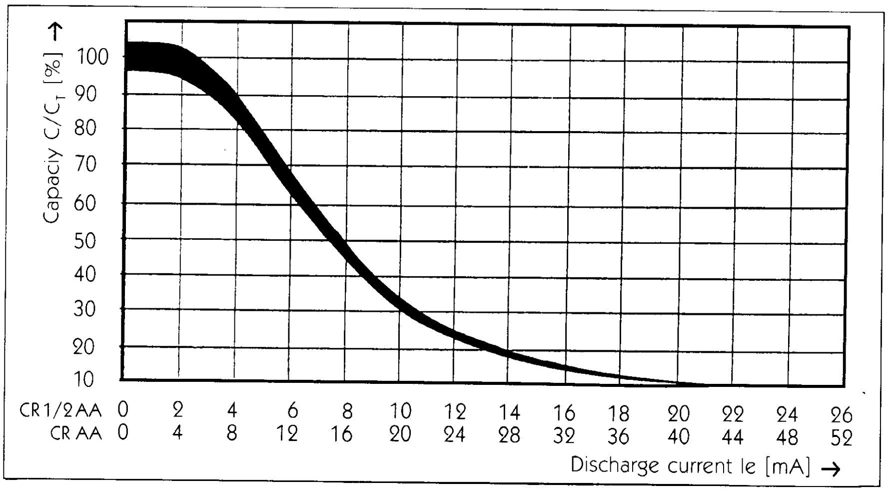


Fig. 30

CR 1/2 AA
CR AA

Capacity dependance on load
(cont. load)
Temperature: $\delta = 20$ °C

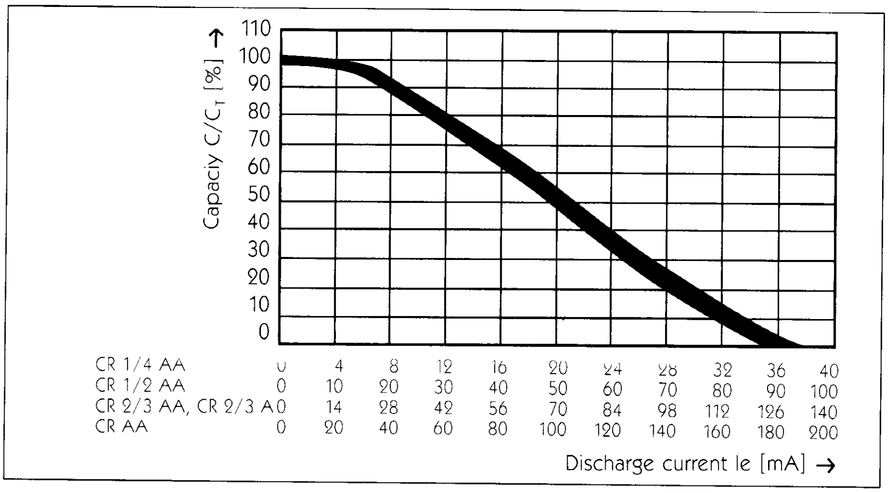


Fig. 31

CR 1/4 AA
CR 1/2 AA
CR 2/3 AA, CR 2/3 A
CR AA

Capacity dependance on load
Impuls-load: 1min load, 59min break
Temperature: $\delta = 20$°C

Abb. 32

CR 1/4 AA
CR 1/2 AA
CR 2/3 AA
CR AA

Typical
Discharge curve

CR 1/4 AA : I_e = 4 µA
CR 1/2 AA : I_e = 10 µA
CR 2/3 AA : I_e = 15 µA
CR AA : I_e = 23 µA

Temperature: δ = 20 °C

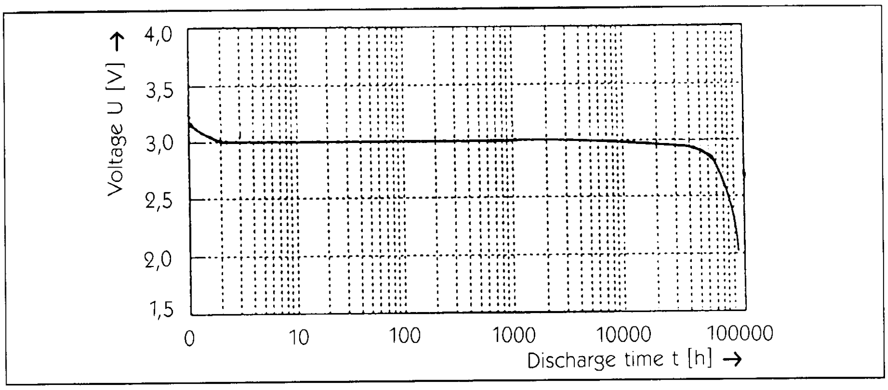


Fig. 33

CR 123 A

Load: cont. 200 Ω

Temperature: δ = 20 °C

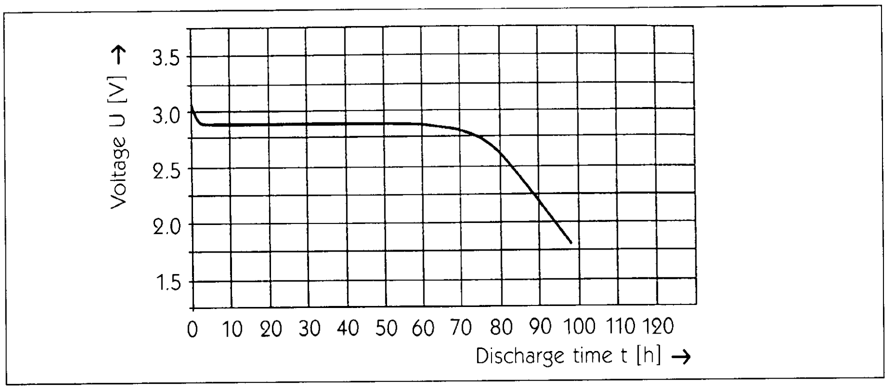


Fig. 34

CR 123 A

Impuls-load:
15 s/m, 7 d/w 3.9 Ω

Temperature: δ = 20 °C

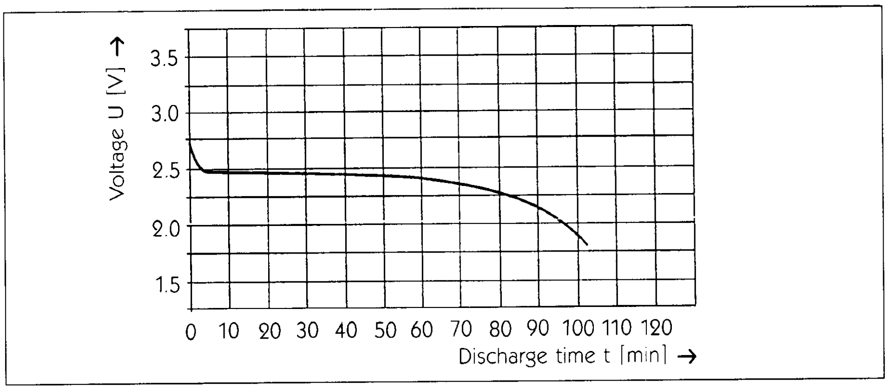
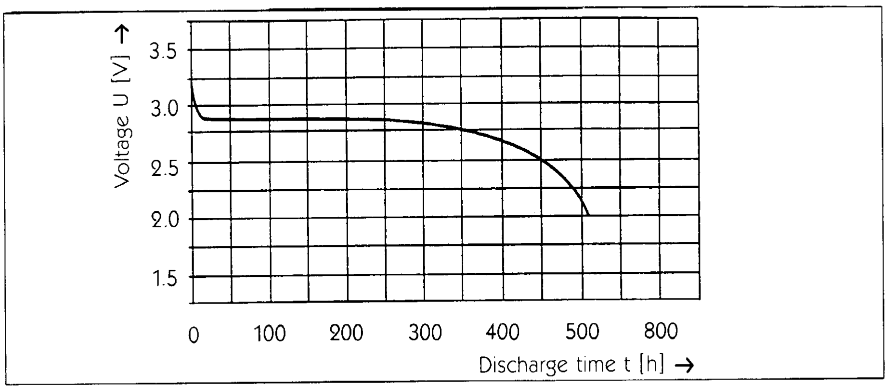


Fig. 35

CR-2 NP

Load: cont. 1 kΩ

Temperature: δ = 20 °C



7. Lithium-Batteries…CR…

7.1 Technical data and type designations

Technical data

Type	2/CR 1/2 AA	2/CR AA	3/CR 1/2 AA	2 CR 5	CR-P2
Version	with wire and standard connector in shrink sleeve with mounting band[1]	with wire and standard connector in shrink sleeve with mounting band[1]	with press stud connectors in plastic case and blocking diode to prevent charging of battery	with surfaces of contact in plastic case	with surfaces of contact in plastic case
Order-No.	6127502077	6117502063	6127503074	6203101401 [2]	6204101401 [2]
Nominal voltage	6 V	6 V	9 V	6 V	6 V
Typical capacity **at 20°C, down to** **on load**	950 mAh 4.0 V 11.0 kΩ	2,000 mAh 4.0 V 2.0 kΩ	950 mAh 6.0 V 16.0 kΩ	1,500 mAh 4.0 V 390 Ω	1,300 mAh 4.0 V 390 Ω
Weight	26.5 g	45.7 g	36.9 g	42 g	38 g

Table 7:

[1] also available with blocking diode to prevent charging of battery

[2] in blister card (1pc)

Type designations

Fig. 36 **2/CR 1/2 AA**

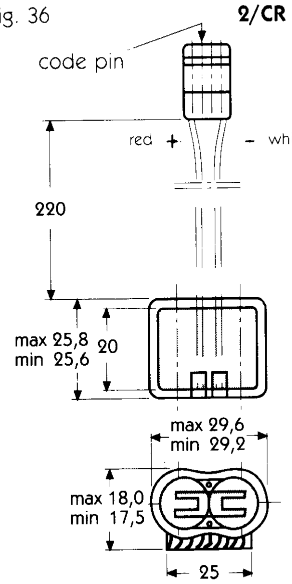


Fig. 37 **2/CR AA**

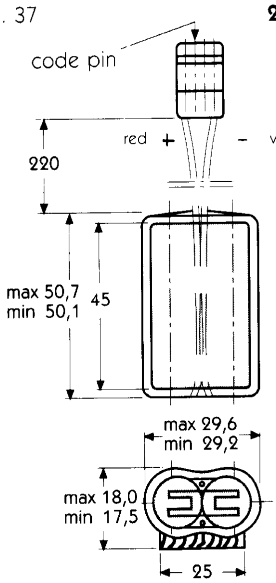


Fig. 38 **3/CR 1/2 AA**

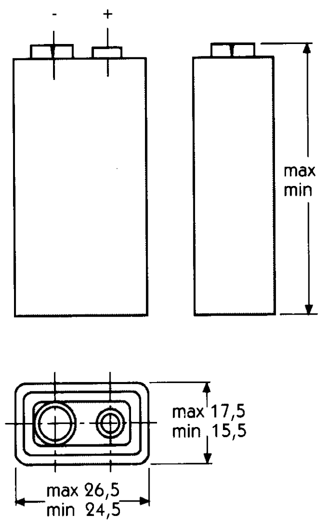


Fig. 39 **2 CR 5**

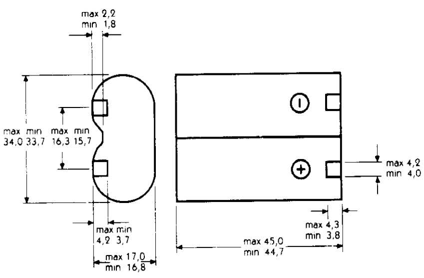
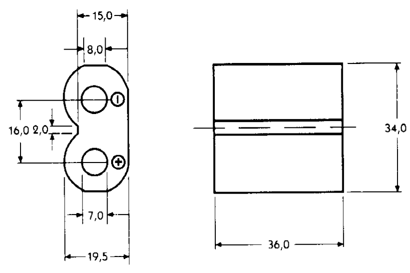


Fig. 40 **CR-P2**



In case of higher quantities special customer battery assemblies are possible.

7.2 Discharge data

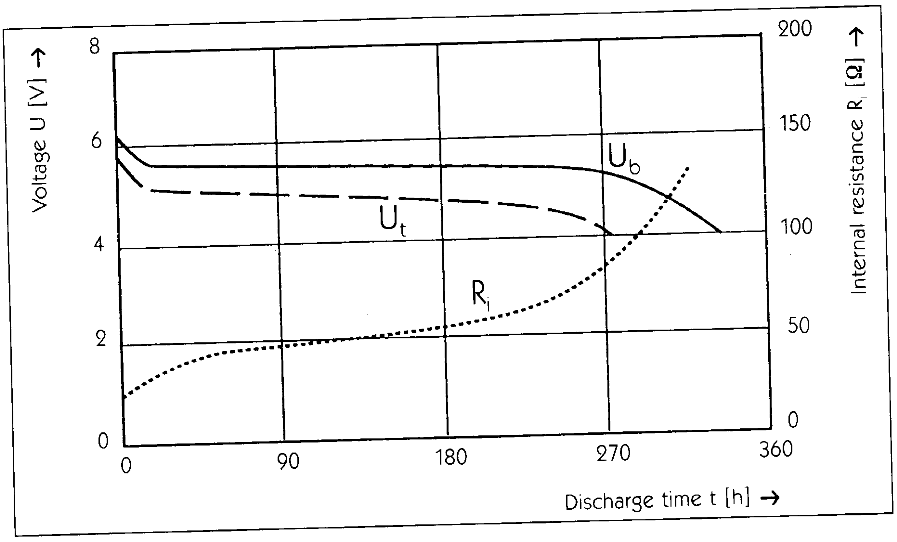


Fig. 41
2/CR 1/2 AA
Load: cont. 2 kΩ : U_b
Impuls-load: 2s/1h 390Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

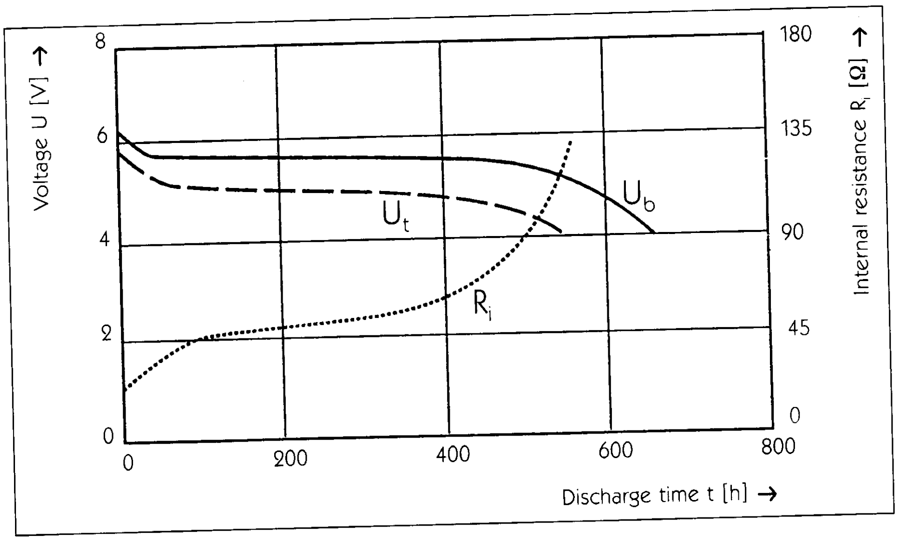


Fig. 42
2/CR 1/2 AA
Load: cont. 3.9 kΩ : U_b
Impuls-load: 2s/1h 390 Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

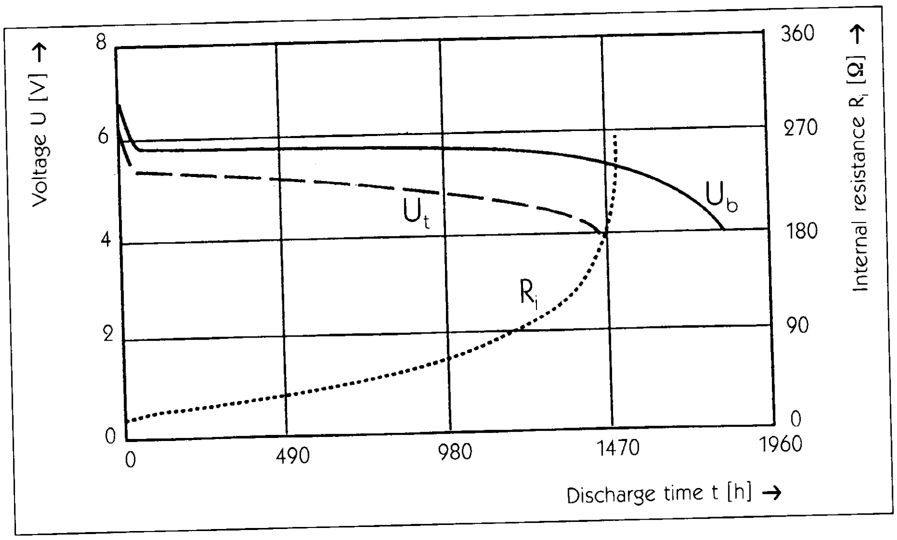


Fig. 43
2/CR 1/2 AA
Load: cont. 11 kΩ : U_b
Impuls-load: 2s/1h 390Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

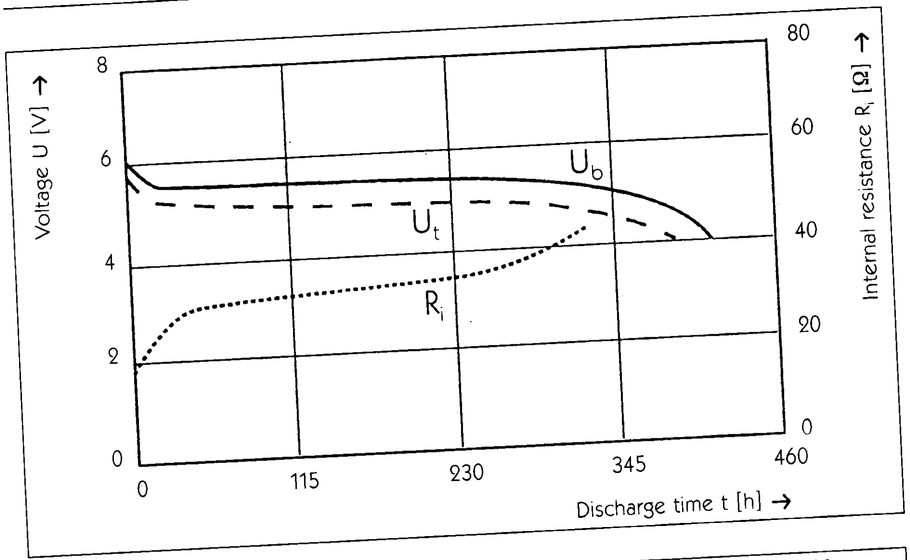


Fig. 44
2/CR AA
Load: cont. 1.2 kΩ : U_b
Impuls-load: 2s/1h 390Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

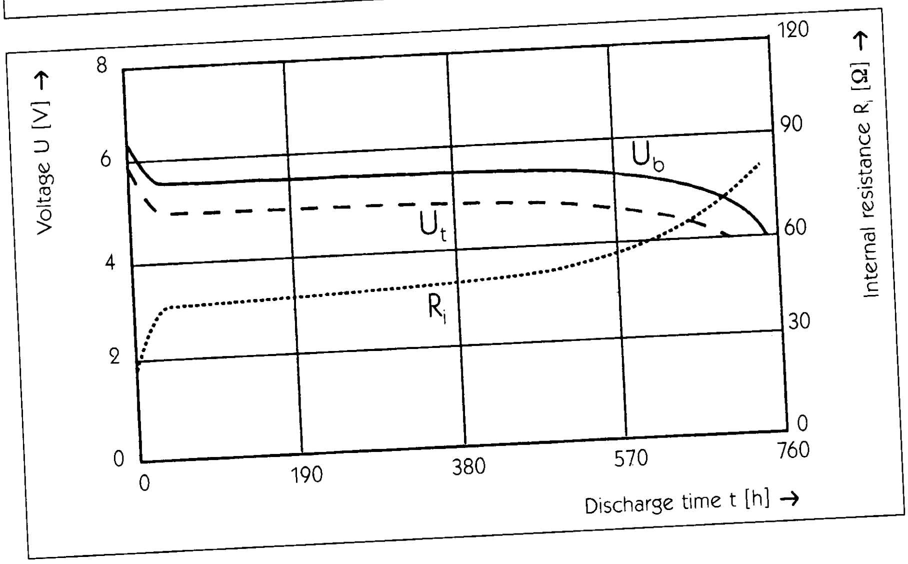


Fig. 45
2/CR AA
Load: cont. 2 kΩ : U_b
Impuls-load: 2s/1h 390Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

Fig. 46

3/CR 1/2 AA

Load: cont. 3 kΩ : U_b
Impuls-load: 2s/1h 620Ω : U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 620Ω and T_t = 2s

Temperature: δ = 30 °C

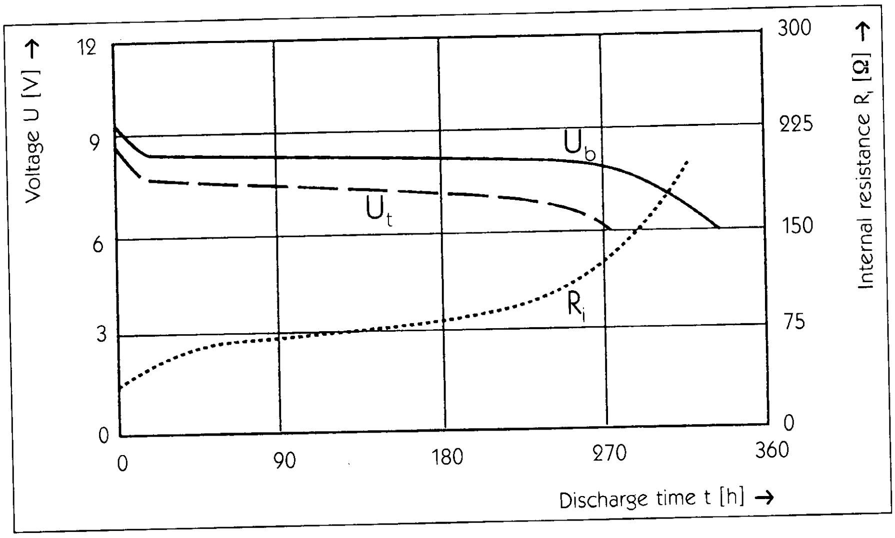


Fig. 47

3/CR 1/2 AA

Load: cont. 6.2 kΩ : U_b
Impuls-load: 2s/1h 620 Ω : U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 620Ω and T_t = 2s

Temperature: δ = 30 °C

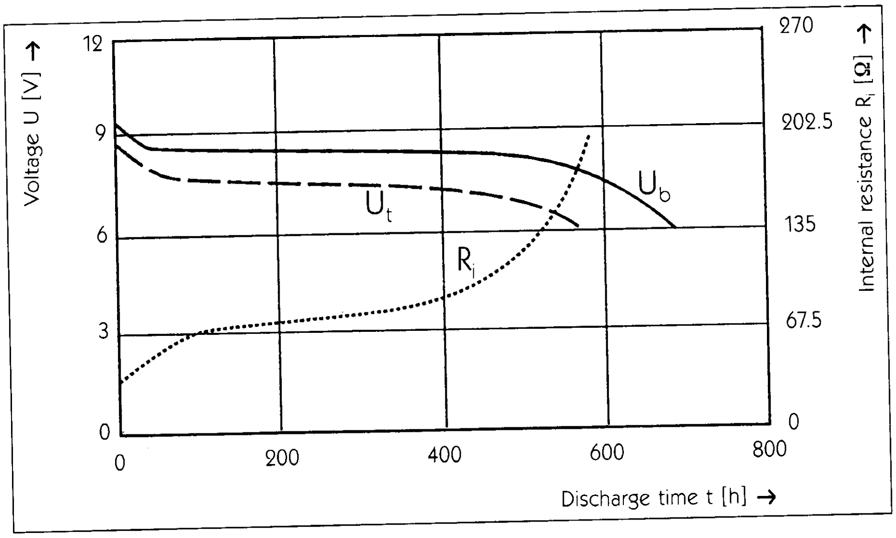


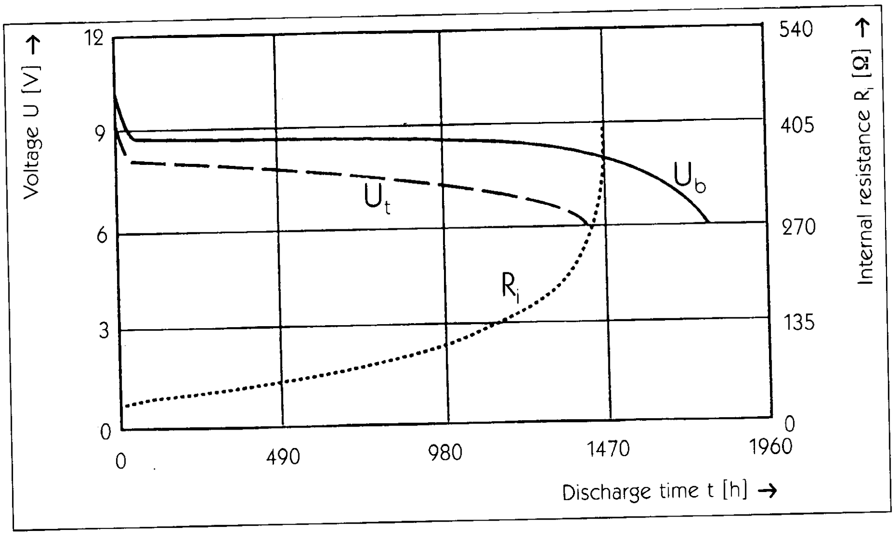
Fig. 48

3/CR 1/2 AA

Load: cont. 16 kΩ : U_b
Impuls-load: 2s/1h 620Ω : U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 620Ω and T_t = 2s

Temperature: δ = 30 °C



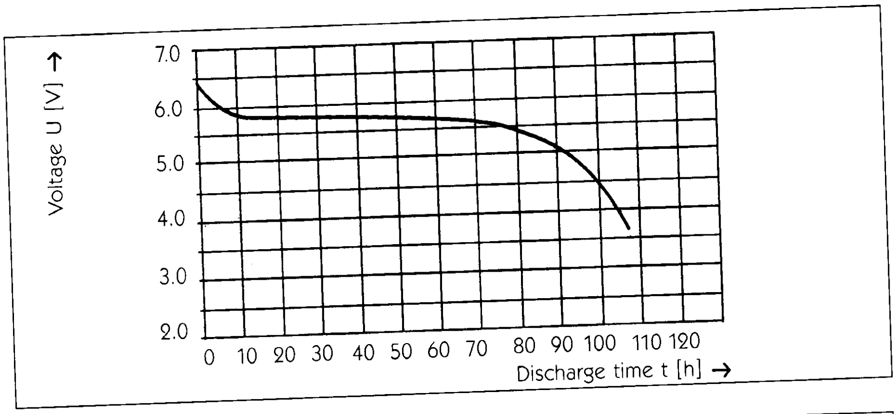


Fig. 49
2 CR 5
Load: cont. 390Ω
Temperature: δ = 20°C

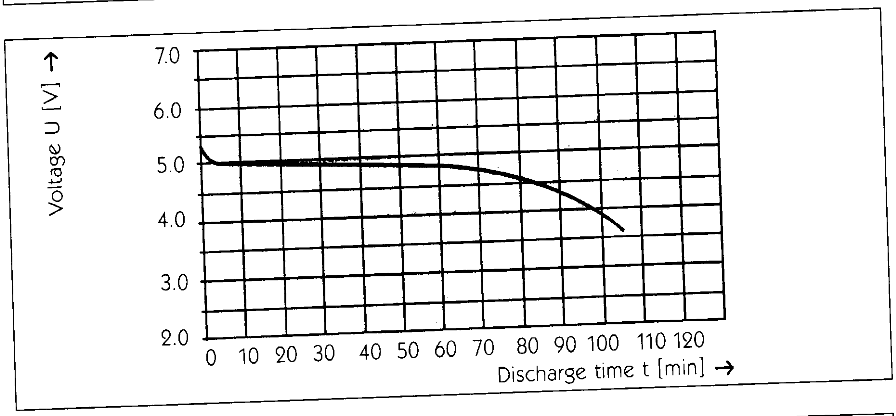


Fig. 50
2 CR 5
Load: 15 s/m, 7 d/w 7,5Ω
Temperature: δ = 20°C

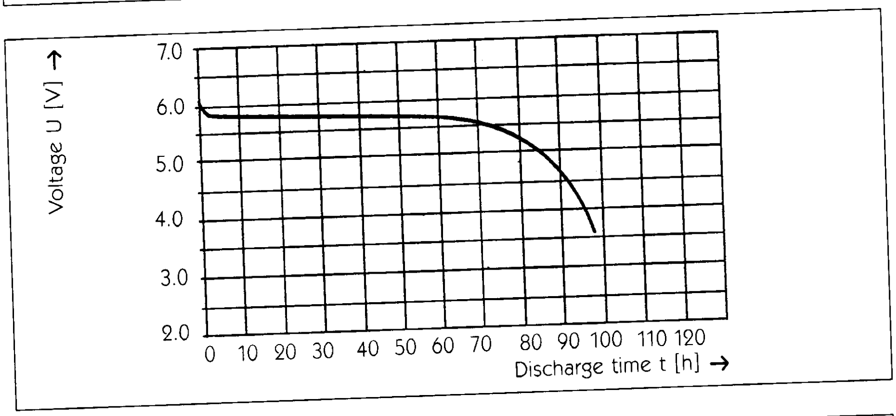


Fig. 51
CR-P2
Load: cont. 390Ω
Temperature: δ = 20°C

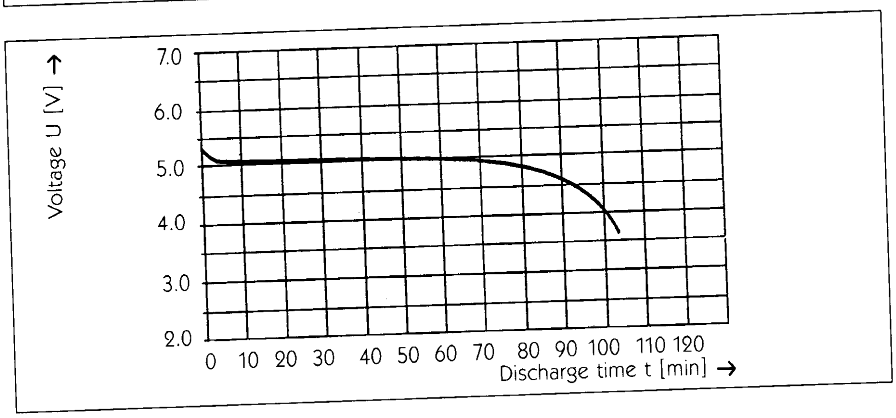
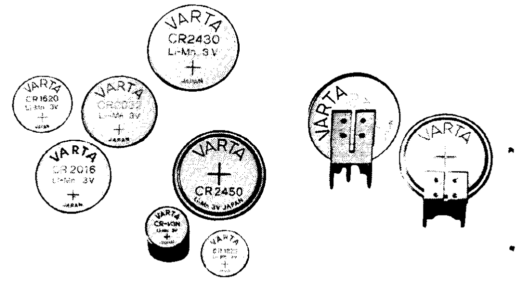


Fig. 52
CR-P2
Load: 15 s/m, 7 d/w 7,5Ω
Temperature: δ = 20°C

8. Lithium Button Cells CR...

8.1 Technical data



Type	Order-No.	Nominal voltage V	Typical capacity mAh	Max. discharge current (continuous) mA	Max. discharge current (pulse) mA	Weight g
CR 1/3 N	6131 101 501	3	170	20	80	3
2 CR 1/3 N (V 28 PXL)	6231 101 501	6	170	20	80	8.8
CR 1216	6216 101 501	3	25	2	5	0.7
CR 1220	6220 101 501	3	30	2	5	0.8
CR 1616	6616 101 501	3	50	3	8	1.2
CR 1620	6620 101 501	3	50	3	8	1.2
CR 2016	6016 101 501	3	70	5	10	1.8
CR 2025	6025 101 501	3	130	3	10	2.5
CR 2032	6032 101 501	3	180	3	10	3.0
CR 2320	6320 101 501	3	135	5	15	2.9
CR 2325	6325 101 501	3	200	5	15	3.0
CR 2430	6430 101 501	3	260	3	20	4.0
CR 2450	6450 101 501	3	500	2	10	6.2

Table 8

Type	Order-No.	Dimensions (mm)											Fig. No.	Remarks
		A	B	C	D	E	F	G	H	I	K	L		
CR 1/3 N	6131 101 501	$11.6_{-0.2}$	$10.8_{-0.4}$	0.4_{min}	–	$7.8_{\pm 0.2}$	–	–	–	–	–	–	53	Ableiter 0.2 mm Tag 0.15 mm (180°)
CR 1/3 N SLF	6131 201 501	$13.0_{-0.5}$	$1.0_{\pm 0.1}$	$10.0_{\pm 0.15}$	$1.0_{\pm 0.3}$	$11.5_{\pm 0.5}$	$12.0_{+0.15}$	–	$1.0_{\pm 0.3}$	3.0	–	–	57	
CR 1/3 N LF	6131 301 501	–	–	–	–	$11.5_{\pm 0.5}$	$12.0_{+0.15}$	–	–	–	19.0	4.0	56	
2 CR 1/3 N (V 28 PXL)	6231 101 501	$13.0_{-0.2}$	$25.1_{-0.7}$	$1.1_{-0.3}$	$0.6_{-0.3}$	$5.5_{-0.2}$	$6.0_{-0.2}$	–	–	–	–	–	54	
CR 1216	6216 101 501	$12.5_{-0.3}$	$1.6_{-0.2}$	0.2_{min}	–	$10.0_{\pm 0.2}$	–	–	–	–	–	–	55	
CR 1220	6220 101 501	$12.5_{-0.2}$	$2.0_{-0.2}$	0.3_{min}	–	$10.0_{\pm 0.2}$	–	–	–	–	–	–	55	
CR 1616	6616 101 501	$16.0_{-0.3}$	$1.6_{-0.2}$	0.2_{min}	–	$12.0_{\pm 0.2}$	–	–	–	–	–	–	55	
CR 1620	6620 101 501	$16.0_{-0.2}$	$2.0_{-0.2}$	0.02_{min}	–	$12.9_{\pm 0.2}$	–	–	–	–	–	–	55	
CR 2016	6016 101 501	$20.0_{-0.2}$	$1.6_{-0.2}$	0.1_{min}	–	$17.0_{\pm 0.2}$	–	–	–	–	–	–	55	
CR 2025	6025 101 501	$20.0_{-0.2}$	$2.5_{-0.2}$	0.2_{min}	–	$16.3_{\pm 0.2}$	–	–	–	–	–	–	55	
CR 2032	6032 101 501	$20.0_{-0.2}$	$3.2_{-0.2}$	0.02_{min}	–	$16.5_{\pm 0.2}$	–	–	–	–	–	–	55	Ableiter 0.15 mm
CR 2032 SLF	6032 201 501	$21.5_{\pm 0.5}$	$1.0_{\pm 0.1}$	$10.0_{\pm 0.15}$	$1.0_{\pm 0.3}$	$4.2_{\pm 0.5}$	$20.5_{-0.2}$	–	$1.0_{\pm 0.3}$	4.5	–	–	58	
CR 2032 LF	6032 301 501	–	–	–	–	$3.5_{+0.5}$	$20.5_{-0.2}$	–	–	–	10.0	4.0	59	
CR 2032 PCB	6032 401 501	$20.0_{-0.2}$	$1.0_{\pm 0.1}$	$10.0_{\pm 0.15}$	$11.0_{\pm 0.5}$	$3.2_{-0.2}$	$17.8_{\pm 0.2}$	$7.5_{\pm 0.2}$	10.0	4.5	11.4	–	60	
CR 2320	6320 101 501	$23.0_{-0.3}$	$2.0_{-0.25}$		–		–	–	–	–	–	–	55	
CR 2325	6325 101 501	$23.0_{-0.3}$	$2.5_{-0.25}$		–		–	–	–	–	–	–	55	
CR 2430	6430 101 501	$24.5_{-0.2}$	$3.0_{-0.2}$	0.3_{min}	–	$20.0_{\pm 0.2}$	–	–	–	–	–	–	55	Tag 0.15 mm
CR 2430 SLF	6430 201 501	$25.8_{\pm 0.5}$	$1.0_{\pm 0.1}$	$10.0_{\pm 0.15}$	$1.0_{\pm 0.3}$	$4.0_{\pm 0.5}$	$25.0_{-0.2}$	–	$1.0_{\pm 0.3}$	4.5	–	–	58	
CR 2430 LF	6430 301 501	–	–	–	–	$3.2_{\pm 0.2}$	$25.0_{-0.2}$	–	–	–	10.0	4.0	59	
CR 2430 PCB	6430 401 501	$24.5_{-0.2}$	$1.0_{\pm 0.1}$	$10.0_{\pm 0.15}$	$11.0_{\pm 0.2}$	$3.0_{-0.2}$	$17.8_{\pm 0.2}$	$7.5_{\pm 0.2}$	10.0	4.5	11.4	–	60	
CR 2430 PCB single pin	6430 701 501	$24.5_{-0.2}$	$1.0_{\pm 0.1}$	–	$11.3_{\pm 0.2}$	$3.0_{-0.2}$	$20.05_{\pm 0.3}$	$7.5_{\pm 0.2}$	10.0	4.5	10.0	–	61	
CR 2450	6450 101 501	$24.7_{-0.4}$	$5.0_{-0.2}$		–		–	–	–	–	–	–	55	
CR 2450 SLF	6450 201 501	$25.8_{\pm 0.5}$	$1.0_{\pm 0.1}$	$10.0_{\pm 0.15}$	$1.0_{\pm 0.3}$	$6.4_{-0.3}$	$25.0_{-0.2}$	–	$1.0_{\pm 0.3}$	4.5	–	–	58	
CR 2450 PCB	6450 401 501	$24.7_{-0.4}$	$1.0_{\pm 0.1}$	$10.0_{\pm 0.15}$	$13.2_{\pm 0.2}$	$5.0_{-0.2}$	$17.8_{\pm 0.2}$	$7.5_{\pm 0.2}$	10.0	4.5	11.4	–	60	

Table 9

Tag

Material: nickel plated sheet-steel

Tag thickness: 0.2 mm

In case of higher quantities special customer cell assemblies are possible.

8.2 Type designations

Fig. 53

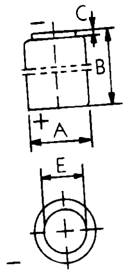


Fig. 54

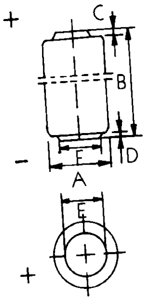


Fig. 55

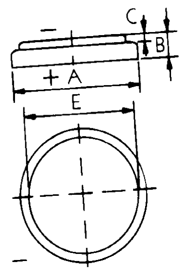


Fig. 56

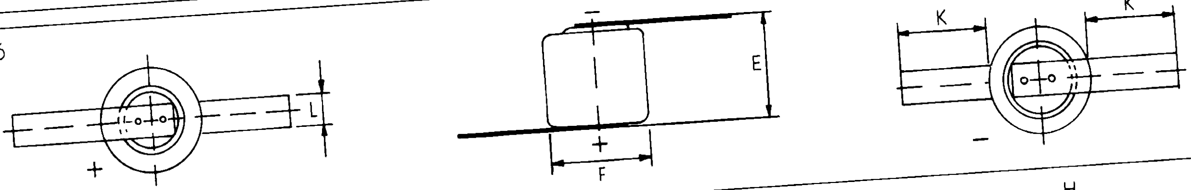


Fig. 57

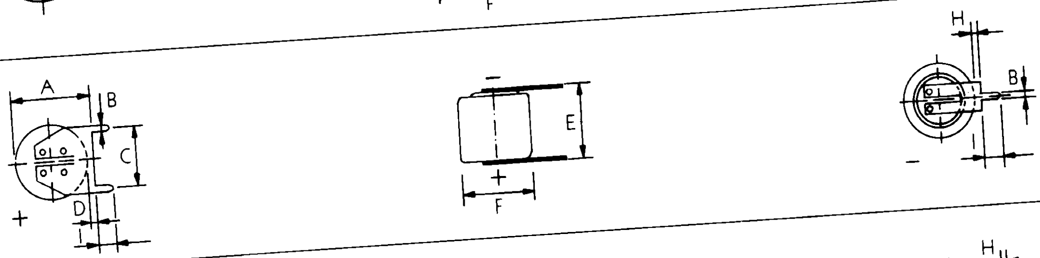


Fig. 58

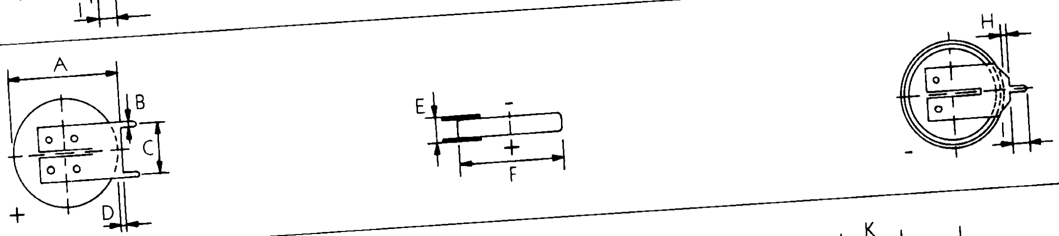


Fig. 59

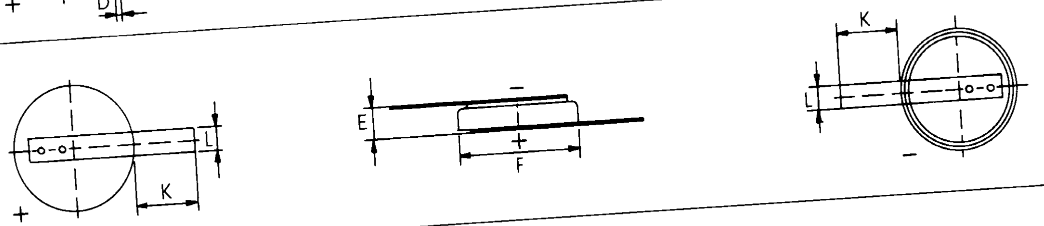


Fig. 60

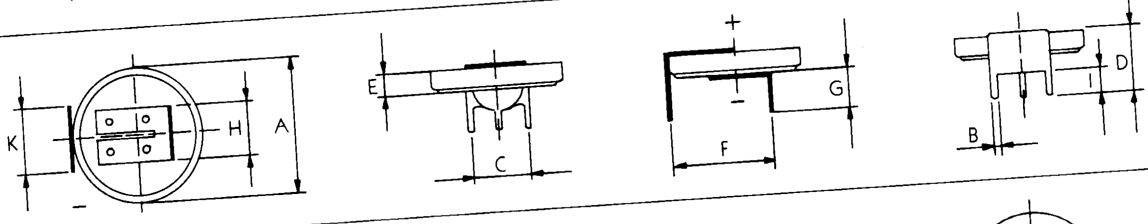
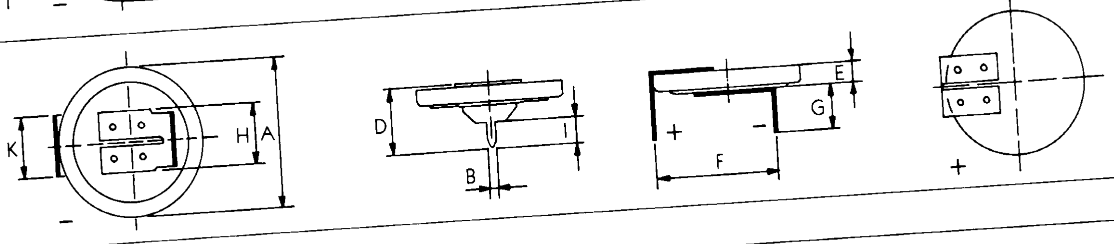


Fig. 61



8.3 Discharge data

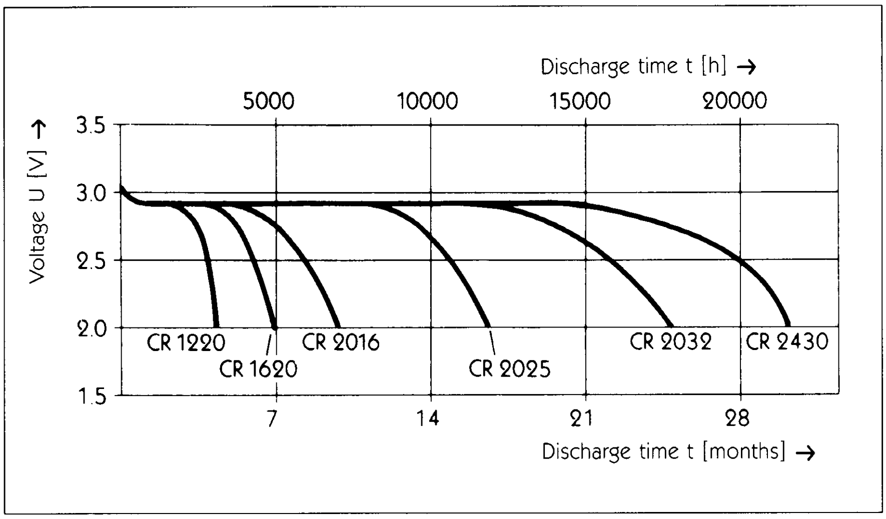


Fig. 62
Discharge curve of button cells
Load: R = 270 kΩ
Mean discharge current:
I = 10 µA
Temperature: δ = 20 °C

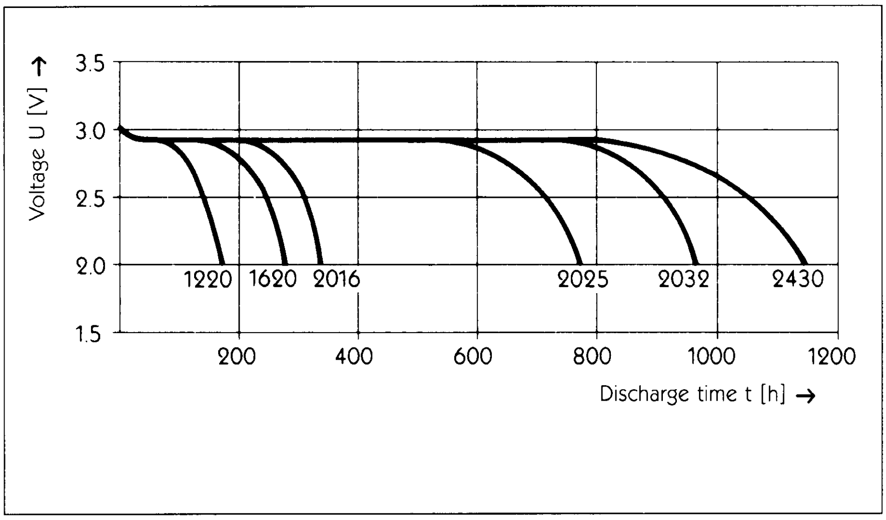


Fig. 63
Discharge curve of button cells
Load: R = 15 kΩ
Mean discharge current:
I = 180 µA
Temperature: δ = 20 °C

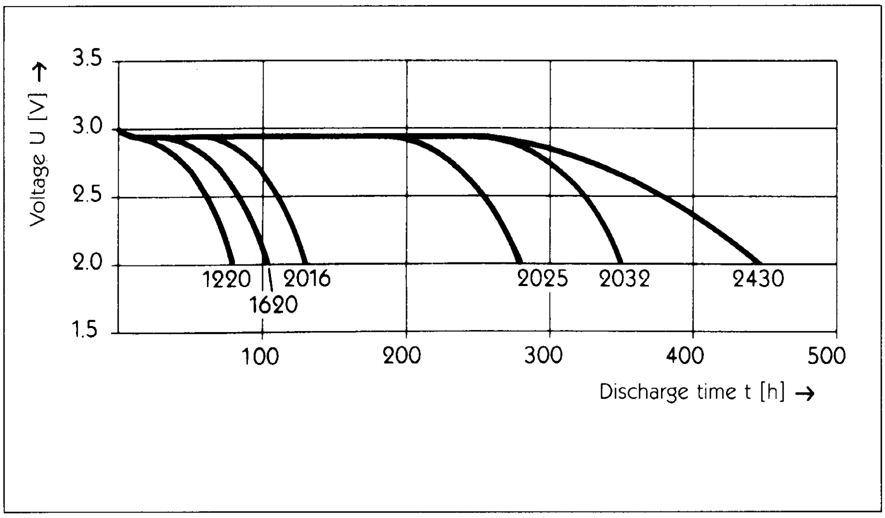


Fig. 64
Discharge curve of button cells
Load: R = 5.6 kΩ
Mean discharge current:
I = 400 µA
Temperature: δ = 20 °C

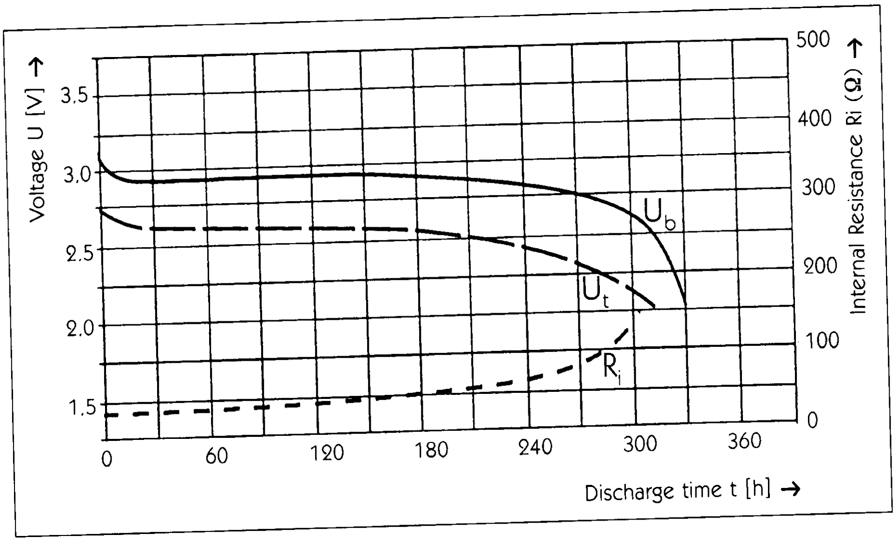


Fig. 65
CR 1216
Load: cont. 39 kΩ : U_b
Impulse-load: 2s/2h 390 Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

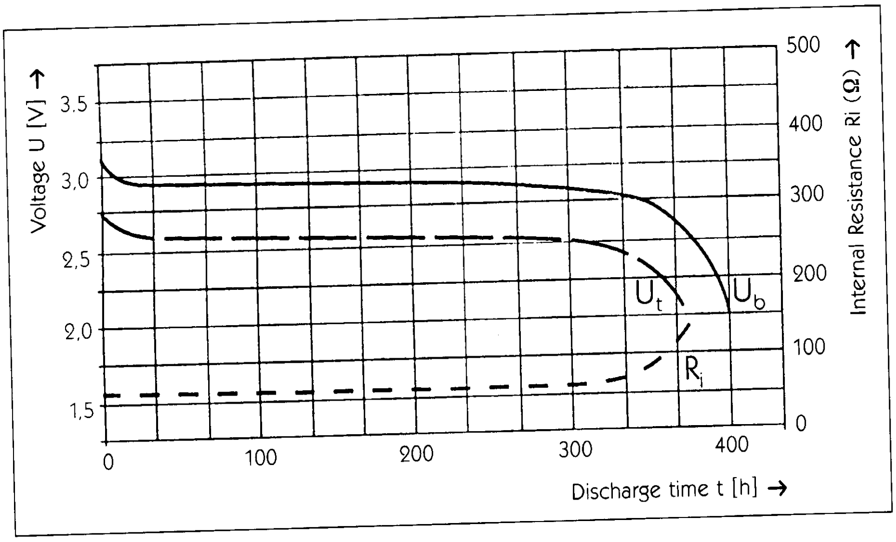


Fig. 66
CR 1220
Load: cont. 39 kΩ : U_b
Impulse-load: 2s/2h 390Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

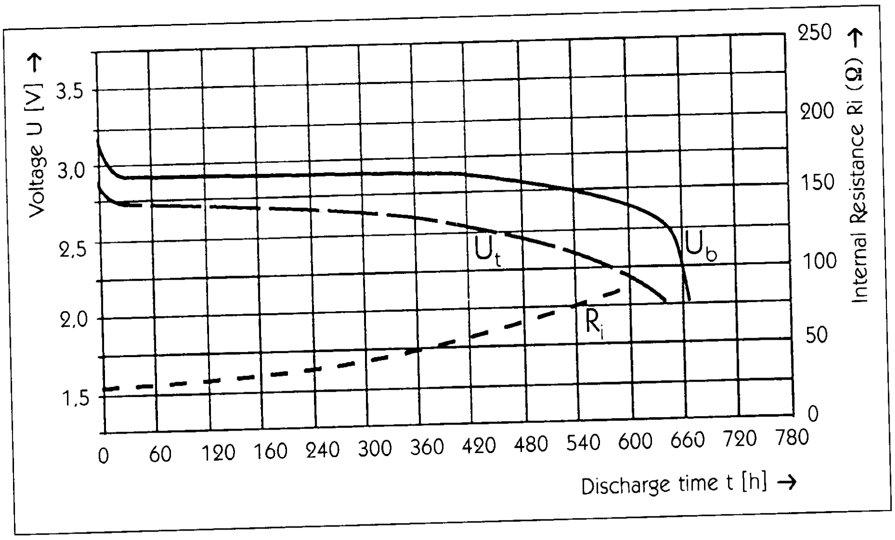


Fig. 67
CR 1616
Load: cont. 39 kΩ : U_b
Impulse-load: 2s/2h 390Ω : U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

Fig. 68

CR 1620

Load: cont. 20 kΩ : U_b
Impuls-load: 2s/2h 390 Ω: U_t (parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s

Temperature: δ = 20 °C

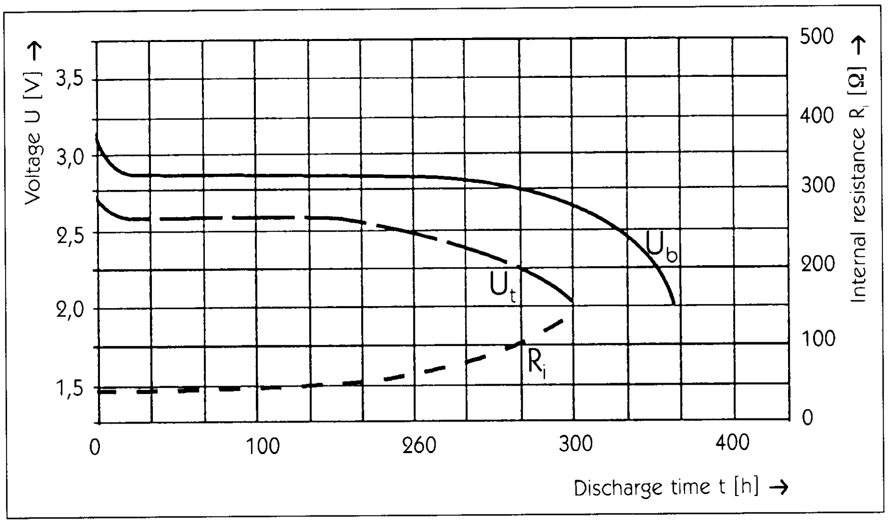


Fig. 69

CR 2016

Load: cont. 15 kΩ : U_b
Impuls-load: 2s/2h 390 Ω: U_t (parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s

Temperature: δ = 20 °C

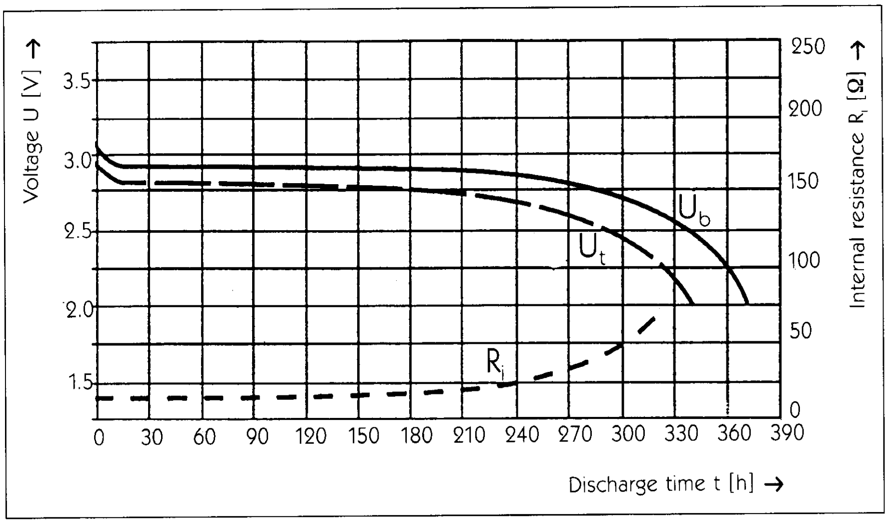


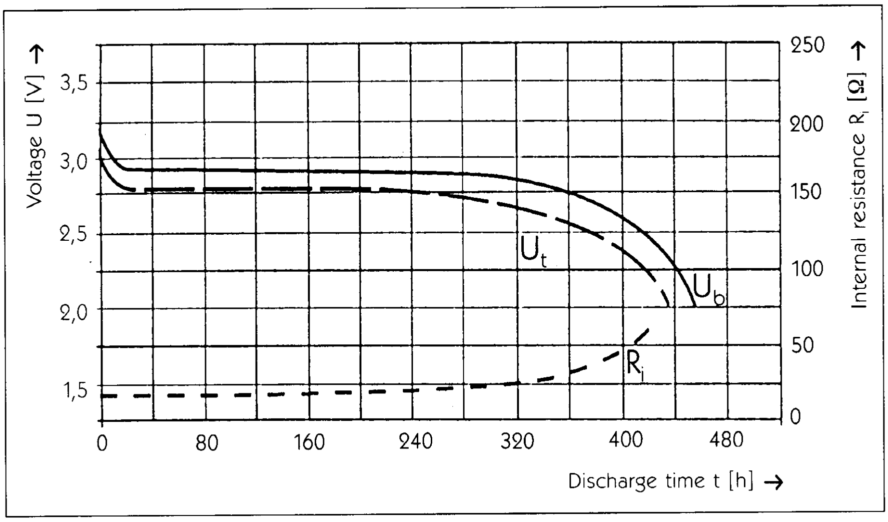
Fig. 70

CR 2025

Load: cont. 10 kΩ : U_b
Impuls-load: 2s/2h 390 Ω: U_t (parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s

Temperature: δ = 20 °C



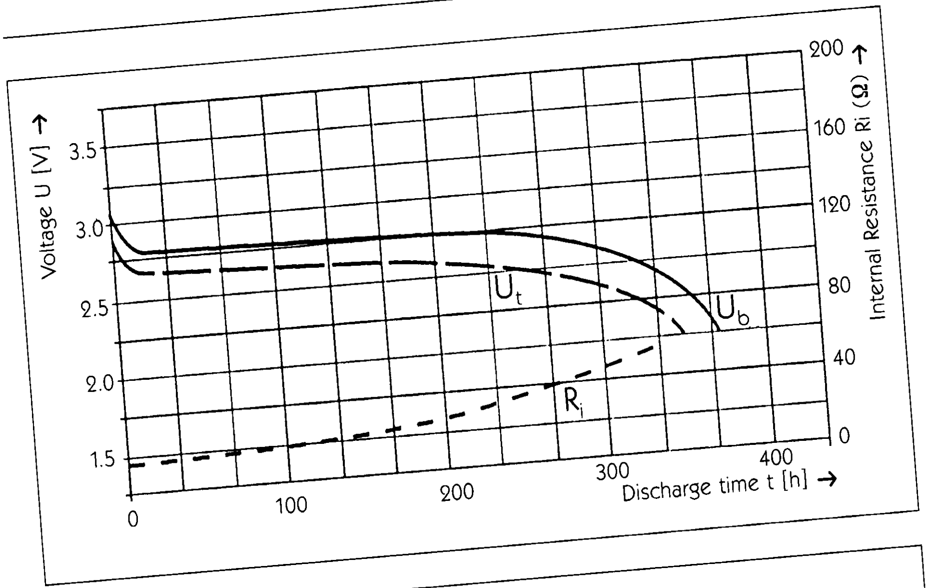


Fig. 71
CR 2032

Load: cont. 5,6 kΩ : U_b
Impuls-load: 2s/2h 390Ω: U_t
(parallel)
Internal Resistance R_i calculated from U_b and U_t at R_t = 390Ω and T_t = 2s
Temperature: δ = 20 °C

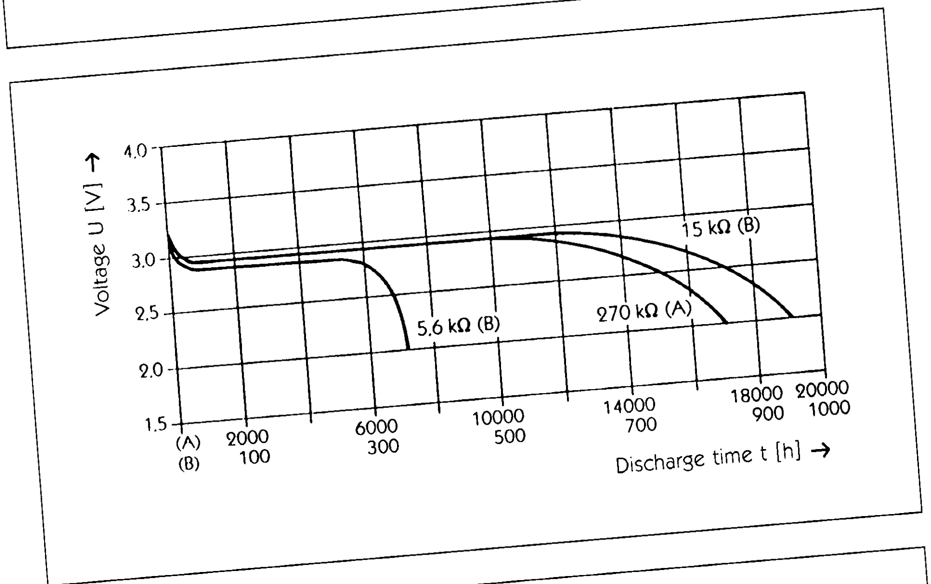


Fig. 72
CR 2032

Load: cont. R_1 = 5,6 kΩ (B)
cont. R_2 = 15 kΩ (B)
cont. R_3 = 270 kΩ (A)

Mean discharge current:
I_1 = 400 μA
I_2 = 180 μA
I_3 = 10 μA

Temperature: δ = 20 °C

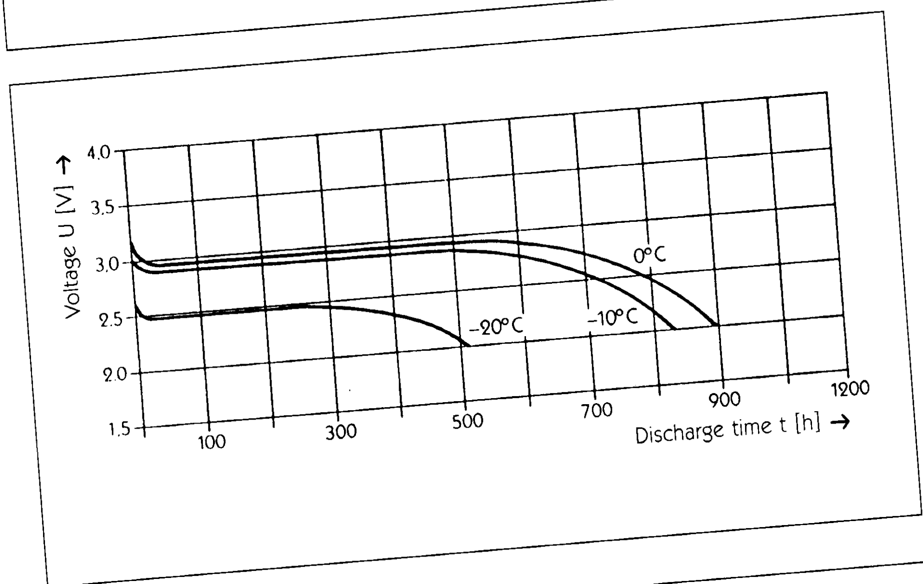


Fig. 73
CR 2032

Discharge curves at different temperatures

Load: cont. R = 15 kΩ

Mean discharge current at temperature:
δ = 0°C ~ 175 μA
δ = −10°C ~ 170 μA
δ = −20°C ~ 155 μA

Fig. 74

CR 2320

Load: cont. 10 kΩ : U_b
Impuls-load:2s/2h 390 Ω : U_t
(parallel)

Internal Resistance R_1 calculated from U_b and U_t at R_t = 390Ω and T_t = 2s

Temperature: δ = 20 °C

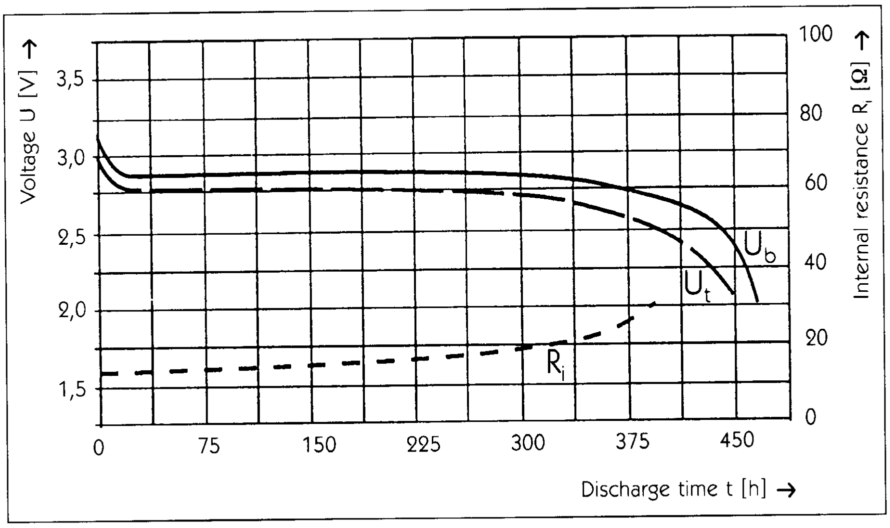


Fig. 75

CR 2325

Load: cont. 10 kΩ : U_b
Impuls-load: 2s/2h 390 Ω : U_t
(parallel)

Internal Resistance R_1 calculated from U_b and U_t at R_t = 390Ω and T_t = 2s

Temperature: δ = 20 °C

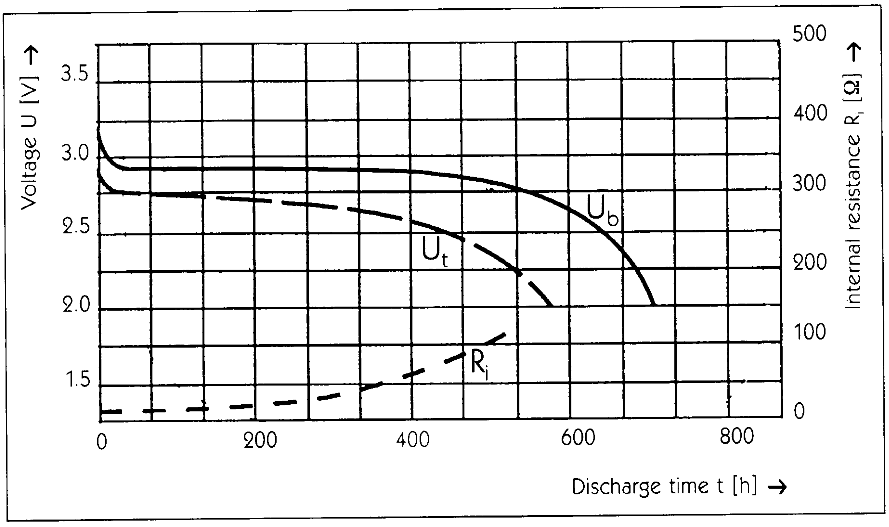


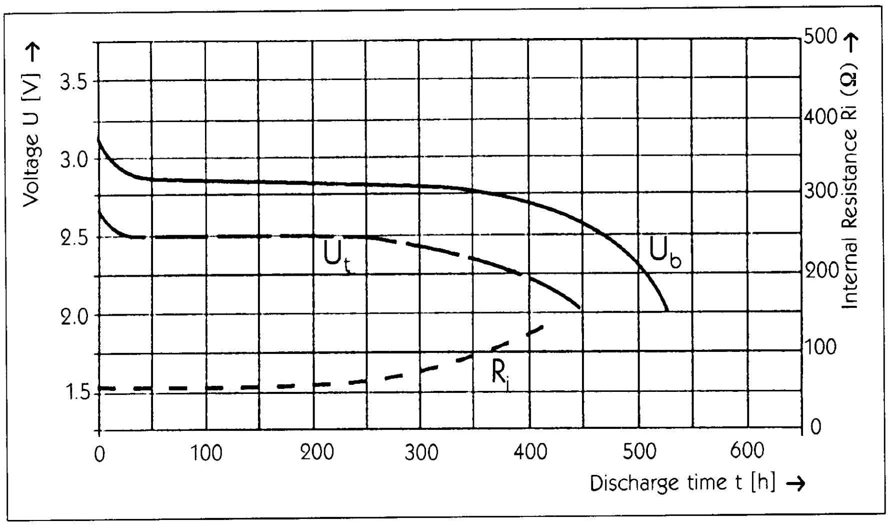
Fig. 76

CR 2430

Load: cont. 5.6 kΩ : U_b
Impuls-load: 2s/2h 390 Ω : U_t
(parallel)

Internal Resistance R_1 calculated from U_b and U_t at R_t = 390Ω and T_t = 2s

Temperature: δ = 20 °C



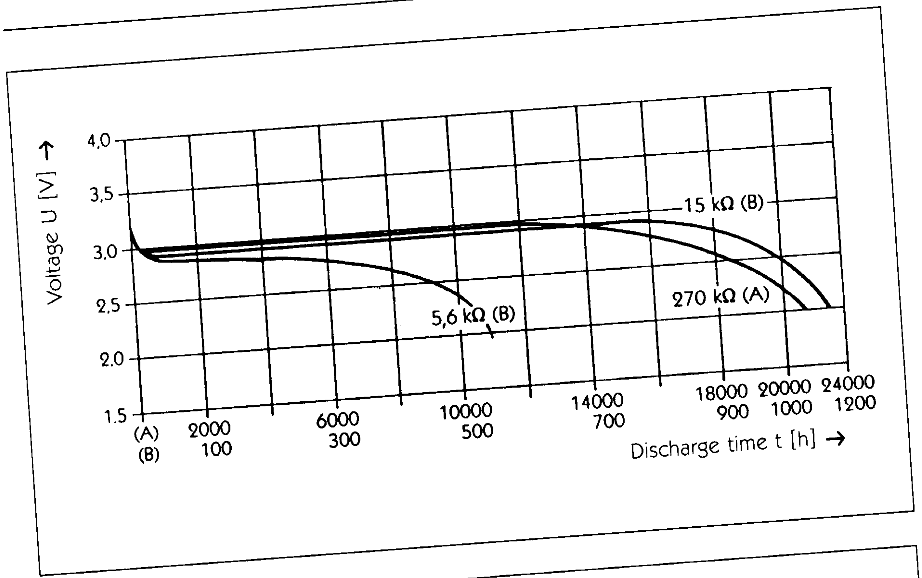


Fig. 77
CR 2430

Load: cont. R_1 = 5.6 kΩ (B)
cont. R_2 = 15 kΩ (B)
cont. R_3 = 270 kΩ (A)

Mean discharge current:
I_1 = 400 µA
I_2 = 180 µA
I_3 = 10 µA

Temperature: $\delta = 20$ °C

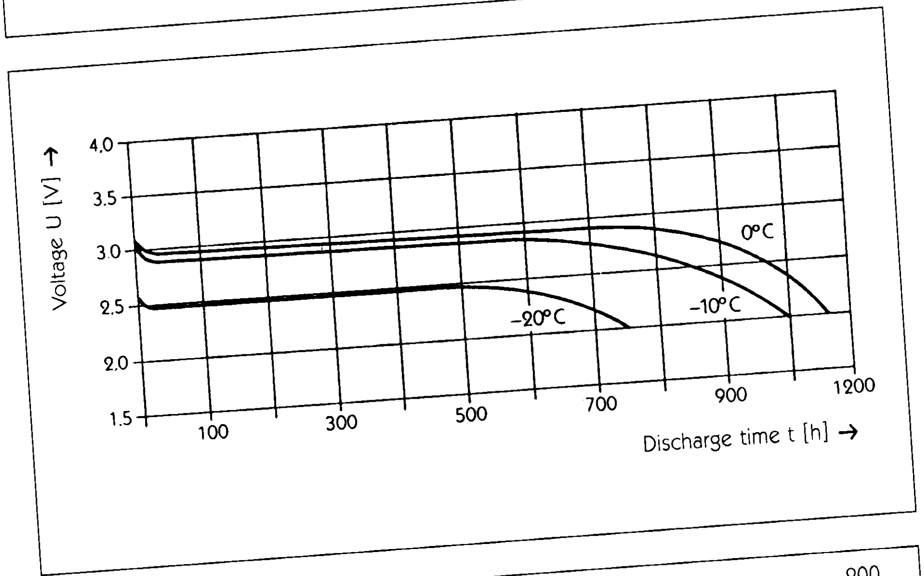


Fig. 78
CR 2430

Discharge curves at different temperatures

Load: cont. R = 15 kΩ

Mean discharge current at temperature:
$\delta =$ 0 °C ~ 175 µA
$\delta = -10$ °C ~ 175 µA
$\delta = -20$ °C ~ 155 µA

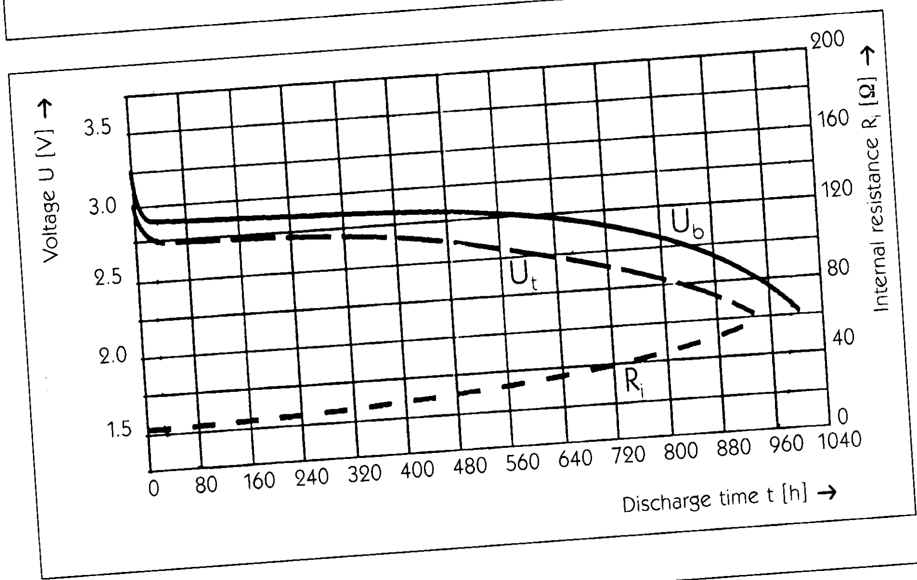


Fig. 79
CR 2450

Load: cont. 5.6 kΩ : U_b

Impuls-losd: 2s/sh 390 Ω : U_t

Internal Resistance R_i calculated from U_b and U_t at R_t = 390 Ω and T_t = 2s

Temperature: $\delta = 20$°C

Fig. 80
Discharge curves
of button cells at 0 °C
Load: cont. R = 15 kΩ
Mean discharge current:
I = 175 μA
Temperature: δ = 0 °C

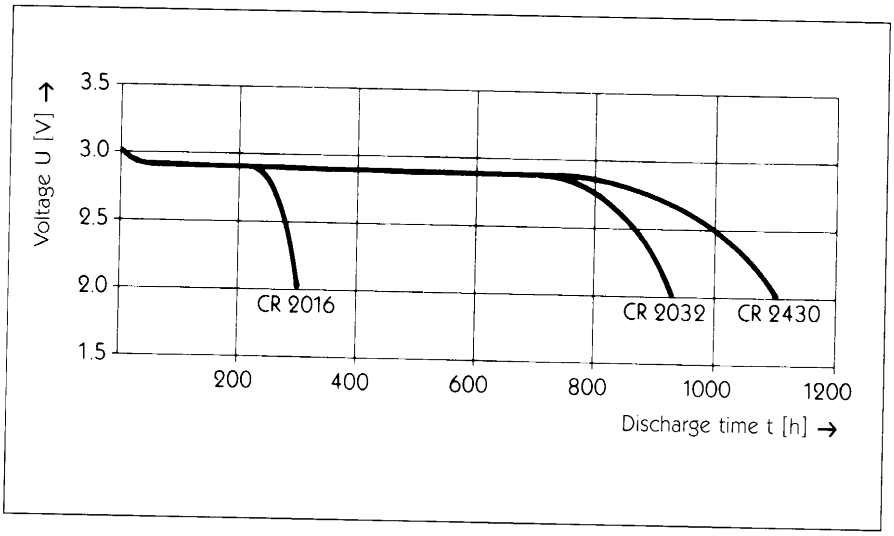


Fig. 81
Discharge curves
of button cells at – 10 °C
Load: cont. R = 15 kΩ
Mean discharge current:
I = 170 μA
Temperature: δ = – 10 °C

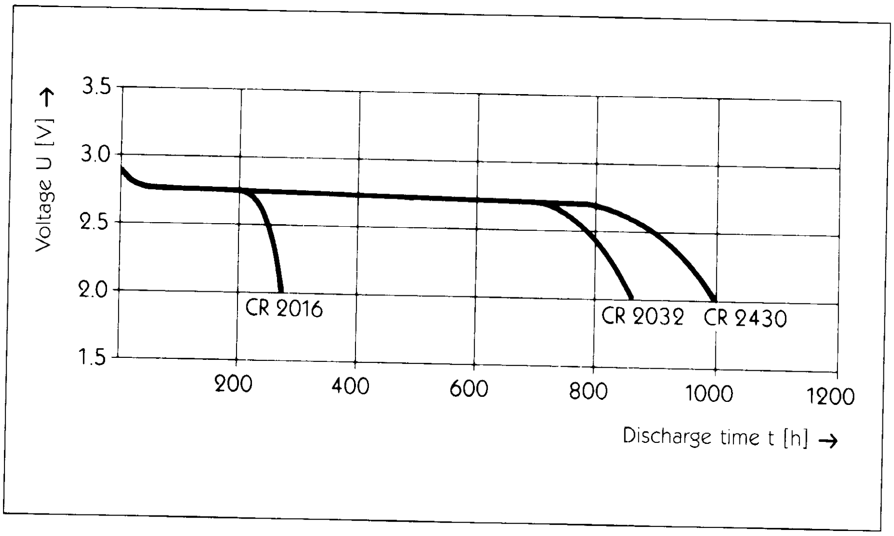
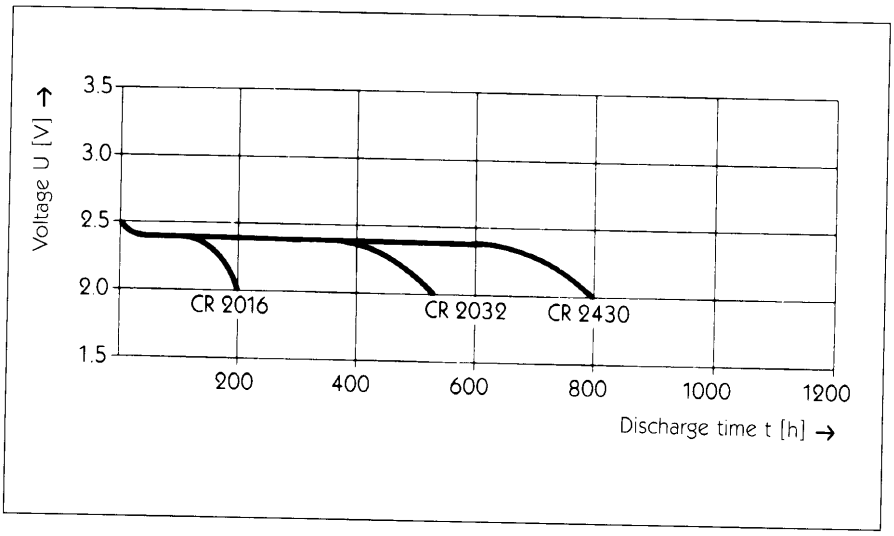


Fig. 82
Discharge curves
of button cells at – 20 °C
Load: cont. R = 15 kΩ
Mean discharge current:
I = 155 μA
Temperature: δ = – 20 °C



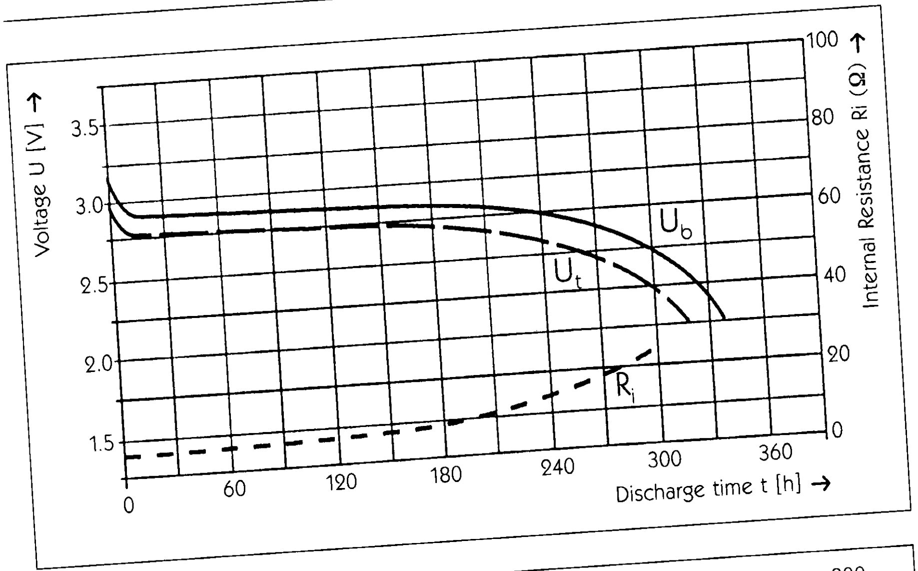


Fig. 83

CR 1/3 N

Load: cont. 5,6 kΩ : U_b
Impuls-load: 2s/2h 100 Ω : U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 100Ω and T_t = 2s

Temperature: δ = 20 °C

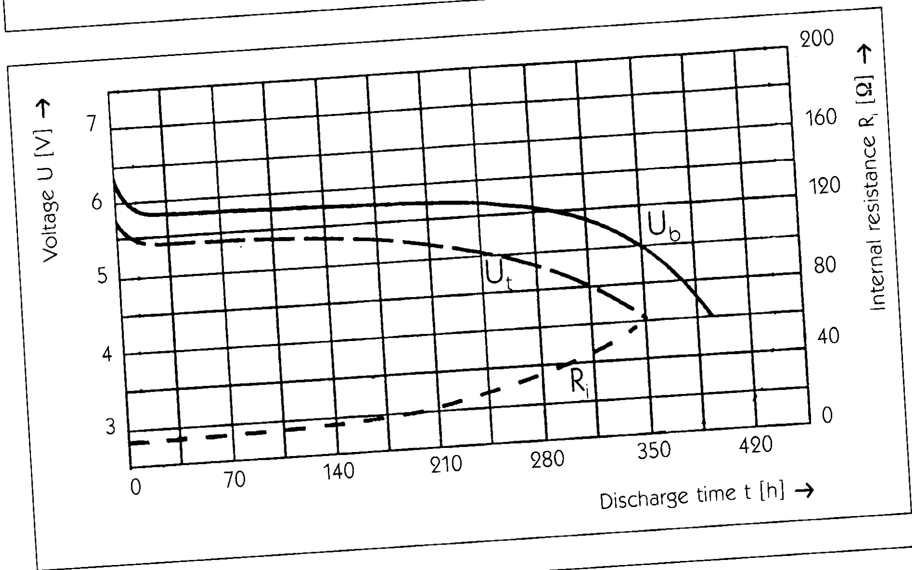


Fig. 84

2/CR 1/3 N (V 28 PXL)

Load: cont. 13kΩ : U_b
Impuls-load: 2s/2h 200Ω : U_t
(parallel)

Internal Resistance R_i calculated from U_b and U_t at R_t = 200Ω and T_t = 2s

Temperature: δ = 20°C

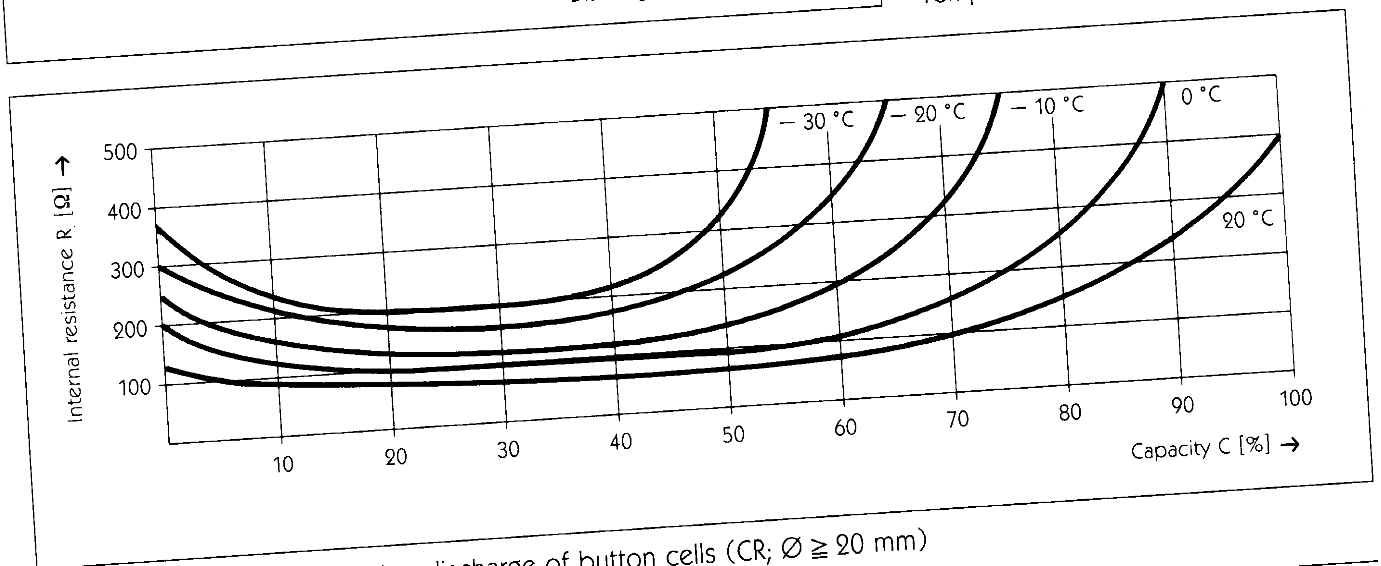


Fig. 85 Internal resistance during discharge of button cells (CR; Ø ≧ 20 mm)

9. Quality, Life Expectancy

Quality

The lithium cylindrical cells from VARTA are manufactured on semi-automatic production lines. A computer controlled laser welding of the lid to the stainless steel cup gives the cylindrical cells CR 1/4 AA, CR 1/2 AA, CR 2/3 AA, CR AA and CR 2/3 A an extremely effective sealing.

After production, VARTA Lithium cells CR...A(A) are predischarged.
This treatment discharges the higher oxidation potentials of the Manganese Dioxide, which otherwise – during long term storage – can develop a thin passivation layer on the Lithium anode. This procedure leaves the cells with an open cicuit voltage (O. C. V.) of 3.2 V.
VARTA Lithium cells CR...A(A) are now free from passivation over years.

In extensive tests the VARTA cells have shown outstanding reliability.

Lithium-weight share per cell:

CR 1/4 AA: 133 mg
CR 1/2 AA: 300 mg
CR 2/3 AA: 460 mg
CR AA : 630 mg

The Lithium-weight share of CR-button cells is less than 500 mg.

Life Expectancy

All VARTA-lithium cells are designed for long discharge durations and life expectancy. The self discharge rate at +25 °C is less than 1 % of the nominal capacity per year. For increase in temperature the self discharge rate is higher and it should therefore be noted that the life expectancy of the lithium batteries, at room temperature, is not limited by self discharge but by other effects. The most critical factor is the cell sealing system and by using organic electrolyte less problems occur in cell sealing compared to cells that use an alkaline electrolyte.

With lithium cells, the sealing system has to prevent not only materials leaking from the cells, which can be achieved easily in the case of organic electrolyte, but also ingress of foreign substances into the cell.

It is essential to prevent ingress of humidity into the cell. Water and the lithium metal react by producing lithium hydroxide and this material forms a passivation lagging on the lithium surface. The loss of lithium metal during this reaction results in it no longer being available for the discharge process. The total result, therefore, is an increase in internal resistance.

Crimp-seals, as used in lithium button cells, are designed for a life expectancy of about 5 years.

If longer periods of operation are required additional sealing is necessary, for example with a minimised compressed plastic feed-through and a laser welding.

A realistic life in excess of 10 years can be expected using fully sealed batteries.

10. Safety Guidelines, General Advice

Safety Guidelines

Please pay attention to the following safety guidelines for Lithium cells/batteries:

- Observe the correct polarity + and −, which is marked on the cells/batteries.
- Do not charge cells/batteries!
- Do not short circuit cells/batteries!
- Do not heat above 100 °C or incinerate cells/batteries (risk of explosion)!
- Observe system voltage (3.2 V)!
- Do not solder or weld on wires directly to the cell's surface (use pre-assembled cells)!
- Do not disassemble cells/batteries!
- Misapplication may result in fire, explosion and/or severe burn hazard!
- Keep cells/batteries out of the reach of children, especially button cells (risk of ingestion)!
- In case of ingestion of a cell or battery the person involved should seek medical assistance promptly!
- The circuits of equipment designed to use alternative power supplies should be such as to eliminate the possibility of the battery being charged.

The amount of accumulated current flowing into the battery must not exceed 1 % of its typical capacity during the lifetime. Higher charge input may result in increase of internal pressure and decomposition of material (page 7, table 2).

General Advice

VARTA are battery manufacturers operating on a worldwide basis and market electrochemical energy storage systems only. VARTA delivers all electrochemical systems and is therefore in a position to offer you unbiased advice.

Whichever system is the optimum solution for your application VARTA can supply:

- Zinc-carbon
- Zinc-manganese alkaline
- Zinc-Ag_2O
- Zinc-HgO
- Zinc-air
- Lithium-MnO_2
- NC-sintered electrodes
- NC-mass electrodes
- Ni-MH
- Lead Acid
- a few special electrochemical couples.

Consult VARTA at one of the addresses printed on the last page of this catalogue.