

VARTA

**Sealed
Ni-Cd- and
Lithium-Batteries for
Memory Protection**

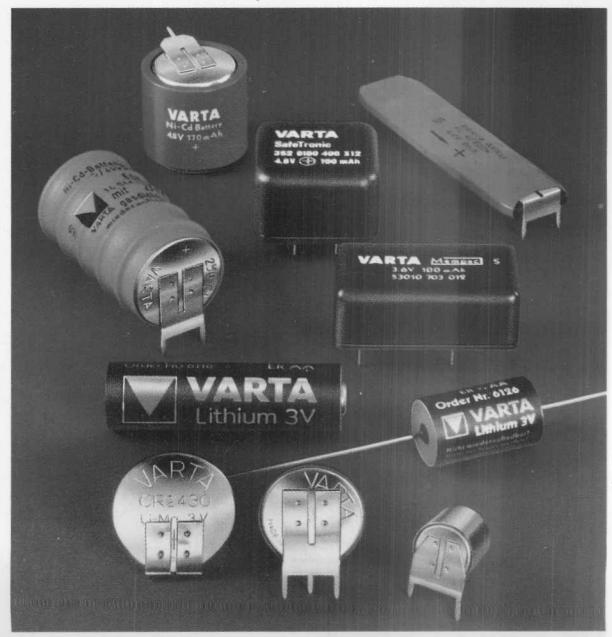


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All dimensional details in this leaflet are maximum figures for design purposes. Weights and electrical characteristics are related to performance at room temperature unless otherwise specified.

Due to our policy of continued development, details in this leaflet may change without prior notice.

General

Two main groups of electrochemical power supply sources are available as an alternative for backing up and supplying electronic semiconductor memories mainly CMOS-RAM's:

1. Rechargeable sealed NiCd-cells, 1,2 V and batteries of higher voltage, button cells with mass plate electrodes in particular.
2. Primary-Lithium cells, 3 V, button and cylindrical cells containing MnO₂ and CrO_X as solid cathode material, with organic electrolytes applying.

Application Guide for Ni-Cd-Batteries

- Charging current is available.
- Back-up time expectancy resulting from one process of charging: max. of 12 month at approx. 40 % of available capacity with mass plate button cells.
- Life expectancy 4 – 6 years.
- High peak currents can be backed up (additional devices may be supplied)
- Operational temperature range:
Mass plate button cells: Charging at 0 to + 45°C, discharging at - 20 to + 50°C; RST-cells: Charging at - 20 to + 65°C, discharging at - 40 to + 65°C.
- Operating voltage: The multiple of 1.2 V.

Application Guide for Li-Cells:

- Capacity valuation of cumulative current consumption required (self-discharge of e.g. 0,5 %/year at room temperature has to be included.)
- Life expectancy of more than 5 years with series CR (Li-MnO₂) and more than 10 years with series ER (Li-CrO_X) due to laser welded sealing.
- Operational temperature range: CR: - 20 to + 60°C, ER: - 30 to + 75°C.
- High peak currents are not available.

Main Application Areas:

Memory preservation for automobile electronics, measuring devices, telephones and telecommunication – equipment, medical instruments, electronic cash register, consumption meters and registration for e. g. gas, water, calorimeters etc., frequency synthesizer, sequencers, machine control, robotronic, aircraft and space equipment, electronic typewriters, printing equipment, recorders, coding equipment, microcomputers, terminals, television sets and many others.

1. Product Range

Ni-Cd-Batteries

Type	Capacity [mAh]	Nominal Voltage [V]	Weight g
Mempac F	60	2.4	10
	60	3.6	15
Mempac S	100	1.2	9
	100	2.4	15
SafeTronic	100	3.6	21
	100	4.8	26
FL 2/60 DK	100	1.2	9
	100	2.4	14
FL 3/60 DK	100	3.6	22
	100	4.8	28
FL 4/60 DK	60	2.4	9
	60	3.6	12.5
FL 5/60 DK	60	4.8	16
	60	6.0	19.5
FL 2/170 DK	170	2.4	23
	170	3.6	33.5
FL 3/170 DK	170	4.8	44.5
	170	6.0	55
FL 4/170 DK	250	2.4	27.5
	250	3.6	41
FL 5/250 DK	250	4.8	54.5
	250	6.0	68
170 DK	170	1.2	9.5
	170	2.4	19.5
2/170 DK	170	3.6	29.5
	170	4.8	39
3/170 DK	170	6.0	49
	250	1.2	12
4/170 DK	250	2.4	24
	250	3.6	36
5/170 DK	250	4.8	48.5
	250	6.0	61
100 RST	100	1.2	7.3
	500	1.2	24

Table 1

Further standard Ni-Cd-battery constructions are summarized in the following leaflet: "NiCd-batteries and battery constructions".

Lithium-Cells

Type	Capacity [mAh]	Nominal Voltage [V]	Weight g
CR 1/3 N SLF	160	3	3.0
CR 1/3 N LF	160	3	3.0
CR 2 NP SLF	1400	3	13.1
CR 2 NP LF	1400	3	13.1
CR 2032 SLF	170	3	3.0
CR 2032 PCB	170	3	3.0
CR 2430 SLF	200	3	4.0
CR 2430 LF	200	3	4.0
CR 2430 PCB	200	3	4.0
ER 1/2 AA LF	1000	3	10
ER 1/2 AASLF	1000	3	10
ER 1/2 AA CD	1000	3	10
ER AA LF	2250	3	18
ER AA SLF	2250	3	18
ER AA CD	2250	3	18

Table 2

CR-type: Li-MnO₂

ER-type: Li-CrO_x

2. Ni-Cd-Batteries for Memory Protection

Product Range and Recommended Application

● **Mempac S** 1.2 V/2.4 V/3.6 V/4.8 V

Standard components of best service reliability at normal temperatures.

Capacity 100 mAh.

Recommended for innovations.

Low rate of self-discharge.

Pin spacing as standardized for electronic components

● **Mempac F** 2.4 V/3.6 V

Standard components of best service reliability at normal temperatures.

Capacity 60 mAh.

Low rate of self-discharge

Pin spacing as standardized for electronic components.

● **Safe Tronic** 1.2 V/2.4 V/3.6 V/4.8 V

Standard components of best service reliability at normal temperatures.

Capacity 100mAh.

Recommended alternative with better service reliability compared to that of uncapsulated 100mAh batteries, with pins compatible.

Low self-discharge rate.

● **Flat Pack** 2.4 V/3.6 V/4.8 V/6.0 V

Components for normal temperatures.

Capacity from 60 mAh up to 250 mAh.

Flat battery dimensions.

Low self-discharge rate.

● **DK** 1.2 V to 6 V

Components of high service reliability at normal temperatures.

Low self-discharge.

● **RST** 1.2 V

Components of high service reliability at normal and high temperatures.

Capacity 100 mAh and 500 mAh.

Suitable for higher discharge rates.

Clear advantages at elevated ambient temperatures, e. g. prolonged life expectancy, better charging acceptance.

Properties

- Trickle-chargeable in stand-by operation
- Stable voltage characteristic during trickle-charging and discharging
- Simple charging technique (constant current)
- Low self-discharge of button cell batteries
- High service reliability due to special battery sealing
- Long service life in trickle-charge operation
- Special cylindrical cells for high temperature applications.



Fig. 1

2.1 Application Data

Battery Type	Trickle-Charge Current		
Mempac S	1 mA		
Mempac F	0.6 mA		
SafeTronic	1 mA		
Flat-Pack	60 DK 0.6 mA	170 DK 1.7 mA	250 DK 2.5 mA
DK	170 DK 1.7 mA	250 DK 2.5 mA	
RST	100 RST 5 mA	500 RST 25 mA	

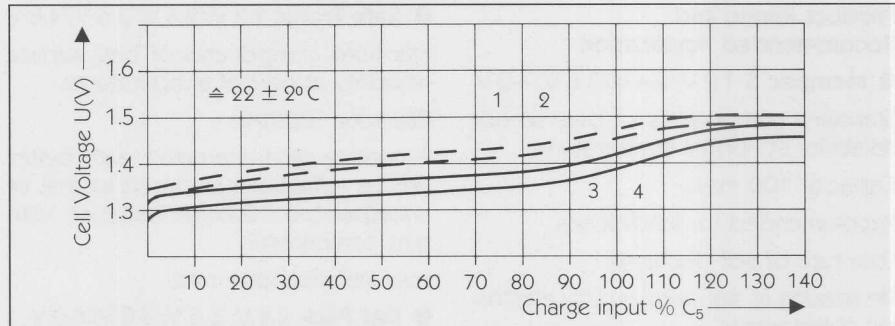


Fig. 2: Schematic diagram of charge voltage curve, when charging at various currents at normal ambient temperature.

Charging (Table 3)

When trickle-charging the currents applied should be $0.01 C_5A$ ($0.1 I_{10}$) for Mempac S + F / DK / SafeTronic / Flat-Pack and $0.05 C_5A$ ($0.5 I_{10}$) for RST.

Cell Voltage during Charging

Both temperature and charging rate determine the charge voltage characteristic. Fig. 2 shows the typical curve at normal ambient temperature and various charging currents.

For Mempac S + F, SafeTronic, Flat Pack, DK

1 \triangleq charge current $0.1 C_5A$ (I_{10})

2 \triangleq charge current $0.01 C_5A$ ($0.1 I_{10}$)

For RST

3 \triangleq charge current $0.1 C_5A$ (I_{10})

4 \triangleq charge current $0.05 C_5A$ ($0.5 I_{10}$)

Charging Circuits

With sealed Ni-Cd-batteries being charged at constant currents, simple charging circuits can be used in practice.

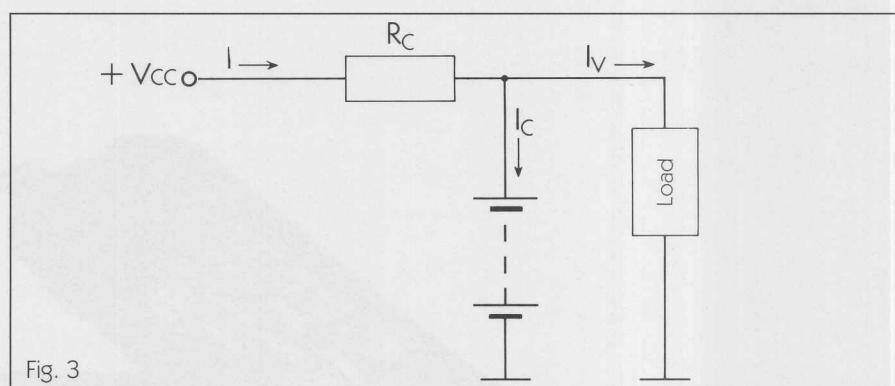
Simple charging circuit for stand-by operation.

Applicable for constant or variable load current at $I_V \leq 0.1 I_C$.

I_C \triangleq Charging current

I_V \triangleq Load current

R_C \triangleq Charging resistance



Simple charging circuit for stand-by operation.

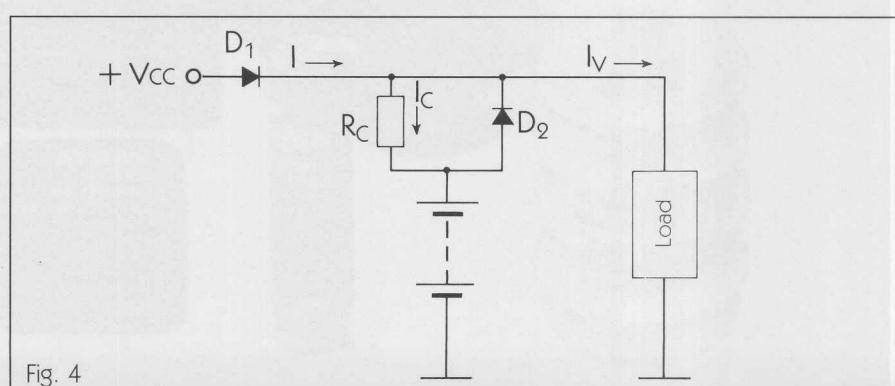
Applicable for variable load current at $I_C > 0.1 I_V$.

I_C \triangleq Charging current

I_V \triangleq Load current

D_1 \triangleq Blocking diode of power supply unit

D_2 \triangleq Bypassdiode for R_C



2.2 Discharge

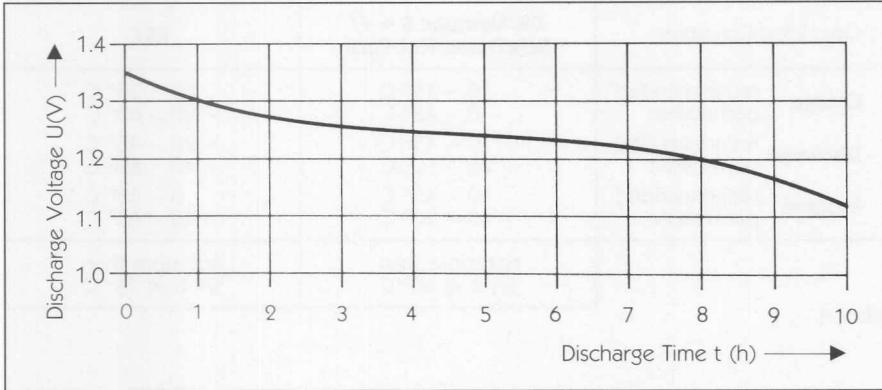


Fig. 5: Time vs. discharge voltage curve at $0.1 \text{ C}_5\text{A}$ (I_{10}) discharge rate at room temperature

At normal ambient temperature and up to a discharge rate of $0.1 \text{ C}_5\text{A}$ (I_{10}) those series recommended for printed circuit board application perform rather similar.

The nominal capacity of batteries is available at an ambient temperature of 20°C and a discharge rate of up to $0.1 \text{ C}_5\text{A}$ (I_{10}).

The end-of-discharge voltage at discharge currents up to $0.1 \text{ C}_5\text{A}$ (I_{10}) is 1.1 V per cell.

When selecting a power supply the following specific properties of the battery should be taken into consideration:

- A reversible loss of capacity of approx. 20 % of nominal capacity can be expected after trickle-charging for several months.
- Higher temperatures affect the storage capacity of the battery unfavourably, with a discharge time reduced.
- Higher temperatures accelerate self-discharge (see Fig. 7).

Example:

$$\begin{aligned} \text{Required performance } P &= 30 \mu\text{W} \\ \text{Nominal voltage } U &= 2.4 \text{ V} \\ U_{\max} &= 3.0 \text{ V} \\ U_{\min} &= 1.5 \text{ V} \end{aligned}$$

Min. operating time 4 months (2.900 h).

$$I = \frac{P}{U} = \frac{30 \times 10^{-6}}{2.4} = 12.5 \times 10^{-6} \text{ A} = 12.5 \mu\text{A}$$

Required battery capacity

$$C = I \times t = 12.5 \times 2.900 = 36.250 \mu\text{Ah} = 36.25 \text{ mAh}$$

A battery consisting of 2 button cells 60 DK or 100 DKO (table 1) is required, with a loss of self-discharge and reversible capacity of 20 % NK being calculated.

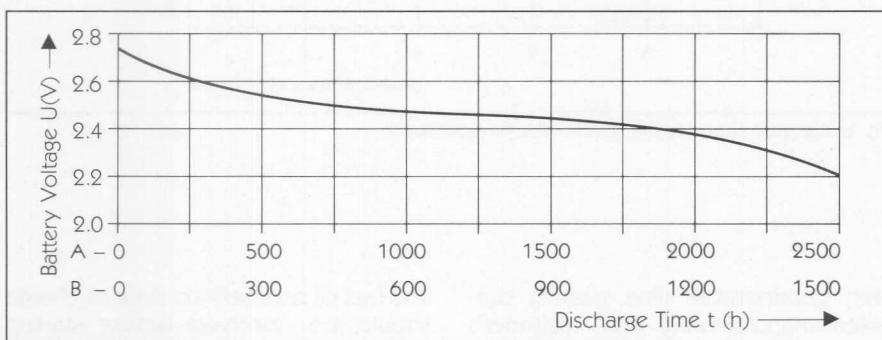


Fig. 6: A – Mempac S battery 2.4 V \triangleq approx. 3 months
B – 2/100 RST battery 2.4 V \triangleq approx. 2 months

Discharge voltage characteristic of Ni-Cd-batteries with a nominal capacity of 100 mAh.

Discharge current $20 \mu\text{A}$ – ambient temperature 20°C .

The reversible loss of capacity as well as the self-discharge rate of the batteries has been considered in the presented discharge time.

2.3 Temperature Range

Ni-Cd-cells can be charged, discharged and stored within the above specified range of temperatures.

The temperature has a considerable influence on capacity voltage and service life of cells.

The user is therefore advised to observe the temperature range as recommended (table 4).

Service Life during Trickle-Charge Operation

Within the normal operating range the service life of sealed Ni-Cd-batteries is hardly affected by external factors, with the age not having any significant importance. However, the temperature and electrical operating conditions have a vital impact on service life.

When using Mempac S + F, SafeTronic, Flat Pack, DK and RST a service life of 4 – 6 years can be obtained, provided constant current charge is used at 20°C. According to IEC 285 and 509 the service life of the battery is considered terminated, when only 60 % of normal capacity at a discharge rate of 0.1 C_{5A} (I₁₀) is available.

The service life can be extended by using more sophisticated charging methods, e. g. impulse charging, which compensates the rate of self discharge by means of charging pulses during trickle-charge condition.

Handling and Storage

- Cells and batteries are maintenance-free.
- Storage is possible in any state of charge without any effect on performance. The recommended storage temperature is between 0° and 35°C.
- Button cells and batteries can be flow-soldered even in a charged state not exceeding a maximum soldering time of 10 sec. This refers to Mempac S + F, SafeTronic, Flat Pack and DK.
- RST-cells and batteries must be discharged before flow-soldering, in order to avoid high short-circuit currents. If this cannot be done, the batteries should be soldered manually.

Operation Condition		DK/Mempac S + F/ SafeTronic/Flat-Pack	RST
Charge	recommended permissible	10 – 35°C 0 – 45°C	10 – 35°C – 20 – 65°C
Discharge	recommended permissible	0 – 45°C – 20 – 50°C	– 20 – 45°C – 40 – 65°C
Storage	recommended permissible	0 – 45°C – 40 – 50°C	0 – 45°C – 45 – 65°C
		not more than 24 h at 60°C	not more than 24 h at 75°C

Table 4

Self-discharge

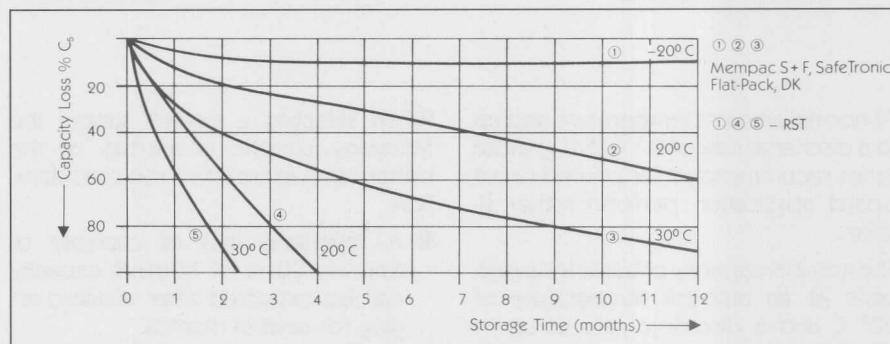


Fig. 7: Self-discharge rate dependant on ambient temperatures

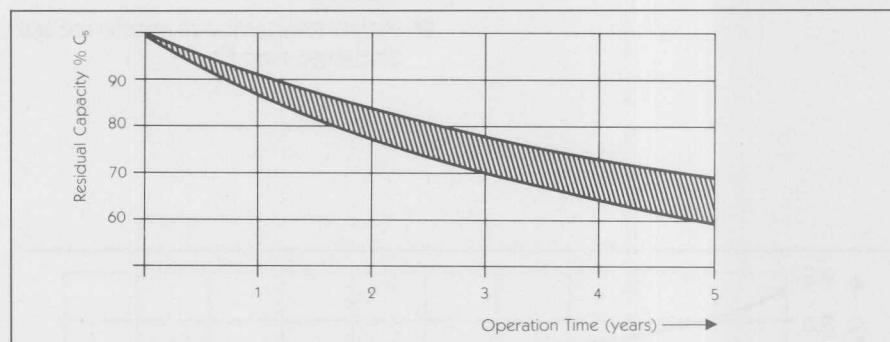


Fig. 8: Capacity loss during trickle-charge operation

With considerable time passing between manufacturing and customer's supply, definite statements on the state of charge cannot be made.

The fact of non defined state of charge should be observed before starting operation.

2.4 Product Range Mempac S + F/ SafeTronic

2.4.1 Mempac S + F

Product Range Mempac S + F

Order-No.	Nominal Voltage [V]	Width B [mm]	Length A [mm]	Height C [mm]	Weight approx. [g]
Mempac S					
53010 701 012	1.2	17 – 0.4	42.4 – 0.6	10.5 – 1	9
53010 702 012	2.4	17 – 0.4	42.4 – 0.6	16.0 – 1	15
53010 703 012	3.6	22.2 – 0.4	40.3 – 0.6	16.0 – 1	21
53010 704 012	4.8	30.0 – 0.3	40.0 – 0.3	16.0 – 0.5	26
Mempac F					
05625 702 012	2.4	20.0 – 0.3	37.0 – 0.3	10.0 – 1	10
05625 703 012	3.6	20.0 – 0.3	55.0 – 0.3	10.0 – 1	15

Table 5

Battery Voltage	D	E	F	G	H	I	J	K	L	M
	[mm]									
Mempac S										
1.2 V	35.6	33.0	–	7.6	4.1	6.2	0.64	2	1.5	1.5
2.4 V	35.6	33.0	–	7.6	4.1	6.2	0.64	2	1.5	1.5
3.6 V	30.5	29.9	10.2	15.24	4.2	6.2	0.64	2	1.5	1.5
4.8 V	30.5	22.9	10.2	15.24	4.2	6.2	0.64	2	1.5	1.5
Mempac F										
2.4 V	30.5	12.25	–	12.7	3.2	6.0	0.64	2	1.5	1.5
3.6 V	48.3	33.0	–	12.7	3.2	6.0	0.64	2	1.5	1.5

Table 6

Detailed dimensions according to fig. 9, 10 and 11

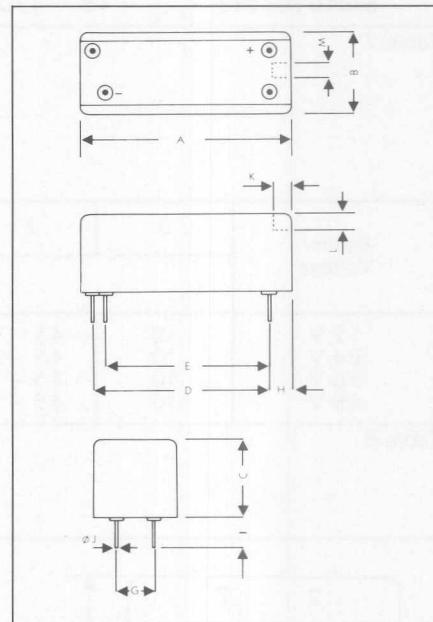


Fig. 9: Mempac S 1.2 V and 2.4 V

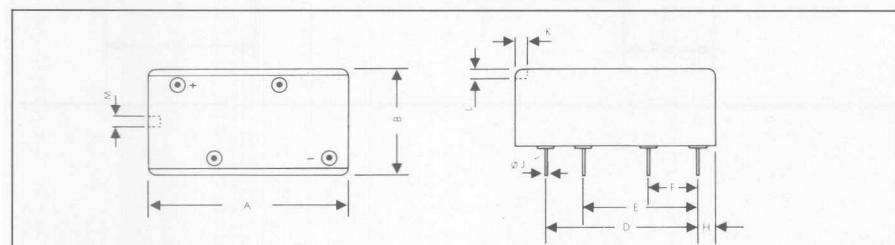


Fig. 10: Mempac S 3.6 V and 4.8 V

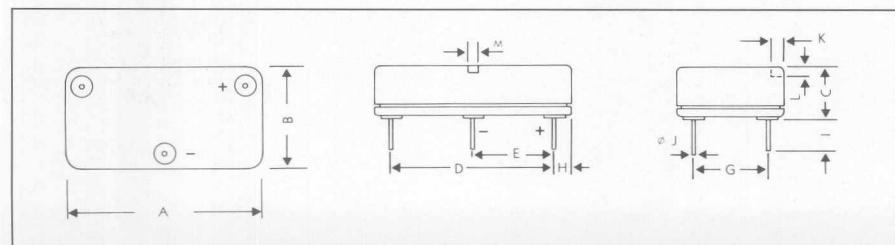


Fig. 11: Mempac F 2.4 V and 3.6 V

2.4.2 SafeTronic

Product Range SafeTronic

Order-No.	Nominal Voltage [V]	Length A [mm]	Width B [mm]	Height C [mm]	Weight approx. [g]
53010 701 013	1.2	29.5 – 0.3	10.0 – 0.3	19.0 – 0.5	9
53010 702 013	2.4	29.5 – 0.3	16.0 – 0.3	19.0 – 0.5	14
53010 703 013	3.6	30.5 – 0.3	23.5 – 0.3	19.0 – 0.5	25
53010 704 013	4.8	30.5 – 0.3	29.0 – 0.3	19.0 – 0.5	28

Table 7

Battery Voltage	D	E	F	G	H
	[mm]				
1.2 V	10	4.5 – 1	1	6.5 – 1	0.25
2.4 V	10	4.5 – 1	1	12.5 – 1	0.25
3.6 V	10	4.5 – 1	1	18.75 – 1	0.25
4.8 V	10	4.5 – 1	1	24.75 – 1	0.25

Table 8

Detailed dimensions according to fig. 12

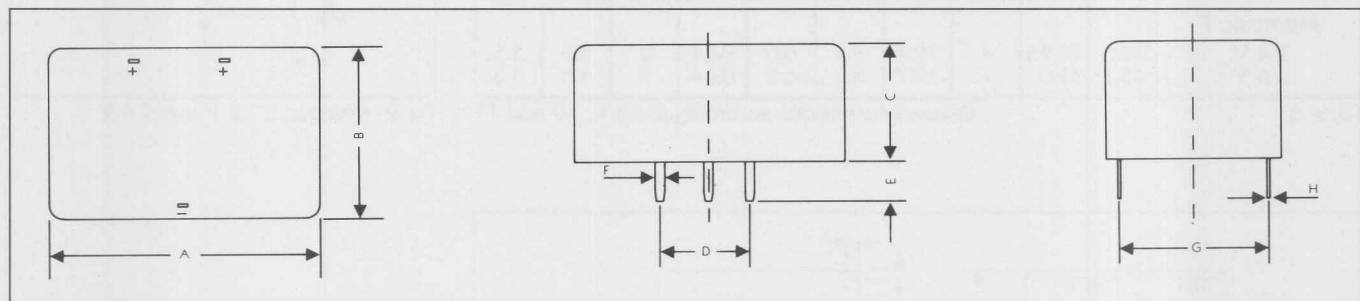


Fig. 12: SafeTronic 1.2 V, 2.4 V, 3.6 V, 4.8 V

2.5 Product Range Flat-Pack/DK/RST

2.5.1 Flat-Pack

Product Range Flat-Pack

Battery type	Order-No.	Nominal Voltage [V]	Length [mm]	Weight [g]
FL 2/ 60 DK	05625 402 059	2.4	36.5	9.0
FL 3/ 60 DK	05625 403 059	3.6	53.0 ± 0.5	12.5
FL 4/ 60 DK	05625 404 059	4.8	69.5	16.0
FL 5/ 60 DK	05625 405 059	6.0	86.0	19.5
FL 2/170 DK	53017 402 059	2.4	55.5	23.0
FL 3/170 DK	53017 403 059	3.6	81.5 ± 0.5	33.5
FL 4/170 DK	53017 404 059	4.8	107.5	44.5
FL 5/170 DK	53017 405 059	6.0	133.5	55.0
FL 2/250 DK	53025 402 059	2.4	55.5	27.5
FL 3/250 DK	53025 403 059	3.6	81.5 ± 0.5	41.0
FL 4/250 DK	53025 404 059	4.8	107.5	54.5
FL 5/250 DK	53025 405 059	6.0	133.5	68.0

Table 9

Battery type	A	B	C	D	E	F
	[mm]					
FL./ 60 DK	18.5	1	10	3	4	8.5
FL./170 DK	27	1	10	3	4	8.5
FL./250 DK	27	1	10	3	6	11

Table 10

Dimensional details according to fig. 13

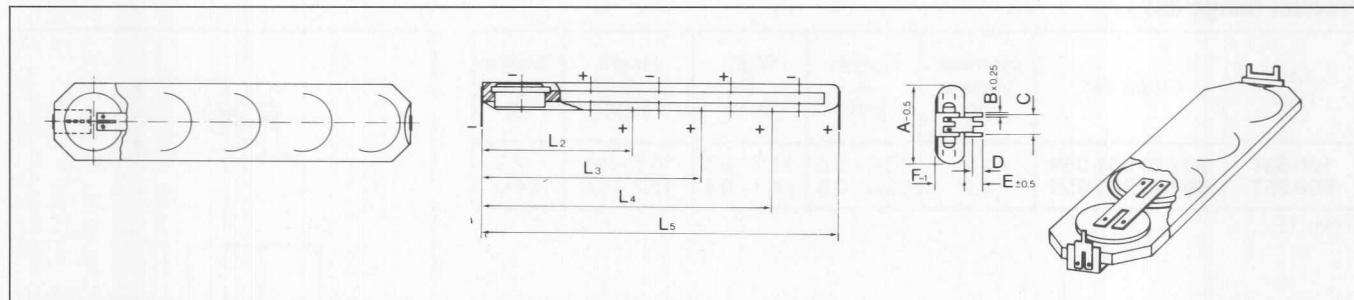


Fig. 13: Flat-Pack

2.5.2 DK

2.5.3 RST

Product Range DK

Battery Type	Order-No.	Nominal Voltage [V]	Length A [mm]	Width B [mm]	Height C [mm]	Weight approx. [g]
170 DK	53017 201 076	1.2	7.0–0.7	25.1–0.15	26.6–1.15	9.5
2/170 DK	53017 302 059	2.4	14.3–2.1	25.8–0.5	27.3–1.5	19.5
3/170 DK	53017 303 059	3.6	21.3–2.1	25.8–0.5	27.3–1.5	29.5
4/170 DK	53017 304 059	4.8	28.3–2.1	25.8–0.5	27.3–1.5	39.0
5/170 DK	53017 305 059	6.0	35.3–2.1	25.8–0.5	27.3–1.5	49.0
250 DK	53025 201 076	1.2	9.1–0.7	25.1–0.15	26.6–1.15	12.0
2/250 DK	53025 302 059	2.4	18.8–2.1	25.8–0.5	27.3–1.5	24.0
3/250 DK	53025 303 059	3.6	27.8–2.1	25.8–0.5	27.3–1.5	36.0
4/250 DK	53025 304 059	4.8	36.3–2.1	25.8–0.5	27.3–1.5	48.5
5/250 DK	53025 305 059	6.0	45.8–2.1	25.8–0.5	27.3–1.5	61.0

Table 11

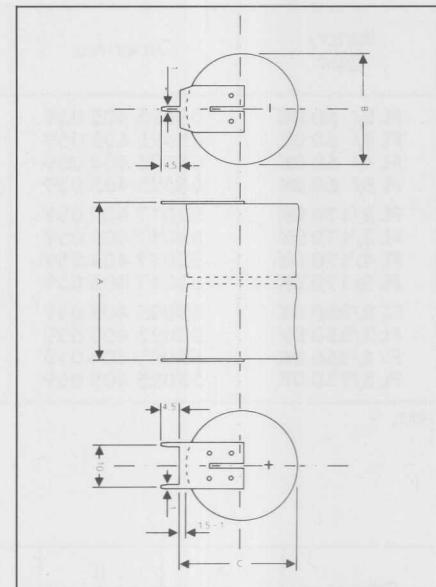


Fig. 14: DK-Battery-Stacks

Product Range RST

Cell Type	Order-No.	Nominal Voltage [V]	Length A [mm]	Width B [mm]	Height C [mm]	Weight approx. [g]
100 RST	50710 201 059	1.2	18.0–0.6	14.7–0.5	15.7–1.5	7.3
500 RST	50750 201 059	1.2	50.0–0.6	14.7–0.5	15.7–1.5	24.0

Table 12

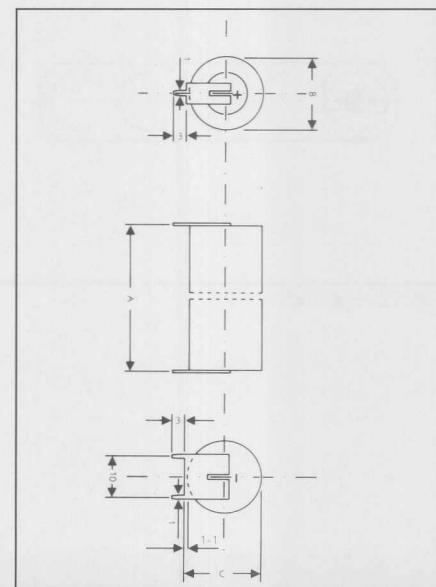


Fig. 15: RST-Cells

3. Lithium-Batteries for Memory Protection

3.1 Application Data

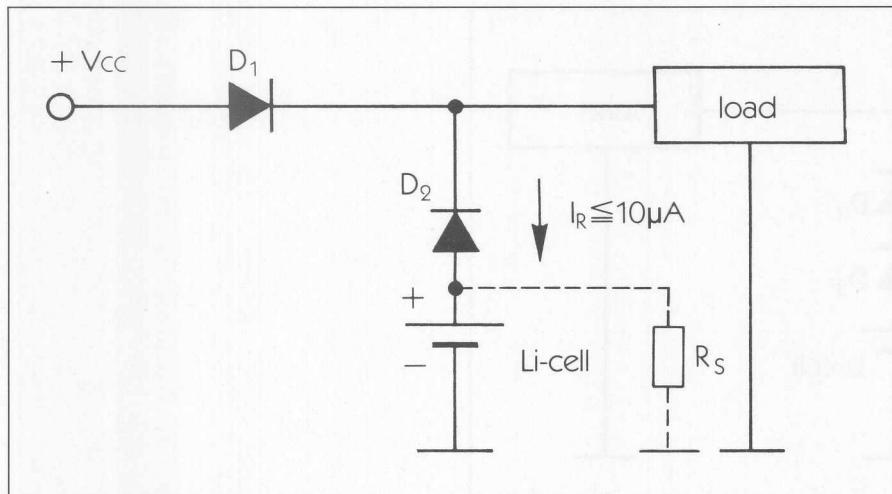


Fig. 1 a: Basic blocking circuit

- VARTA Lithium cells are suitable as a standby power source for supply of electronic memory devices and their protection against loss of mains power supply.

For this type of application, VARTA Lithium CR... or ER... are recommended. Batteries used for protection against mains failure need to be blocked by diodes from the mains operated DC power supply (D₁).

Blocking diode D₂ prevents the battery from being charged by the main d.c. supply. The reverse current through this diode should be no greater than 10 μ A in all circumstances (see Fig. 1 a – 1 c).

In the case of a supply voltage breakdown at + V_{CC} D₂ (and D₃) automatically connects the battery to the memory device. D₁ in many cases will be present in the circuitry anyway by means of a control transistor of a rectifier. Consideration must be given to the fact that the voltage available to the memory is reduced by the forward voltage drop of D₂ (or D₂ + D₃).

D₁, D₂, D₃:
Standard silicon diodes

D₂, D₃:
Shottky diodes preferable

The value of R_S has to be calculated thus, that the limiting current is about one power of ten above the required standby current.

15 mA or above should be avoided in any case (see Fig. 1 b).

Fig. 1 c demonstrates a highly safe circuit configuration. Even if one diode fails, a high charge current into the battery is avoided by means of the second diode. This circuitry however needs a relatively high voltage reserve or the application of special diodes with a low forward voltage drop.

A shunt resistor R_V should be specified if no power failure is to be expected over prolonged (years) periods of time. The value of R_V is determined by making the discharge current through it equal to the diode leakage current.

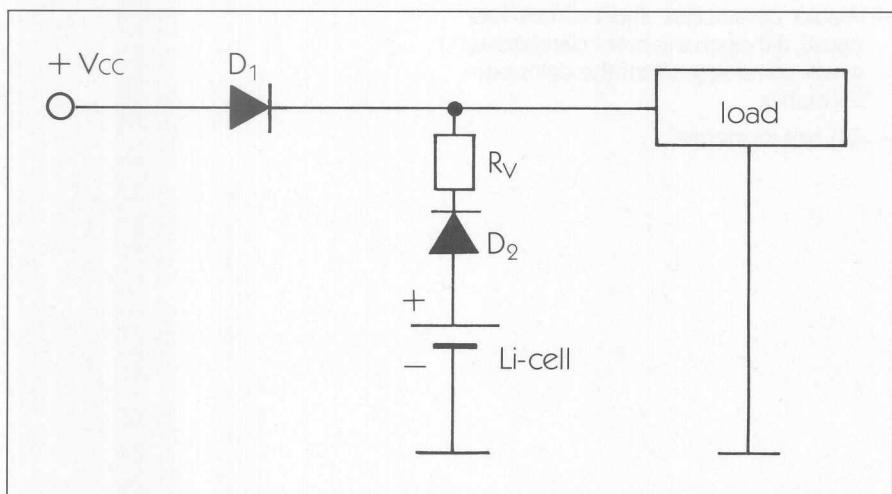


Fig. 1 b: Blocking circuit with current limiting resistor R_V in case of D₂-failure

3.1 Application Data

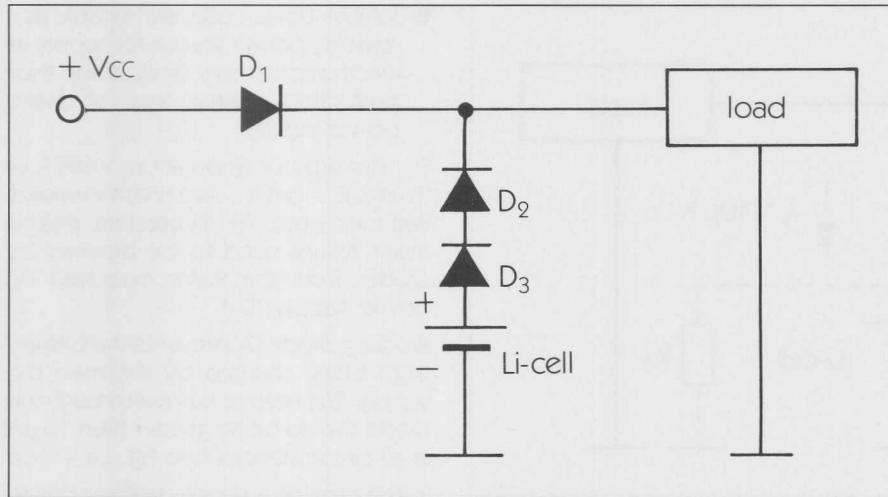


Fig. 1 c: Blocking circuit with additional protection diode

● 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 immeasurable amount of capacity is lost, due to the short circuiting of the battery in the solder bath.

● Attention is drawn to the following when handling VARTA lithium batteries:

- Do not recharge VARTA lithium batteries
- Do not solder wires directly to the cell's surface
- Observe the battery's correct polarity
- Avoid continuous short circuit because, although this is not dangerous, it will adversely affect the cell's performance
- Do not incinerate

3.1 Application Data

To enable battery selection
the following is required:

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

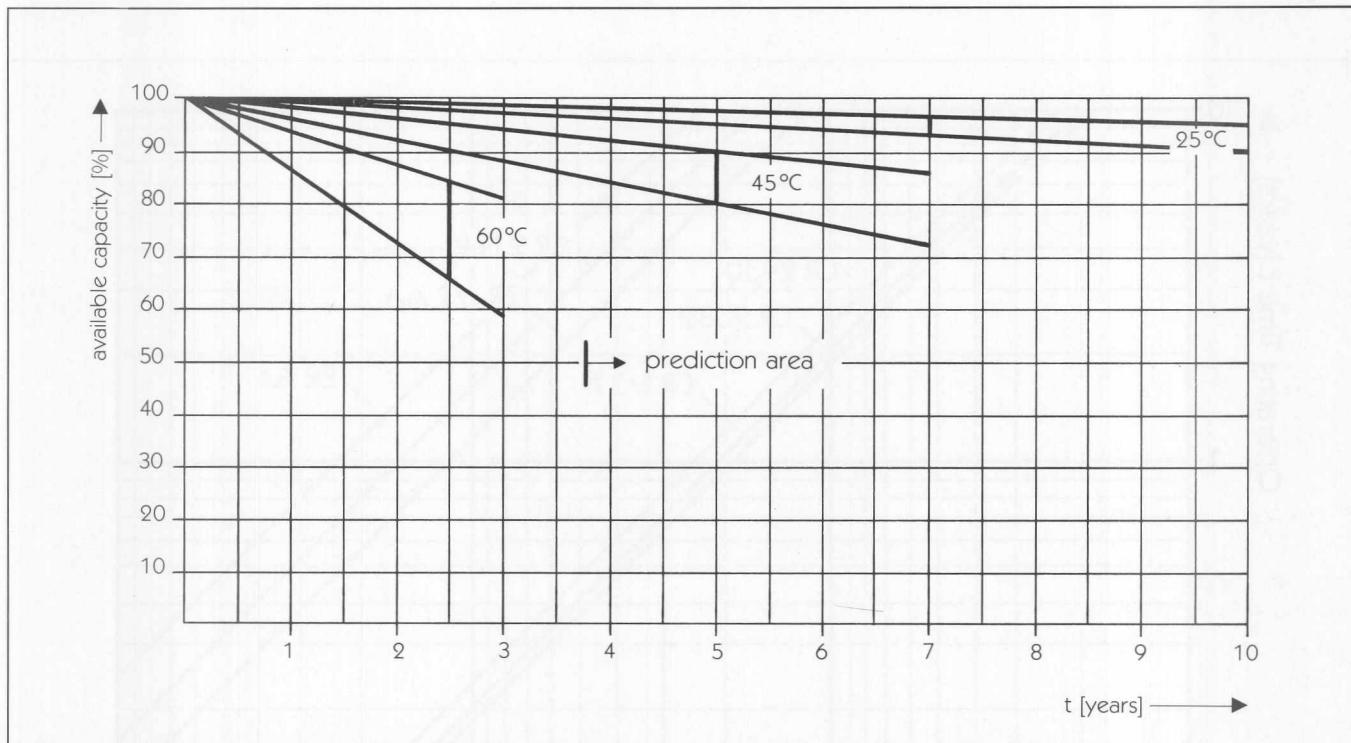


Fig. 2: Charge Retention Characteristics of VARTA Lithium Cells

CR (up to approx. 5 years)
ER (up to approx. 10 years)

3.1 Application Data

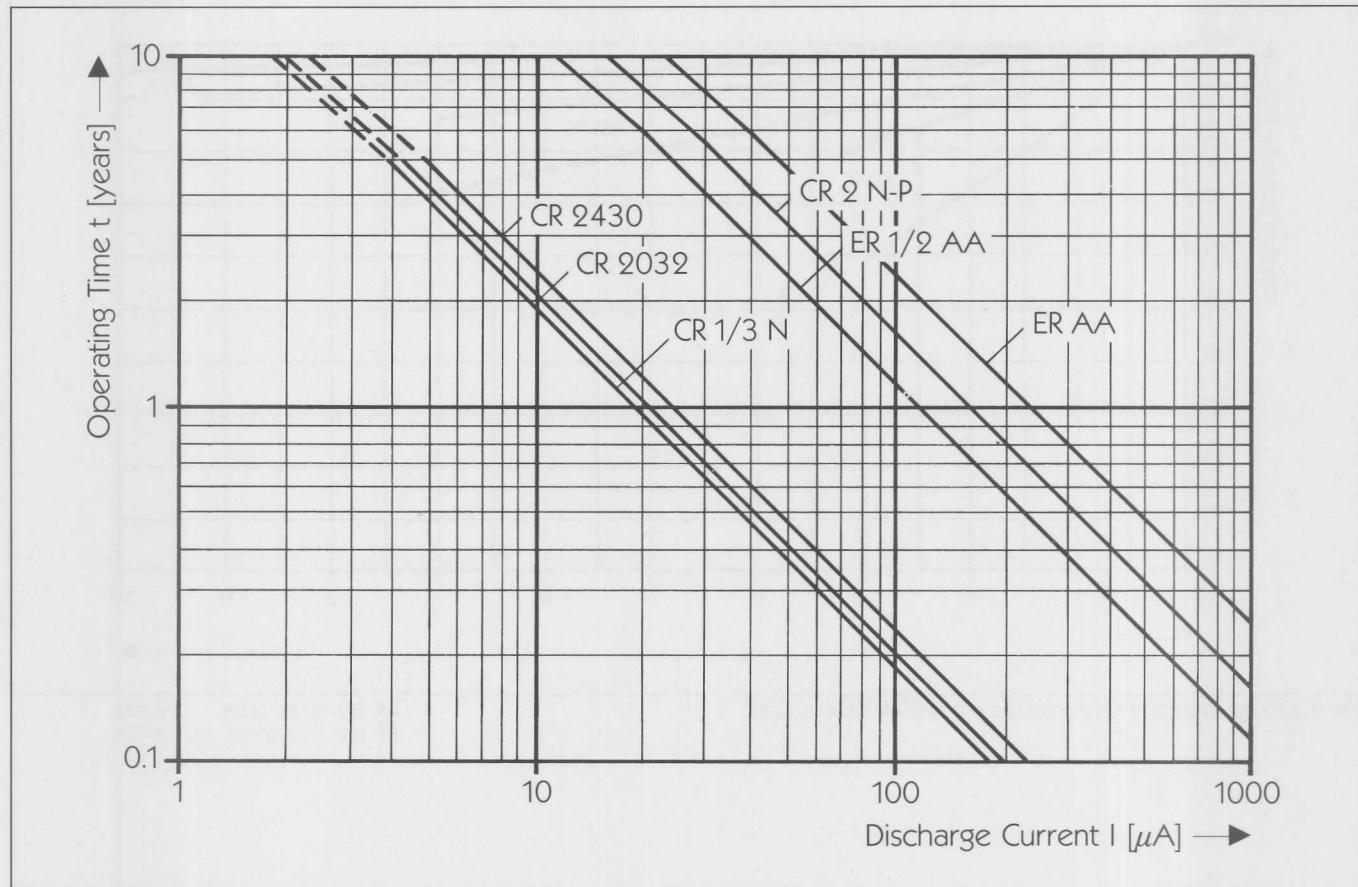


Fig. 3: Discharge current/operating time – Lithium-battery selection diagram

3.2 VARTA-series CR

3.2.1 Additional Data for Cells with Strip Solder Tag resp. Pin Solder Tag Construction

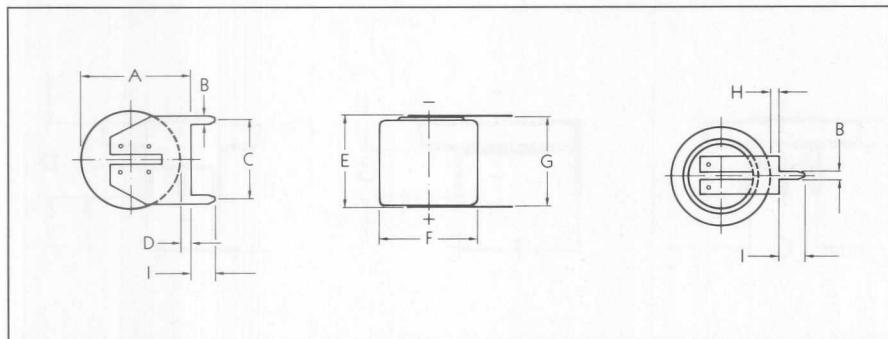


Fig. 4

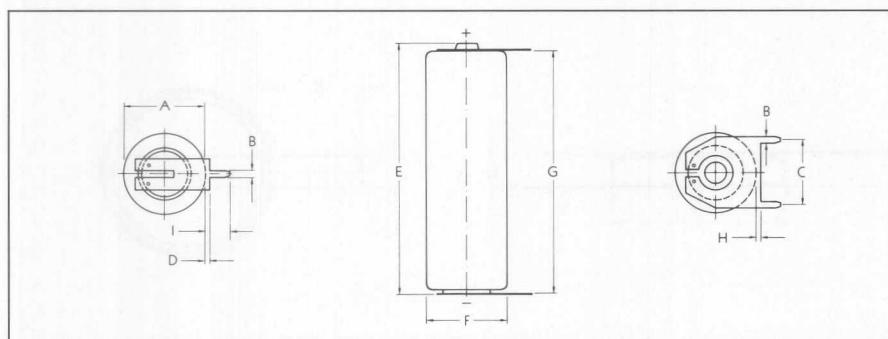


Fig. 5

Fig. 4 – 6: Drawings for cells with pin solder tags (SLF)

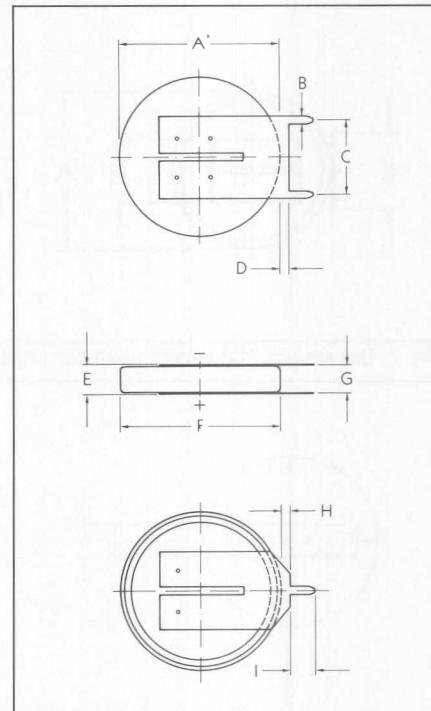


Fig. 6

Type	Order-No.	Dimensions (mm)												Weight [g]	Fig. No.
		A	B	C	D	E	F	G	H	I	K	L			
CR 1/3 N SLF	6131 201 501	13–0.5	1.0±0.1	10.0±0.15	1.0±0.3	11.5±0.5	11.6–0.2	11.05±0.2	1.0±0.3	3.0	–	–	3.0	4	
CR 1/3 N LF	6131 301 501	–	–	–	–	11.5±0.5	11.6–0.2	–	–	–	19	4.0	3.0	8	
CR 2 NP SLF	6202 201 501	12.6–0.4	1.0±0.1	10.0±0.15	0.3±0.3	60.55–0.4	12.0–0.2	58.8±0.3	0.3±0.3	3.0	–	–	13.1	5	
CR 2 NP LF	6202 301 501	–	–	–	–	60.55–0.4	12.0–0.2	–	–	–	10	4.0	13.1	9	
CR 2032 SLF	6032 201 501	21.5±0.5	1.0±0.1	10.0±0.15	1.0±0.3	4.2±0.5	20.5–0.2	3.7±0.5	1.0±0.3	4.5	–	–	3.0	6	
CR 2032 LF	6032 301 501	–	–	–	–	4.2±0.5	20.5–0.2	–	–	–	10	4.0	3.0	10	
CR 2032 PCB	6032 401 501	20.0–0.2	1.0±0.1	10.0±0.15	11±0.5	3.2±0.2	18.05–0.2 ^{+0.4}	8.0–0.5	10.0	4.5	11.4	–	3.0	7	
CR 2430 SLF	6430 201 501	25.8±0.5	1.0±0.1	10.0±0.15	1.0±0.3	4.0±0.5	25.0–0.2	3.5±0.5	1.0±0.3	4.5	–	–	4.0	6	
CR 2430 LF	6430 301 501	–	–	–	–	4.0±0.5	25.0–0.2	–	–	–	10	4.0	4.0	10	
CR 2430 PCB	6430 401 501	24.5–0.2	1.0±0.1	10.0±0.15	11±0.5	3.0–0.2	18.05–0.2 ^{+0.4}	8.0–0.5	10.0	4.5	11.4	–	4.0	7	

Table 1: Detailed dimensions of cells with pin (SLF) and strip solder tags (LF)
Thickness of strip and pin solder tag material is 0.25 mm.

3.2.1 Additional for Cells with Strip Solder Tag resp. Pin Solder Tag Construction

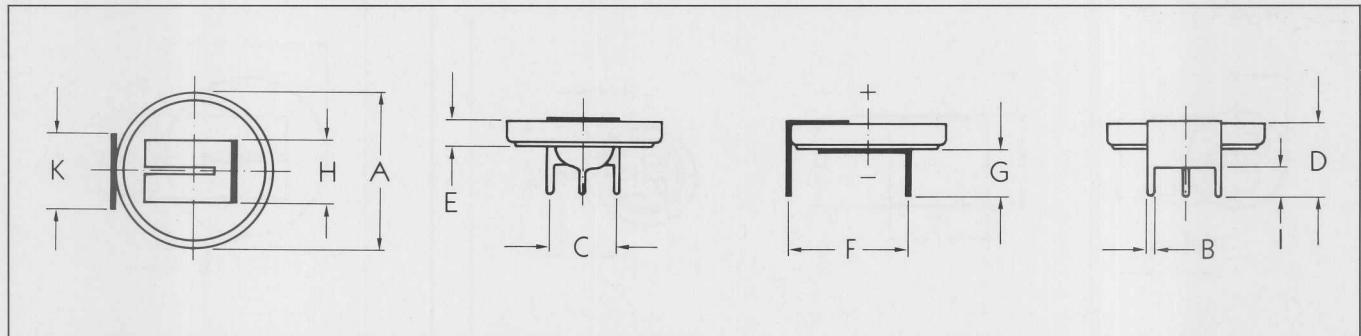


Fig. 7: Drawing of PCB design (with flat pin solder tags)

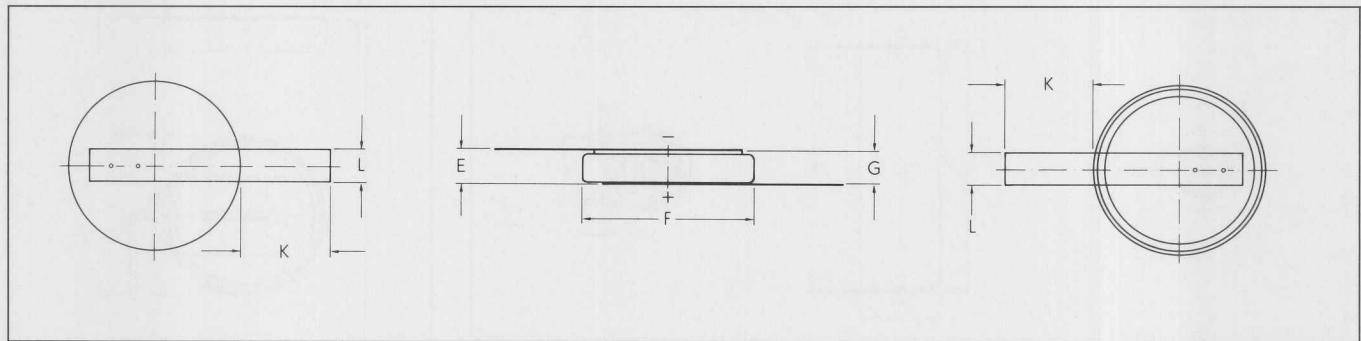


Fig. 10

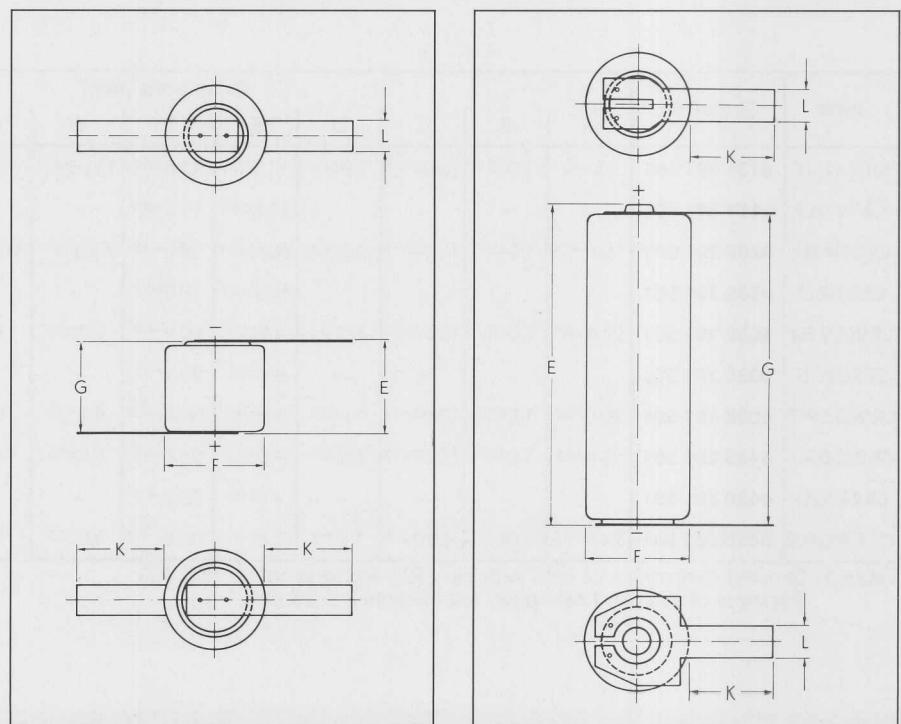
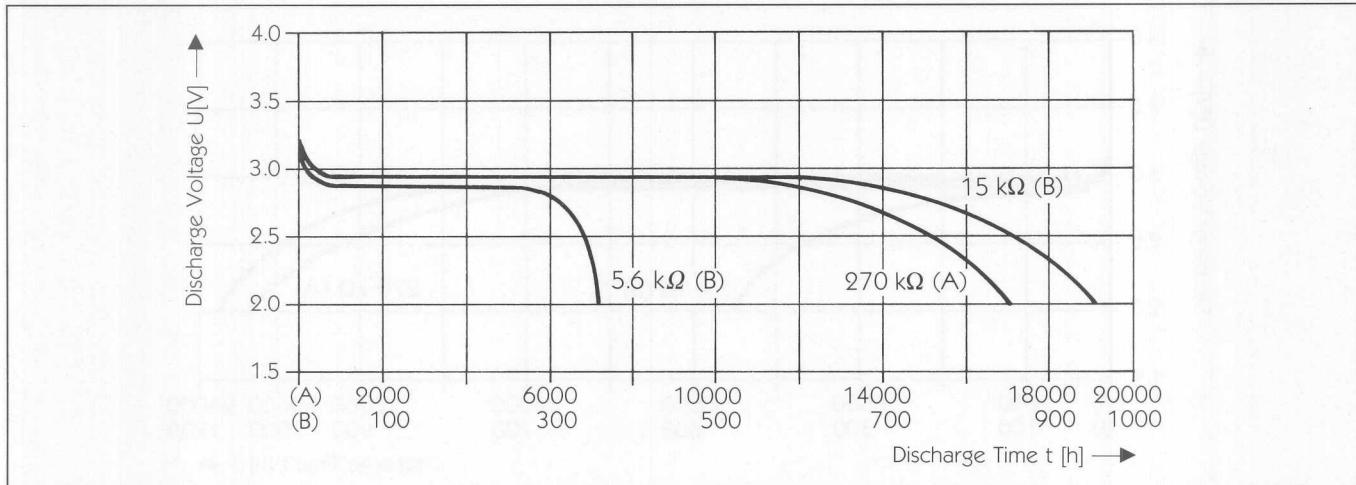


Fig. 8 – 10:
Drawing for cells with strip solder tags

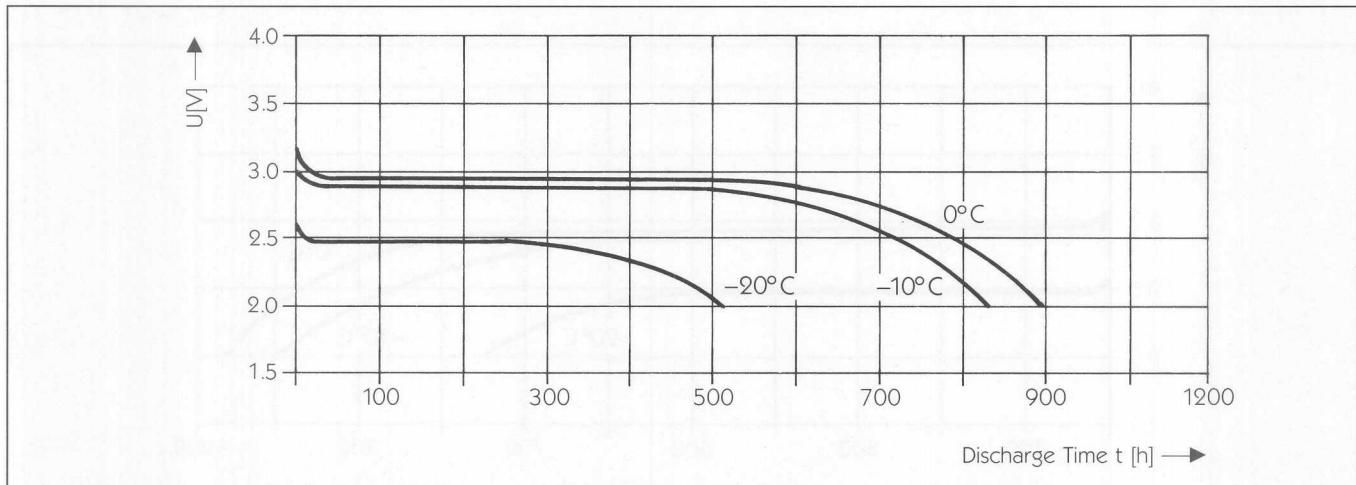
3.2.2 Discharge Voltage Curve of Button Cells at Various Ambient Temperatures and Discharge Rates



CR 2032

Fig. 11
 Discharge rate $R_1 = 5.6 \text{ k}\Omega$ (B)
 $R_2 = 15 \text{ k}\Omega$ (B)
 $R_3 = 270 \text{ k}\Omega$ (A)

Average	Discharge current	$I_1 \sim 400 \mu\text{A}$
	$I_2 \sim 180 \mu\text{A}$	
	$I_3 \sim 10 \mu\text{A}$	

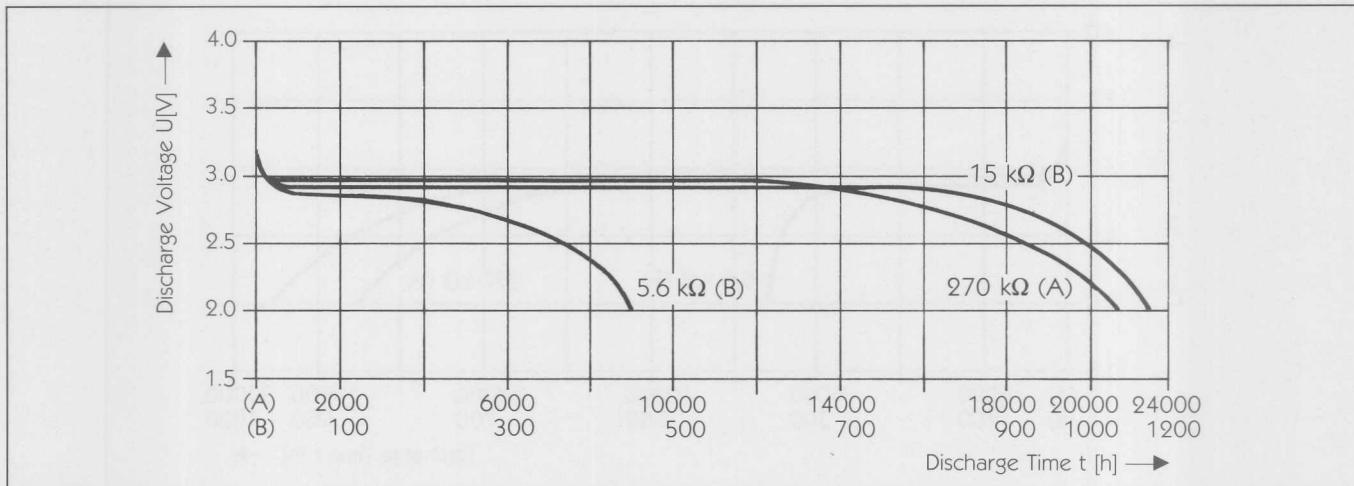
 $\delta = 20^\circ \text{C}$


CR 2032

Fig. 12
 Discharge rate 15 k Ω

Average	Discharge current	at $\delta = 0^\circ \text{C} \sim 175 \mu\text{A}$
		$\delta = -10^\circ \text{C} \sim 170 \mu\text{A}$
		$\delta = -20^\circ \text{C} \sim 155 \mu\text{A}$

3.2.2 Discharge Voltage Curve of Button Cells at Various Ambient Temperatures and Discharge Rates



CR 2430

Fig. 13

Discharge rate $R_1 = 5.6 \text{ k}\Omega \text{ (B)}$
 $R_2 = 15 \text{ k}\Omega \text{ (B)}$
 $R_3 = 270 \text{ k}\Omega \text{ (A)}$

Average
Discharge current $I_1 \sim 400 \mu\text{A}$
 $I_2 \sim 180 \mu\text{A}$
 $I_3 \sim 10 \mu\text{A}$
 $\delta = 20^\circ \text{C}$

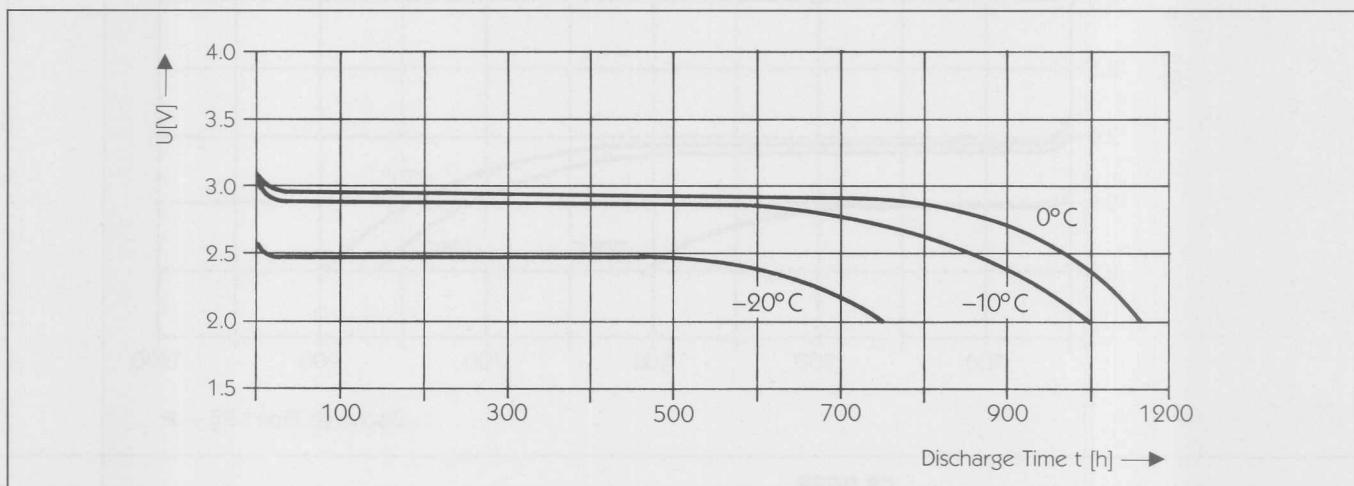


Fig. 14
Discharge rate 15 k Ω

Average
Discharge current
at $\delta = 0^\circ \text{C} \sim 175 \mu\text{A}$
 $\delta = -10^\circ \text{C} \sim 170 \mu\text{A}$
 $\delta = -20^\circ \text{C} \sim 155 \mu\text{A}$

3.2.3 Discharge Voltage Curve of Cylindrical Cells at Room Temperature

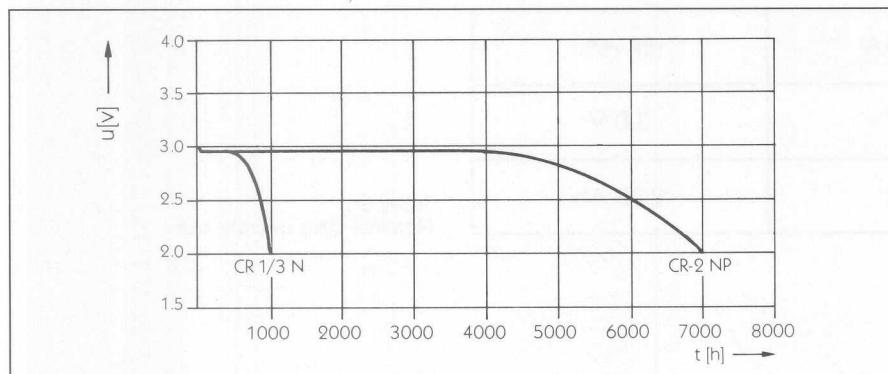


Fig. 15
Discharge voltage curve of cylindrical cells.
Discharge rate $13 \text{ k}\Omega$
Average discharge current $I \sim 210 \mu\text{A}$
 $\delta = 20^\circ \text{C}$

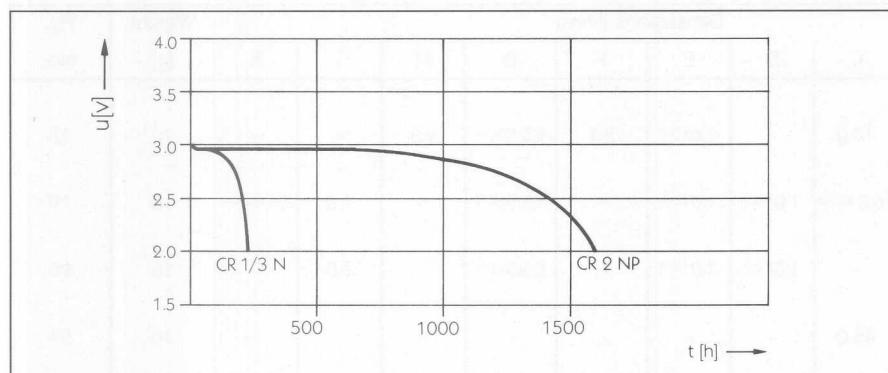


Fig. 16
Discharge voltage curve of cylindrical cells.
Discharge rate $3 \text{ k}\Omega$
Average discharge current $I \sim 0.9 \text{ mA}$
 $\delta = 20^\circ \text{C}$

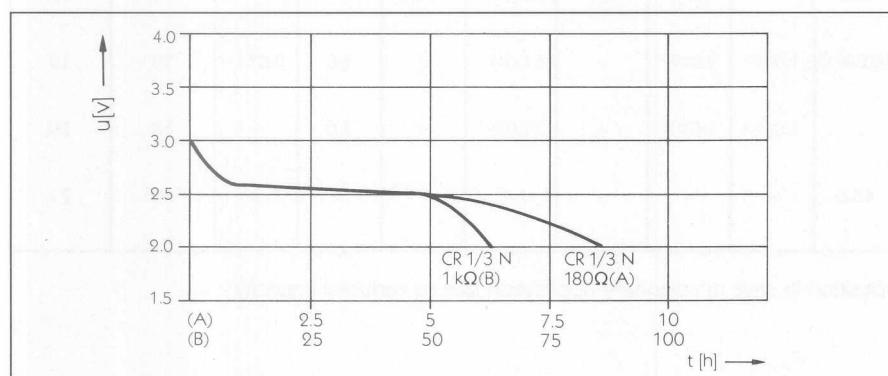


Fig. 17
Discharge voltage curve CR 1/3 N at high discharge currents.
Discharge rate $180 \Omega / 1 \text{ k}\Omega$
Average discharge current $I \sim 13.5 \text{ mA} / 2.5 \text{ mA}$
 $\delta = 20^\circ \text{C}$

Safety

All cells are regarded as safe referring to a continuous short circuiting and inadvertent charging. Cells are likely to vent at high continuous charge currents

($> 5 \text{ mA}$), with a short flame bursting (not like an explosion!). There is no danger in case of a continuous charge current below $10 \mu\text{A}$.

4. VARTAlith Li/CrOx-Cells, Product Range ER

4.1 Technical Data

Type	ER ½ AA	ER AA
Nominal Voltage	3.0 V	3.0 V
Capacity	1 Ah	2.25 Ah

Table 2
Nominal data Li/CrOx-cell

Type	Order-No.	Dimensions (mm)											Weight [g]	Fig. No.
		A	B	C	D	E	F	G	H	I	K			
ER ½ AA LF	6126 301 501	14.8±0.1	25.0±0.1	10.0	—	1.0±0.1	2.1	25.5±0.5	2.5	—	—	10	18	
ER ½ AA SLF	6126 201 501	14.8±0.1	25.0±0.1	10.0±0.15	1.0±0.3	1.0±0.1	—	25.5±0.5	—	3.0	5.0±0.25	10	19	
ER ½ AA SLF single	6126 701 501	14.8±0.1	25.0±0.1	—	1.0±0.3	1.0±0.1	—	25.5±0.5	—	3.0	—	10	20	
ER ½ AA CD	6126 501 501	14.8±0.1	25.0±0.1	45.0	—	—	—	—	—	—	—	10	21	
ER AA LF	6116 301 501	14.8±0.1	50.0±0.5	10.0	—	1.0±0.1	2.1	51.0±0.5	2.5	—	—	18	18	
ER AA SLF	6116 201 501	14.8±0.1	50.0±0.5	10.0±0.15	1.0±0.3	1.0±0.1	—	51.0±0.5	—	3.0	5.0±0.5	18	19	
ER AA SLF single	6116 701 501	14.8±0.1	50.0±0.5	—	1.0±0.3	1.0±0.1	—	51.0±0.5	—	3.0	—	18	20	
ER AA CD	6116 501 501	14.8±0.5	50.0±0.5	45.0	—	—	—	—	—	—	—	18	21	

Table 3: Detailed dimensions

Do not design cells in neg. pole down position in case of stationary application due to reduced capacity.

4.1 Technical Data

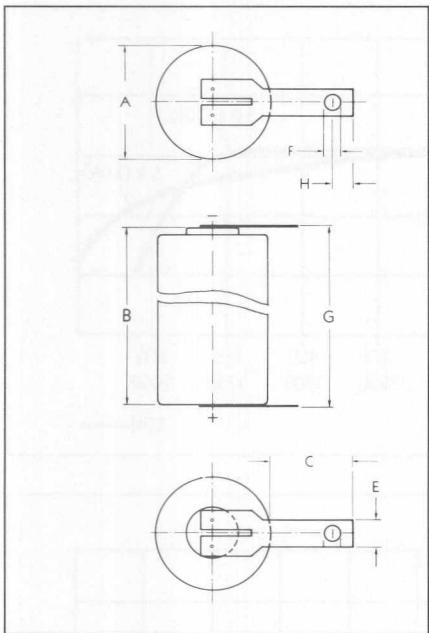


Fig. 18
LF

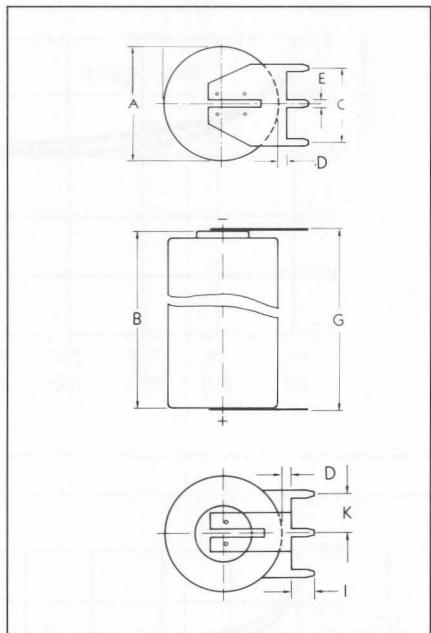


Fig. 19
SLF

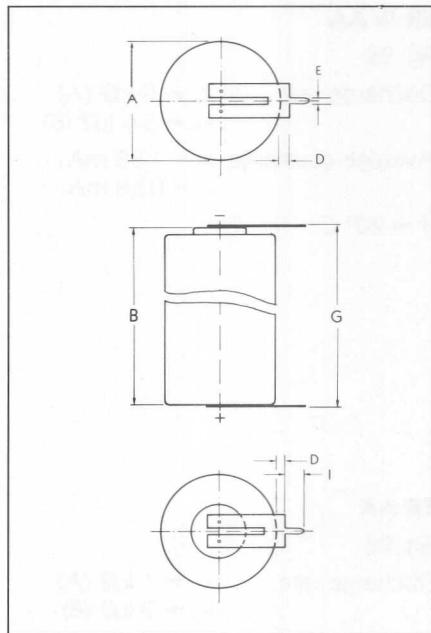


Fig. 20
SLF single

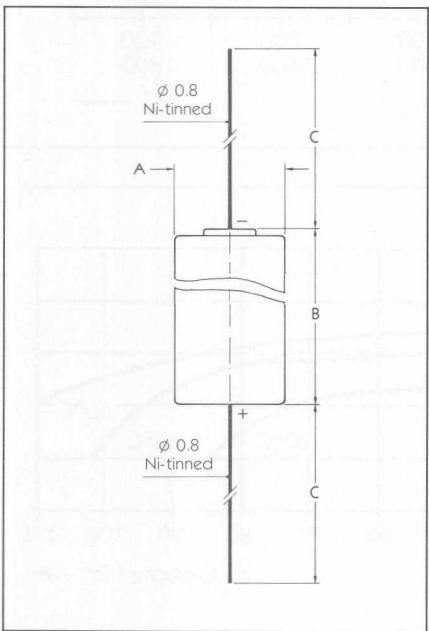


Fig. 21
CD

4.2 Discharge Voltage Curve at Various Ambient Temperatures and Discharge Rates

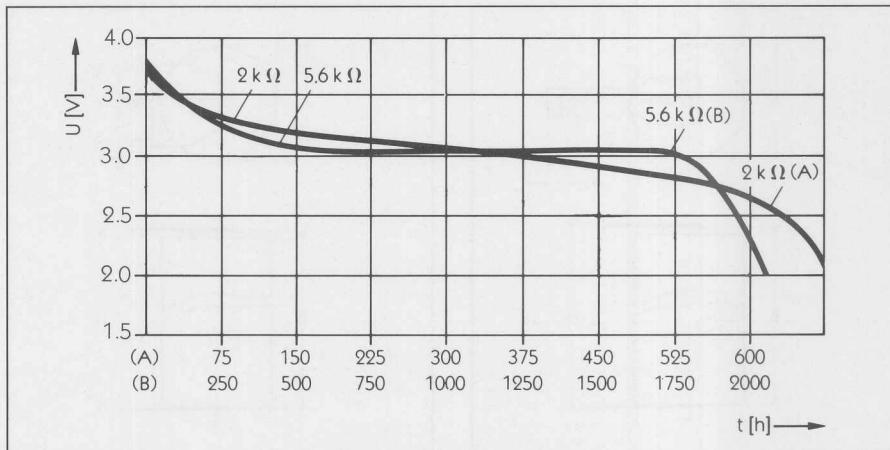
ER ½ AA

Fig. 22

Discharge rate $R_1 = 2 \text{ k}\Omega$ (A)
 $R_2 = 5.6 \text{ k}\Omega$ (B)

Average discharge $I_1 \sim 1.55 \text{ mA}$
 $I_2 \sim 0.58 \text{ mA}$

$\delta = 20^\circ \text{ C}$



ER AA

Fig. 23

Discharge rate $R_1 = 1 \text{ k}\Omega$ (A)
 $R_2 = 2 \text{ k}\Omega$ (B)

Average discharge $I_1 \sim 3 \text{ mA}$
 $I_2 \sim 1.5 \text{ mA}$

$\delta = 20^\circ \text{ C}$

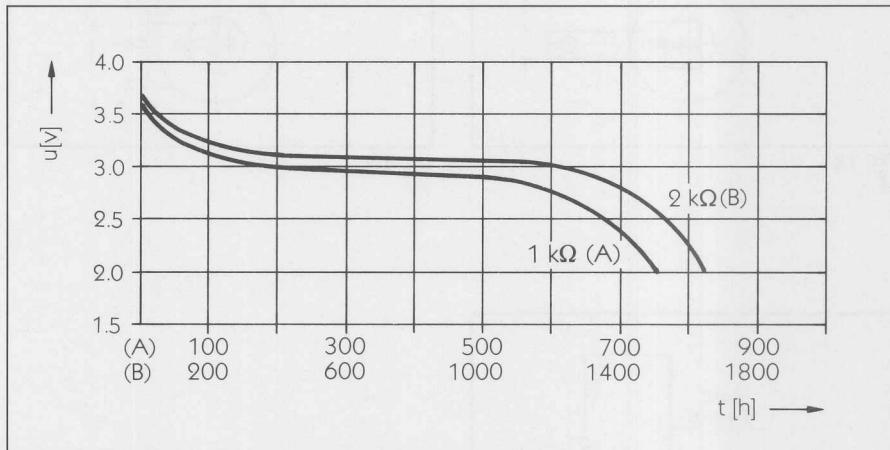
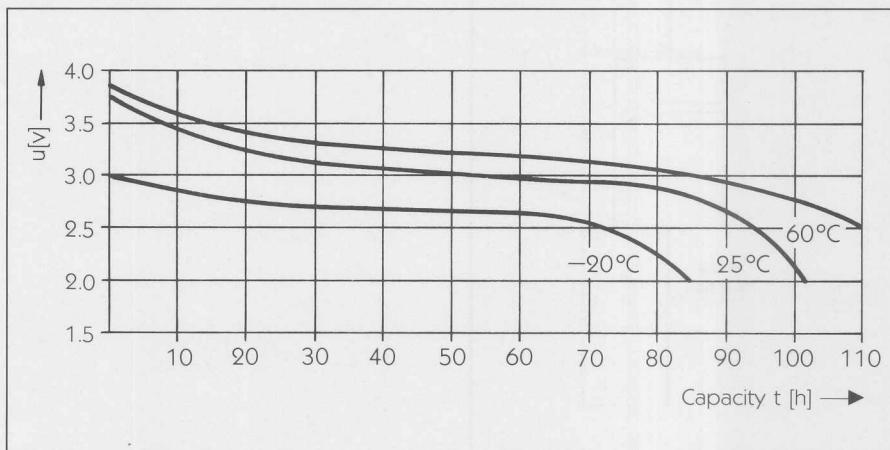


Fig. 24

Discharge voltage curve at 60° C , 25° C and -20° C .

Average discharge current
 for ER ½ AA $I_1 \sim 0.55 \text{ mA}$
 ER AA $I_2 \sim 1.10 \text{ mA}$



4.2 Discharge Voltage Curve at Various Ambient Temperatures and Discharge Rates

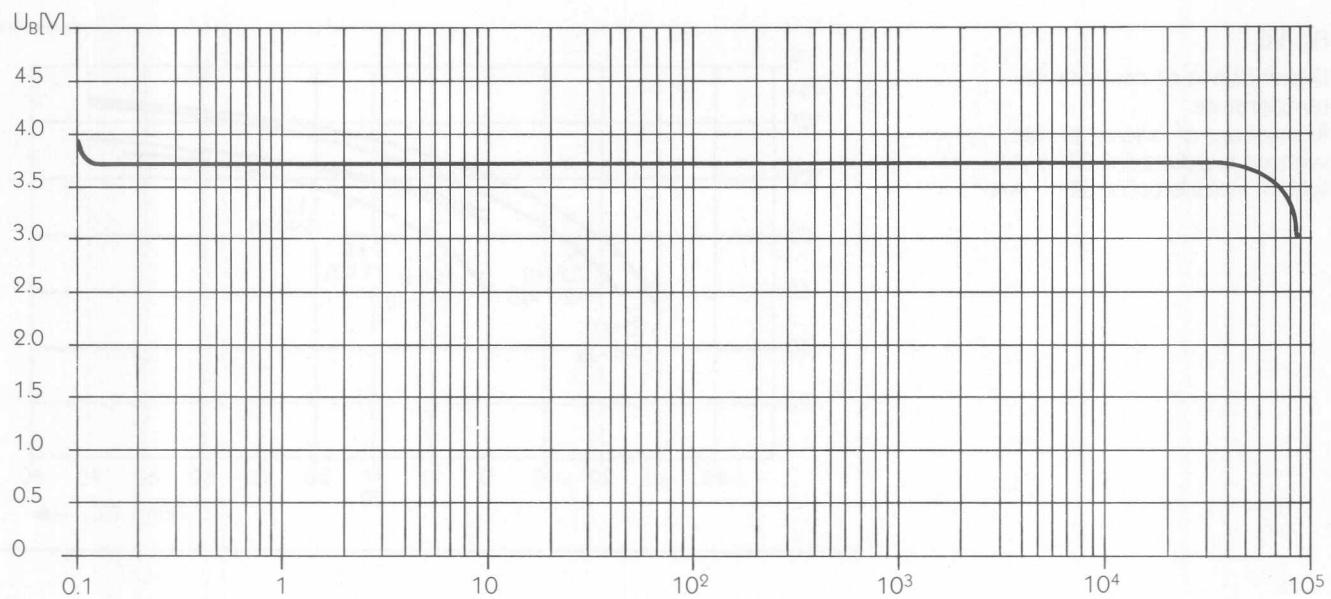


Fig. 25
Discharge voltage curve
Average discharge current

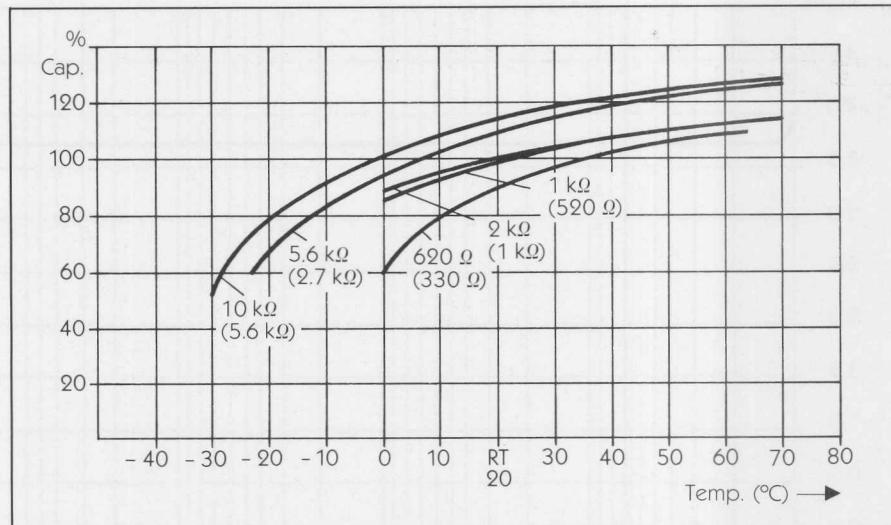
for ER ½ AA $I_1 \sim 10 \mu\text{A}$
ER AA $I_2 \sim 22.5 \mu\text{A}$

4.3 Application Data

Fig. 26

Dependence of capacity on temperature.

Resistances of discharge rate:
without brackets for ER ½ AA
with brackets for ER AA



Safety Tests

Test

- Compression test
Cell compression down
to a height of 15 mm

- Puncture test
total penetration of the cell
by a nail Ø 3 mm

- In short circuit condition
24 h 0.1 ohm

- Test at + 150° C for 2 hours

Results

- no significant electrolyte loss
- no explosion

- no splashing or pressurized electrolyte loss
- no explosion

- after 24 h the bottom of the cell is curved
by only 0.1 mm; diameter unchanged
- no electrolyte creepage or loss
- no explosion

- open circuit voltage almost unchanged at 3.8 V
- the cell base bowed, causing cell height to increase
by 1 mm, diameter unchanged
- no electrolyte creepage or loss
- no explosion

Handling

Most primary electrochemical couples, in production today, contain zinc as an 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 system in terms of weight. It has only half the specific weight of water. In VARTA lithium batteries, organic non-aggressiv, non creeping electrolyte and solid cathode materials, such as manganese dioxide and chromium oxide are used.

To extract cell's full capacity and to achieve maximum life, the following rules should be followed:

- Avoid short circuiting batteries! Although this is not dangerous, the battery's available capacity will be reduced.
- Observe the correct polarity of the battery – to ensure the battery does not receive charge. (See no. 4)
- Do not incinerate. Incineration may cause the battery case to rupture.
- VARTA lithium batteries are primary batteries and not rechargeable. Current flowing into the battery, up to a magnitude of $10 \mu\text{A}$ is permissible. At higher rates of charge, internal gassing will occur, resulting in an increase in internal pressure.

Like in all primary systems there is the danger of cells rupture in such cases.

Life expectancy

All VARTA lithium cells are designed for long discharge durations and life expectancy. The self discharge rate, at $+20^\circ\text{C}$, is less than 1 % of the nominal capacity per annum. For each 10°C increase in temperature, the self discharge rate approximately doubles, it can, therefore, be noted that the life expectancy of lithium batteries, at room temperature, is not limited by self discharge but by other effects. The most important factor is the cell sealing system. By using organic electrolyte, less problems occur in cell sealing compared to cells that use an alkaline electrolyte. In the case of lithium cells, the sealing system has to prevent not only materials leaking from the cell, 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 diffusion of humidity into the cell. Water and the lithium metal react by producing lithium hydroxide, this material forms a passivation film on the lithium surface. The loss of lithium metal in this reaction results in it no longer being available for the discharge process. So the total result is an increase in internal resistance and a loss of capacity.

Plastic 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. Sealing systems, such as glass to metal seals and/or fully encapsulated (in resin), may be used.

A minimized compressed plastic feed-through is applied to the standard VARTA ER range in order to avoid problems with the attack of lithium to glass.

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

General Advice

VARTA are battery manufacturers operating on a worldwide basis.

VARTA operates in the field of electrochemical energy storage only. VARTA delivers all electrochemical systems and thus is in a position to offer unbiased advice to you.

Which ever system is the optimum solution for your application?

VARTA CAN SUPPLY:

- Zinc-carbon
- Zinc-manganese alkaline
- Zinc-silver oxide
- Zinc-mercuric oxide
- Zinc-air
- Lithium MnO_2
- Lithium- CrO_2
- NiCd-sintered electrodes
- NiCd-mass electrodes
- Lead acid
- and a few special electro-chemical couples.

Consult VARTA at one of the adresses printed on the last page of this catalog!

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