Cylindrical Lithium Primary Battery for Long Term Applications

Energy Solution Business Unit
Energy Company
Panasonic Corporation

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Features of Cylindrical BR Lithium Primary Battery

- **High Energy Density**
  - Nominal Voltage 3V (150mAh/cc ~ 300mAh/cc)
- **Low Self Discharge Rate**
  - Max. 0.5%/year capacity deterioration (at +20ºC)
- **Wide Operating Temperature Range**
  - -40ºC ~ +85ºC (+100ºC)
- **Stable Impedance During Low Rate Discharge**
  - Improved on pulse handling capability
- **Superior Safety and Environmental Friendly**
  - Thermal stable and non-toxic materials
- **The Truck Record of Long Term Operation**
  - Actual operation over 10 years as gas meter power source in Japan
  - Experience of various applications over 30years (since 1971)

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Product Line-up of BR Battery

Model	Electrical Characteristics			Operating Temp. Range [deg C]	Dimensions		Approx. Weight [g]
	Nominal Voltage [V]	Nominal Capacity [mAh]	Standard Continuous Drain [mA]		Diameter [mm]	Height [mm]	
BR-C	3.0	5,000	5.0	-40 to +85	26	50.5	42
BR-AA (under development)	3.0	2,500	2.5	-40 to +100*	14.5	50.5	15
BR-AG	3.0	2,200	2.5	-40 to +85	17	45.5	18
BR-A	3.0	1,800	2.5	-40 to +85	17	45.5	18
BR-2/3AG	3.0	1,450	2.5	-40 to +85	17	33.5	13.5
BR-2/3A	3.0	1,200	2.5	-40 to +85	17	33.5	13.5
BR-1/2AA (New)	3.0	1,000	2.5	-40 to +100*	14.5	25.5	8

Over +60℃ usage, please consult Panasonic engineers.

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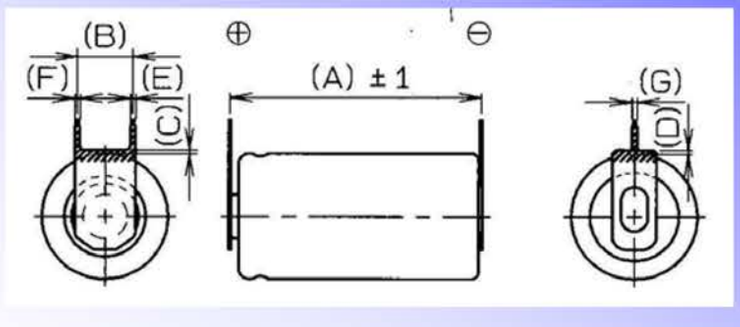
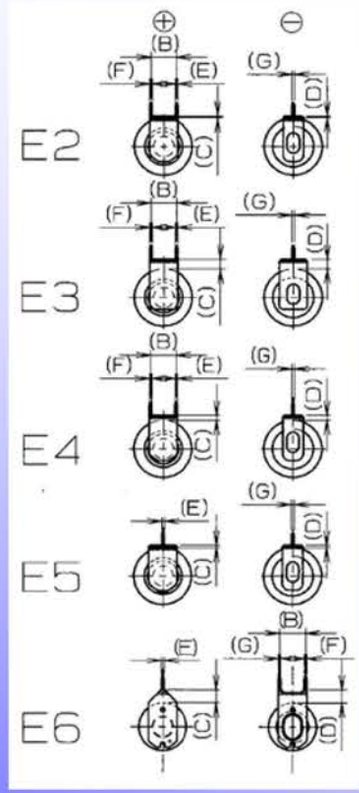
Various Tab-terminals and Battery Packs





(A)	1/2AA	25.5
	AA	50.5
	2/3A	34
	A	46
(B)	E2~E4, E6	7.5
	E5	——
(C)	E2	≦1.5
	E3	$3.5^{+0.2}_{-0.5}$
	E4	2±0.4
	E5	≦1.5
	E6	≧3.2

(D)	E2	≦1.5
	E3	$3.5^{+0.2}_{-0.5}$
	E4	2±0.4
	E5	≦1.5
	E6	≧3.2
(E)	E2~E5	0.7
	E6	0.8
(F)	E2~E4	0.7
	E5	——
	E6	0.8
(G)	E2~E5	0.7
	E6	0.8

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Various Tab-terminals and Battery Packs

○Insulating Tube Material:
Pet-Nylon Polymer Alloy
(Inflammable)

○Lead Wire Material:
UL3385(Polyolefin)
(un-flammable：UL VW-1)
Size: AWG 22-24-26

○Connector:

Maker	Housing	Contact
JST	SMP-02V-BC	SHF-001T-0.8SS
Molex	5051-02	2759G

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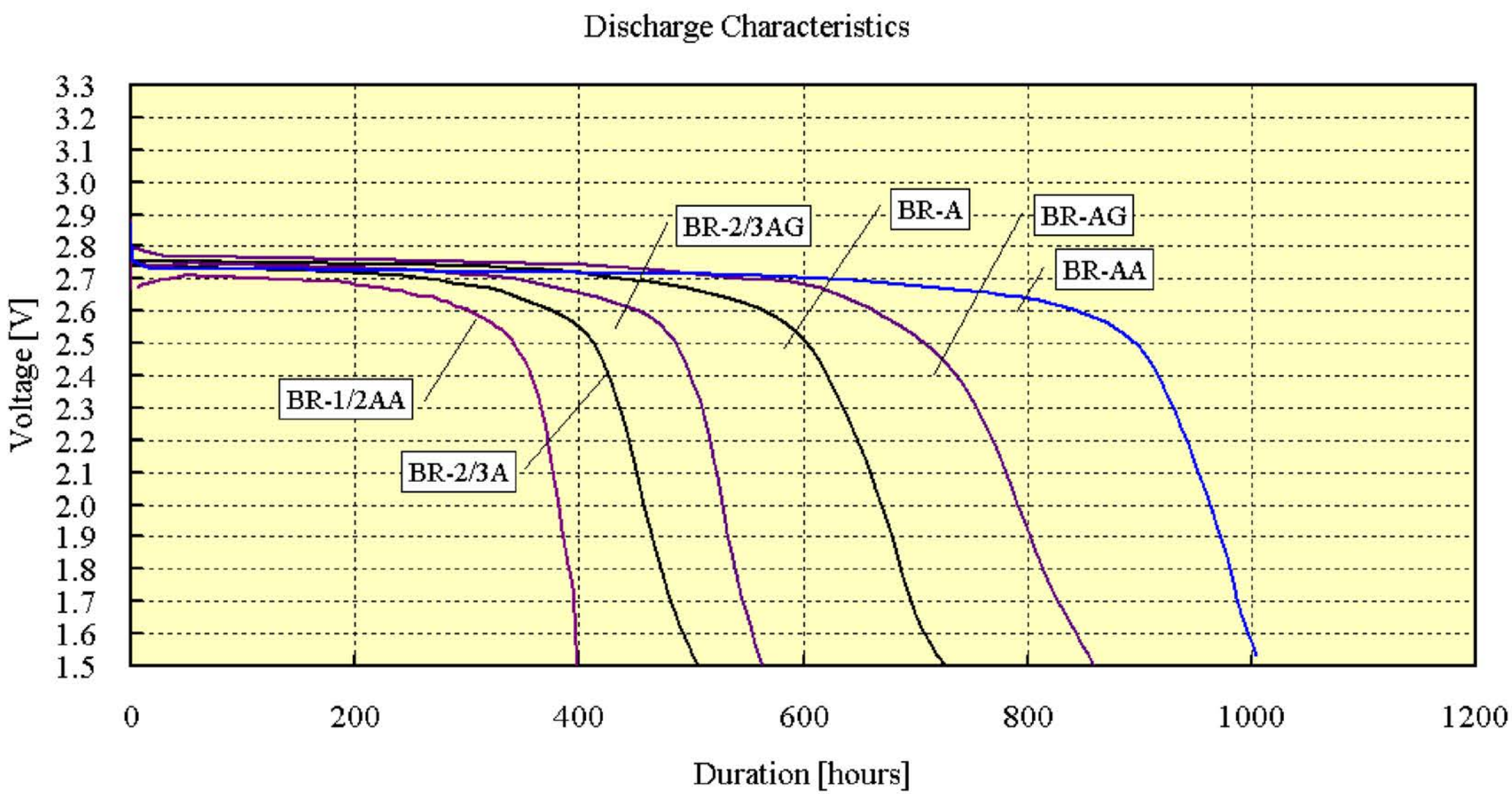
Standard Discharge Curves (1kohm at 20ºC)



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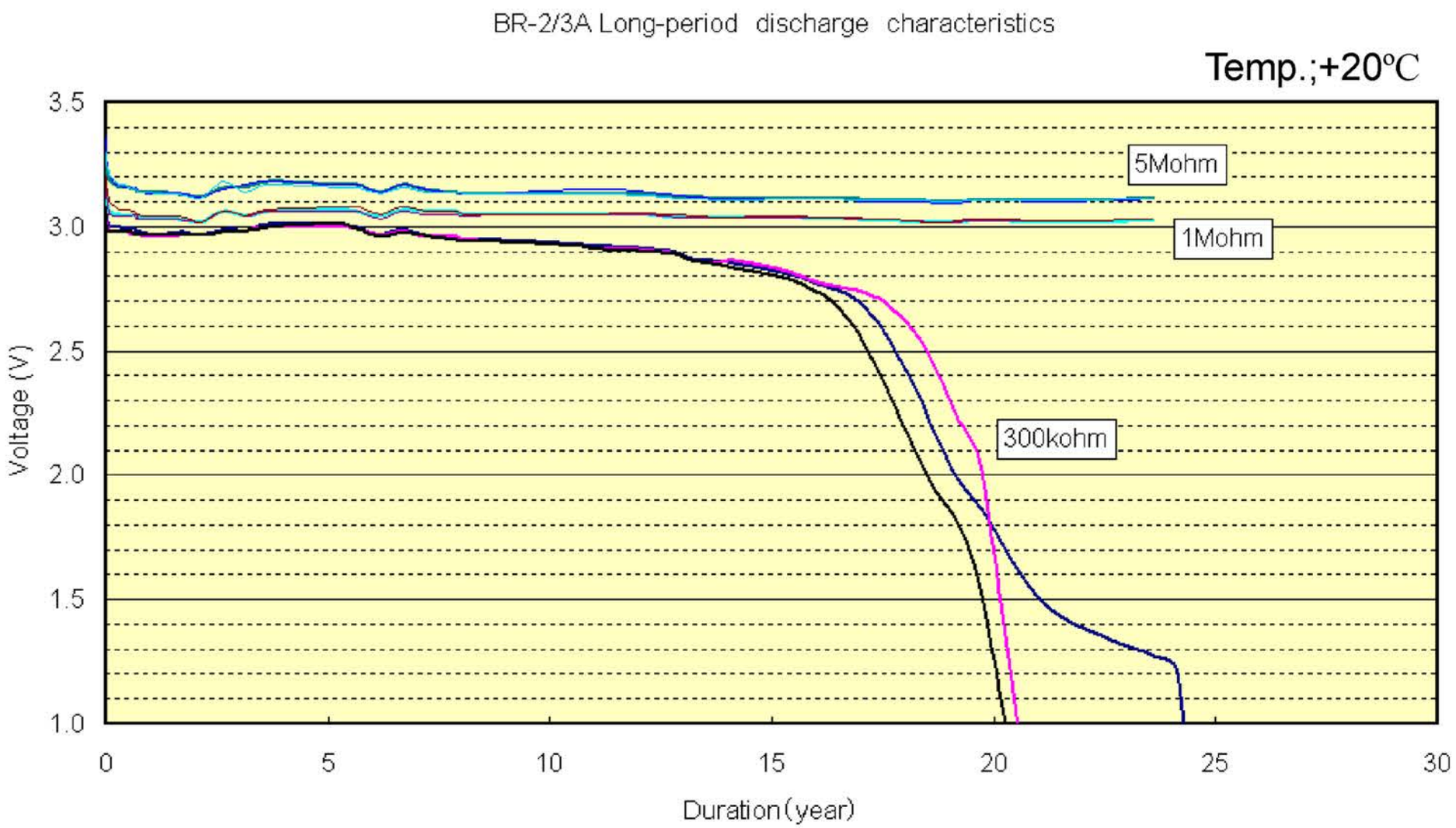
Long-term Discharge Characteristics of BR-2/3A



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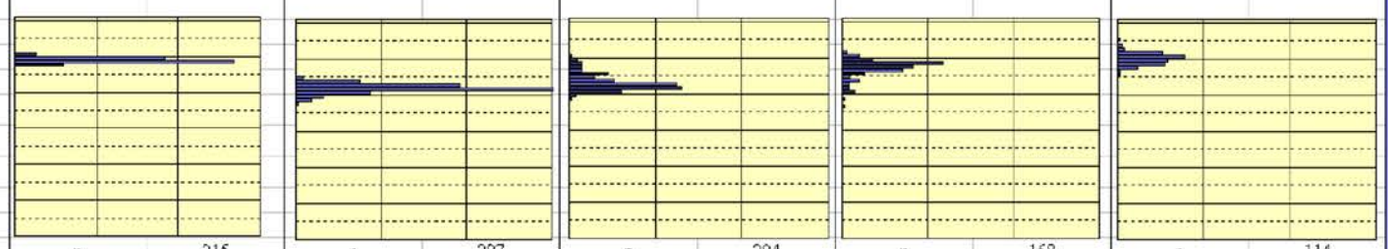
Long-term Storage Data of BR-2/3A

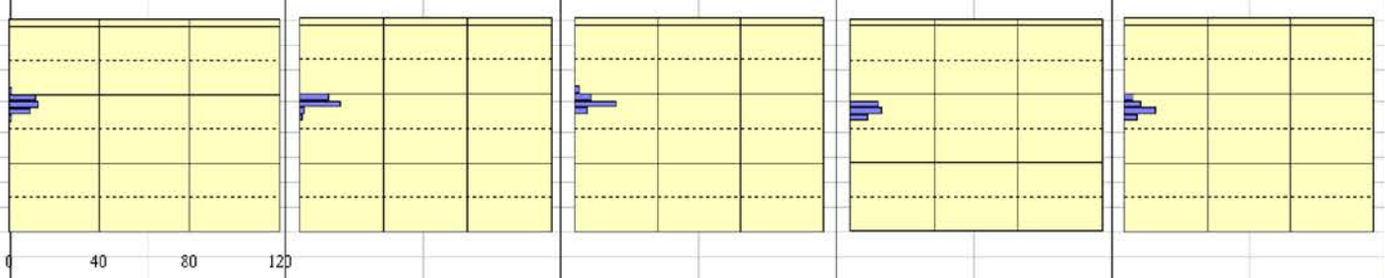
BR-2/3A Storage Characteristics (Room Temperature)

Term	Initial	1year	3years	5years	10years
	1990	*1991*	*1993*	*1995*	*2000*



	Initial	1year	3years	5years	10years
n	215	297	204	168	114
Ave.	3.385	3.311	3.325	3.365	3.394
s	0.035	0.011	0.023	0.026	0.015

	Initial	1year	3years	5years	10years
n	215	297	204	168	114
Ave.	0.339	0.300	0.307	0.308	0.364
s	0.021	0.025	0.023	0.027	0.018



	Initial	1year	3years	5years	10years
n	36	36	36	35	33
Ave.	476	478	476	466	469
s	9	7	7	8	8

Leakage	0/215	0/297	0/204	0/168	0/114

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Advantage of BR Batteries for Automatic Meter Reading

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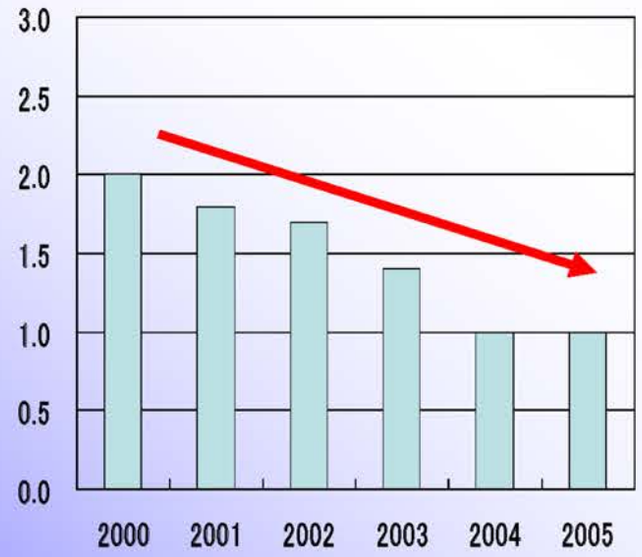
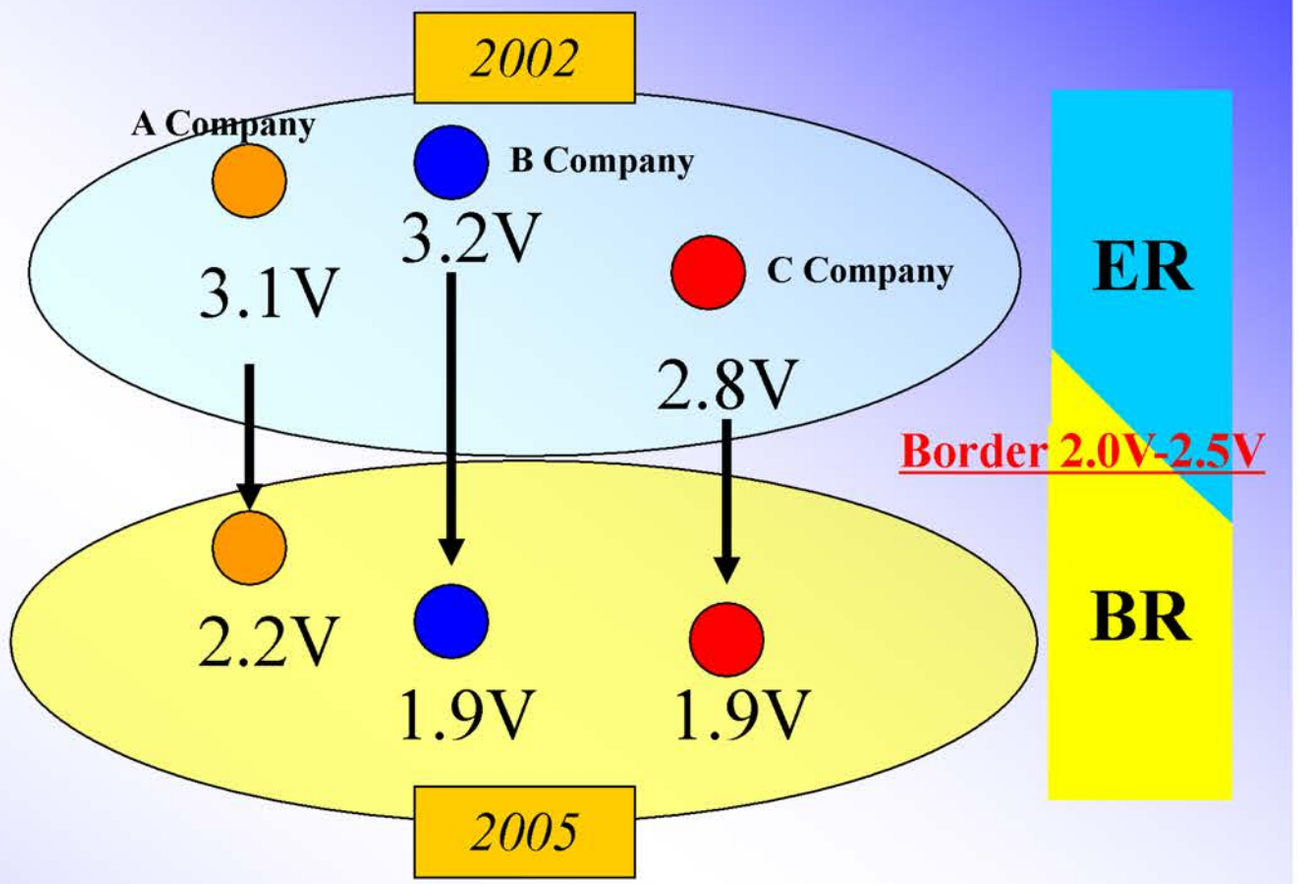
Advantage for BR Batteries for Auto Meter Reading

High-end CPU Cut-off voltage(minimum) Trend



Data : Renesas Technology

Meter Makers CPU Trend



Now BR (3V System) is APPLICABLE!

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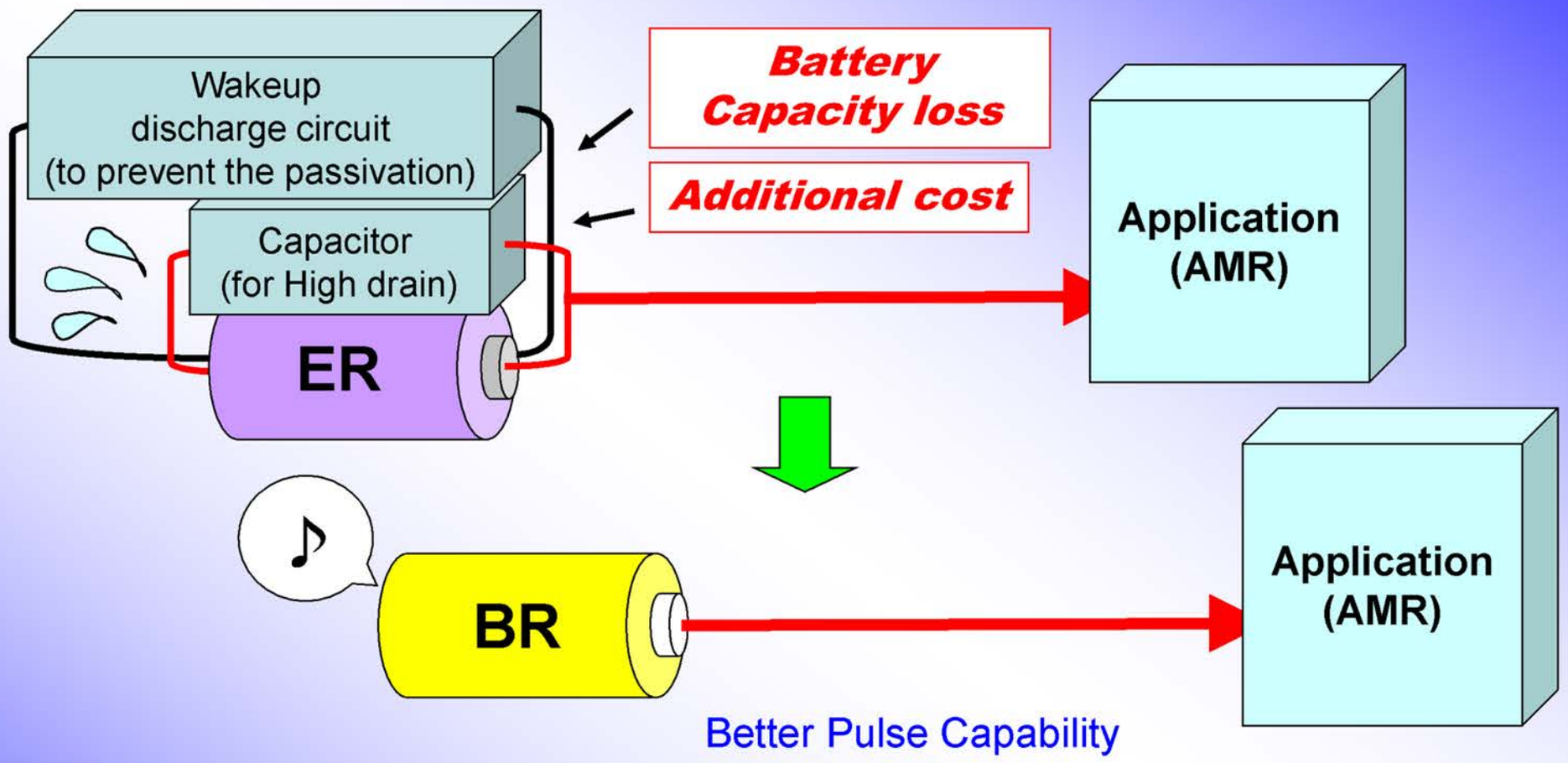
Advantage for BR Batteries for Auto Meter Reading



BR advantage

1. **Smaller capacity (size) can be applicable!**
2. **No capacitor required !**
3. **Safety & Environmental Friendly!**

Cost Reduce

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Comparison Data
BR v.s. CR v.s. ER

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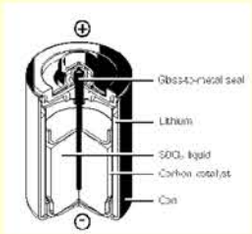
Comparison of General Features

Chemistry	BR	CR	CR for INDUSTRIAL	ER
Construction	Spiral Crimping 	Spiral / Inside-out Crimping or Laser welding 	Spiral / Inside-out Crimping or Laser welding 	Spiral / Bobbin Glass-metal seal 
Reaction	$(CF)_n + nLi \rightarrow nLiF + nC$	$MnO_2 + Li \rightarrow LiMnO_2$	$MnO_2 + Li \rightarrow LiMnO_2$	$2SOCl_2 + 4Li$ $\rightarrow 4LiCl + S + SO_2$
Nominal Voltage	3.0V	3.0V	3.0V	3.6V
Discharge Characteristics	Stable discharge Stable impedance Good pulse capability -40degC to +85degC Light weight	Good discharge performance Impedance increase after 3y Good pulse capability (but depends on impedance) -40degC to +70degC	Good discharge performance Good pulse capability -40degC to +70degC	High voltage Stable discharge (very flat) Unstable impedance (due to **Passivation**) -40degC to +85degC
Reliability	Very good (Over 10Y actual operation)	Less than BR (Impedance increase reduces pulse capability)	Equal with or less than BR	Doubtful (Impedance increase reduces pulse capability)
Safety & Environmental	Safe (very good) Environmental friendly	Safe (good) Environmental friendly	Safe (good) Environmental friendly	Unsafe ($SOCl_2$ is toxic material)

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Comparison of Safety (Material Characteristics)

TOTAL SAFETY EVALUATION OF Li - BATTERY

(Typical Cylindrical Lithium Batteries)

Battery System	Symbol	Cathode		Internal Pressure	Electrolyte		Total Safety Rank
		State	Property		Solute	Solvent	
(CF)n／Li	BR	Solid	Stable	Normal	$LiBF_4$(stable)	GBL	AA
MnO_2／Li	CR	Solid	Oxidizer	Normal	$LiCF_3SO_3$ etc. (stable)	PC + DME etc.	A
$SOCl_2$／Li	ER	Liquid	Toxicity Corrosive	Normal	$LiAlCl_4$(corrosive)	———	C
SO_2／Li		Gas	Suffocation	High	LiBr(stable)	AN	D
CuO／Li		Solid	Stable	Normal	$LiClO_4$(explosive)	DOX	B

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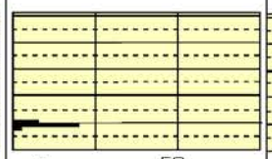
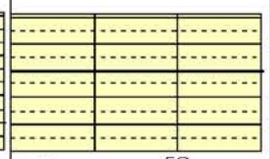
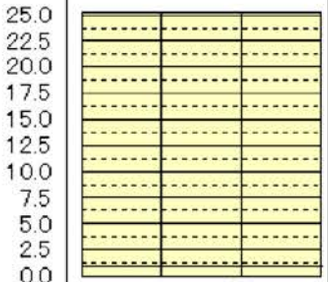
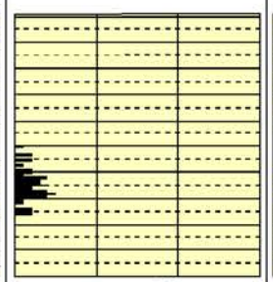
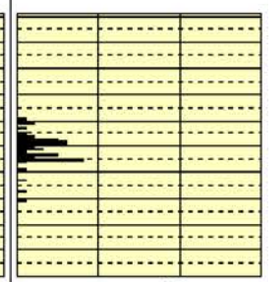
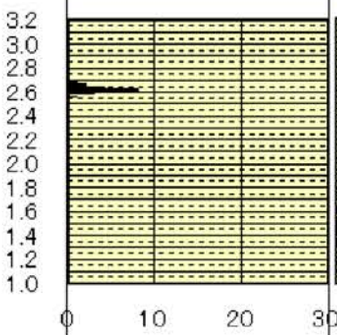
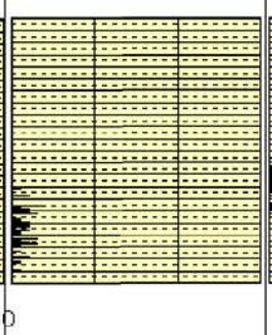
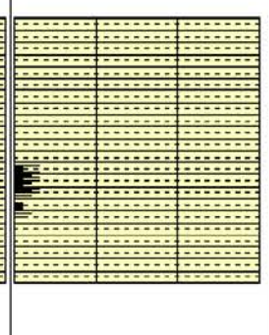
Comparisons of Static Characteristics

Model	BR-1/2AA	CR-1/2AA	ER-1/2AA
	Panasinic		
Capacity	1,000mAh	950mAh	1,000mAh
Open Circuit Voltage [V]			
	n 46 Ave 3.402 s 0.018	n 50 Ave 3.265 s 0.010	n 50 Ave 3.670 s 0.001
Internal Resistance [ohm] (AC-1kHz)			
	n 46 Ave 0.554 s 0.016	n 50 Ave 8.327 s 1.523	n 50 Ave 11.878 s 1.482
Close Circuit Voltage [V] (4ohm140ms 20℃)			
	n 46 Ave 2.606 s 0.025	n 50 Ave 1.449 s 0.165	n 50 Ave 1.789 s 0.120

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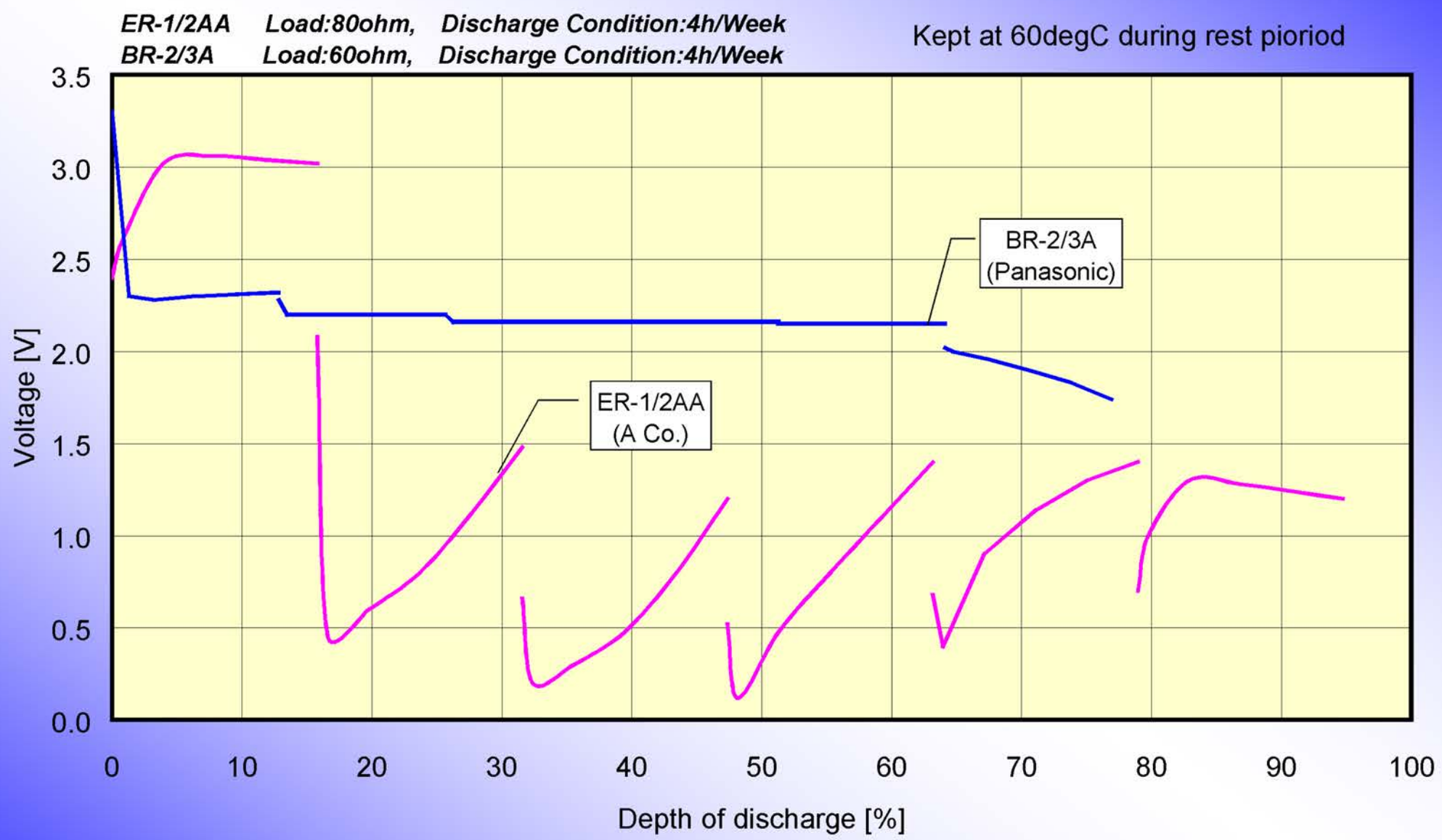
Comparisons of Reliability (v.s. ER)



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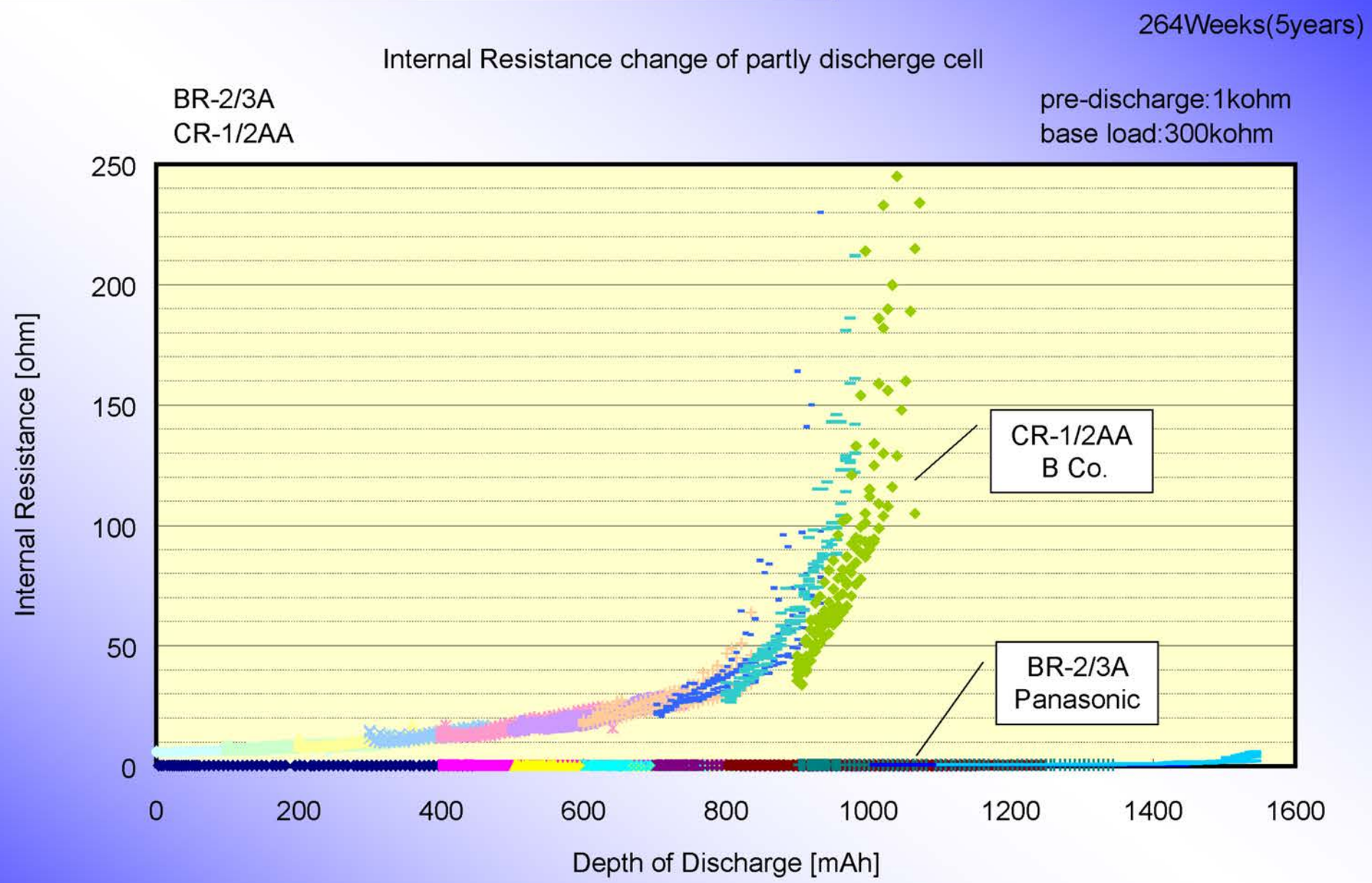
Comparisons of Reliability (v.s. CR)



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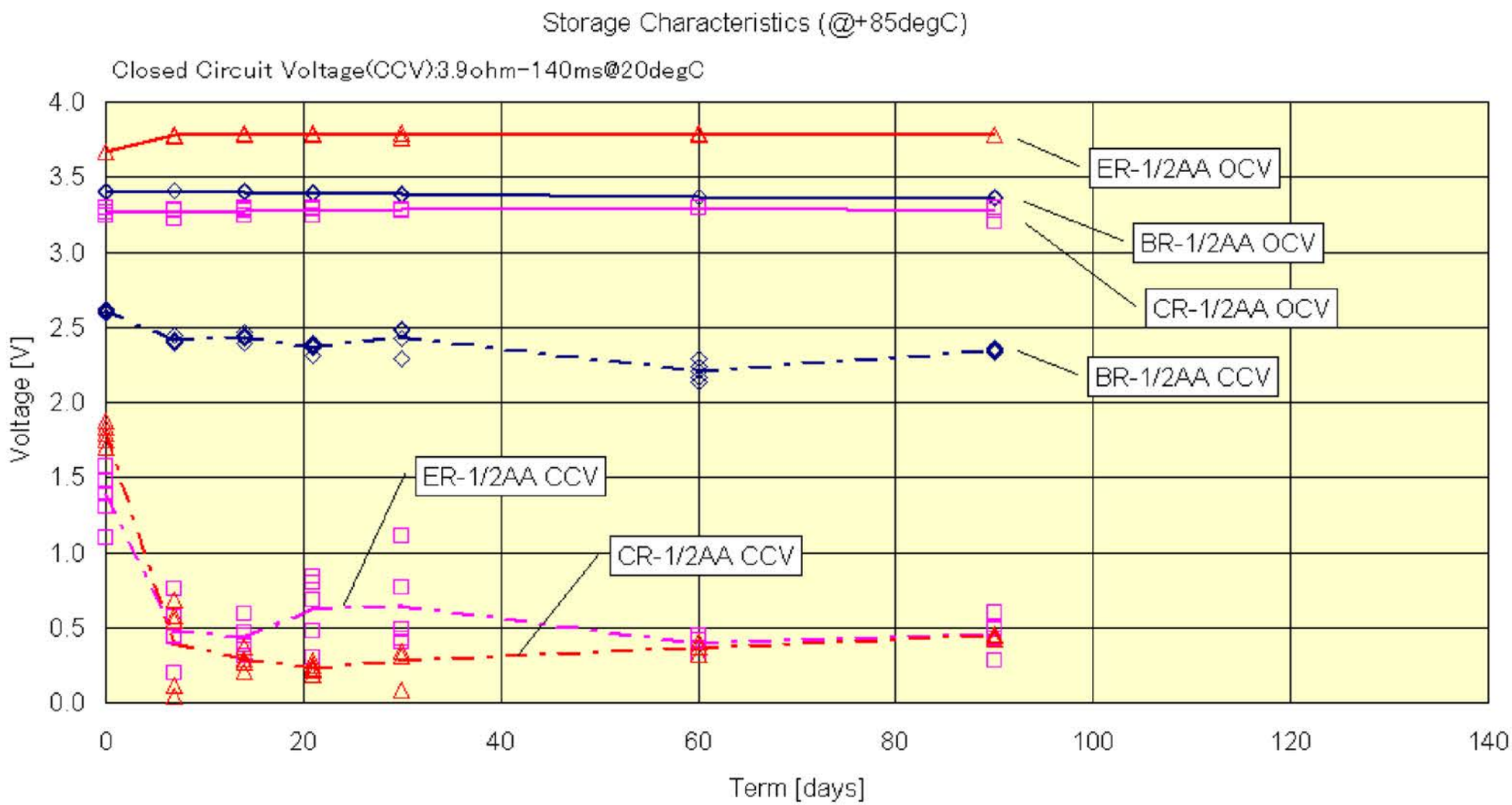
Comparisons of Reliability (v.s. CR)

High Temperature Storage Performance (+85degC)



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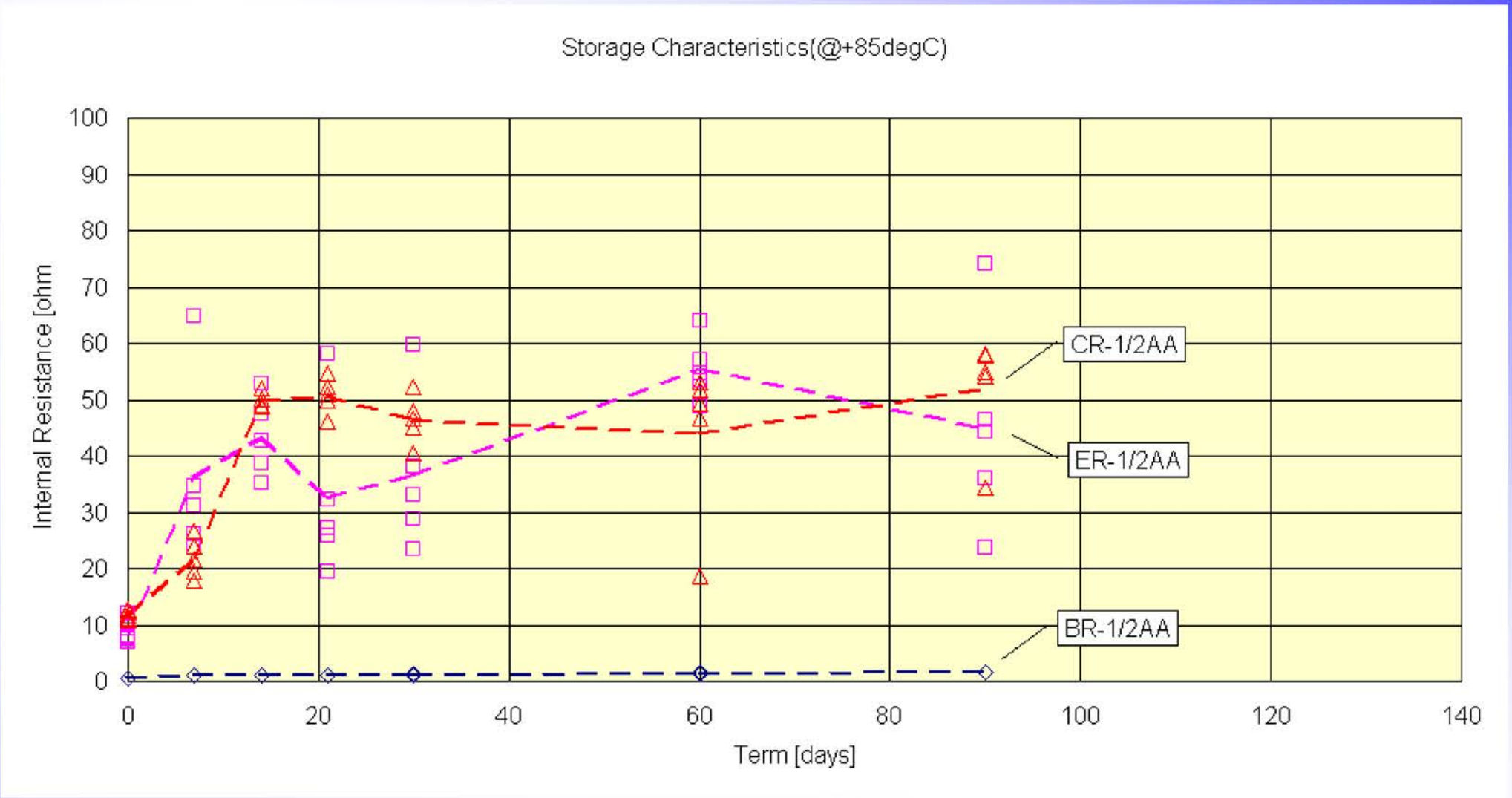
Comparisons of Reliability (v.s. CR)

High Temperature Storage Performance (+85degC)



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