

# ECaSS<sup>®</sup> の現況と今後の展開

- 世界の蓄電技術と電気二重層キャパシタ
- ECaSSの挑戦 ~ 正確な理解を
  - ➔ 直列キャパシタの初期化と平均化
  - ➔ キャパシタの放電時間と効率
  - ➔ エネルギー密度を増す方法
  - ➔ ECaSSの展開

Network with key executives and innovators at the world's foremost forum dedicated to electrochemical capacitors (ECs)...



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## WORLD SUMMIT 2003

Building the Technology, Applications and New Business Opportunities for High Performance Electrochemical Capacitors (ECs)

August 11-13, 2003

Capitol Hilton Hotel

Washington DC

### Conference Highlights

#### Six Conference Sessions:

1. Market Assessment and Growth Outlook
2. Advances in Materials and Manufacturing
3. EC Applications in Portable Devices
4. ECs in Military and Defense Applications
5. EC Applications in Stationary Power
6. EC Applications in Vehicles and Transport

#### Two Pre-conference Seminars:

1. EC Fundamentals
2. EC Application Engineering



#### Conference Chair

Dr. John R. Miller  
President, JME Inc.

#### 27 Speakers from:

Frost & Sullivan	Cap-XX
W.L. Gore	Giner
Power Systems	ESMA
Norit	Kuraray
BAE Systems	Kold Ban
Nevada Testing	General Motors
Ness	BP
ELIT	EPRI PEAC
US DOE	Maxwell
NIST	US Navy
US Air Force	US Army
Netherlands Energy Research Centre	
Okamura Laboratory	
Energy Storage Research Group	
University of California-Davis	
Bowling Green State University	
University of Michigan	

### A comprehensive update of strategic market and technical development for electric double-layer capacitors...

- ECs in wind turbines
- Vehicle integration issues
- Assessment of acetonitrile
- Advanced cell designs
- Wireless and consumer markets
- Keys to market penetration
- Bridging the power/energy gap
- Technology roadmap
- Market size and growth forecasts
- Premium power conditioning
- "Batteryless" trucks and buses
- New electrodes and electrolytes
- Pulse power rail guns
- Asymmetric designs
- High power electrodes
- EC-battery combinations

"A great opportunity to meet and discuss with the world's cutting edge people and to get the most up-to-date information."

**Yuko Miki, Engineering Specialist, Toyota Technical Center**

"Very informative for an end-user to see what is coming in the near future. It brought me up-to-speed on all the emerging technologies."

**Tommy Edwards, Maintenance Director, Sunline Transit Agency**

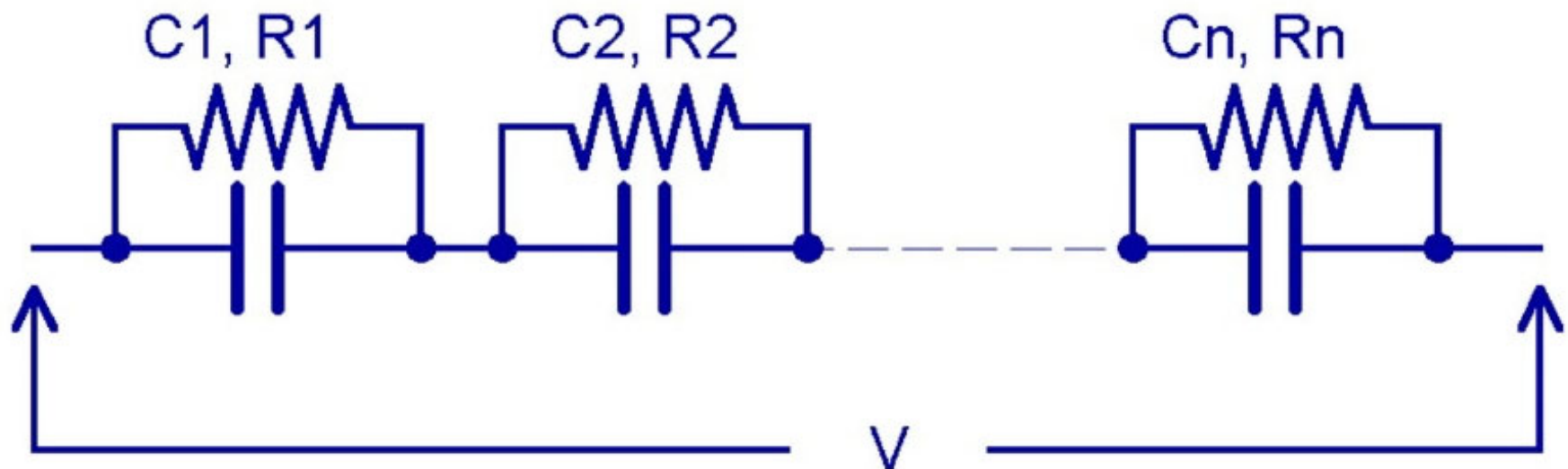
#### Supporting Organizations and Publications:



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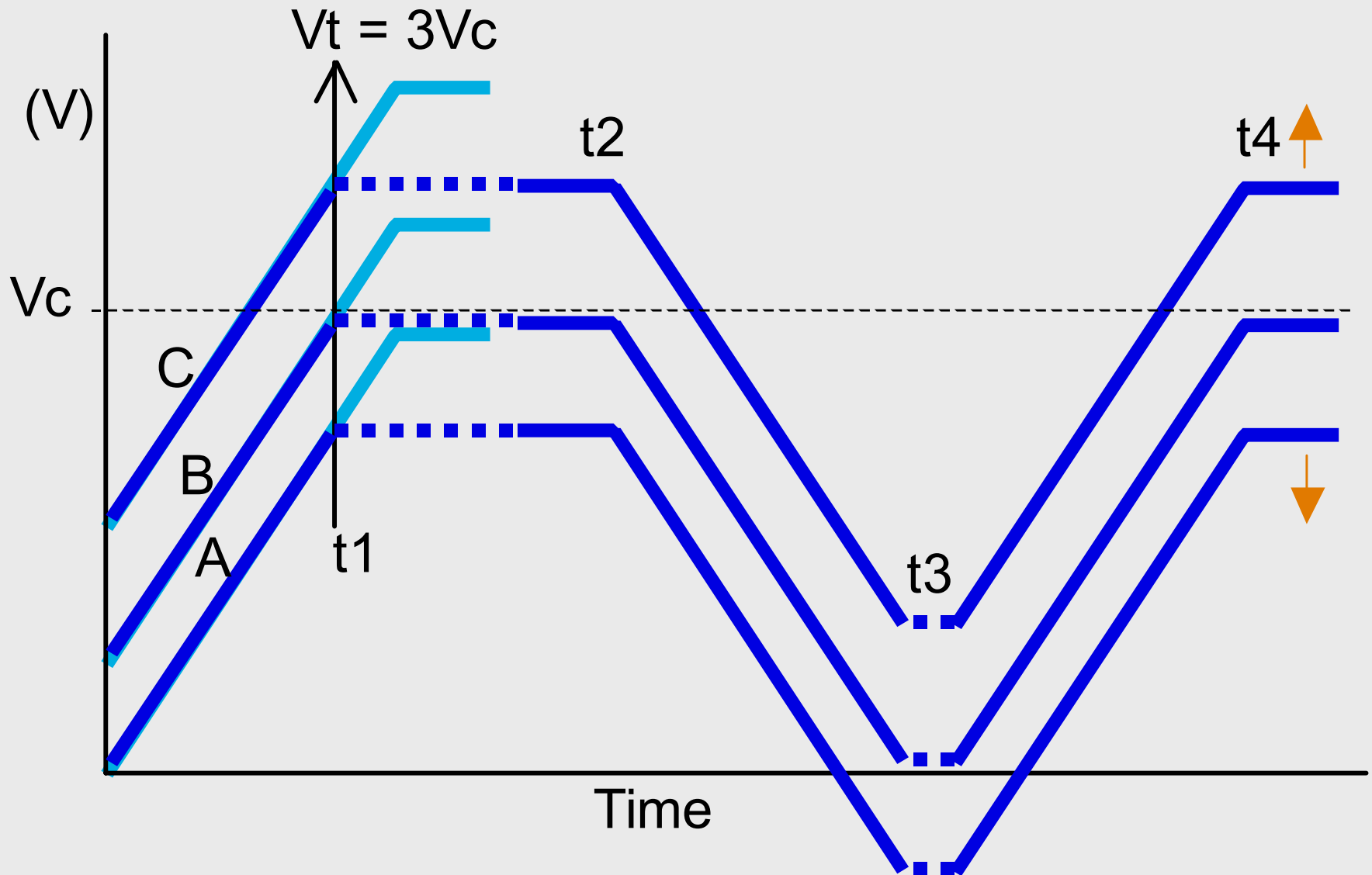
# 世界の蓄電技術 とキャパシタ

# キャパシタの直列接続の解

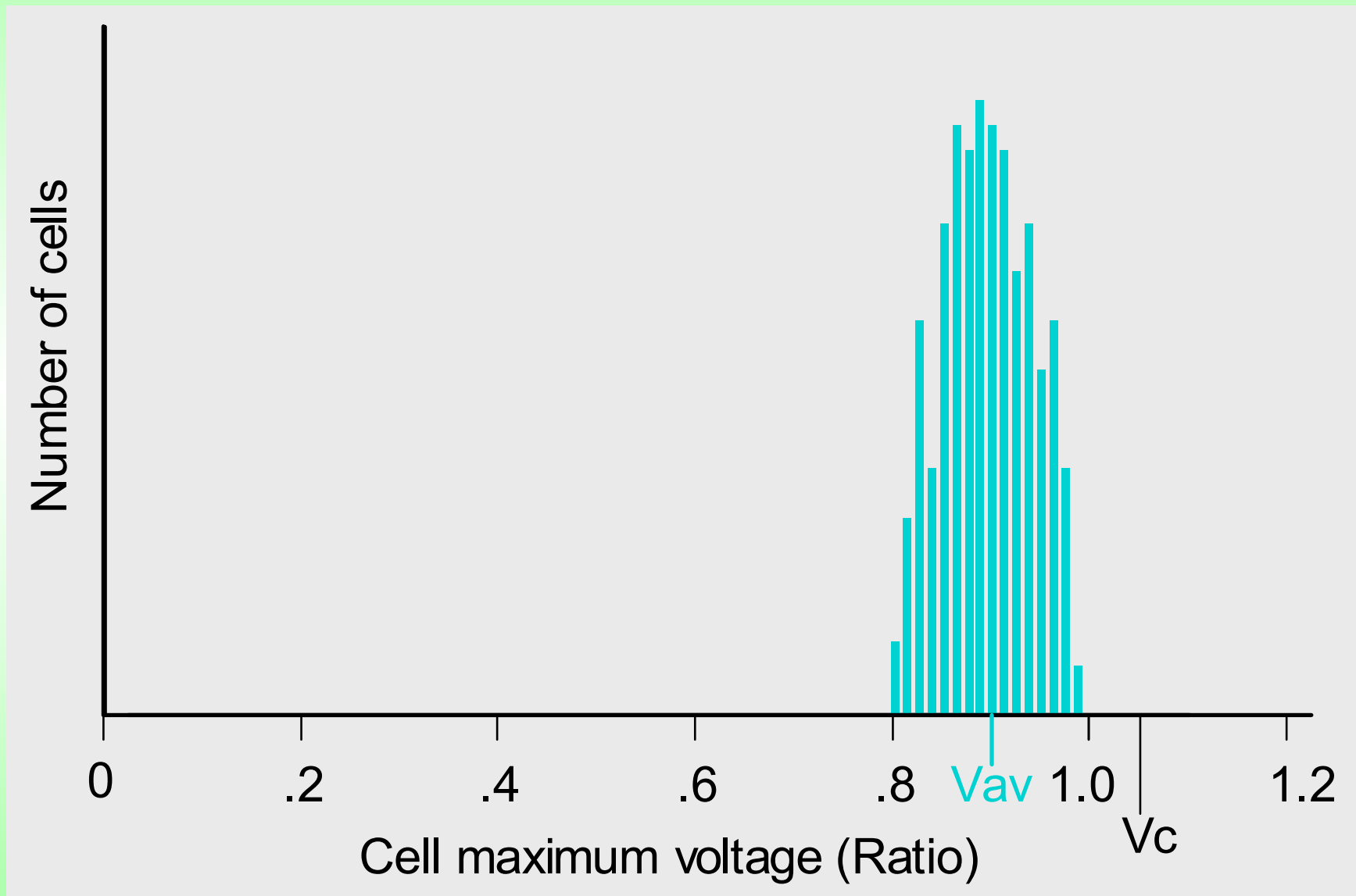


$$V_X = \left( \frac{k \cdot R_X}{R_1 + \dots + R_n} + \frac{(1-k) \cdot \frac{1}{C_X}}{\frac{1}{C_1} + \dots + \frac{1}{C_n}} \right) \cdot V \quad \dots\dots(1)$$

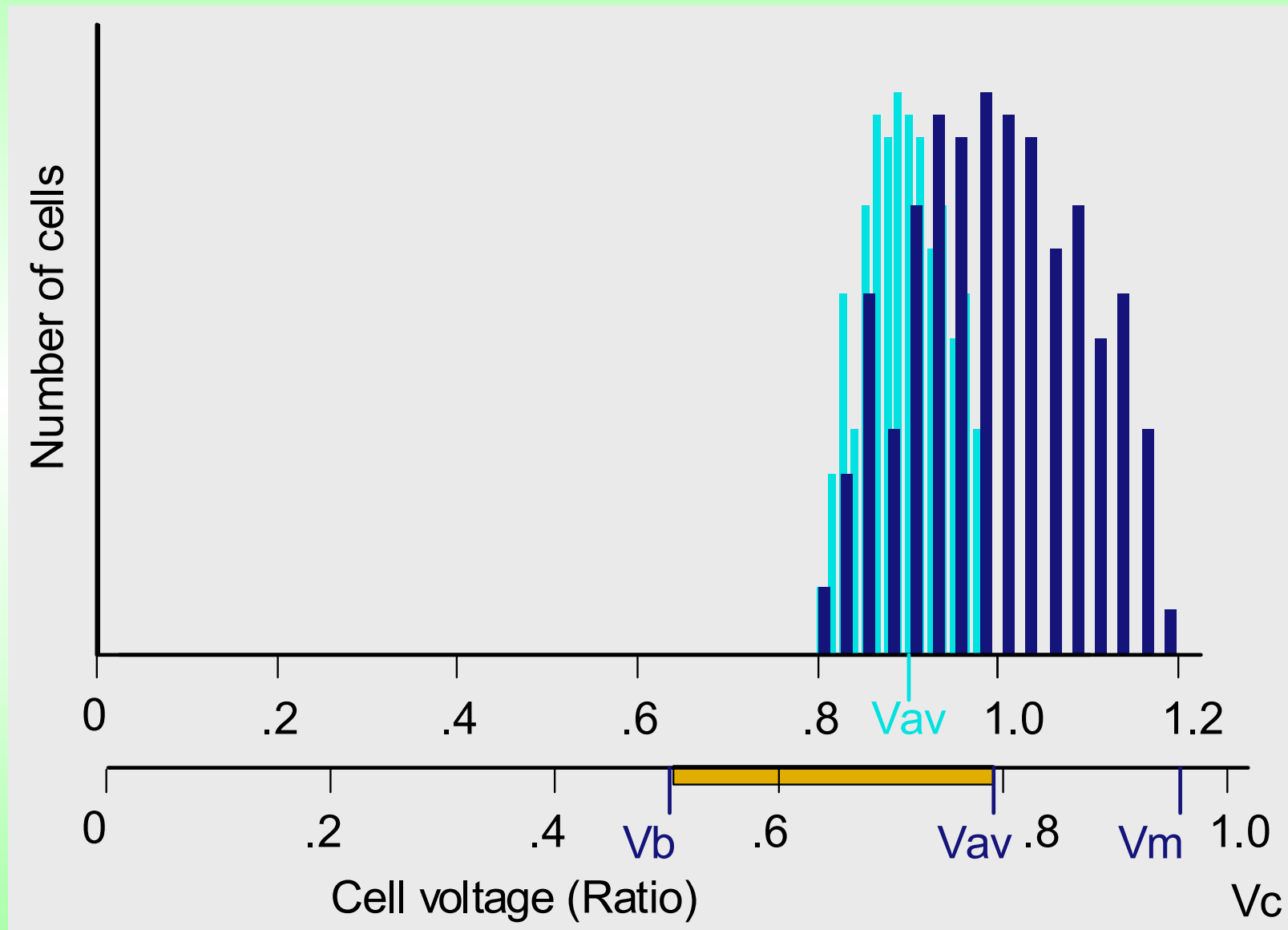
# 直列キャパシタ 3 個の充放電



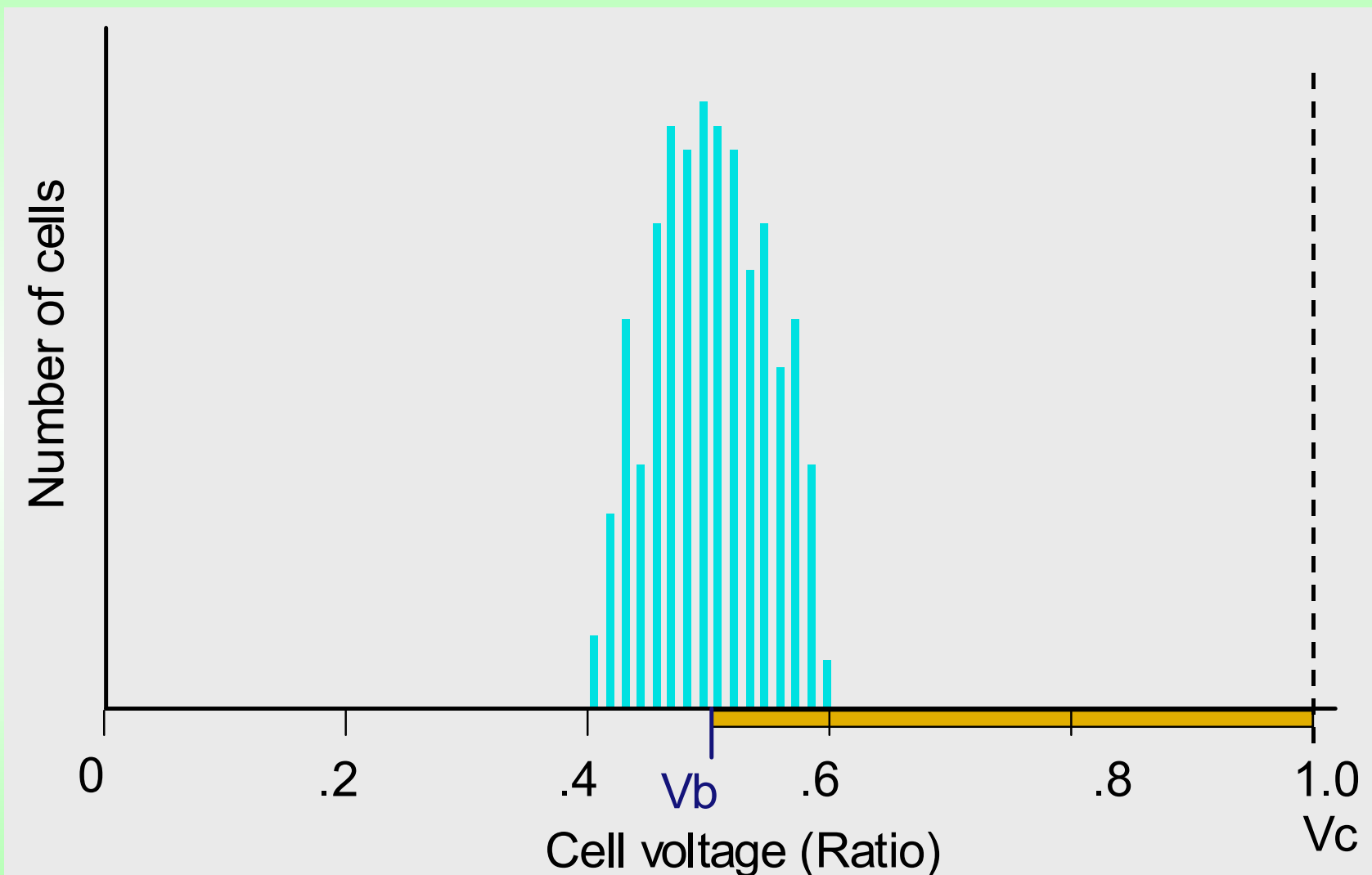
# 直列で充電したセルの電圧分布



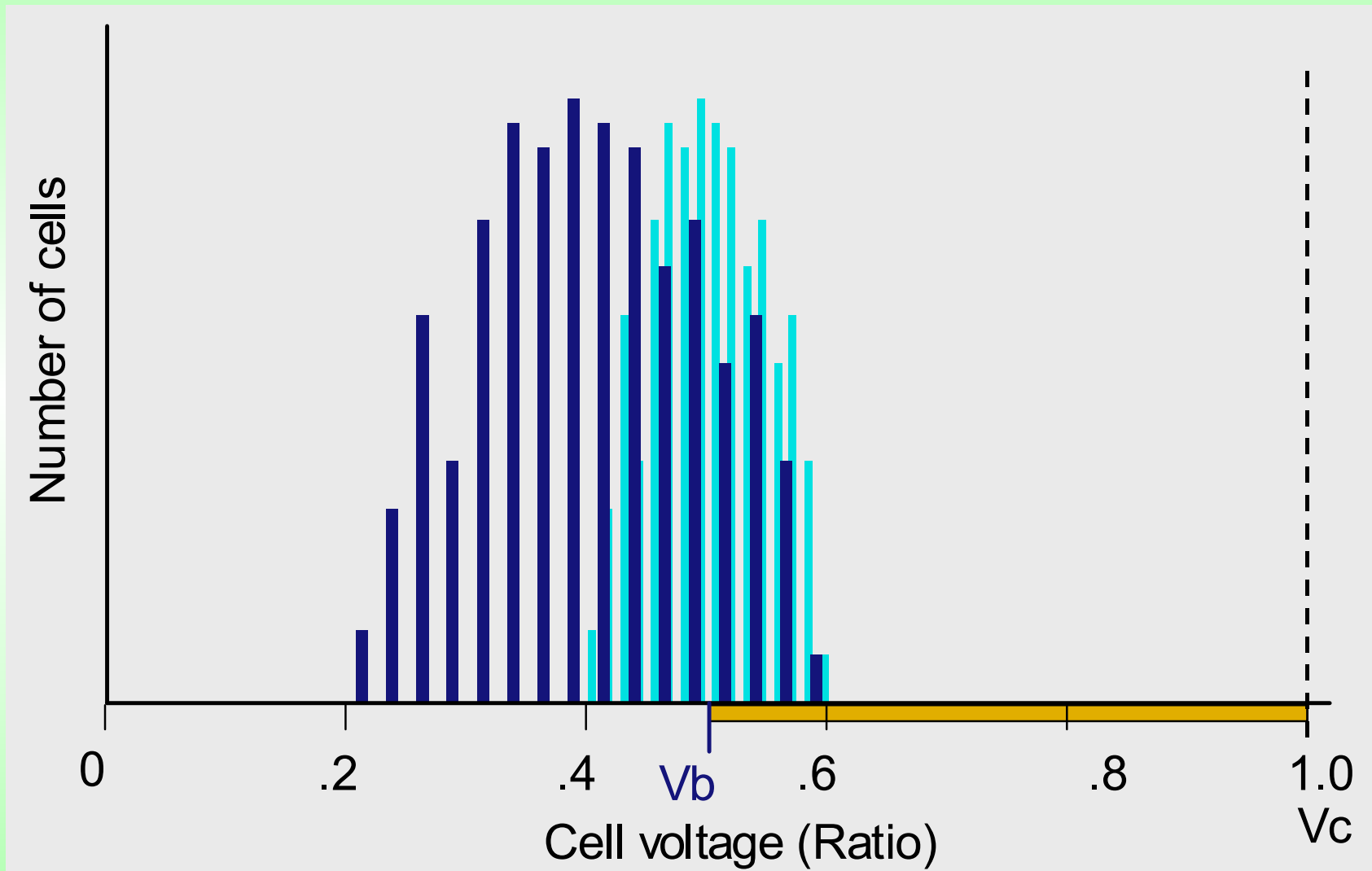
# 劣化20%としたセルの電圧分布



# ECaSSではVc基準に充放電する

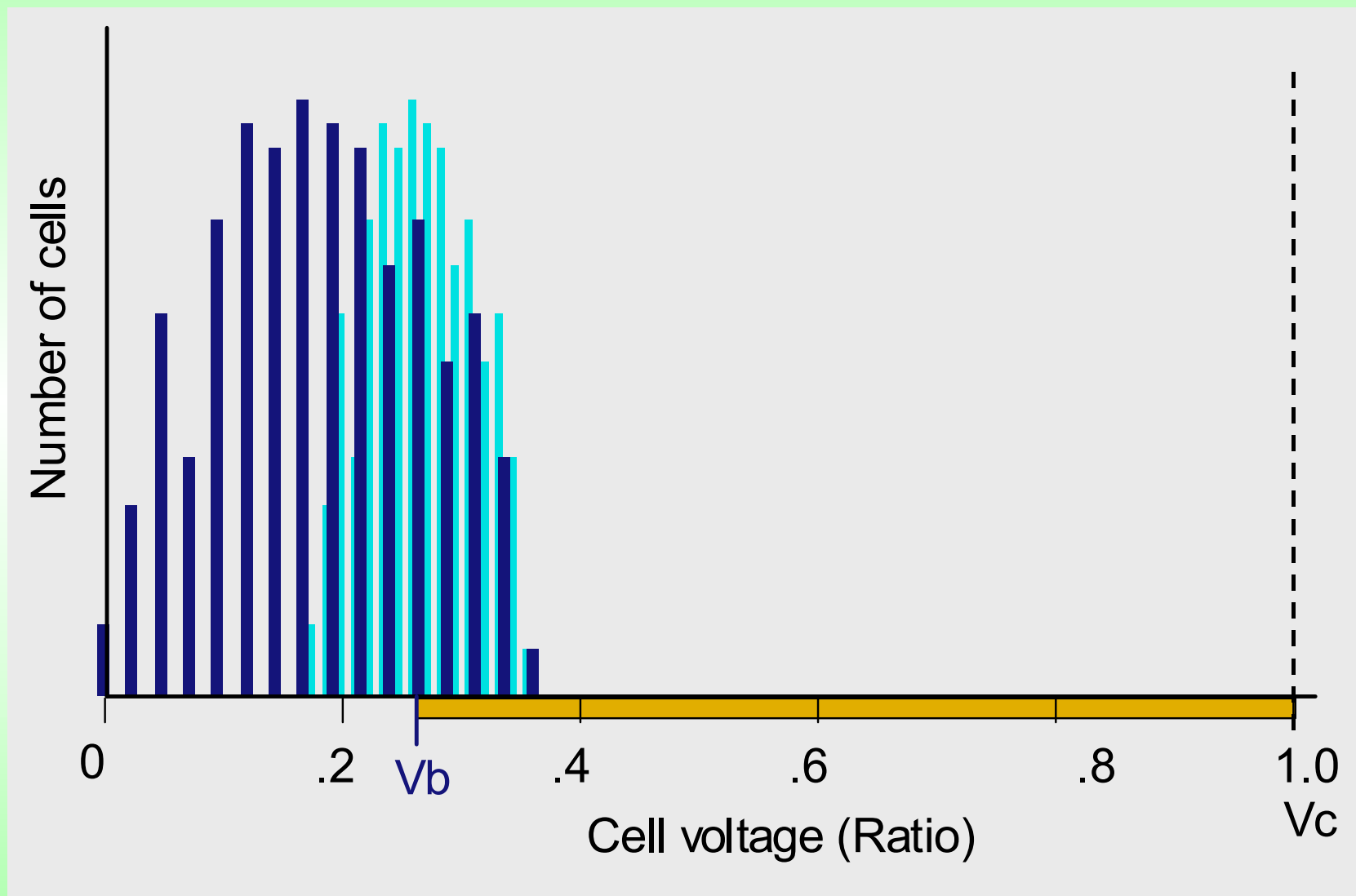


# ECaSSのセル容量20%低下状態



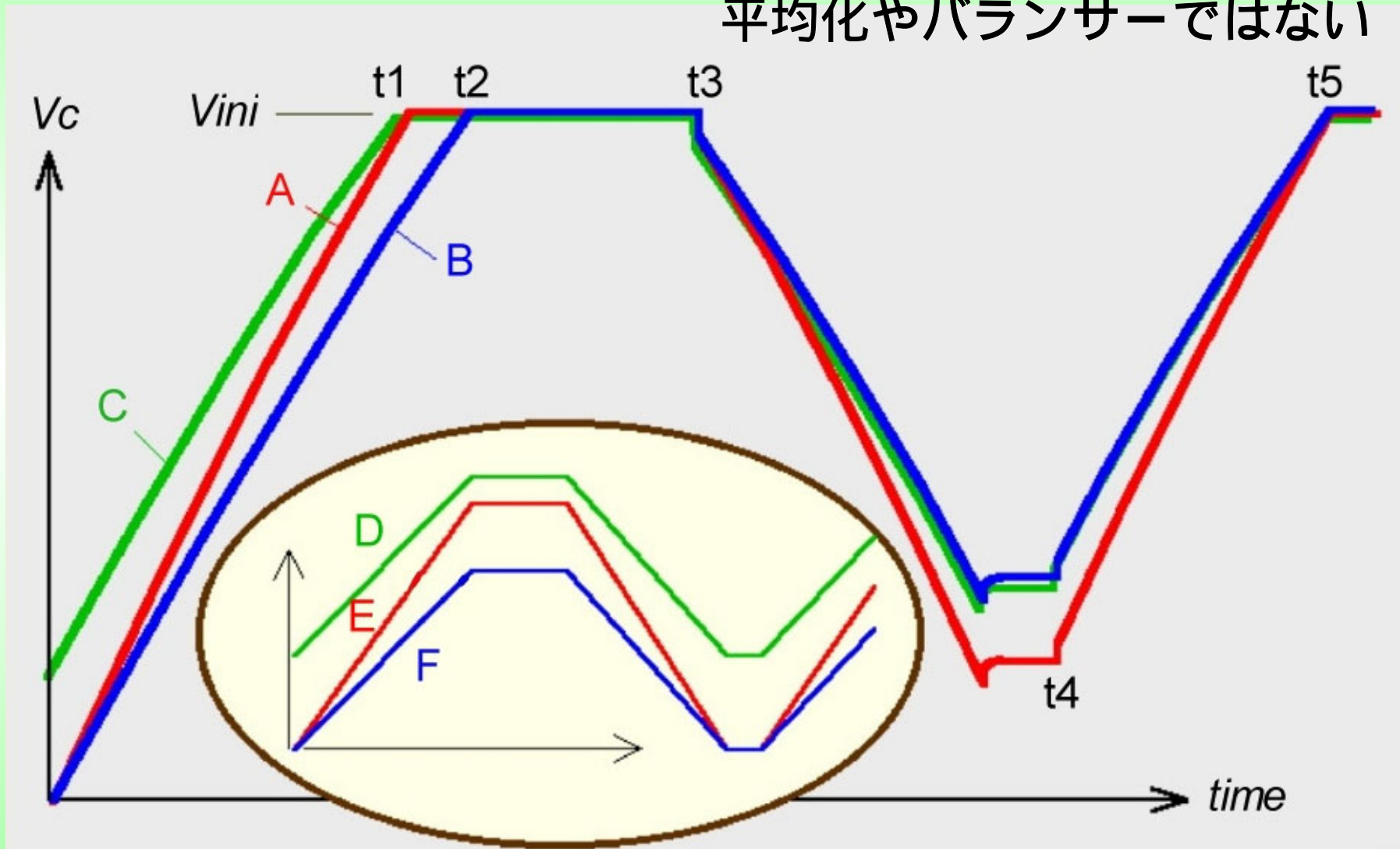


# ECaSSでの94%放電, 20%劣化

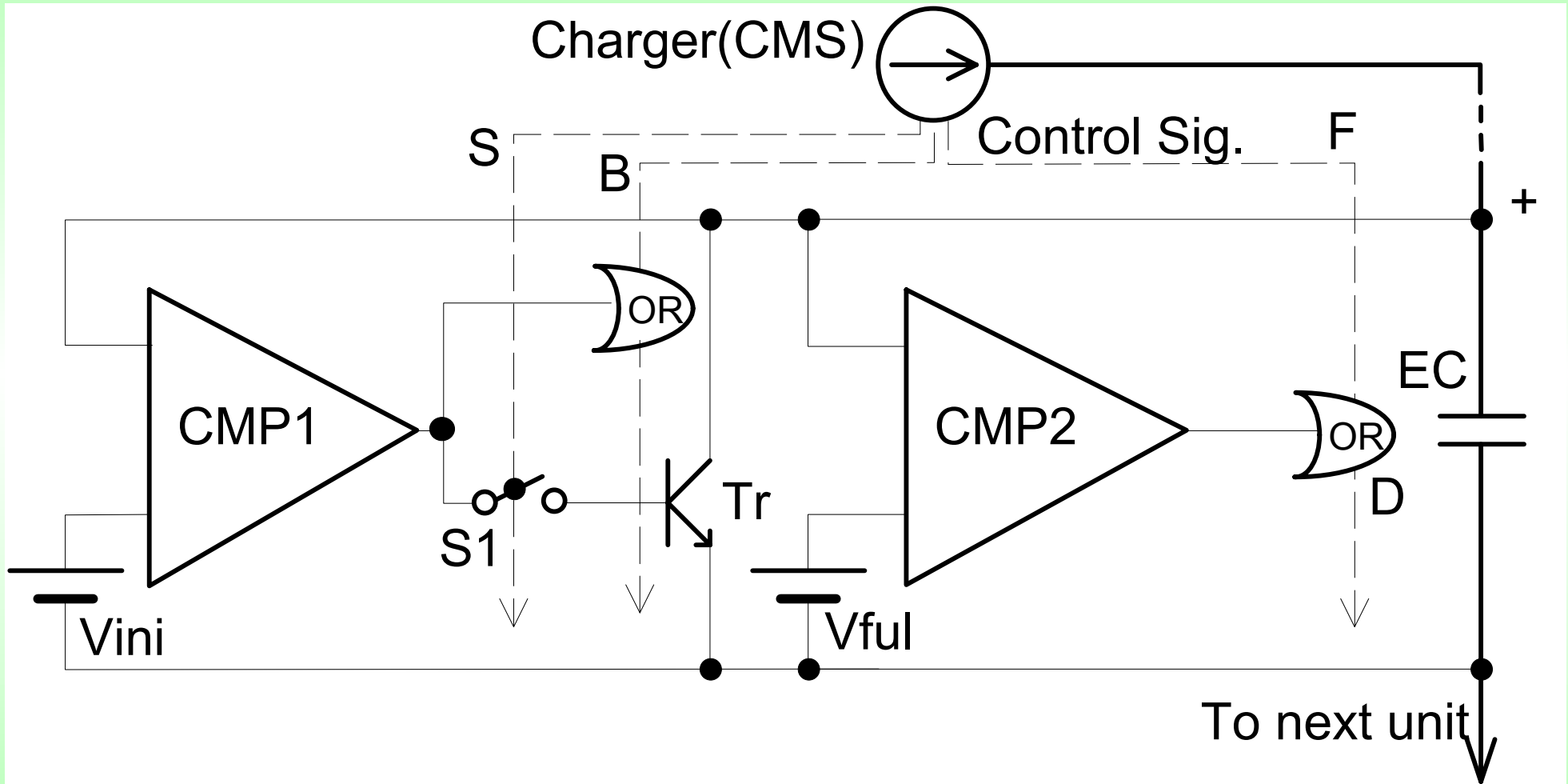


# キャパシタの初期化

平均化やバランサーではない

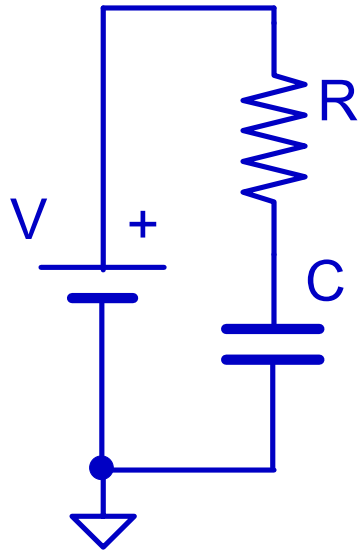


# 並列モニタの回路例



# キャパシタの充電と放電の計算

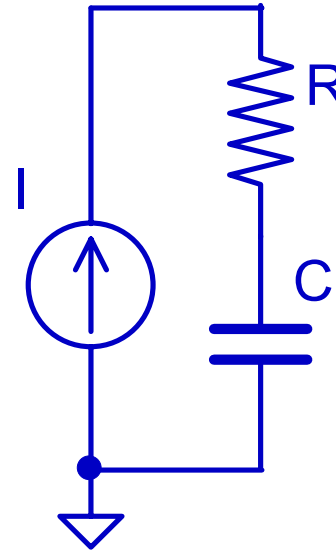
Voltage mode



$$i = \frac{V}{R} \exp\left(-\frac{t}{CR}\right) \dots\dots (2)$$

$$\int_0^{\infty} i^2 R dt = \frac{1}{2} CV^2 \dots\dots (3)$$

Current mode



$$P_c = U / (U + L) = 1 / (1 + 2RC/t) \dots\dots (7)$$

$$P_d = (U - L) / U = 1 - 2RC/t \dots\dots (8)$$

# オームファラッドという単位

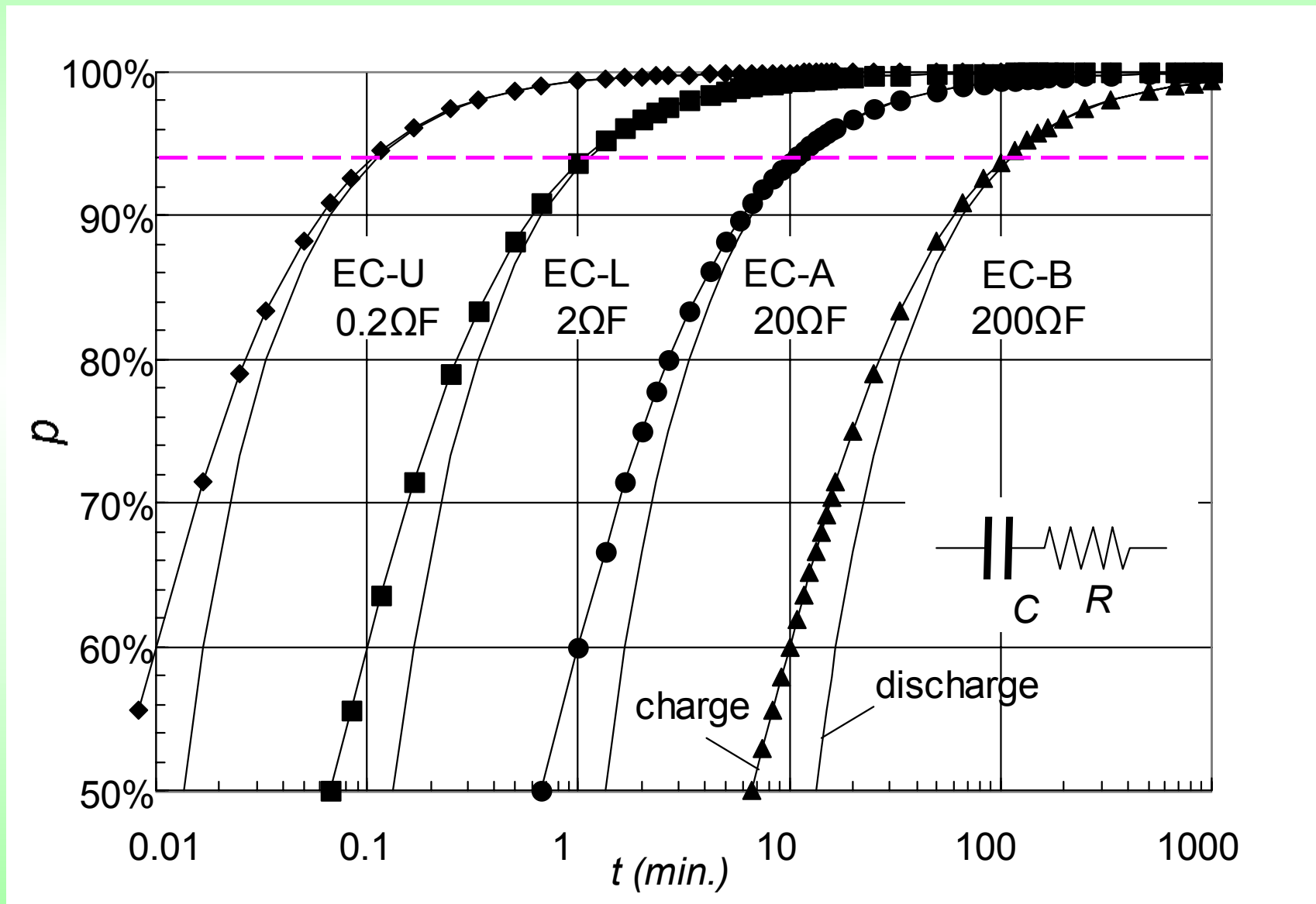
to normalize ESR per capacitance

- **Conductivity/Capacity = (Siemens)/(Farad)**
- **(Siemens) = 1/( $\Omega$ )**
- **(Siemens)/(Farad) = 1/( $\Omega$ F)**
- **Resistivity/Capacity = 1/1/( $\Omega$ F) = ( $\Omega$ F)**

$$P_c = 1/(1+2RC/t) \dots (2)$$

$$P_d = 1-2RC/t \dots (3)$$

# 内部抵抗と充放電時間 効率



# 内部抵抗は低いほど有利か？

$$t=U/k \dots\dots\dots(4)$$

$$Pd=1-2k(RC/U)\dots(5)$$

U:capacitor energy density

k:arbitrary constant

# ECaSSキャパシタの現状

