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Passive Cell Balancing Circuit Using Operational Amplifier

Nisshinbo Micro Devices Inc.

SLB 2-Series Cell Balancing

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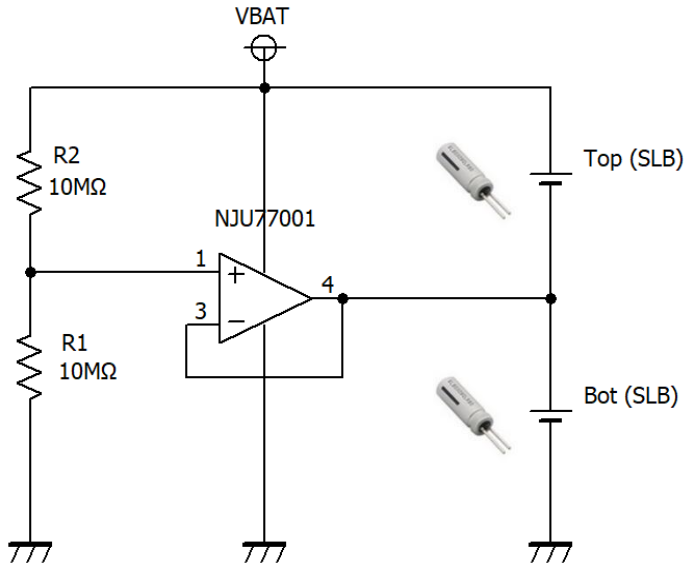
This is a cell balancing circuit using an op-amp for two SLB cells in series.



Main Features of NJU77001 Op-Amp:
- Supply Voltage: 1.5V–5.5V
- Input Offset Voltage: 1.0mV max.
- Power Consumption: 0.29μA typ.

Power Consumption:
- NJU77001 : 0.29μA typ.
- Resistor : 0.23μA (at SLB = 2.3V)
- **Total : 0.52μA**

This circuit achieves cell balancing with a very small current of approx. 0.52μA.

Note
- **This circuit provides only the cell balancing function.**
- **Overcharge and over-discharge protection for SLB must be implemented separately.**

Operation Example 1 - Two Cells in Series

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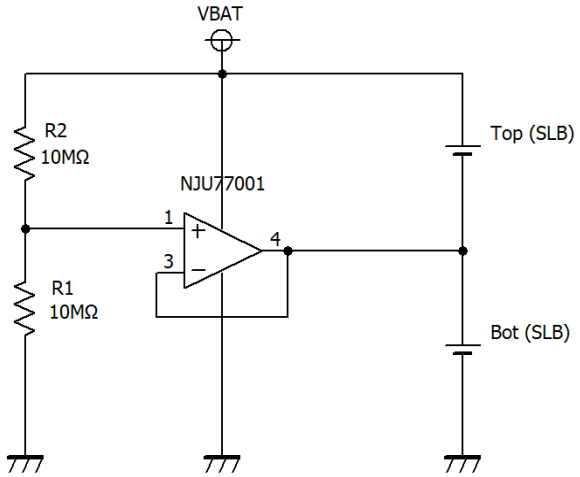
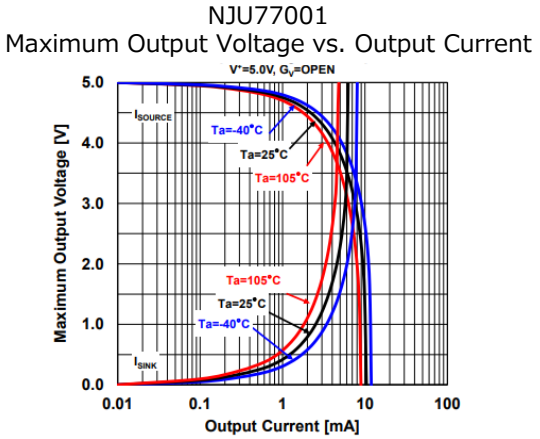
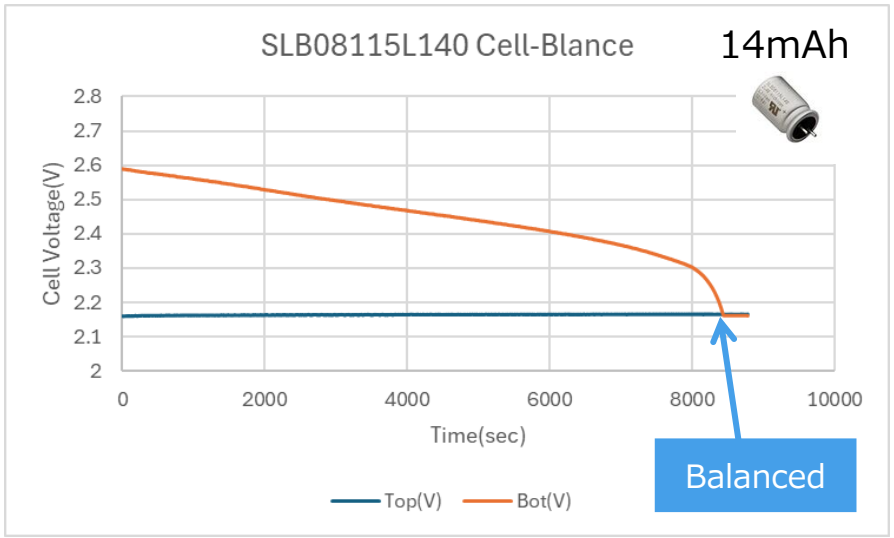
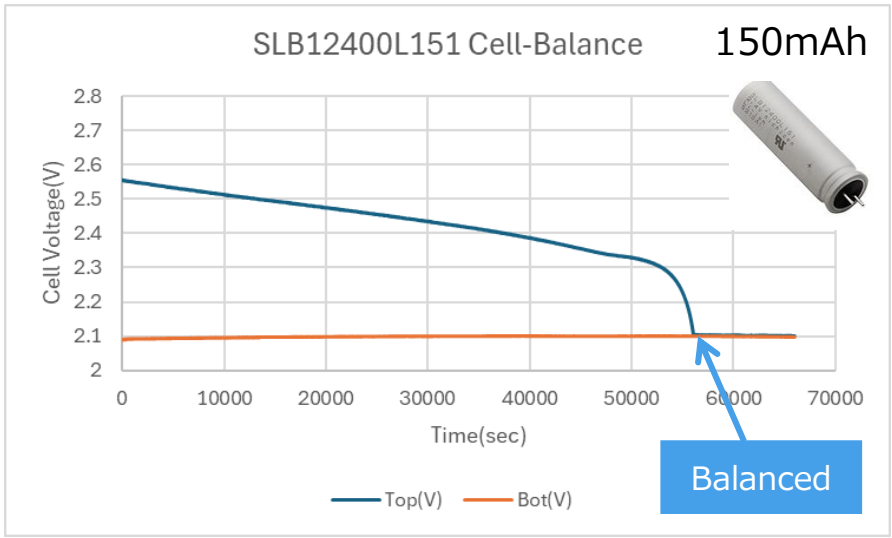
Cell balancing operation for SLB batteries with different initial voltages.





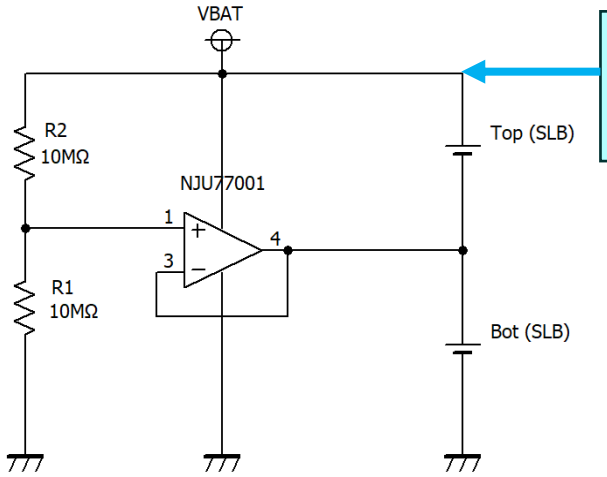




- 14mAh SLB: Balancing achieved in approx. 2 hours
- 150mAh SLB: Balancing achieved in approx. 15 hours
- The time to converge voltage depends on the output current characteristics of the op-amp used.

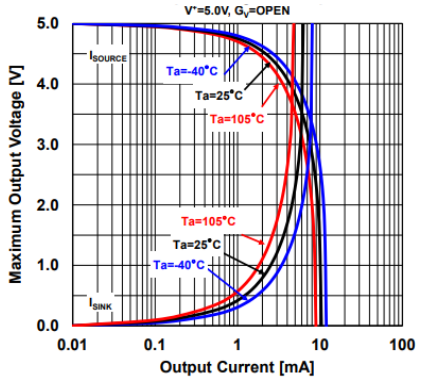
Operation Example 2: Charging Behavior (SLB08115L140:14mAh)

Charging behavior from different initial voltages at 1C and 10C rates.

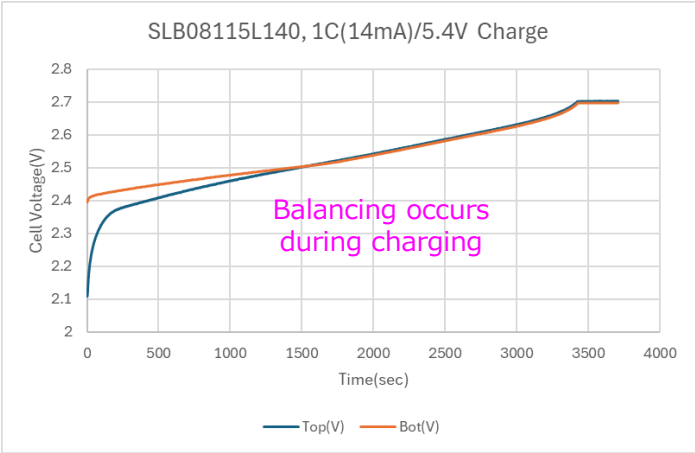


- Charging Voltage: 5.4V
- Charging Current:
  - 1C: **14mA**
  - 10C: **140mA**

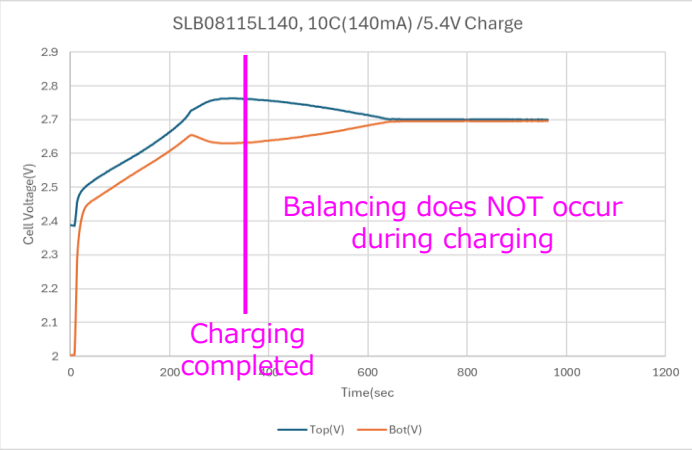
NJU77001
Maximum Output Voltage vs. Output Current



1C(14mA) Charge



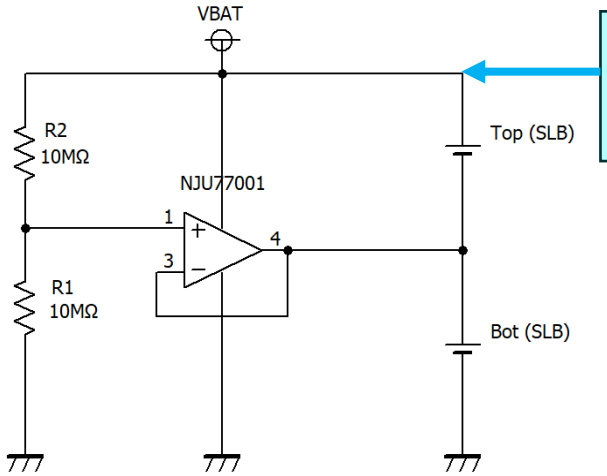
10C(140mA) Charge



Note:
- If (Op-Amp Output Current capability) << (Charging Current), balancing does not work.
- Select an appropriate op-amp according to the charging current.

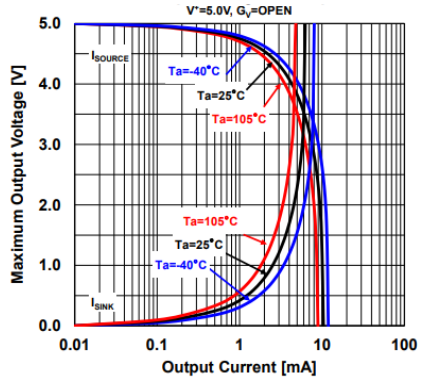
Operation Example 3: Charging Behavior (SLB12400L151:150mAh)

Charging behavior from different initial voltages at 1C and 10C rates.

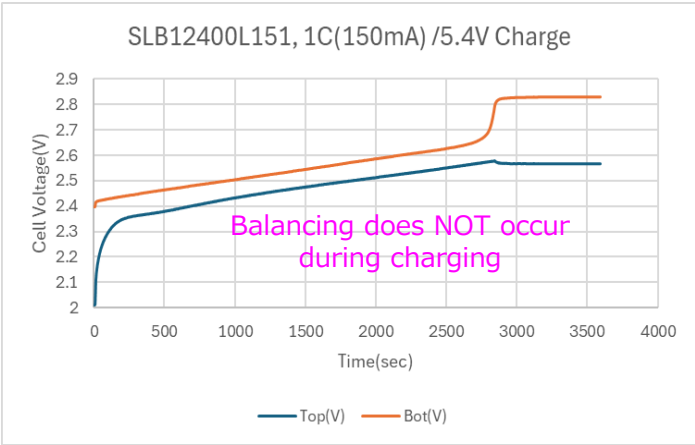


- Charging Voltage: 5.4V
- Charging Current:
  - 1C: **150mA**
  - 10C: **1500mA**

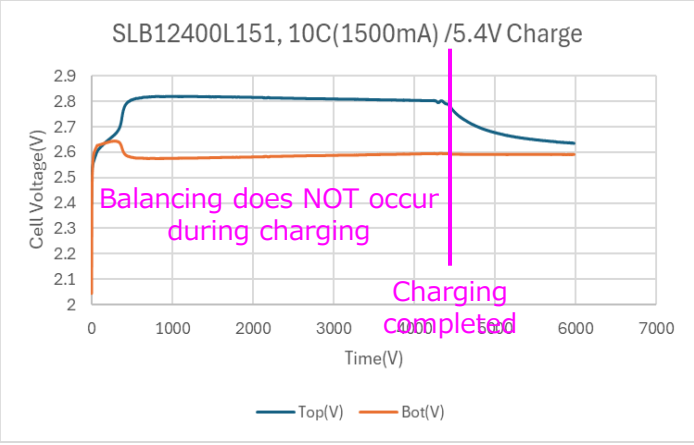
NJU77001
Maximum Output Voltage vs. Output Current



1C(150mA) Charge



10C(1500mA) Charge

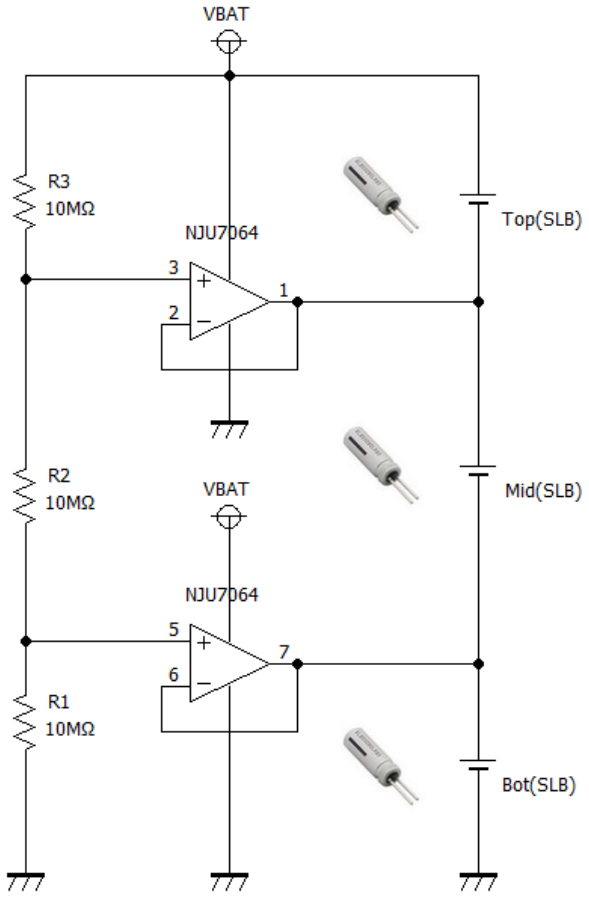


Note:

- If (Op-Amp Output Current) << (Charging Current), balancing does not work.
- Select an appropriate op-amp according to the charging current.

SLB 3-Series Cell Balancing

This is a cell balancing circuit using an op-amp for three SLB cells in series.



Main Features of NJU7064 Op-Amp:

- Number of Circuits: 2
- Supply Voltage: 4V–16V
- Input Offset Voltage: 4mV max.
- Power Consumption: 29μA typ. at Vdd = 7V

Power Consumption:

- NJU7064 : 29μA typ.
- Resistor : 0.23μA (at SLB = 2.3V)
- **Total : 29.23μA**

Note

- **This circuit provides only the cell balancing function.**
- **Overcharge and over-discharge protection for SLB must be implemented separately.**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