



Category: SABFET

CIRCUIT IDEAS FOR DESIGNERS

Schematic no. sabfet_11109.0

Balancing 2-Supercap Stack with SAB MOSFETs in Series**Description**

Two 5.0V supercaps in series are balanced using two MOSFETs each of the quad supercapacitor auto balancing (SAB) MOSFET ALD810025. The ALD810025 quad SAB MOSFET has a threshold voltage, V_t , equal to 2.5 volts. When the gate-source voltage, V_{GS} , is equal to V_t , the I_{DS} ON current for each SAB MOSFET M1/M2/M3/M4 is set at $1\mu A$. The I_{DS} ON current of M1/M2/M3/M4 change exponentially with slight changes in V_{GS} . Each SAB MOSFET M_x behaves like a voltage sensitive resistor (See sabfet_11101.0). At V_{GS} voltages below or above V_t , the SAB MOSFET I_{DS} ON current changes at a rate of approximately 1 decade for every 0.1V change in V_{GS} . When V_{GS} drops low enough, the I_{DS} ON current becomes essentially zero. For example, if the V_{GS} voltage for the ALD810025 falls below 1.9V, the I_{DS} current decreases to pA range, which is near zero compared to $1\mu A$.

The voltages across M1/M2 automatically self-adjust to accommodate different leakage currents for the supercap C1 and the voltages across M3/M4 automatically self-adjust to accommodate different leakage currents for the supercap C2. V_1 settles to approximately $\frac{1}{2}(V_+)$, depending upon relative leakage currents of each supercap in the stack. With V_+ equal to 10V, V_1 is 5.0V. Since there are two SAB MOSFETs in series for each supercap, the voltages across M1/M2 automatically compensate the C1 voltage, and the voltages across M3/M4 automatically compensate the C2 voltage. A higher supercap voltage results in a higher corresponding V_{GS} voltage of M_x connected across it, at a higher I_{DS} ON current, which opposes the tendency for the higher supercap voltage to increase. A lower supercap voltage results in lower I_{DS} ON currents in the corresponding SAB MOSFET until I_{DS} ON ≈ 0 . In equilibrium, the total leakage current across both M1/M2/M3/M4 and C1/C2 of each network is approximately equal to the highest leakage current of any one of C1/C2.

For full schematic diagram and notes, please register and login at aldinc.com