Category: SABFET

CIRCUIT IDEAS FOR DESIGNERS

Schematic no. sabfet_11102.0

Balancing 4-Supercap Cells in Series

Description

A quad supercapacitor auto balancing (SAB) MOSFET array connects across four-supercaps in series, using the ALD 8100xx series, with xx equal to the threshold voltage, V_t, in 0.10V increments. At V_t, the I_{DS} ON current for each SAB MOSFET M1/M2/M3/M4 is set at 1µA. The I_{DS} ON current of M1/M2/ M3/M4 change exponentially with slight changes in the gate-source voltage, 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, the ALD810025 has a V_t of 2.50V. If its V_{GS} voltage falls below 1.9V, the I_{DS} current decreases to pA range, which is near zero compared to 1µA.

The voltages across M1/M2/M3/M4 automatically self-adjust to accommodate different leakage currents for each supercap C1/C2/C3/C4. V_1, V_2 and V_3 settle to approximately ¾ (V+), ½ (V+) and ¼ (V+) respectively, depending upon relative leakage currents of each supercap in the stack. The currents through M1/M2/M3/M4 automatically compensate for different supercap voltages. 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/C3/C4 network is approximately equal to the highest leakage current of any one of C1/C2/C3/C4.

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