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 1\( \mu \)A. 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 \( I_{DS\,ON} \) current decreases to pA range, which is near zero compared to 1\( \mu \)A.

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 \( \frac{1}{4} \) \((V^+)\), \( \frac{1}{2} \) \((V^+)\) and \( \frac{3}{4} \) \((V^+)\) 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 \( I_{DS\,ON} \approx 0 \). 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