Category: SABFET **CIRCUIT IDEAS FOR DESIGNERS** Schematic no. sabfet_11110.0

ALD810026 Balances Four 2.5V Supercaps in Series

Description

Four 2.5V supercaps in series are balanced using the quad supercapacitor auto balancing (SAB) MOSFET ALD810026. ALD810026 has a threshold voltage, V_t, equal to 2.60 volts. When the gate-source voltage, V_{GS}, is equal to V_t, the I_{DS} ON current for M1/M2/M3/M4 is set at 1µA. 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. In this example, the V_{GS} voltage of each SAB MOSFET M1/M2/M3/M4 is set at approximately 2.5V, which has a nominal I_{DS} ON current of 0.1 µA. If the V_{GS} voltage for the ALD810026 falls below 2.0V, 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 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. With V+ equal to 10V, V_1 is 7.5V, V_2 is 5.0V, and V_3 is 2.5V. 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