Physical Meaning of Topology 11

What Happens When Both Switches Are ON (Storage Mode)

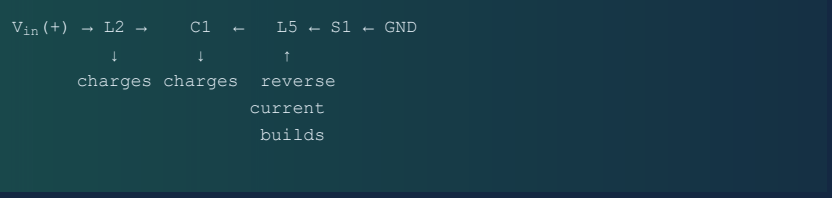
Topology 11: Both S1 and S2 Closed

Operating Mode: MAXIMUM ENERGY STORAGE - Both phases simultaneously accumulate energy

Diode States: D7 and D8 are REVERSE BIASED → No power flows to output

Output Behavior: Load is supplied only by output capacitor C0 (discharging)

Phase 1 (Switch S1 Closed)



- **L2 charges:** Current increases as $di_{L2}/dt = V_{in}/L2$ (direct path from source)
- **C1 accumulates:** Voltage rises as $dv_{C1}/dt = (i_{L2} - i_{L5})/C1$
- **L5 reverse charges:** Current becomes MORE negative as $di_{L5}/dt = -v_{C1}/L5$
- **Energy stored:** Magnetic energy in L2, L5; electric energy in C1

Phase 2 (Switch S2 Closed)

- **L1 charges:** Current increases as $di_{L1}/dt = V_{in}/L1$ (direct path from source)
- **C3 accumulates:** Voltage rises as $dv_{C3}/dt = (i_{L1} - i_{L6})/C3$
- **L6 reverse charges:** Current becomes MORE negative as $di_{L6}/dt = -v_{C3}/L6$
- **Energy stored:** Magnetic energy in L1, L6; electric energy in C3

Why "Reverse Charging" of L5 and L6?

Current direction convention: We define positive current as flowing toward the output (through D7/D8).

When S1/S2 close, they create a low-resistance path to ground. Current in L5/L6 flows **AWAY from output** (toward the switch). This is the **opposite direction** from our convention → current becomes negative.

The key insight: This "reverse momentum" is intentional. When switches open, inductors cannot change current instantly. The built-up reverse current will now be forced to flow forward through D7/D8, transferring stored energy to the output.

Practical Implication: Topology 11 occurs when both switches have high duty cycles that overlap. During this interval, the converter draws maximum current from the AC source, storing energy for later transfer. The output voltage sag during this phase is minimal due to C0's large capacitance (hundreds of µF).