IDEAL POWER OR-ING DIODE USING N-FET

HP INC
Ideal Power OR-ing Diode using N-FET

Abstract: In portable electronic devices which can take in power on multiple connectors from different sources, an isolation switch using an active low Vf input power OR-ing diode with fast reverse current protection using an N-FET as the pass element allows power to be switched from one source to another without power being lost at the device.
This disclosure relates to the field of supplying power to portable electronic devices.

An active low Vf input power OR-ing diode with fast reverse current protection using an N-FET as the pass element is disclosed.

Because users too often forget their power adapters when traveling, portable devices such as Notebooks, Tablets, 2-in-1's, and mini-Workstations are currently being designed to take in power on multiple connectors. Each of these input paths requires back-to-back isolation switches (i.e. FETs). However, this can result in power loss when transitioning between two different power paths. One approach to mitigate this limitation converts one of the back-to-back FETs into an "ideal diode". The converted FET is a P-FET with associated circuitry to lower its effective Vf (forward voltage drop). However, a P-FET inherently has higher Qg and typically a more pronounced Miller plateau than its "equivalent" N-FET (based on Rds).

According to the present disclosure, and as understood with reference to the schematic diagram of the Figure, an N-FET implementation, rather than a P-FET one, reduces the required gate drive, and offers a quicker response for reducing undesired reverse current flow. Minimizing the Miller plateau facilitates regulation of Q4 within its linear region to emulate a diode with as low Vf as possible, allowing for the faster turn-off response.

Each power input path has its own associated isolation switch (back-to-back FETs) to prevent one power input from feeding back to another power input causing problems such as over-voltage or excessive current draw. These associated isolation switches reside in the mobile device. The onboard embedded controller and/or PD controller chooses which power input path to enable, turning on the corresponding isolation switch. In one example, the power input paths are mutually exclusive, with only one enabled at any particular time. However, in other examples more than one power input path may be enabled simultaneously.

In operation, V+ provides drive for Q4. The dual Q1A-Q1B pair act as a diff amp via a current mirror (Ves are matched). The Q1 diff amp action via Q3 forces Q4 Vsd to match Q2 Vds, emulating a low Vf.

If Vout rises, Q1B's Ic exceeds Q1's Ic. This causes Q3 to open Q4. CR1 protects Q1A/B.

Disclosed by Stephen Ken Gustafson, HP Inc.