Circuit Idea
20040201

Power Supply Output Disable Circuit with Reduced Current Spikes

Summary of the Idea

A power supply output disable circuit includes a series pass switch with additional capacitance to reduce turn-on current spikes of the series pass switch.

Description

In order to meet stringent standby power consumption specifications, a power supply may disconnect its output when a standby signal is active. Generally, this is achieved by turning off series-pass bipolar junction transistors (BJTs) or MOSFETs. For lower current outputs, BJTs are a viable alternative to MOSFETs since the BJTs are lower in cost. BJTs may be used as long as the additional voltage drop of the BJT is accounted for in the design of the power supply's transformer.

Figure 1 shows a simple BJT series pass switch for a 12 V, 100 mA output, which has a significant capacitance, C_{LOAD}.

Transistor Q1 is the series pass element, and transistor Q2 turns transistor Q1 on and off according to the state of the standby signal. Resistor R1 is sized such that the base current of transistor Q1 is enough to guarantee it operates in saturation at minimum beta and maximum output current. Additional capacitor, C_{NEW} moderates the transient current at turn-on of transistor Q1. Without C_{NEW}, Q1 turns on very rapidly into the capacitive load C_{LOAD} and conducts a large spike of current. Transistor Q1 would need to be oversized to accommodate this transient spike, adding to the cost.

The capacitance C_{NEW} acts as an additional "Miller capacitance" for transistor Q1 and capacitor C_{NEW} eliminates transient current spikes. The extra capacitance C_{NEW} limits the dv/dt of the collector of transistor Q1. A lower dv/dt results in a lower charging current for capacitance C_{LOAD}. The capacitance of C_{NEW} can be chosen such that the desired output dv/dt of transistor Q1 multiplied by the value of capacitance C_{NEW} would equal the current into resistor R1.

$$i_{R1} = C_{NEW} \times \frac{dv_{Q1}}{dt}$$

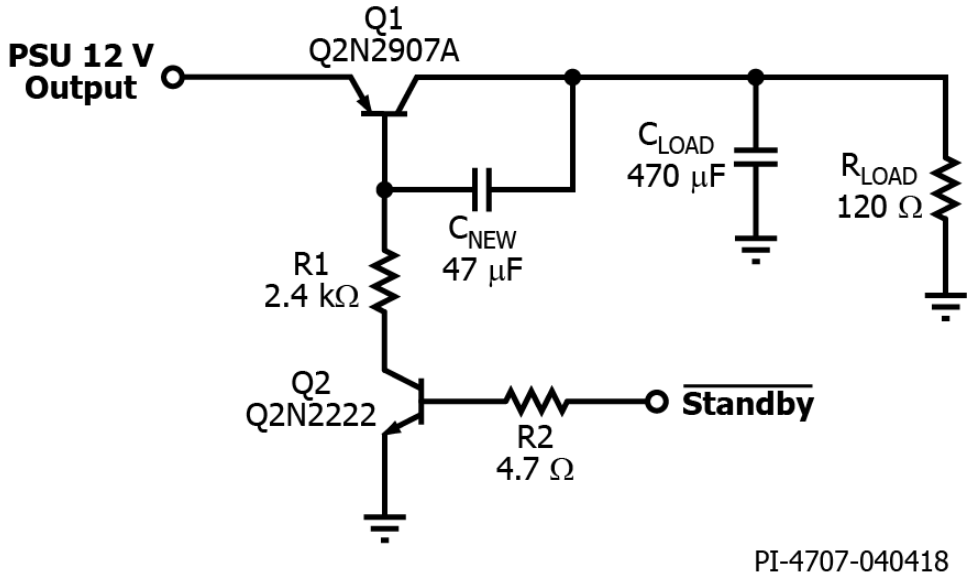

Figure 1. Soft-start circuit disables the power supply output during standby while reducing the turn-on current spike conducted by transistor Q1.

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