Transistors offer overload delay

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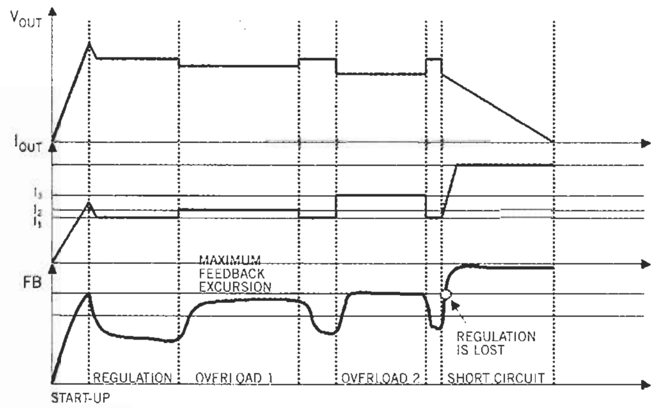

Figure 1 **Overloads and short circuits can be similar in this typical power profile for a printer.**

Although an SMPS (switch-mode power supply) can protect itself against permanent short circuits, it sometimes has problems when dealing with transient overloads. Transient overloads are not short circuits but can push the power supply above its nominal load value. This scenario occurs with typical loads such as printer heads and small motors. When facing such a load profile, the power supply can easily trigger its protection circuit, especially if the open-loop gain is high. You will see any decrease in the output voltage on the primary side as a loss of feedback current, because the controller cannot keep the voltage constant.

Figure 1 shows a typical power profile for a printer. You can clearly see the power variations and the corresponding feedback-voltage swings that occur. The start-up sequence is a short circuit because, with V_{OUT} far from its target, the feedback current is not yet established. The nominal output current, I_1, corresponds to the regulation zone, in which the load is constant. When a first overload occurs (I_2 in **Figure 1**), the feedback pin pushes the primary-current setpoint (in a current-mode controller), but the waveform's excursion starts to diminish, because it is approaching its maximum level. In I_3, the power supply has difficulty remaining in regulation and, in short-circuit condition, V_{OUT} collapses to ground. If the primary PWM controller has a simple short-circuit-protection scheme, the protection mechanism can trigger in the overload zones 1 and 2, whereas it should trigger only in the final one. **Figure 2** portrays an approach based on the NCP1200 from On Semiconductor (www.onsemi.com).

This circuit permanently monitors the feedback line (Pin 2) to detect whether a short circuit is present on the secondary side. If so, Pin 2 jumps to its internal pullup voltage and triggers a protective burst mode. Note that this protection acts independently of any badly coupled auxiliary level, because the high-voltage source (Pin 8) directly powers the controller. In the presence of overloads 1 and 2, Pin 2 would jump to the maximum of its capability and would trigger the protection. This circuit does not delay the rise of the feedback voltage but momentarily increases the output-power level by a given percentage. When I_{OUT} is within regulation, Pin 2 is below 3V and D_1 is not biased. As a result, Q_2 is blocked and Q_1 pulls R_3's lower terminal to ground. The current-sense pin therefore sees a current image, which the voltage-divider ratio of R_2 and R_3 affects.

In this example, $V_{PIN4} = V_{SENSE} \times R_3/(R_3+R_2) = 0.82 \times V_{SENSE}$, where V_{SENSE} is the voltage across R_{SENSE}. If the NCP1200 imposes a maximum-current setpoint of 1V, the IC authorizes 1.2V over R_{SENSE} as long as Q_1 is biased (instead of 1V in a regular configuration). As soon as Pin 2 jumps to a higher value, such as 4V, indicating a loss of regulation or a severe overload, D_1

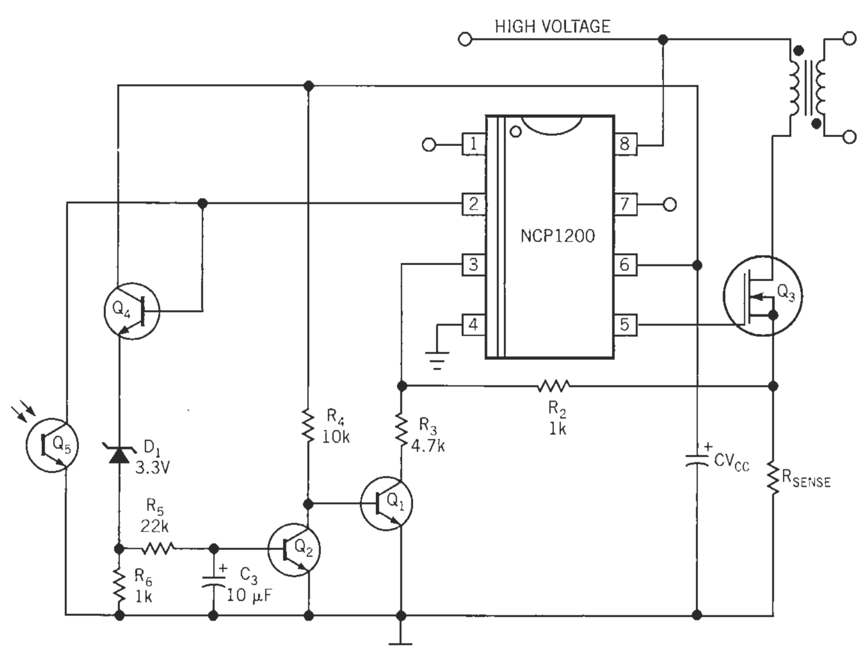

Figure 2 **A transistor network increases the peak current for a moment until the power supply gives up by reducing the peak setpoint.**

starts to conduct via Q_4. This transistor buffers the feedback-pin impedance: C_3 starts to charge up via R_5, and, when it reaches approximately 0.7V at 25°C, Q_1 opens. The divider goes away, the power supply no longer ensures a large peak current, and V_{OUT} goes down, thereby properly triggering the protection. As result, by dimensioning the R_5 and C_3 elements, you can insert a delay to enable the supply to cope with transient loads.□