8.2 The Type 3: An Origin Pole plus a Double Pole/Zero Pair

The type 3 compensator offers a larger phase boost than its type 2 counterpart. Unfortunately, because of the fixed internal 7-kHz pole present in the duty ratio modulator and the limit set for the resistor R_s, we cannot expect the full flexibility as with a traditional op amp approach. That being said, let us have a look at a type 3 implementation as it appears in Figure 8.10. The principle remains the same: how do we add another pole/zero pair given the fast lane presence? As we did for the TL431 with a voltage-mode feedback control, a RC network will be added in parallel with the LED series resistor. The network will add the zero/pole pair we are looking for in a type 3 architecture. As we already derived the transfer function of the type 2—see (8.8)—going to the type 3 simply requires us to replace R_{LED} with the equivalent impedance brought by the new network Z_{LED} highlighted in Figure 8.10:

$$Z_{LED} = \frac{R_{LED}\left(R_3 + \frac{1}{sC_3}\right)}{R_{LED} + \left(R_3 + \frac{1}{sC_3}\right)} = R_{LED}\frac{sR_3C_3 + 1}{sC_3\left(R_{LED} + R_3\right) + 1} \tag{8.32}$$

Now substituting this expression in (8.8), we have

$$\frac{I_{FB}(s)}{V_{out}(s)} = \frac{\text{CTR}}{R_{LED}}\frac{1 + 1/sR_1C_1}{1 + sC_{V_{cc}}\left(R_s + R_d\right)}\left(1 + sR_sC_{V_{cc}}\right)\frac{sC_3\left(R_{LED} + R_3\right) + 1}{sR_3C_3 + 1} \tag{8.33}$$

The current $I_{FB}(s)$ is injected into the duty ratio modulator whose transfer function includes a gain as described by (8.3), followed by a 7-kHz pole:

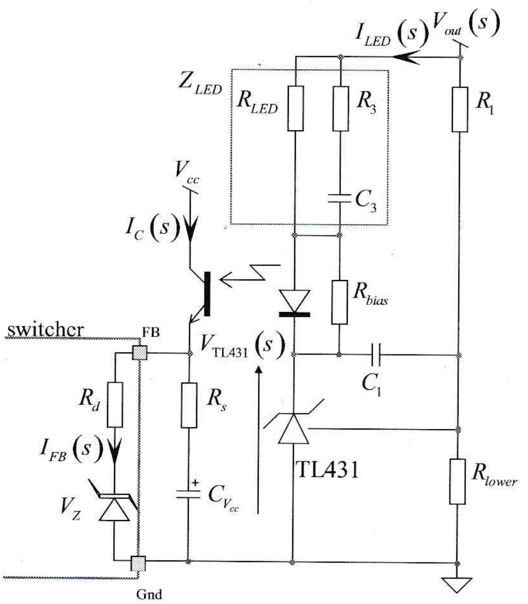

Figure 8.10 A type 3 implementation with a shunt regulator suffers from the limits imposed on R_s and the internal 7-kHz pole.