

## Parameters

$$V_{out} = 5$$

$$R_{upper} = (V_{out} - 2.5)/250\mu$$

$$f_c = 1k$$

$$pm = 100$$

$$G_{fc} = -20$$

$$p_{fc} = -55$$

$$G = 10^{(-G_{fc}/20)}$$

$$\text{Boost} = pm - (p_{fc} - 90)$$

$$pi = 3.14159$$

$$K = (\tan((\text{boost}/4 + 45) \cdot \pi/180))^2$$

$$C2 = 1/(2 \cdot \pi \cdot f_c \cdot G \cdot R_{upper})$$

$$C1 = C2 \cdot (K - 1)$$

$$R2 = \sqrt{k} / (2 \cdot \pi \cdot f_c \cdot C1)$$

$$R3 = R_{upper} / (k - 1)$$

$$C3 = 1/(2 \cdot \pi \cdot f_c \cdot \sqrt{k} \cdot R3)$$

$$F_{zero} = f_c / \sqrt{k}$$

$$F_{pole} = \sqrt{k} \cdot f_c$$

$$R_{pullup} = 20k$$

$$a = (F_{pole}^2 + f_c^2) \cdot (f_c^2 + F_{zero}^2) \cdot (F_{pole}^2 + f_c^2) \cdot (f_c^2 + F_{zero}^2)$$

$$b = F_{pole}^2 \cdot F_{pole}^2 + F_{pole}^2 \cdot f_c^2 + f_c^2 \cdot F_{pole}^2 + f_c^4$$

$$R_{led} = (\sqrt{a/b}) \cdot R_{pullup} \cdot F_{pole} \cdot F_{pole} / (F_{zero} \cdot f_c \cdot G)$$

$$C_{zero1} = 1/(2 \cdot \pi \cdot F_{zero} \cdot R_{upper})$$

$$C_{pole2} = 1/(2 \cdot \pi \cdot F_{pole} \cdot R_{pullup})$$

$$C_{pz} = (F_{pole} - F_{zero}) / (2 \cdot F_{zero} \cdot F_{pole} \cdot R_{led} \cdot \pi)$$

$$R_{pz} = 1/(2 \cdot \pi \cdot F_{pole} \cdot C_{pz})$$

$$CTR = 1$$

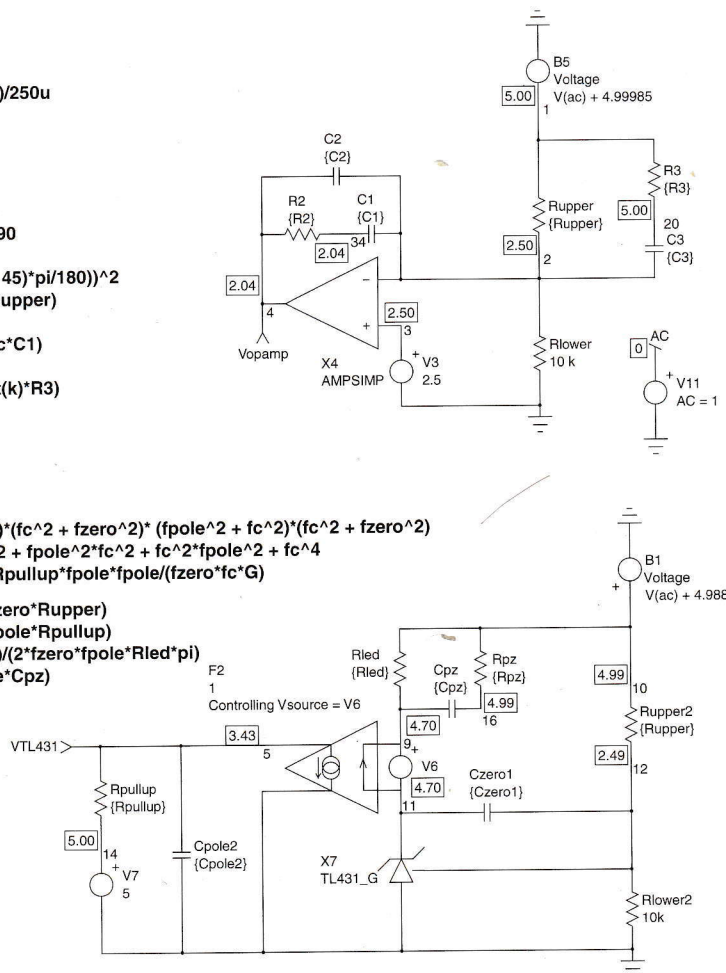


FIGURE 3-43 Placing an RC network in parallel with the LED resistor makes the type 3 amplifier!

Extracting the value of  $R_{LED}$  from the module expression leads to the following (complicated) result:

$$R_{LED} = \frac{\sqrt{(f_{p1}^2 + f_c^2)(f_{z1}^2 + f_c^2)(f_{p2}^2 + f_c^2)(f_{z2}^2 + f_c^2)} \cdot CTR \cdot f_{p1} f_{p2} R_{pullup}}{f_{p1}^2 f_{p2}^2 + f_{p2}^2 f_c^2 + f_{p1}^2 f_c^2 + f_c^4} \cdot \frac{CTR \cdot f_{p1} f_{p2} R_{pullup}}{f_{z2} f_c G} \quad (3-73)$$

Fortunately, if poles and zeros are coincident (respectively  $f_p$  and  $f_z$ ), the formula simplifies to

$$R_{LED} = \frac{(f_z^2 + f_c^2) f_p^2 R_{pullup} CTR}{(f_p^2 + f_c^2) f_c f_z G} \quad (3-74)$$

Thanks to the above equations, we can derive the value of  $R_{LED}$ , given the gain needed at the crossover frequency. Now, manipulating Eqs. (3-68a) and (3-69), we can compute a

value for  $C_{pz}$ , as t  
Eq. (3-68a), we c

Inserting this resu

Solving for  $C_{pz}$  le

As we did for the  
of the example, v

- Crossover freq
- Needed phase
- Gain needed a
- Phase observe
- $k = 3.32$  given

First, the  $k$  facto  
locations [Eq. (3  
as discussed abo

Via Eq. (3-74),  
From Eq. (3-  
(3-68a), and (3-

Figure 3-43 po  
also works in C  
plots perfectly  
As we will  
implementation  
pole-zero posit  
the crossover r  
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