比例电流源&use in FB of SMPS

1 Basic principle

2 Application case

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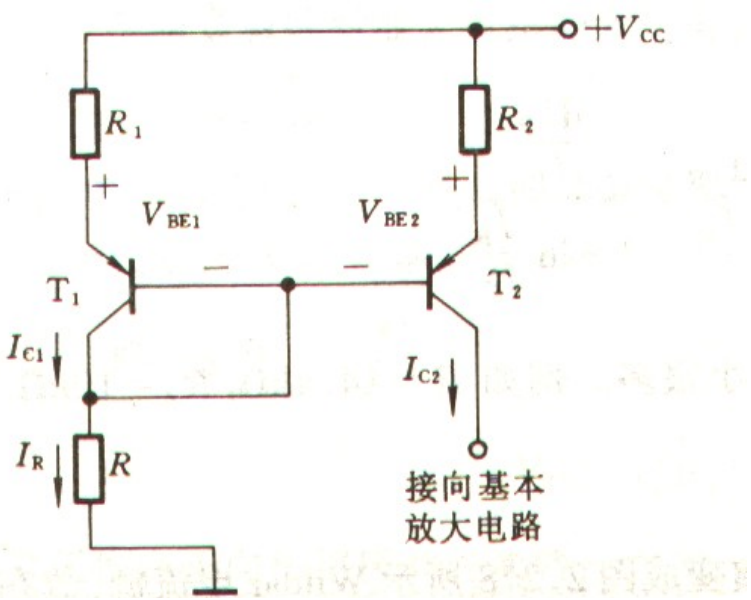
1 Basic principle



$$I_{C2} \approx \frac{R_1}{R_2} I_R$$

特点：I_{C2}和I_R成比例关系，比例系数由R_1/R_2控制

IR=[Vcc-Vbe1]/(R1+R)

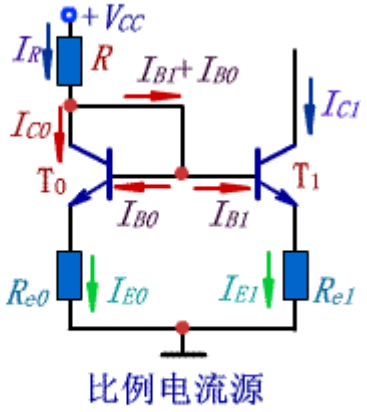
二、比例电流源

比例电流源如图所示，克服镜像电流源缺点。经分析推导可得：

$$I_{C1} \approx \frac{R_{e0}}{R_{e1}} I_R$$

改变的 R_{e0} 和 R_{e1} 阻值，可改变的 I_{C1} 和 I_R 的比例关系。式中基准电流

$$I_R \approx \frac{V_{CC} - U_{BE0}}{R + R_{e0}}$$

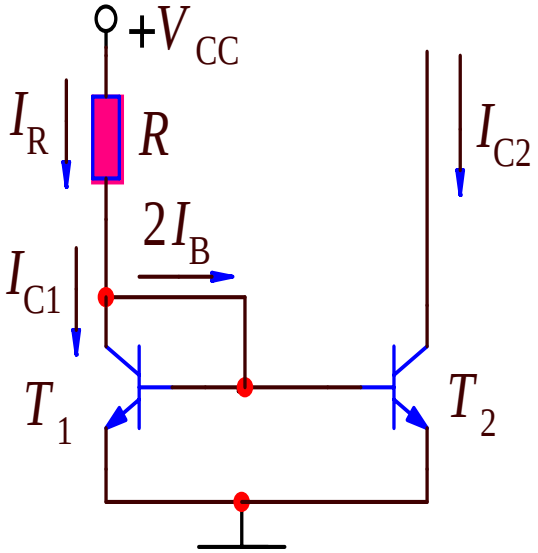


比例电流源

R_{e0} 和 R_{e1} 是电流负反馈电阻，因此，与镜像电流源比较，比例电流源的输出电流 I_{C1} 具有更高的温度稳定性。

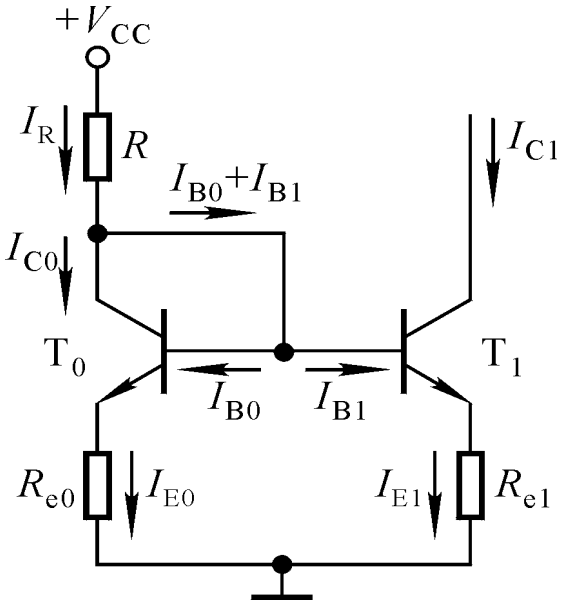
1 basic principle

镜像电流源



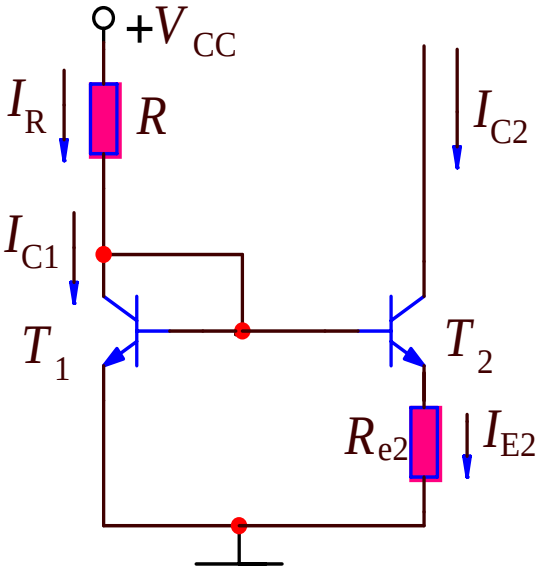
$$I_{C2} \approx I_R$$

比例电流源



$$I_{C1} \approx \frac{R_{e0}}{R_{e1}} I_R$$

微电流源

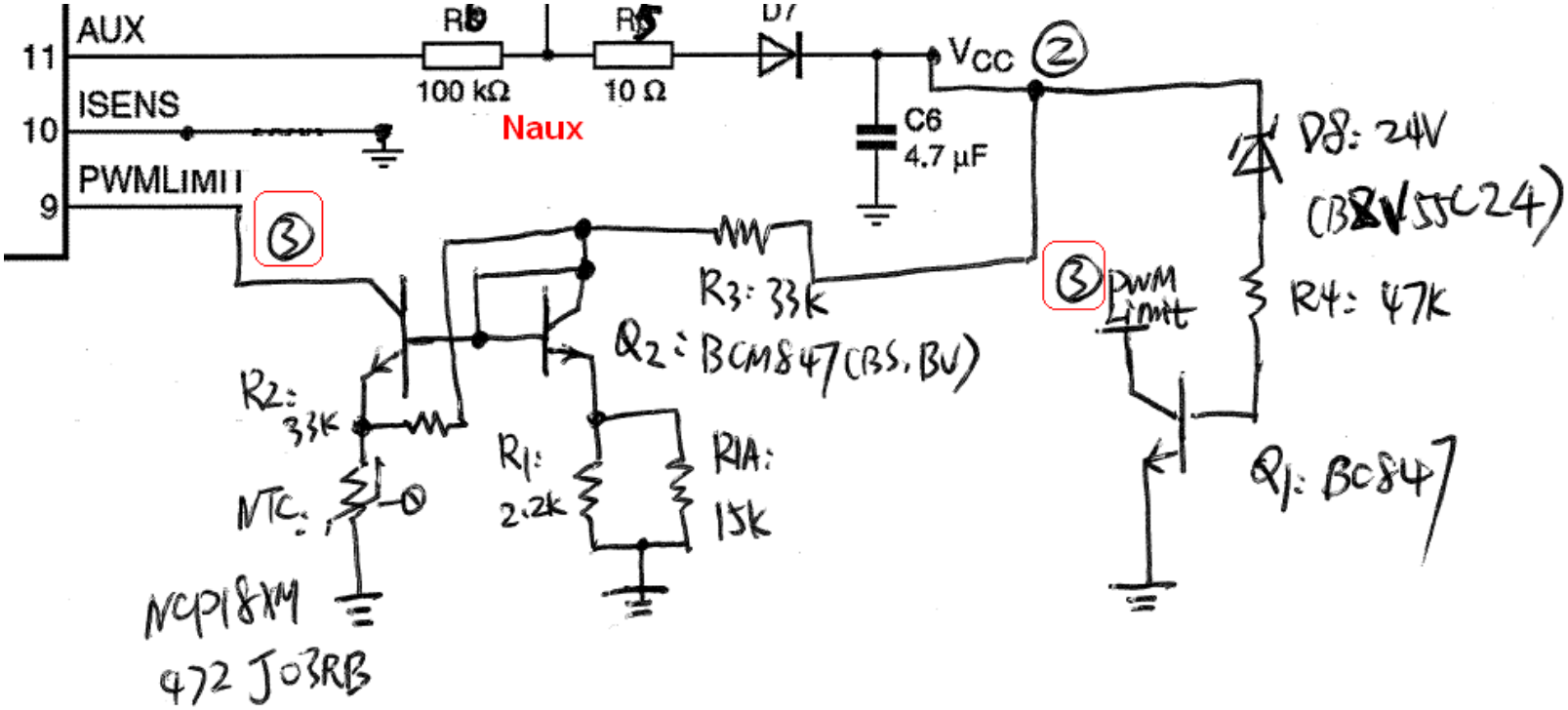


$$I_{C2} \approx \frac{U_T}{R_{e2}} \ln \frac{I_R}{I_{C2}}$$

分析这些电路时都忽略了I_B，近似认为$I_C \approx I_R$，所以这种近似程度的好坏，直接影响电流源的精度。

2 Application case

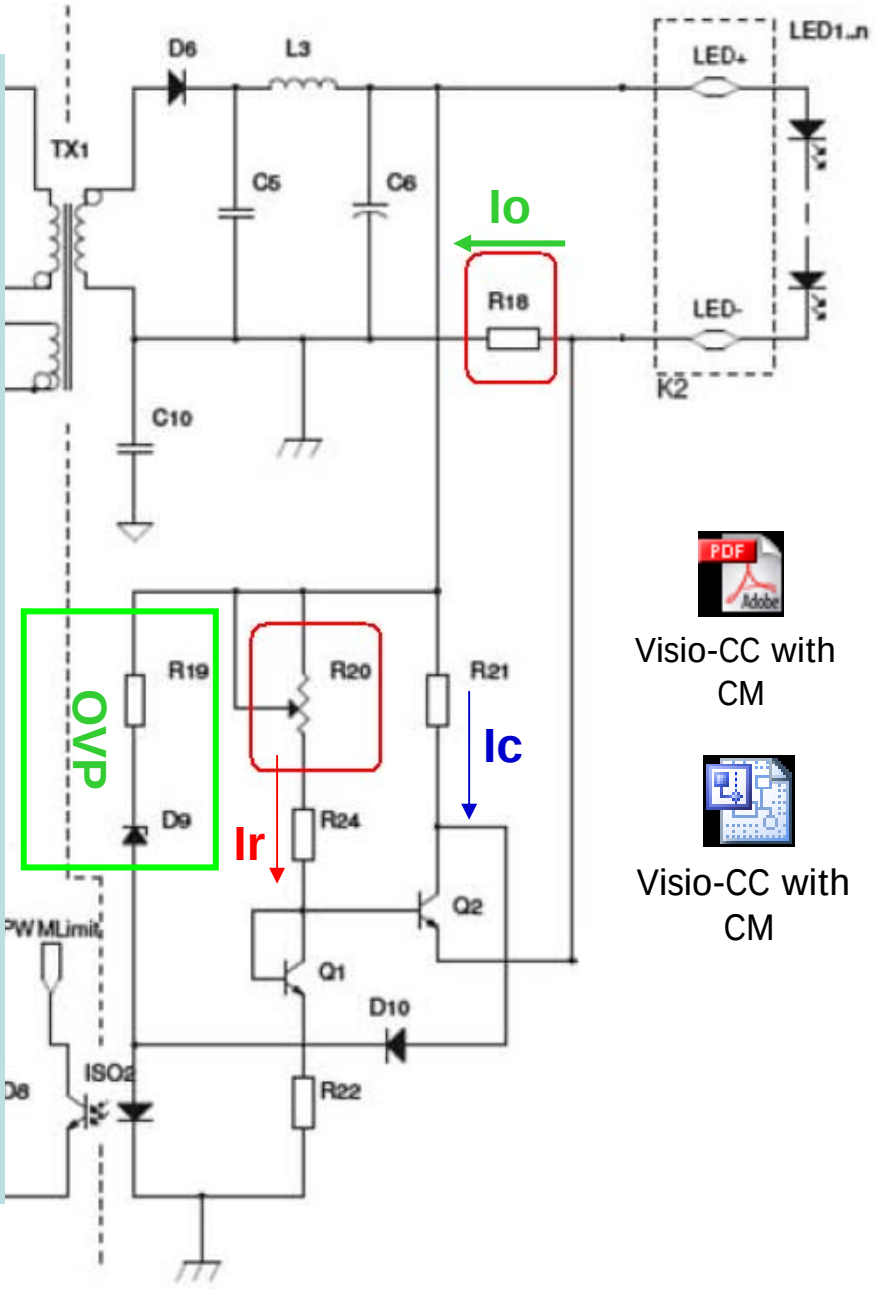
2-1 TLM



2-2 CC-1

The board is equipped with a feedback loop that limits the output current. This feedback loop senses the LED current over sense resistor R18 and a current mirror is used, consisting of Q1/Q2. Using R20, the current level can be set.
The same feedback loop is also used for overvoltage protection. If the LED voltage exceeds 23 V, a current through R19 and D9 will start flowing. The current through the opto-coupler IC2 will pull down the PWMLIMIT and BRIGHTNESS pin.
At a value below 400 mV, the “on”-time is zero.

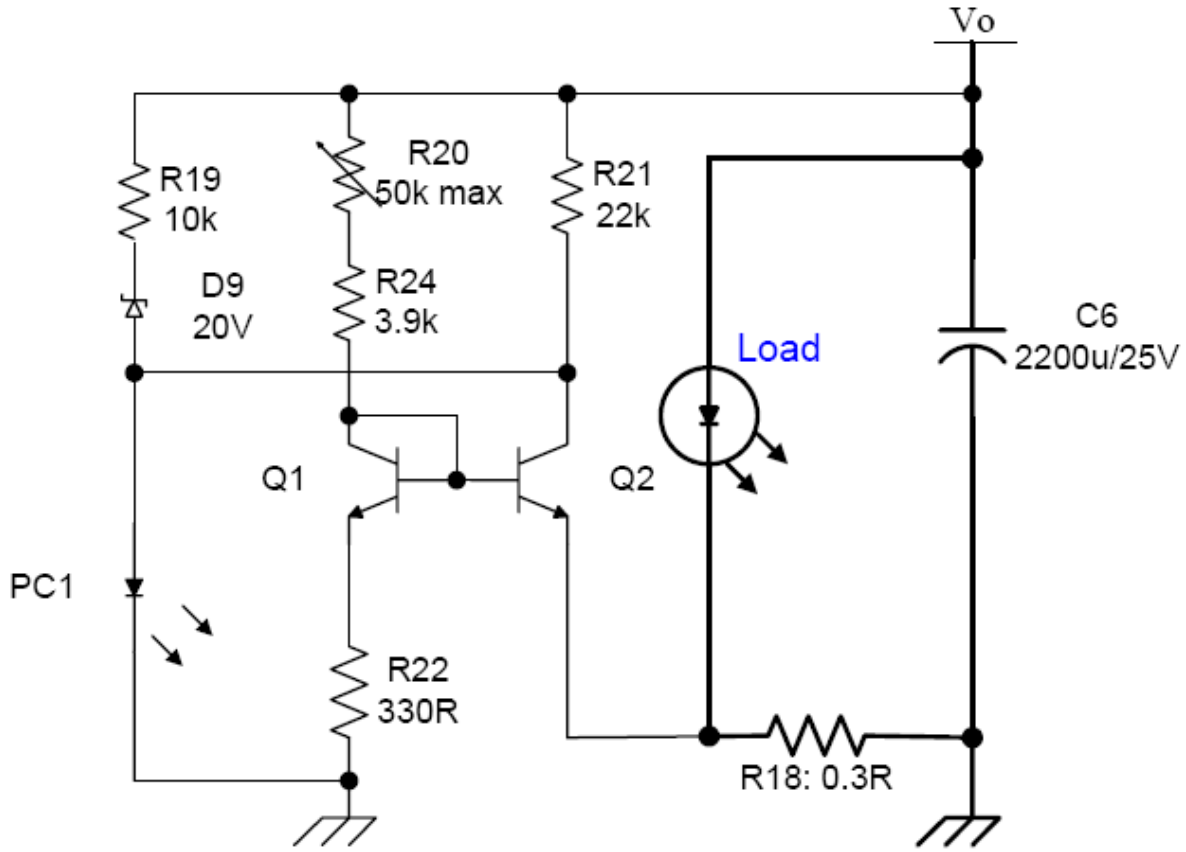
The feedback loop has proportional action only, and the gain is critical because of phase shift caused by the converter and C6. The relation between PWMLIMIT and output current is quadratic in nature. The resulting output current spread will be acceptable for most LED applications.



Visio-CC with CM

Visio-CC with CM

2-2 CC-1

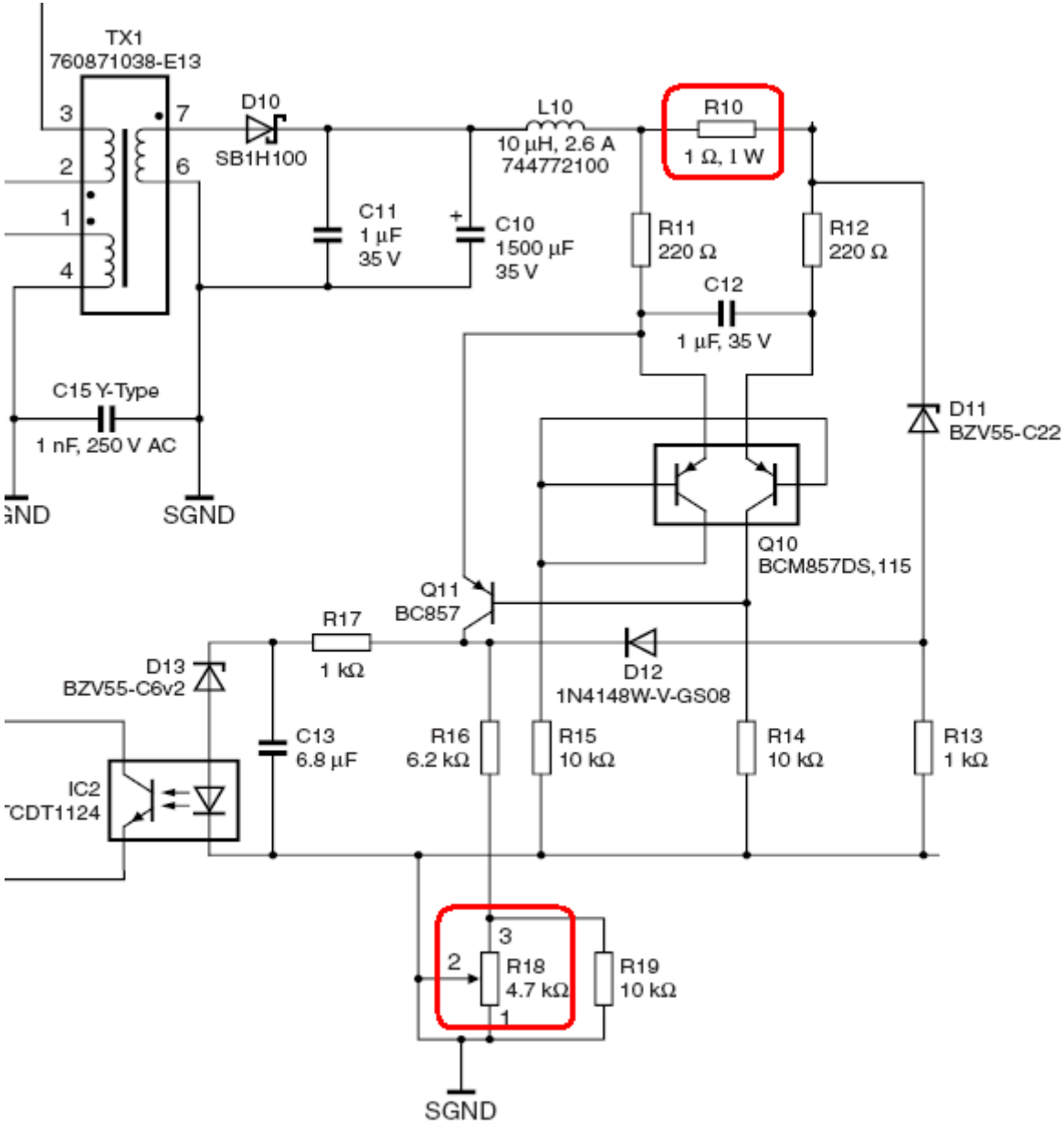


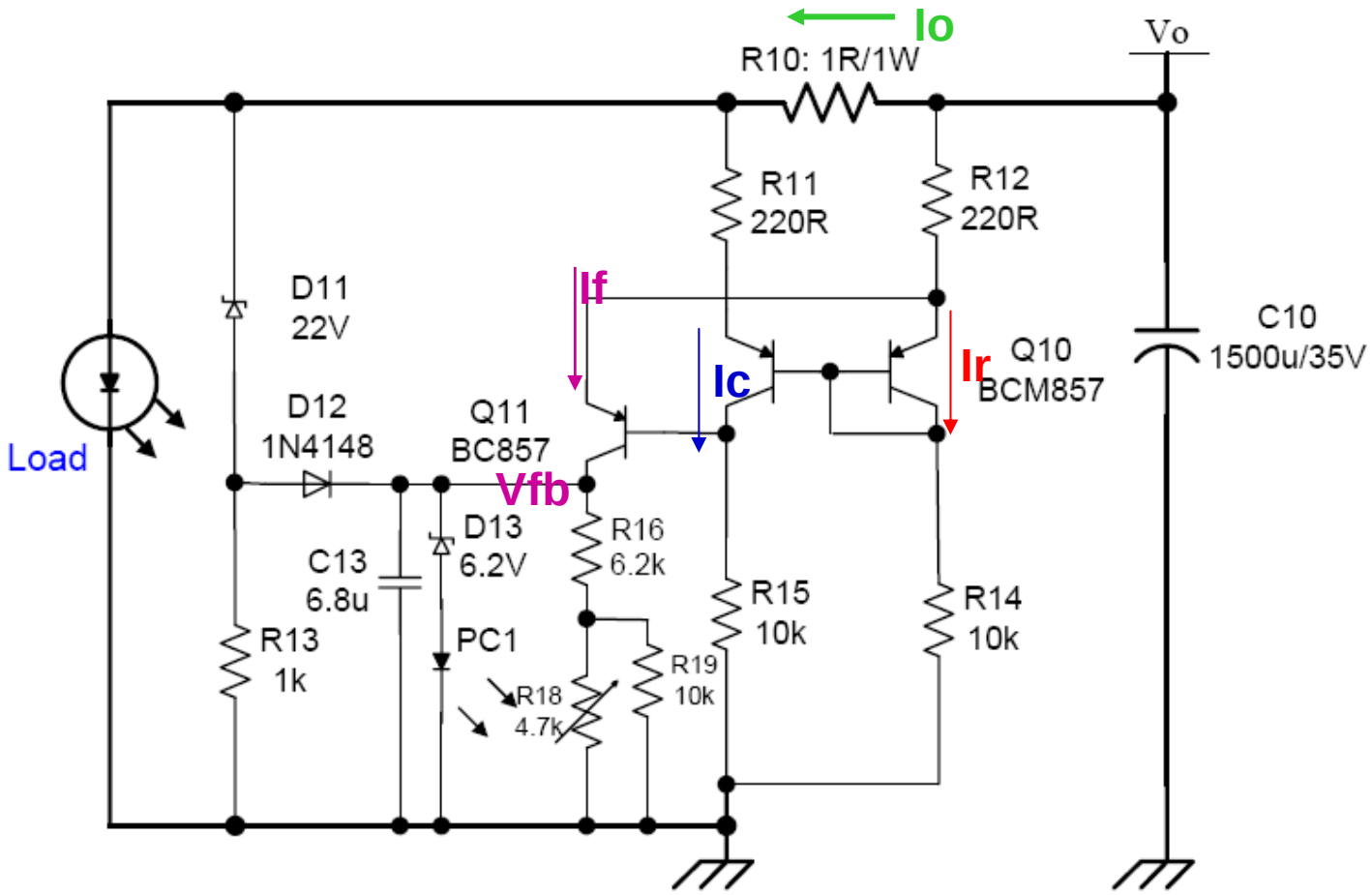
推导：

Ir*R22=(Io+Ic)*R18~=Io*R18;
Ir=(Vo-Vbe)/(R20+R24+R22);
→Io=R22*(Vo-Vbe)/[R18*(R20+R24+R22)]
→R20 increases, Io decreases

2-3 CC-2

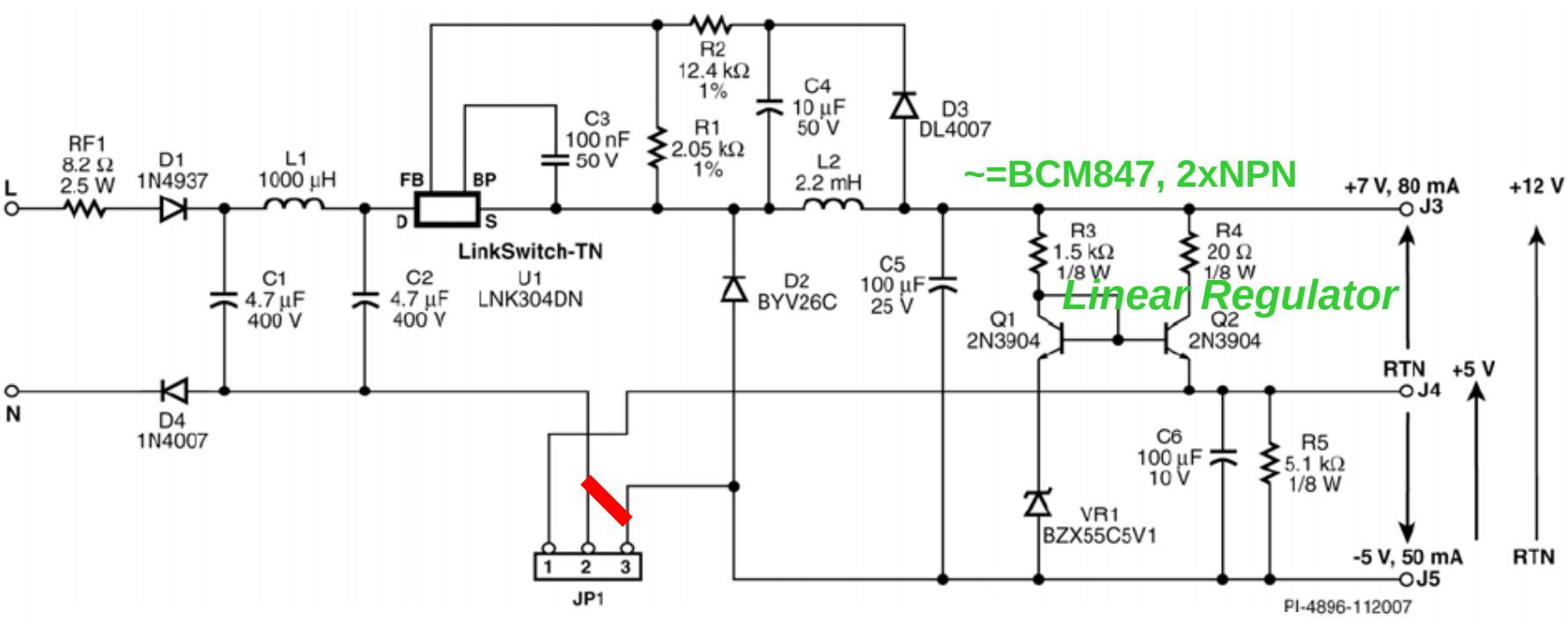
The board is equipped with a feedback loop to regulate the output current. This feedback loop senses the LED current over sense resistor R10, and a current mirror is made from transistors Q10a/Q10b. Using R18, the current level can then be set. The same feedback loop is also used to provide overvoltage protection. If the LED voltage exceeds 33 V, a current through R17 and D11, D12 and D13 will start running. The current through the opto coupler IC2 will pull up the REG pin. At values above 2.7 V, the ‘on time’ of the internal MOSFET is zero. The feedback loop has a proportional, and partially integrated action. The gain is critical due to the phase shift caused by the converter and the output capacitor C10. Increased gain will make the feedback loop intrinsically unstable.





设Ru=R11=R12, Rd=R14=R15 → Io*R10+Ic*Ru+Vbe=(If+Ir)*Ru+Vbe, Ir~=Ic
→Io=(If)*Ru/R10∝If.
→Vfb=If*(R16+R18//R19)=Io*R10*(R16+R18//R19)/Ru
→**Io**=Vfb(th)*Ru/[R10*(R16+**R18**//R19)]
→R18 increases, Io decreases!!

2-4 LDO



Zener diode VR1 defines the voltage on the emitter of Q2 (via Q1), and therefore J4, to be 5.1 V above the voltage on J5. Should this difference in voltage across J4 and J5 reduce, then the voltage on the base of Q2 rises, increasing collector and load current delivered to the -7 V output (J4 to J5) and maintaining the voltage difference.

Maximum dissipation within the linear regulator occurs when the +5 V (J4 to J5) is fully loaded. At full load of 50 mA, this dissipation can be estimated as

$P_{DQ2} = V_{CEQ2} \times I_{CQ2}$

$P_{DQ2} = 5.9\ V \times 50\ mA = 295\ mW$

2N3904

2N3904_DS

Resistor R3 sets the bias current through VR1 to be ~ 4 mA, which also acts as a pre-load for the 12 V output (J5 to J3). For better efficiency and lower no-load consumption, a low test current Zener diode should be used.

[END]