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A New Type Of Semiconductor Laser Power Supply

Yue yubo[1] Xu yang[2] Li rui[1]

(School of Electronics and Information Engi .Changchun University of Science and Technology,changchun，130022,China)

(changchun FAWAY-JOHNSON controls auto motives systems CO.LTD,jilin,130000，China)

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Abstract. In this paper development a new Semiconductor laser power supply,for the rising Technology of Semiconductor laser that used in laser beam riding guidance.it contains over current protection and over voltage protection Circuit,with the advantage of small,light,precise,reliable and high efficiency. SettingStructure model on the base of System control theory,using matlab for simulation,and Given the experimental conclusion.

Circuit structure model

Semiconductor Laser Diode has the same volt-ampere characteristics with normal diode. When the voltage amplitude is higher than its turn-on voltage, the tiny change in voltage can lead to significant changes in current. Therefore, two important aspects must be considered in the design of its power. The one is the supplying of current must be constant. The other one is the system can not work in underdamped state to avoid the pulse when power switch on. According to the requirements above, the components of semiconductor laser power circuit system shown in Figure 1:

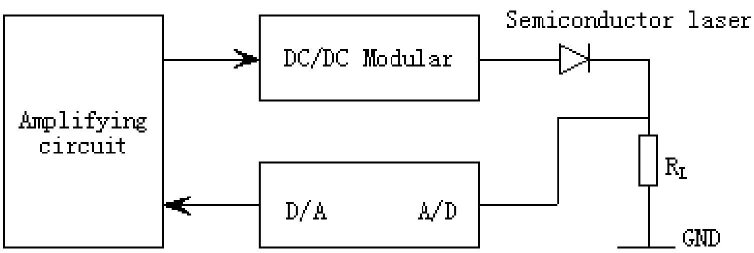

Figure 1 Semiconductor laser principle

The voltage of sampling resistor sampled by ADC is compared with reference voltage of the noninverting input of amplifier, when its value is higher than reference voltage, system increase the DAC output to reduce the amplifier output, and thus the purpose of reducing the voltage across the laser is achieved, which reduces the current through the laser also. Otherwise reduce the output of DAC. Then the system will constitute a dynamic voltage-controlled current source. The amplifier circuit including current limiting circuit and the overvoltage protection circuit, the design shown in Figure 2:

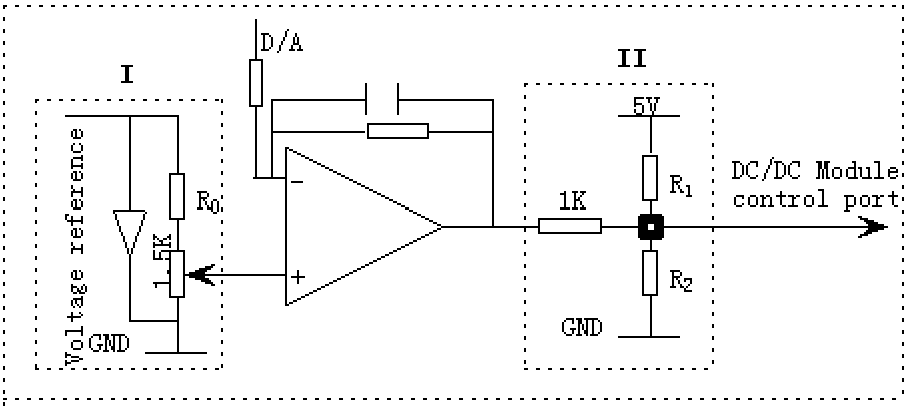

Figure 2 Amplifying circuit design principle

As shown in Figure 2, I is the current limit circuit. The selection of appropriate value of R0 can limit the maximum voltage which across the sliding rheostat, and thus limit the maximum adjustable value of current (Imax=Vmax/RL). The output will be terminated or even device damaged when DC to DC module output an excessive voltage, which is not conducive to the normal operation of semiconductor lasers. In view of this, an over-voltage protection circuit is designed as part II. According to Thevenin theorem, the amplifier output resistance composed of voltage divider circuit with R1 and R2, regulating the value of R1 and R2 appropriately can limit the voltage range of the DC to DC module, and thus control the maximum voltage of the laser.

Traditional semiconductor laser power usually have large current ripple. For the effect of temperature drift characteristics of the amplifier, the current stability and precision constant current can not be effectively guaranteed. The introduction of NC part greatly increase the accuracy of current and reduce the temperature influence on the current stability.

CircuitMathematical model

As the Transfer function of the Amplifier is $H_1(s)$,and that of DC/DC Modular is H_2（s).by the way of Series they are connected.The system is a Two order
deep negative feedback amplification one.its Mathematical model shown as
Figure 3:

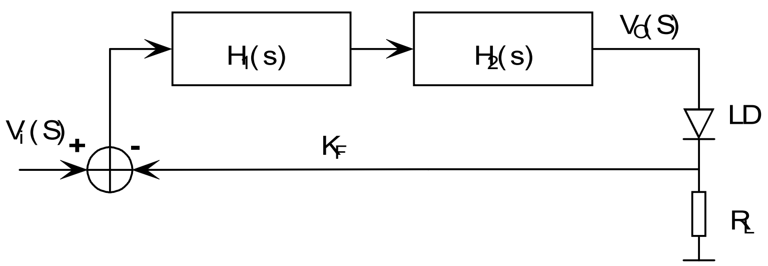

Figure 3 Mathematical model of laser power supply

K_F is Feedback coefficient.

$$K_F=R_F/R_F+R_D \quad (1)$$

In which R_D is the resistance of Semiconductor laser.Although R_D has
A little Change with the temperature,it has Almost no effect on K_F.
The Value of K_F is 811/10000.According to the actual circuit:

$$H_1(s)=1000/(s+1) \quad (2)$$

$$H_2(s)=10/(s+189) \quad (3)$$

And then

$$H(S)=V_O(S)/V_I(S)=H_1(S)H_2(s)/[1+K_FH_1(s)H_2(s)]=10000/s^2+190s+10000 \quad (4)$$

Theory simulation

On the step input signal,use matlab to observation System response, the Result shown as Figure 4:

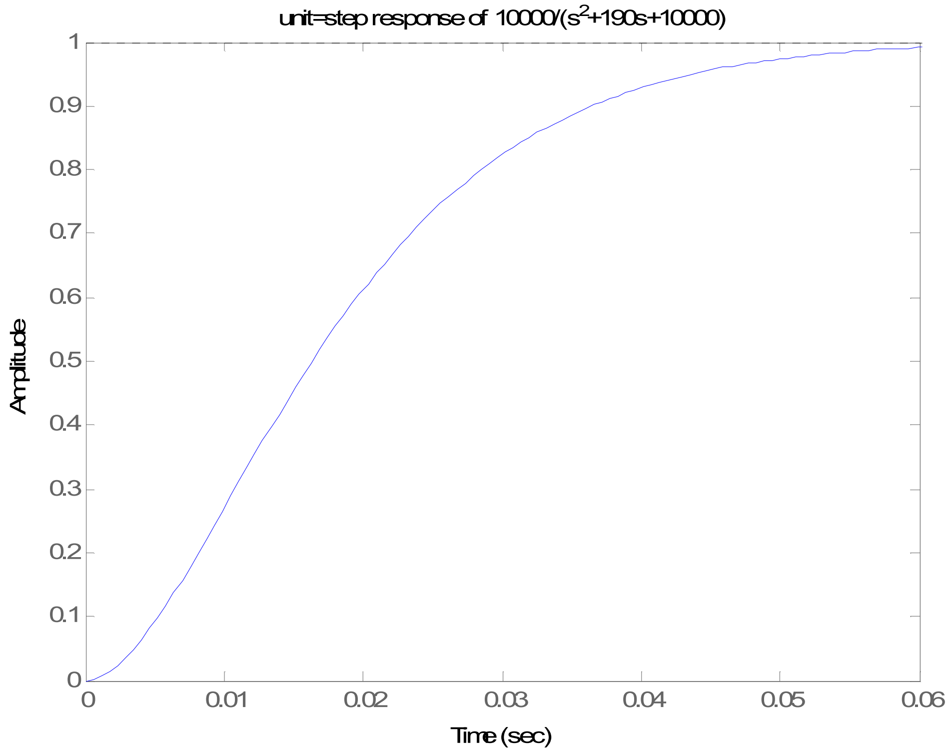

Figure 4 System response simulation

The Program shown as next:

num=[10000];

den = [1,190,10000];

step(num,den);

Title('unit=step response of 10000/(s^2+190s+10000)')

This shows,the system has no shock.

Research findings

After 5000 times switch test,-50 ~60 high and low temperature test and impact vibration test, performance of the power supply is verified.the efficiency of the power supply can arrive 90%,and its maximum absolute value of power is 50w.Also It can realization of function that constant current intervals and current limit interval 0~3A.physical picture shown

As Figure 5 and waveform picture as Figure 6.

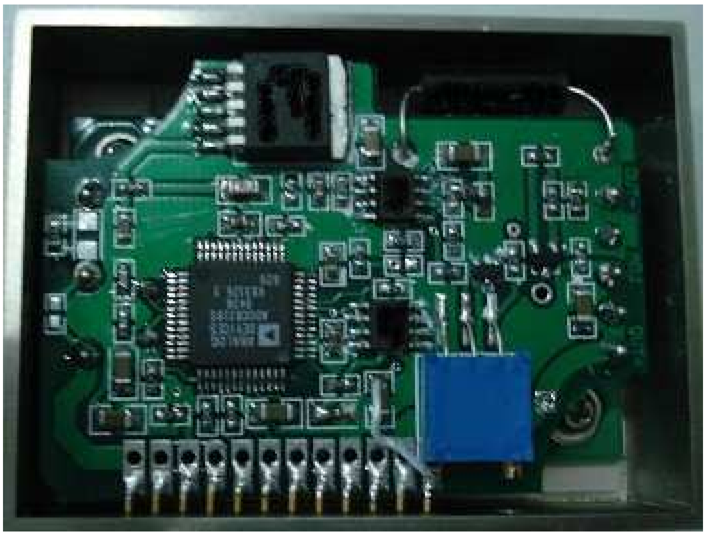

Figure 5 Physical picture

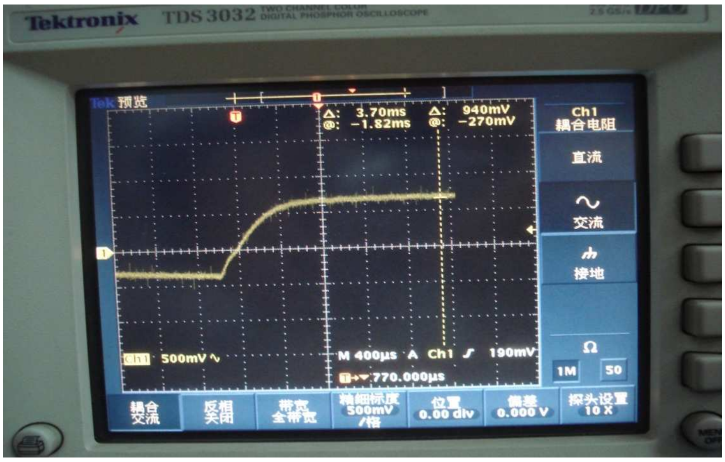

Figure 6 Waveform picture

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