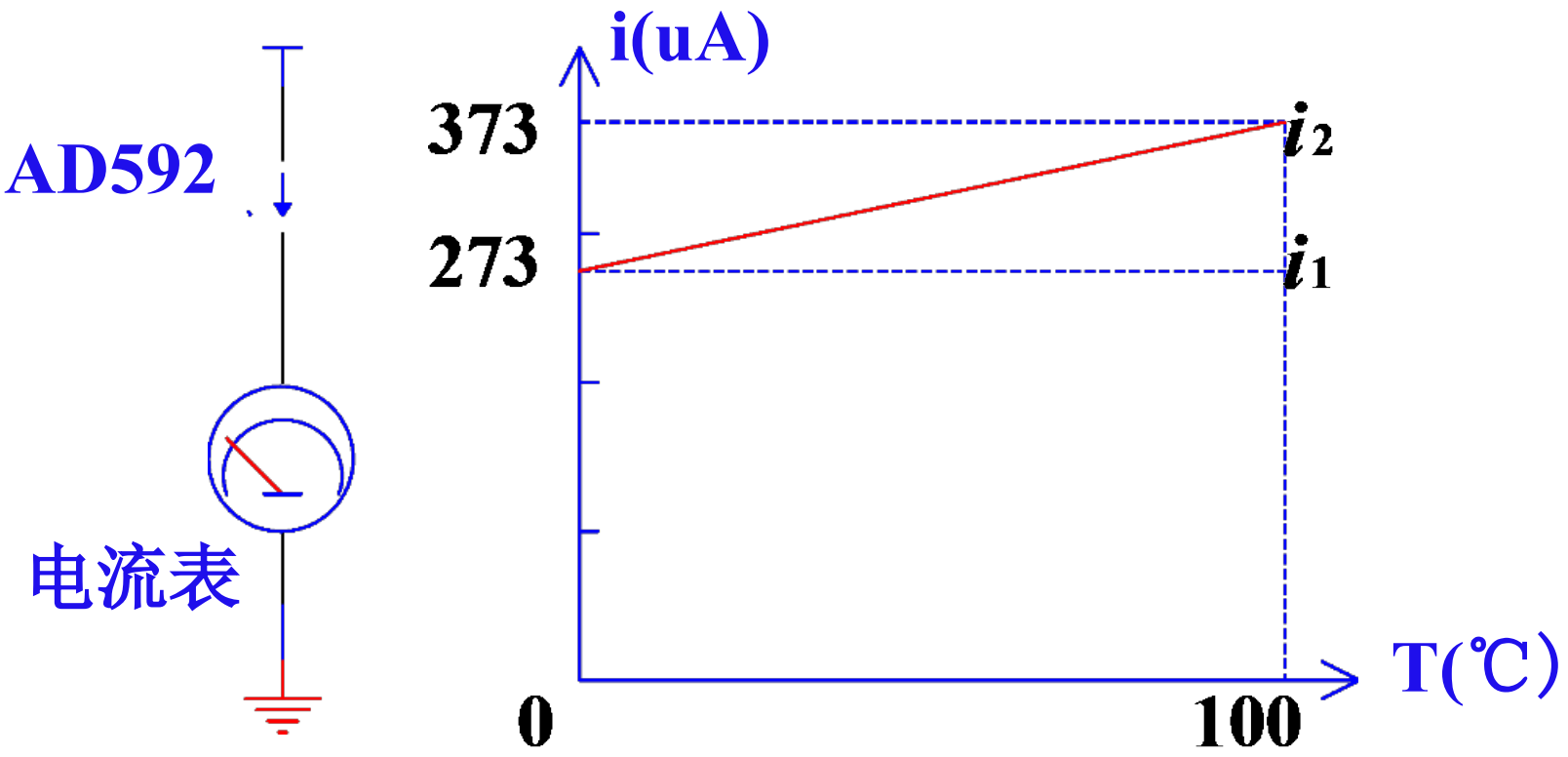
基于运放AD输入信号调理电路设计

一. 电流/电压转换电路设计

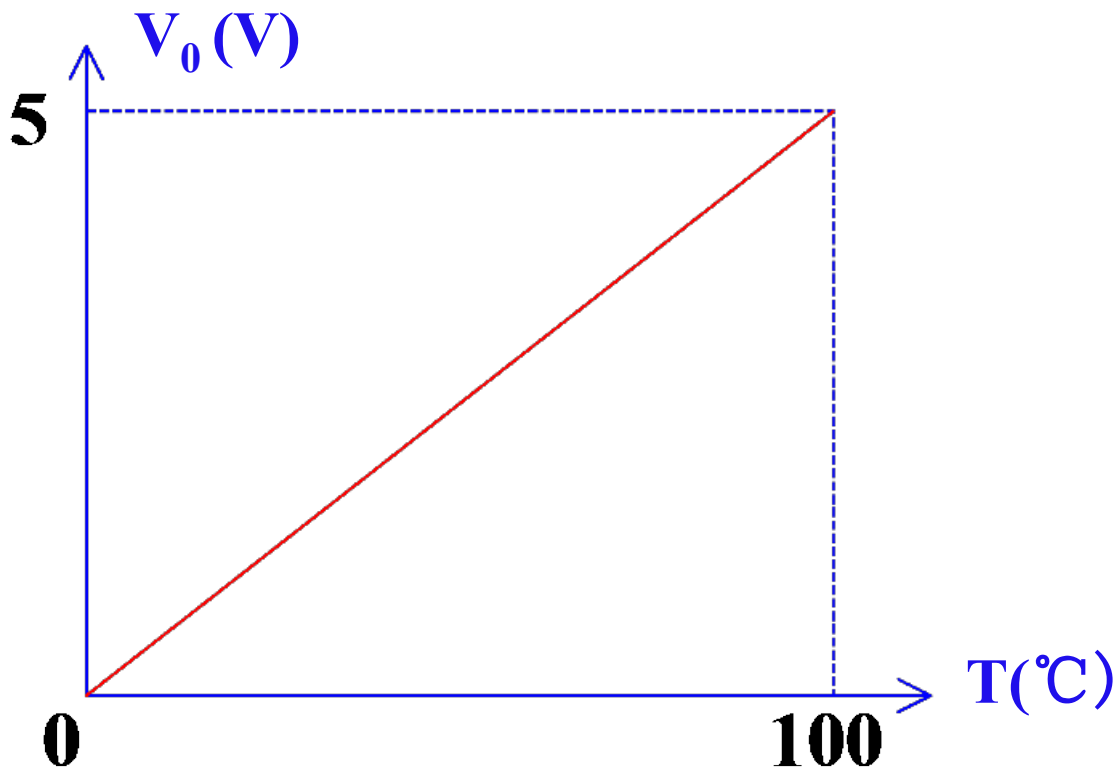
1. AD592 特征分析



1uA/℃　T=0℃　i_1=273uA　i_2-i_1=100uA

T=100℃　i_2=373uA

2. 变送器特征分析



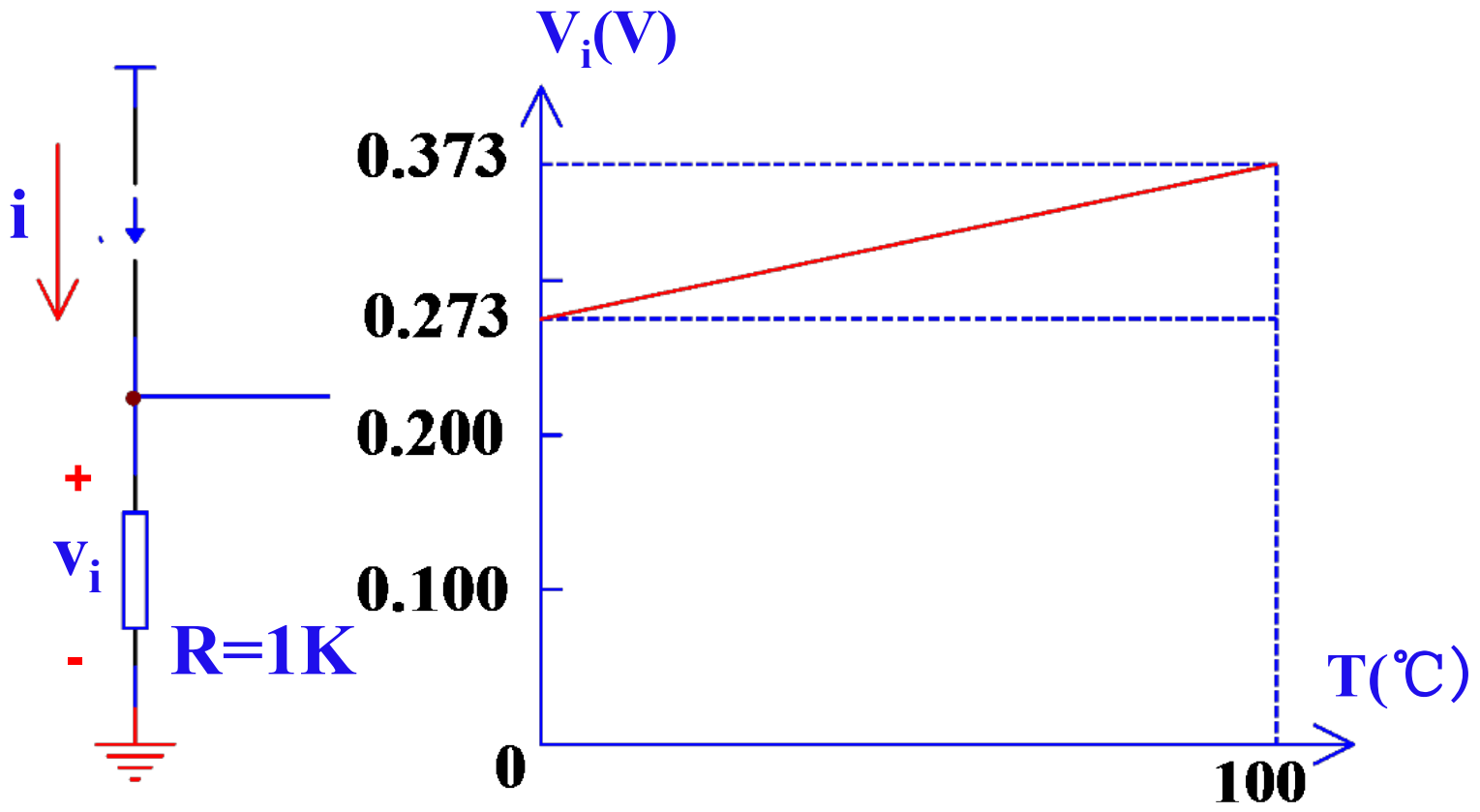
T=0℃　　v_o=0V

T=100℃　v_o=5V

5V/100 ℃ = 0.05V/℃

3. 电流→电压转换电路方案

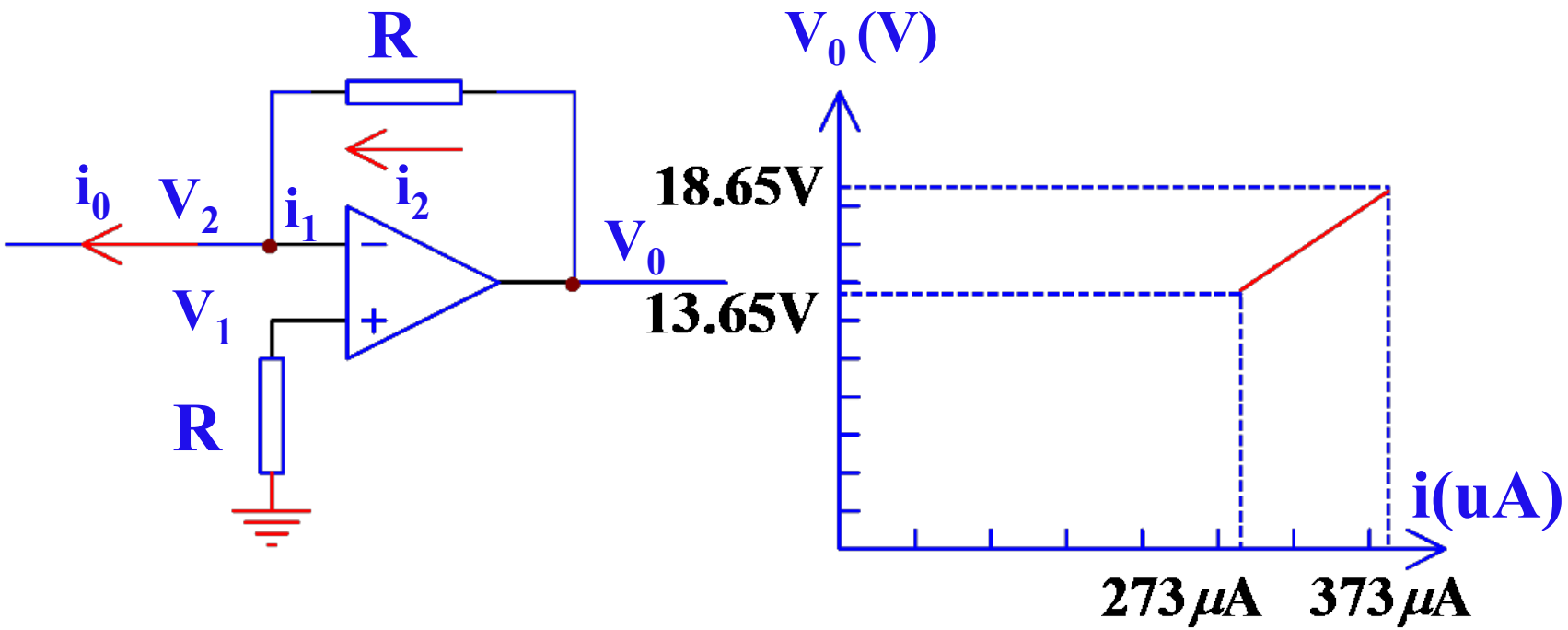
(1) 电阻取样电路



T = 0℃　　i = 273uA　　V_i=0.273V

T = 100℃　　i = 373uA　　V_i=0.373V

(2) 运算放大器电流→电压转换电路

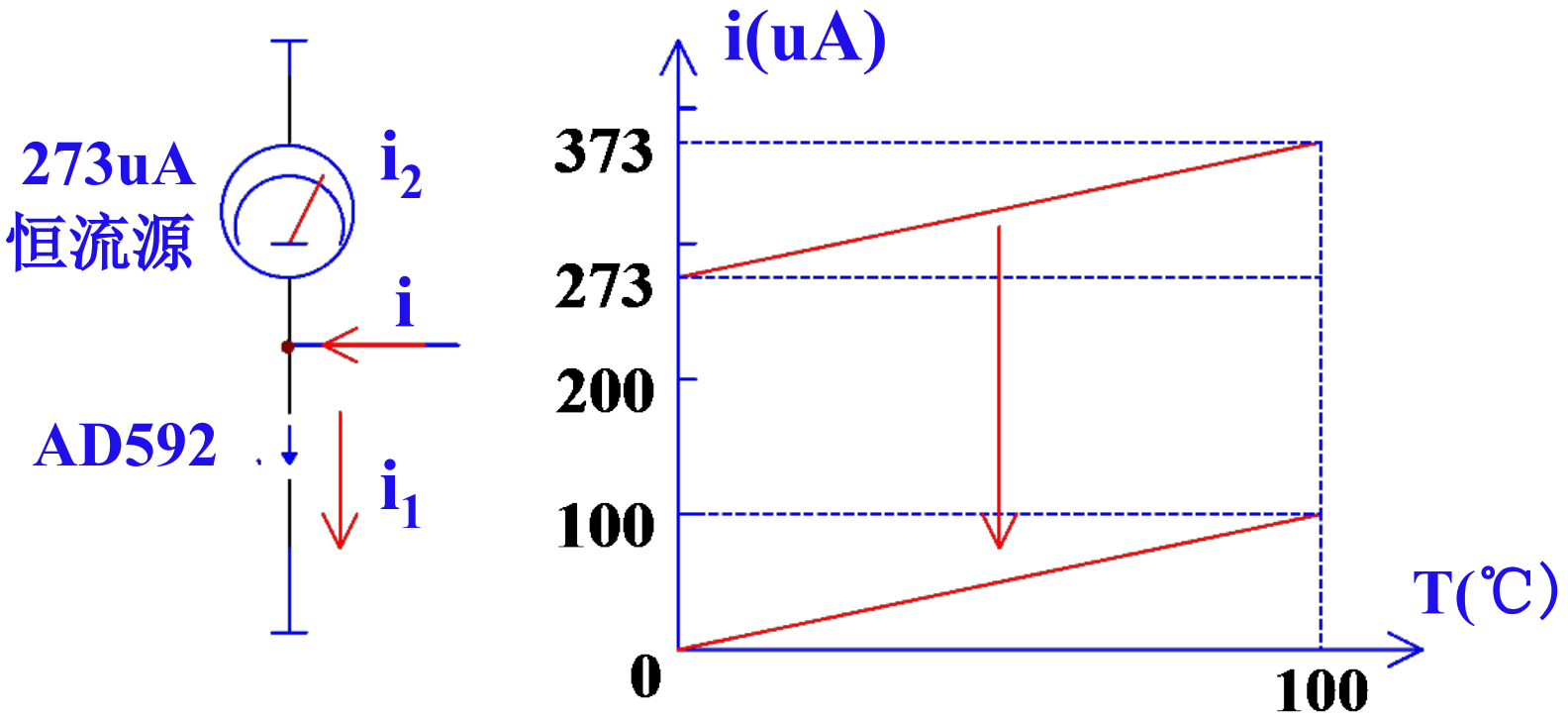


$i_1=0$	$i_0=0$	R=50K	
$i_2=i_0-i_1=i_0$	$V_o=R\times i_0=0V$	T = 0℃	T = 100℃
$V_1=V_2=0$	$i_0=100uA$	i_0 = 273uA	i_0 = 373uA
$V_o=R\times i_0$	$V_o=R\times i_0=5V$	V_o=13.65V	V_o=18.65V

二. 放大与平移电路设计

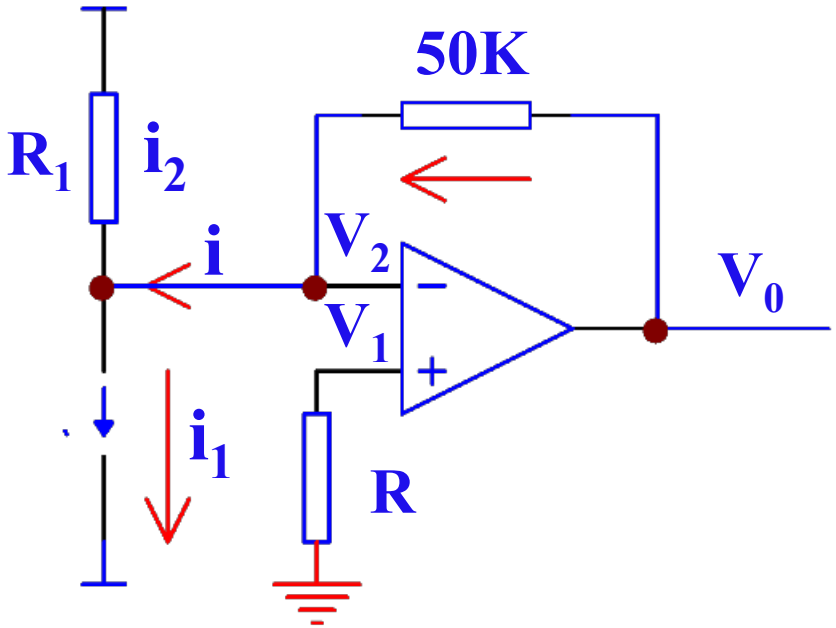
1.运算放大器电流→电压转换电路平移方案

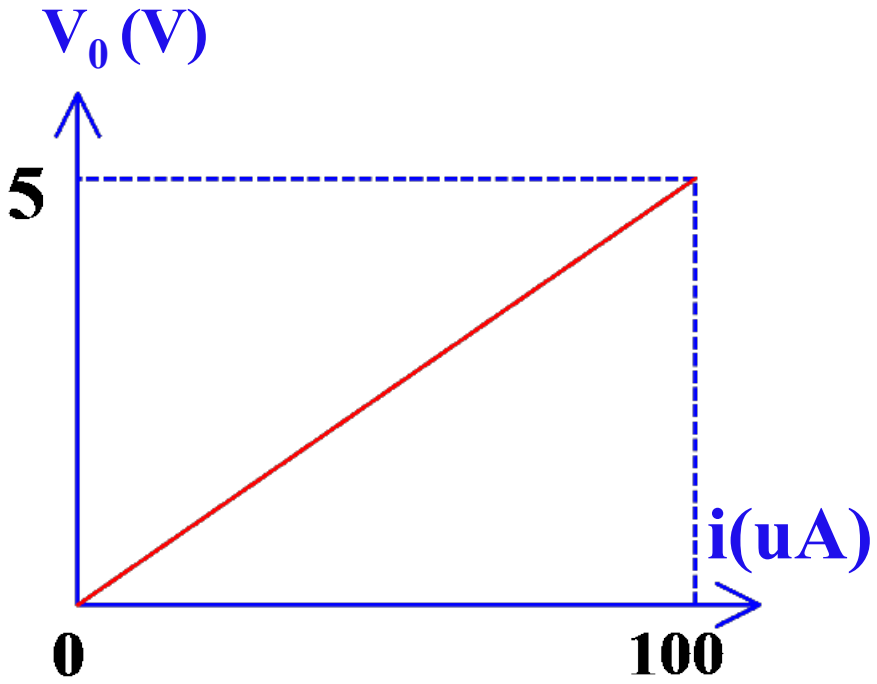
(1) AD592恒流赔偿电路



T = 0℃	i_1 = 273uA	i_2 = 273uA	i = 0uA
T = 100℃	i_1 = 373uA	i_2 = 273uA	i = 100uA

(2) 平移后电流→电压转换电路特征





$V_1=V_2=0$

$i_2= +V/R_1 = 273uA$

$i = i_1- i_2=i_1- 273uA$

$V_o=50\times(i_1- 273)\times10^{-3}$

$i_1 = 273uA(0℃)$

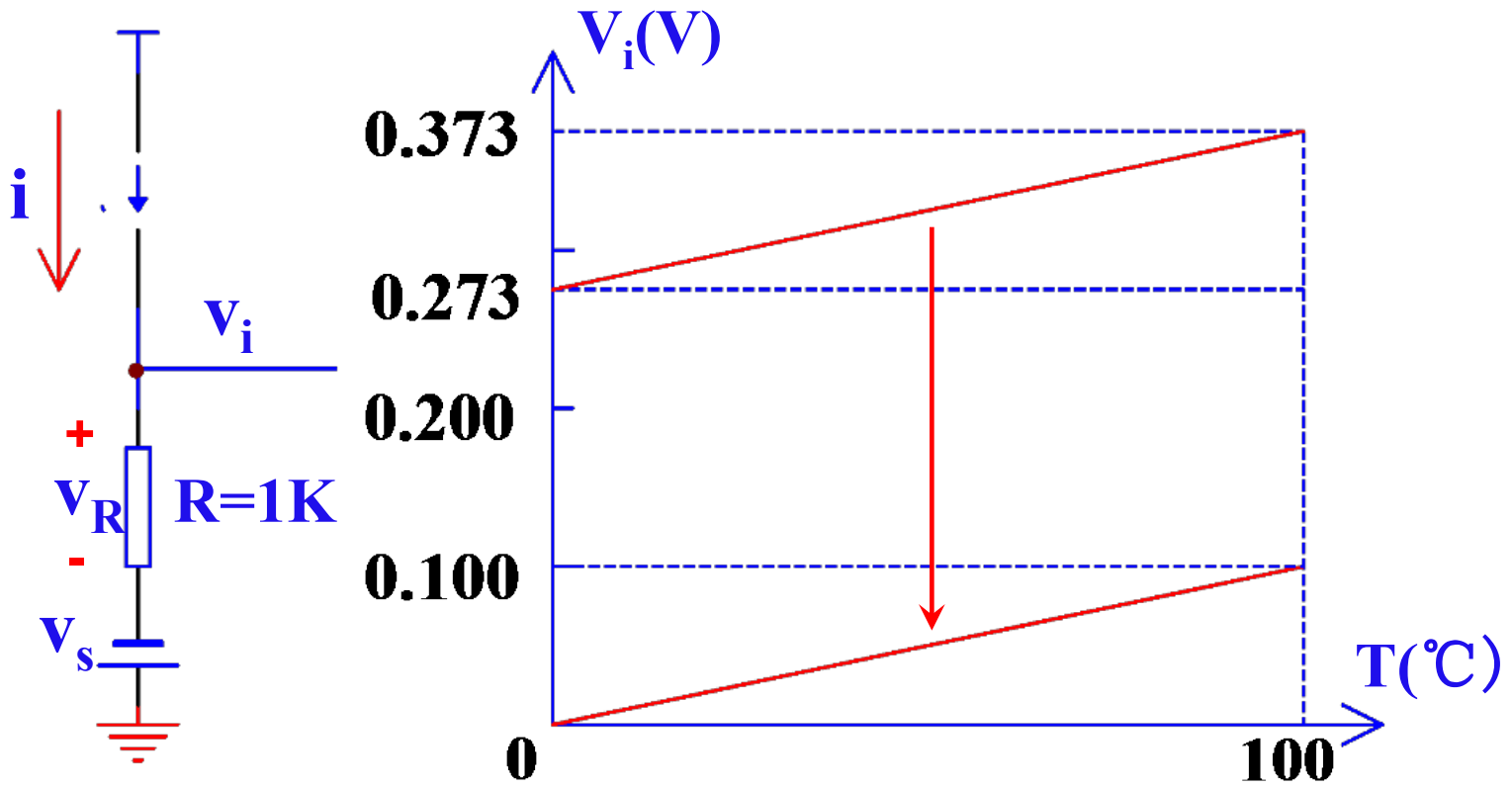
$i_1 = 373uA\ (100℃)$

$V_o=0V$

$V_o=5V$

2.电阻取样电路平移方案

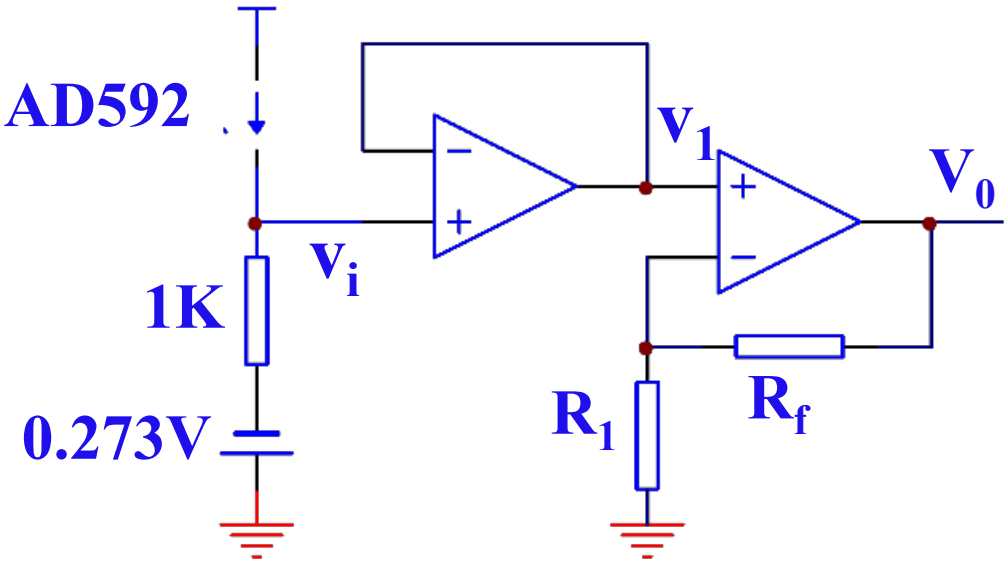
(1) 电阻取样恒压赔偿电路

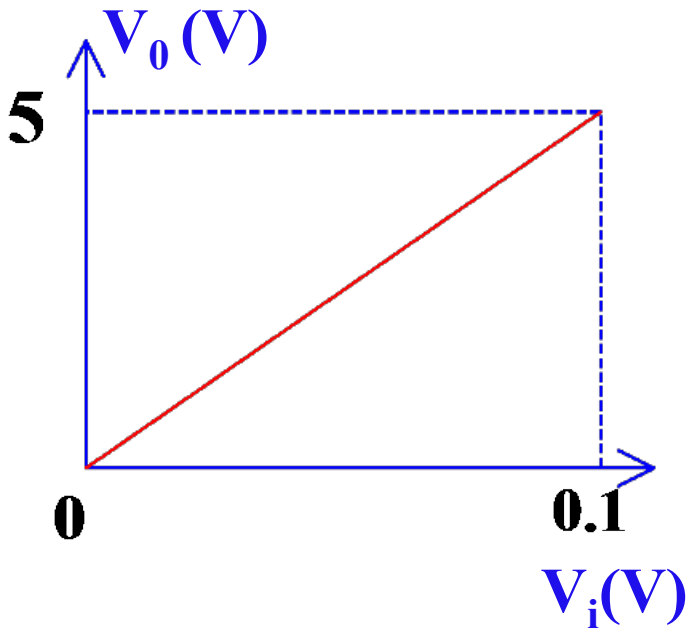


V_S= -0.273V　T = 0℃　V_R = 0.273V　V_i=V_R+V_S=0V

T = 100℃　V_R = 0.373V　V_i=V_R+V_S=0.1V

(2) 用同相百分比放大电路实现设计要求





$V_1 = V_i$，　$V_o = V_1(1 + R_f/R_1)$

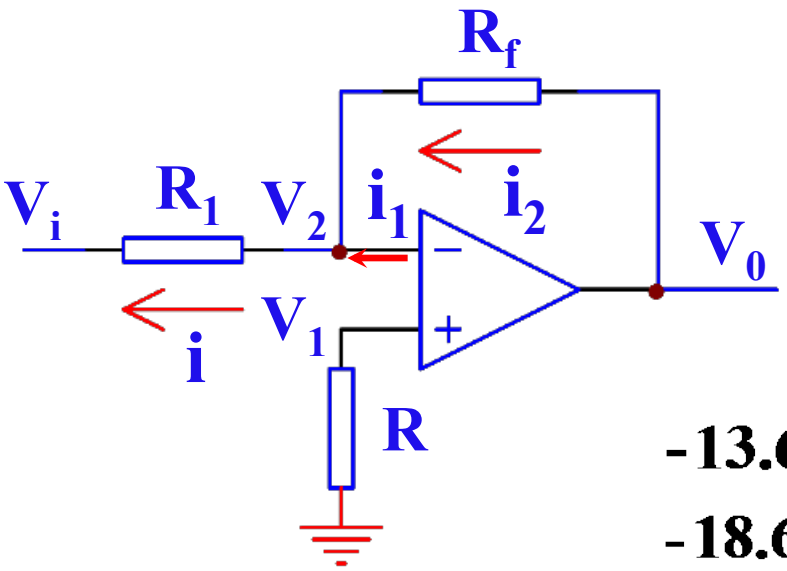
$T = 0℃$，　$V_1 = 0V$，　$V_o = V_1 \times (1 + R_f/R_1) = 0V$

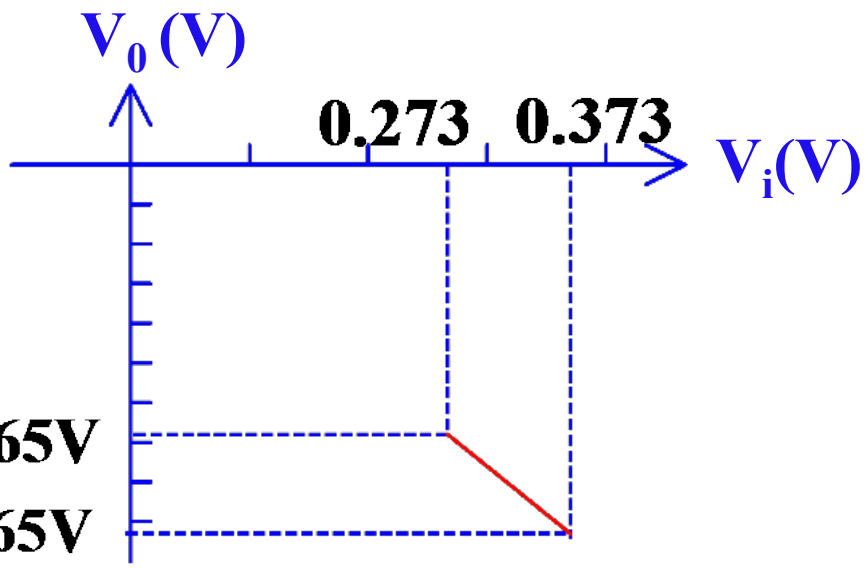
$T = 100℃$，　$V_1 = 0.1V$，　$V_o = 0.1 \times (1 + R_f/R_1) = 5V$

解得：$R_f/R_1 = 49$

3.反相加法电路实现平移方案

(1) 运算放大器实现反相放大电路





$i_1=0$ $i_0=0$

$i_2=i-i_1=i$ $V_o=-R_f\times i=-V_i\times R_f/R_1$

$V_1=V_2=0$ $\Delta V_i=0.1V$

$i=V_i/R_1$ $V_o=-\Delta V_i\times R_f/R_1=-5V$

$R_f/R_1=50$

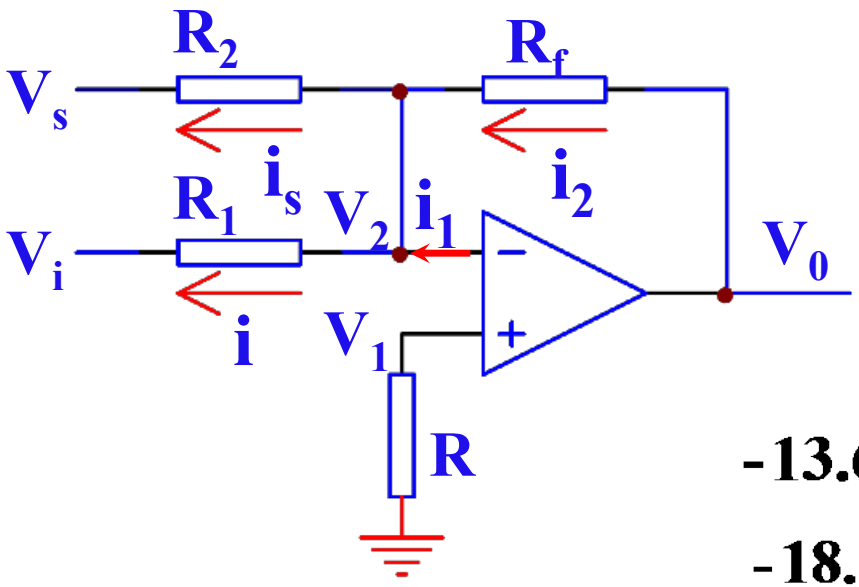
T = 0℃ V_i=0.273V

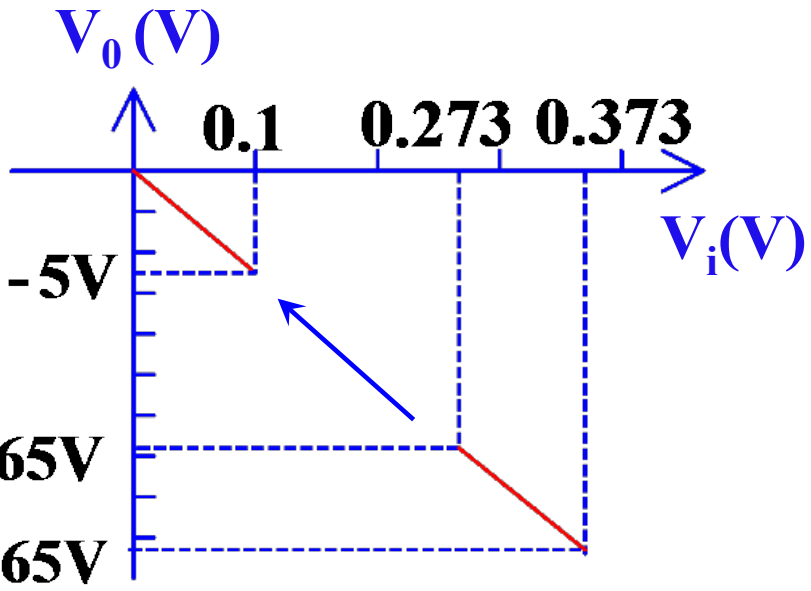
V_o= -13.65V

T = 100℃ V_i=0.373V

V_o= -18.65V

(2) 运算放大器平移电路方案





$i_1=0$

$i_2= i + i_s - i_1= i + i_s$

$i_2= V_i/R_1+ V_s/R_2$

若 $R_1=R_2$

$i_2= (V_i+ V_s)/R_1$

$V_o= -R_f\times i_2$

$= -(V_i+V_s)\times R_f/R_1$

$= -(V_i+V_s) \times 50$

$V_s = -V_{i0}= -0.273V$

T = 0℃ V_i=0.273V

$V_o= -0\times 50=0V$

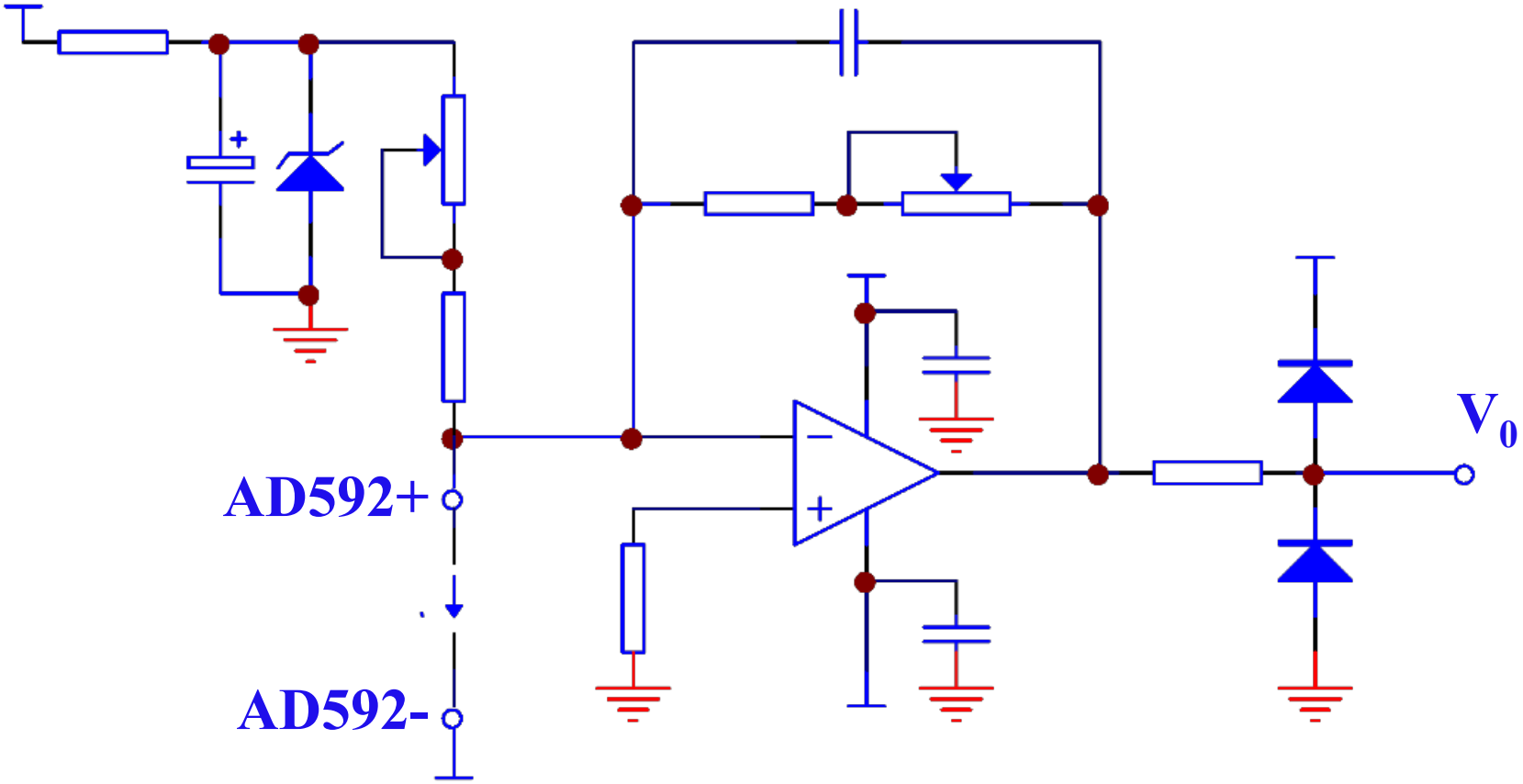
T = 100℃ V_i=0.373V

$V_o= -0.1\times 50= -5V$

七. 信号调理电路设计

1. 恒流赔偿原理变送器电路

(1) 电路原理图



(2) 电路参数计算

稳压电路 — 为恒压赔偿电路提供稳定电压

稳压二极管 D1 工作电流取 3mA

限流电阻 $R1=(12V-9.1V)\div 3mA=970\Omega$

R1 取 1K

恒压赔偿电路 — 提供 273uA 恒定赔偿电流

限流电阻 $R2+VR1=9.1V\div 273\mu A=33.3K$

R2 取 30K，VR1 取 5K

增益控制电路 — 控制输出满度电压为 5V

满度输入电流为 $373\mu A-273\mu A=100\mu A$

电阻 $R4+VR2=5V\div 100\mu A=50K$

R4 取 47K，VR2 取 10K

2. 恒压赔偿原理变送器电路

(1) 电路原理图