电压比较器

一、无滞回电压比较器

(1) 设计验算过程

$$U_D + U_Z = 6 \sim 6.5V$$

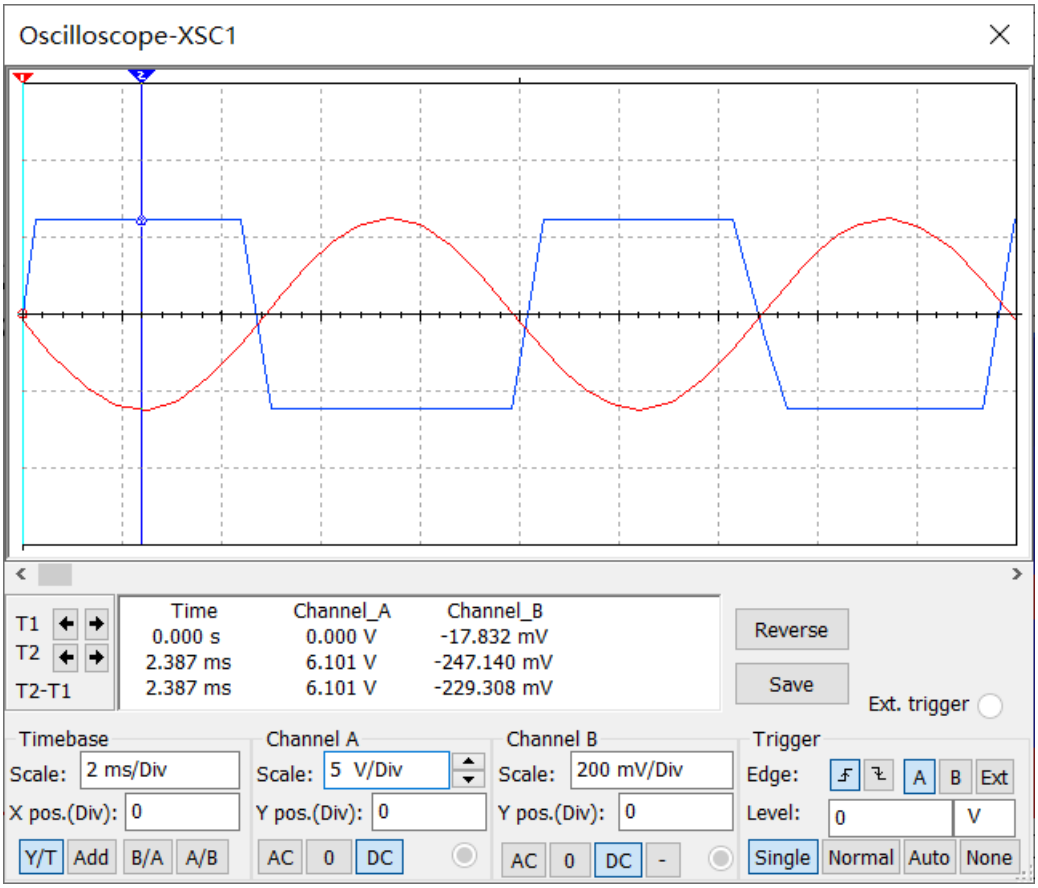
$$I_{Zmax} = 30mA$$

取$R_1 = R_2 = 2k\Omega$

$$R_O = \frac{V_{CC} - (U_D + U_Z)}{I_Z} = \frac{12V - 6V}{30mA} = 200\Omega$$

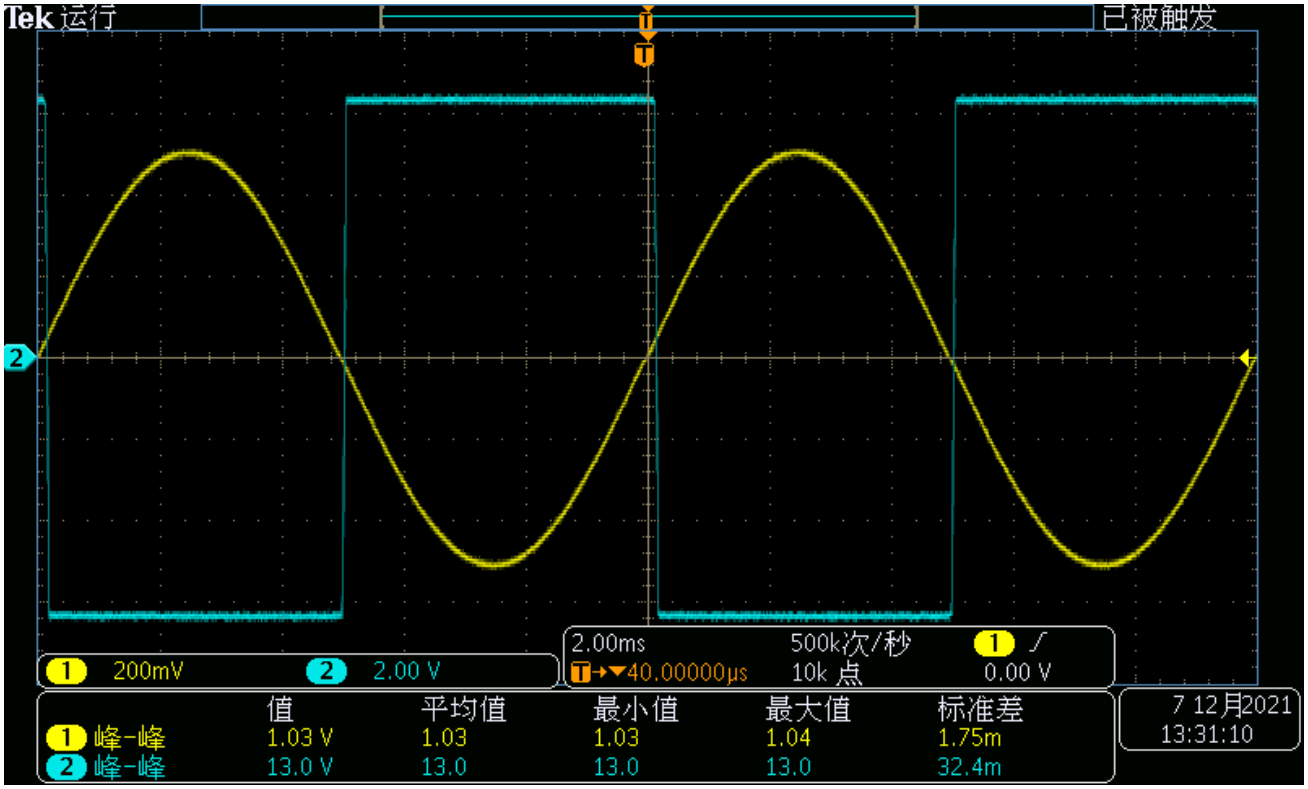
取$R_O = 510\Omega$

(2) 仿真结果



$$U_{OH} = 6V，\ U_{OL} = -6V，\ U_{th+} = U_{th-} = 0V$$

（3）实验波形存图



$U_{OH} = 6.5V$，$U_{OL} = -6.5V$，$U_{th+} = U_{th-} = 0V$

二、有滞回电压比较器

(1)设计验算过程

取$U_R = 0$，$U_{th+} = 400mV$

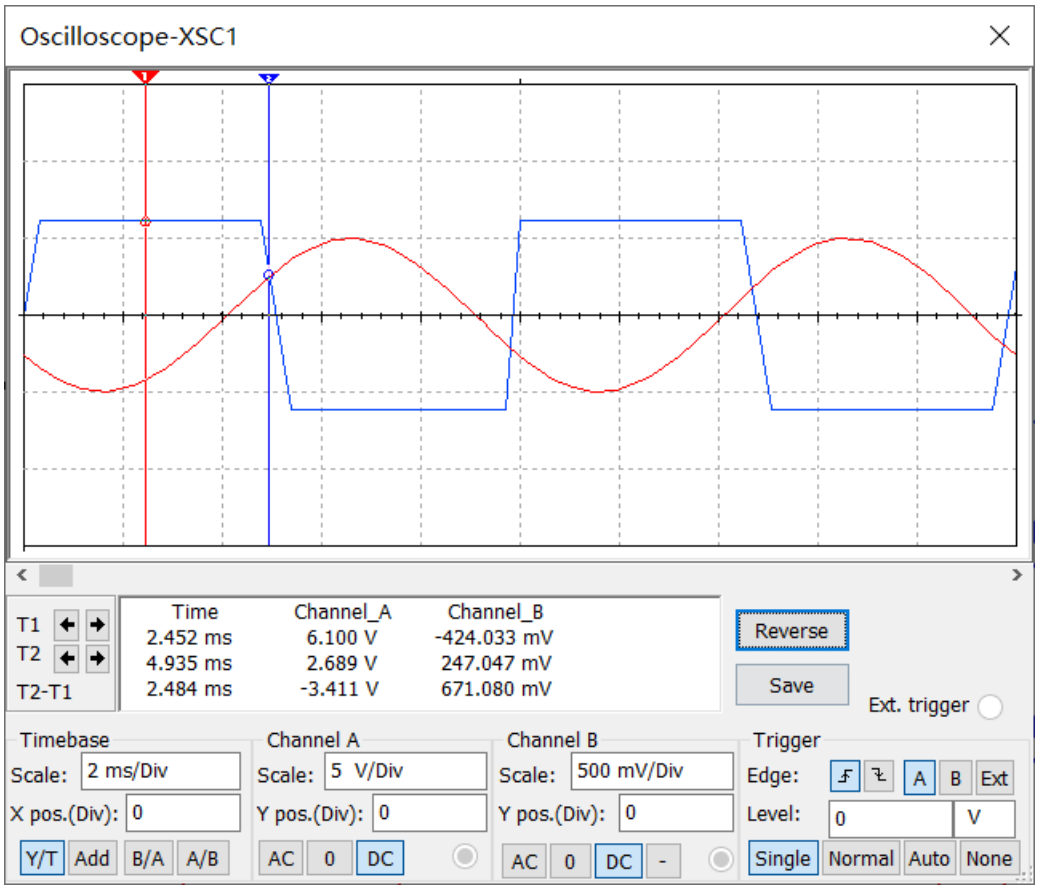
$$U_{th\pm} = \frac{R_3}{R_2+R_3}U_R \pm \frac{R_2}{R_2+R_3}(U_Z + U_D)$$

得$R_3 = 28k\Omega$，取$R_3 = 33k\Omega$

因二极管参数问题，仿真实验中取$R_3 = 58k\Omega$

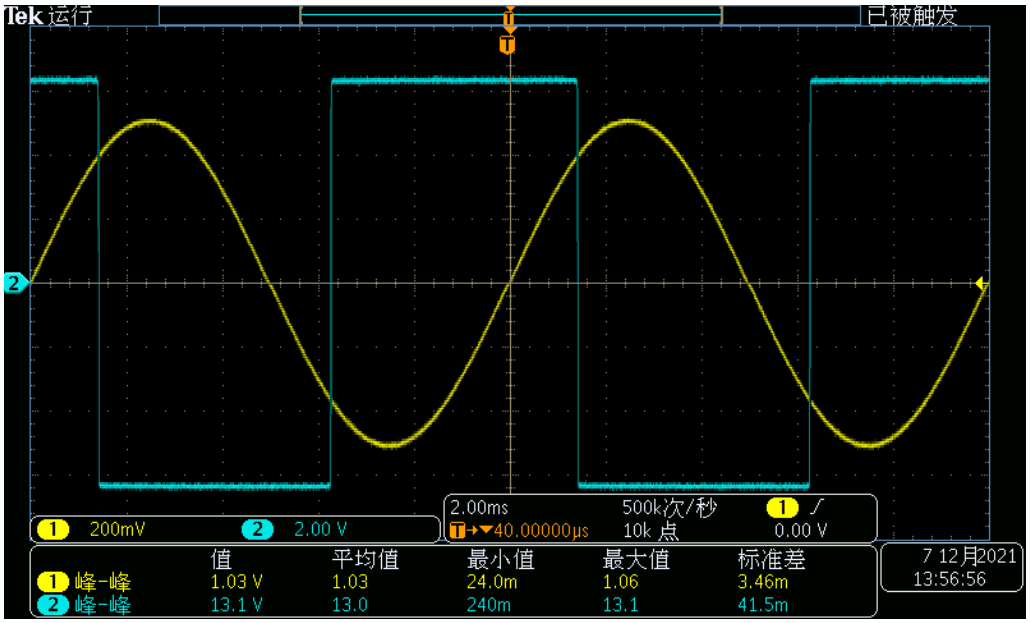
其余参数与无滞回电压比较器相同

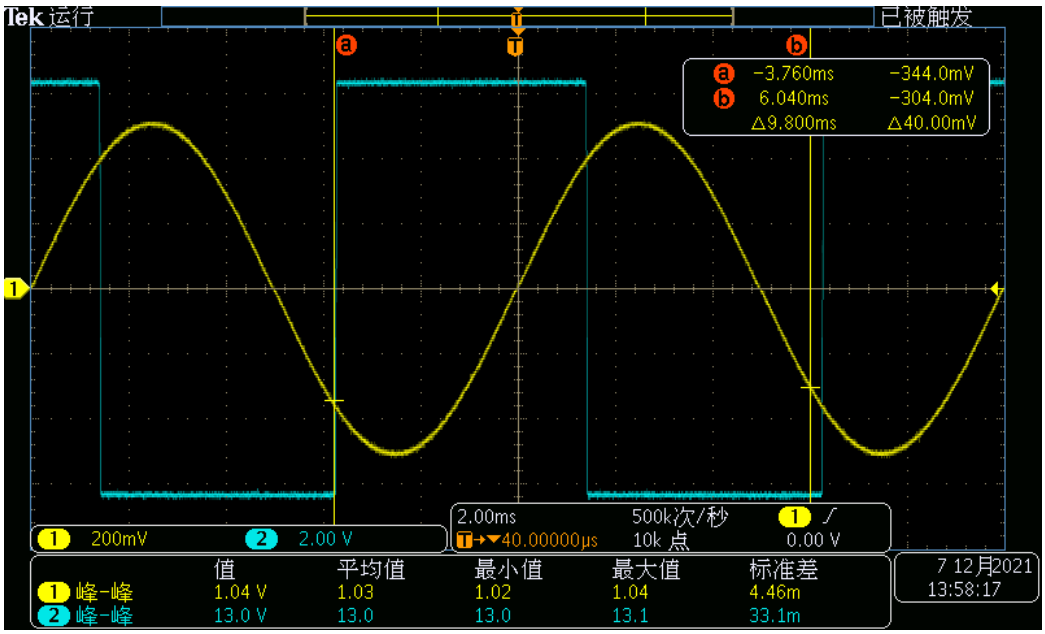
(2)仿真结果

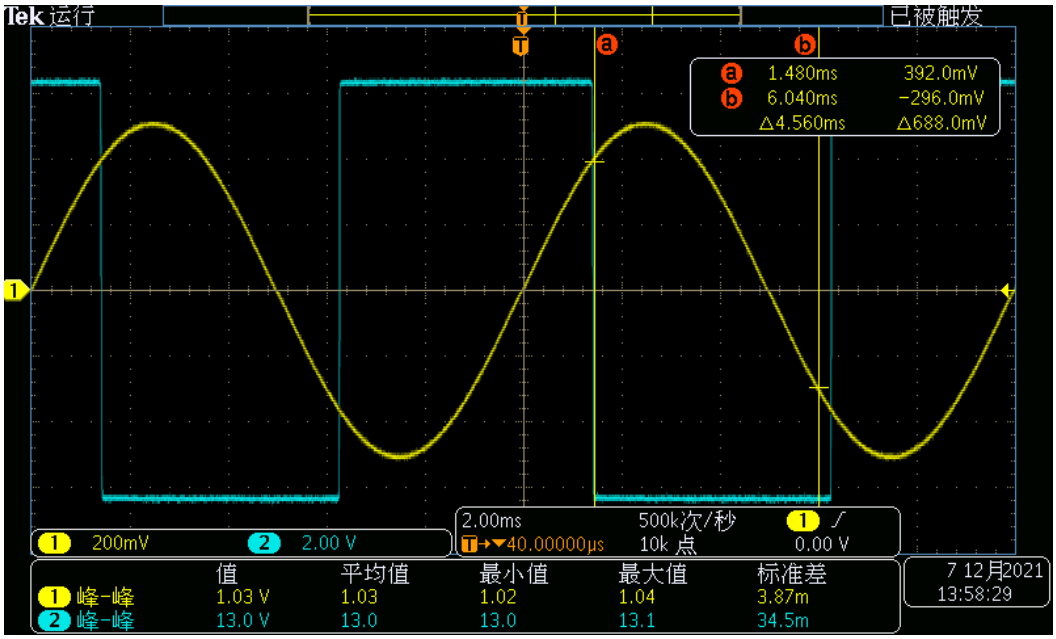


$$U_{OH} = 6V，\ U_{OL} = -6V，\ U_{th+} = -U_{th-} = 424\text{mV}$$

(3)实验波形存图







由上图中光标可以读出

$U_{OH} = 6.5V$，$U_{OL} = -6.5V$，$U_{th+} = 392\text{mV}, U_{th-} = \text{-}344\text{mV}$

三、湿度控制电路

(1)设计验算过程

$$取R_1 = R_2 = 2k\Omega$$

$$\begin{cases} \dfrac{R_4}{25k\Omega + R_4} \cdot (V_{CC} - V_{EE}) + V_{EE} = U_{th+} \\ \dfrac{R_4}{100k\Omega + R_4} \cdot (V_{CC} - V_{EE}) + V_{EE} = U_{th-} \end{cases}$$

$$解得R_4 = 50k\Omega, U_{th\pm} = 1.67V$$

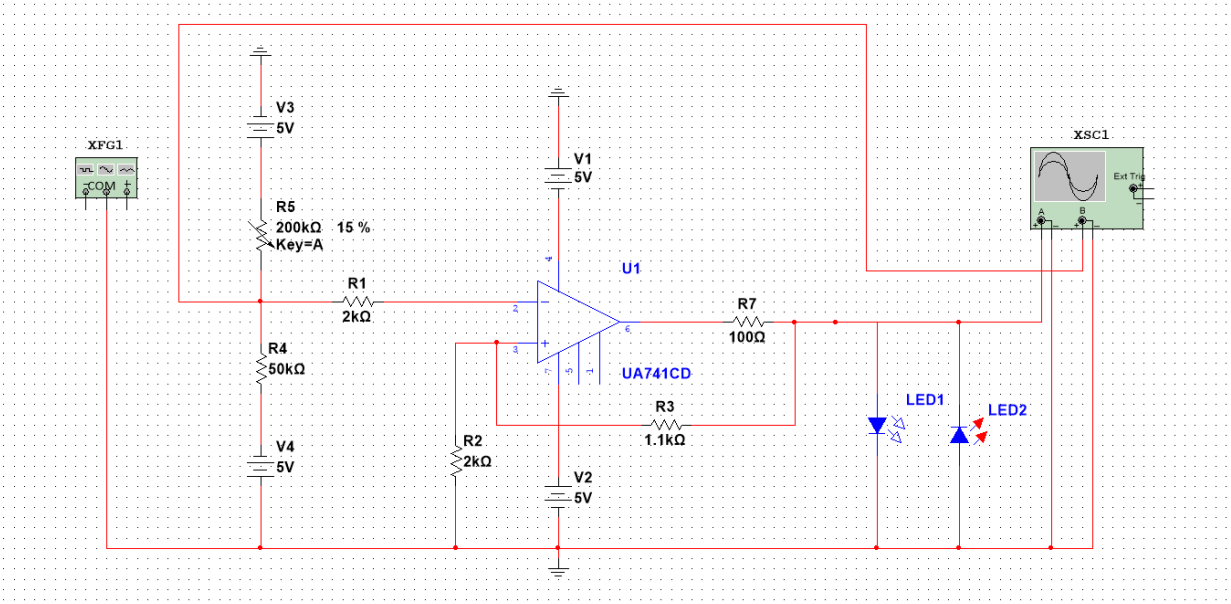
$$R_O = \frac{V_{CC}}{I_Z} = \frac{5V}{30mA} \approx 167\Omega, 取R_O = 100\Omega$$

$$U_{th\pm} = \frac{R_2}{R_2 + R_3}(U_Z + U_D)$$

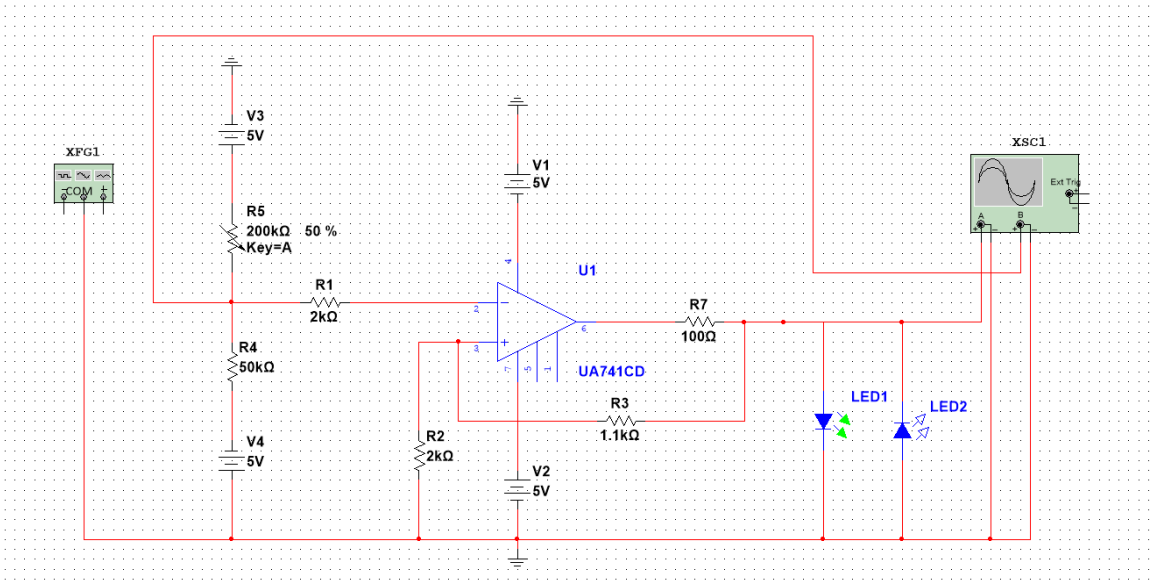
$$解得R_3 = 4k\Omega, 实物实验取R_3 = 3.3k\Omega$$

$$经测试调整，仿真中取R_3 = 1.1k\Omega$$

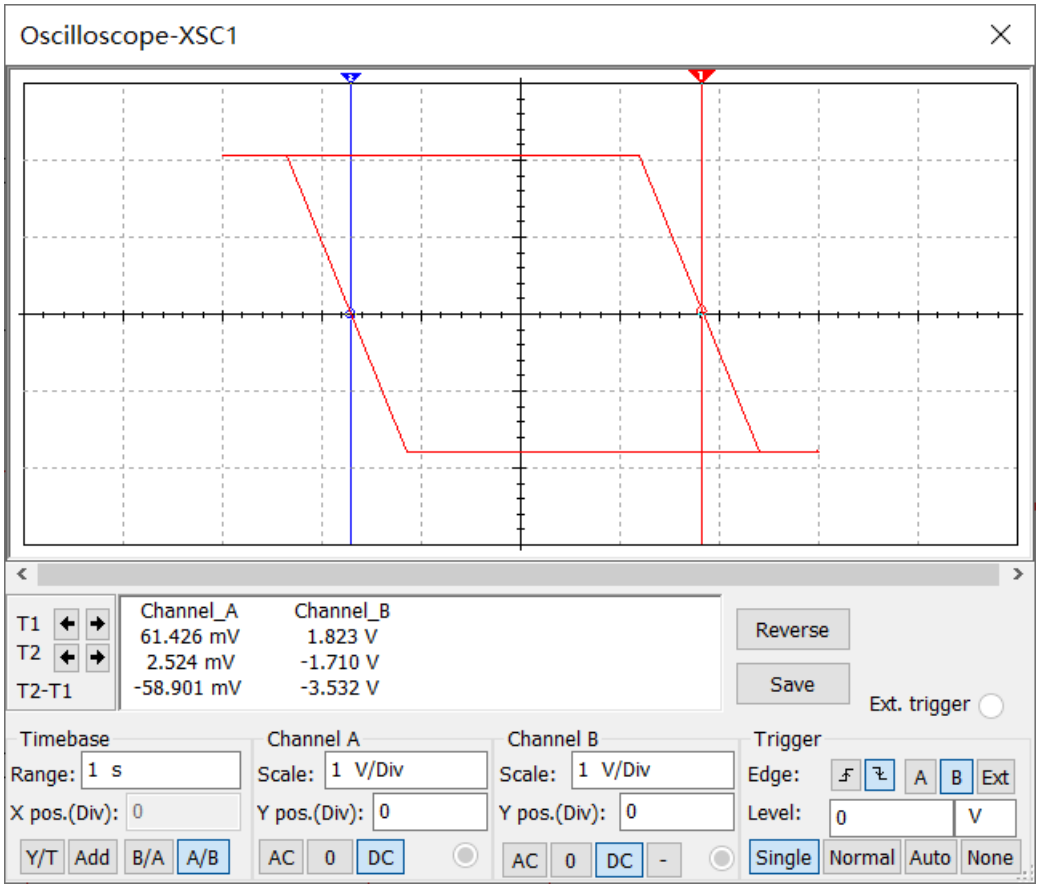
(2)仿真结果



湿敏电阻的阻值（R5）小于30kΩ时，即湿度大于 70%时，加湿器停止工作，即红色 LED 灯亮起。



湿敏电阻的阻值（R5）大于100kΩ时，即湿度小于 40%时，加湿器开始工作，即绿色 LED 灯亮起。

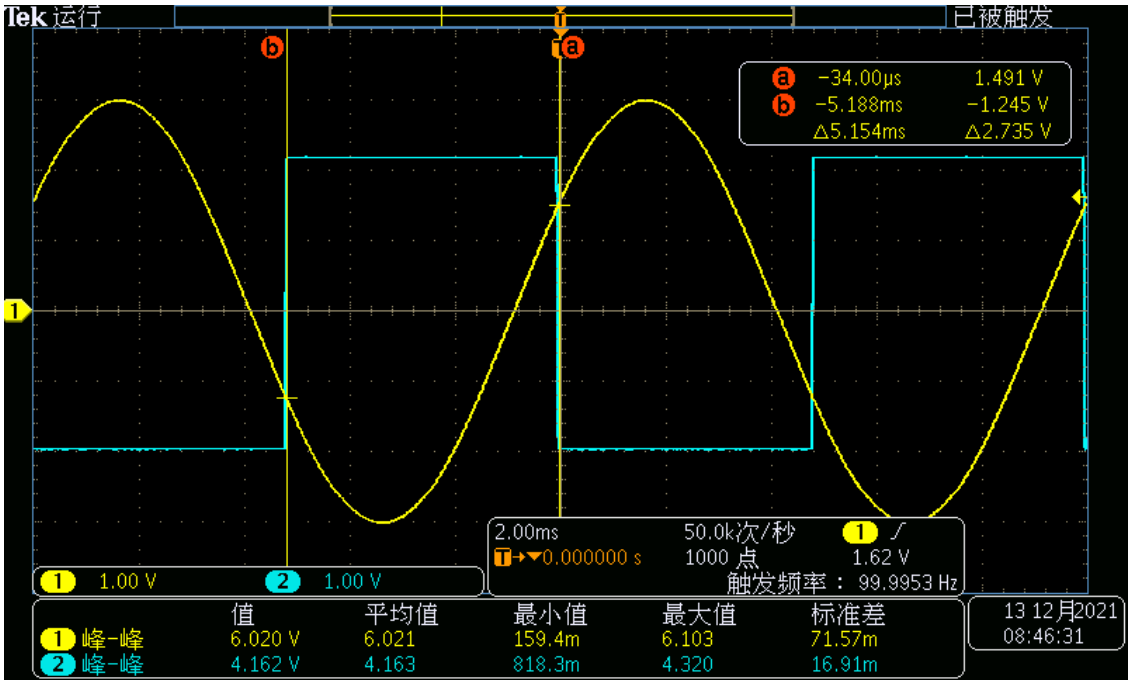


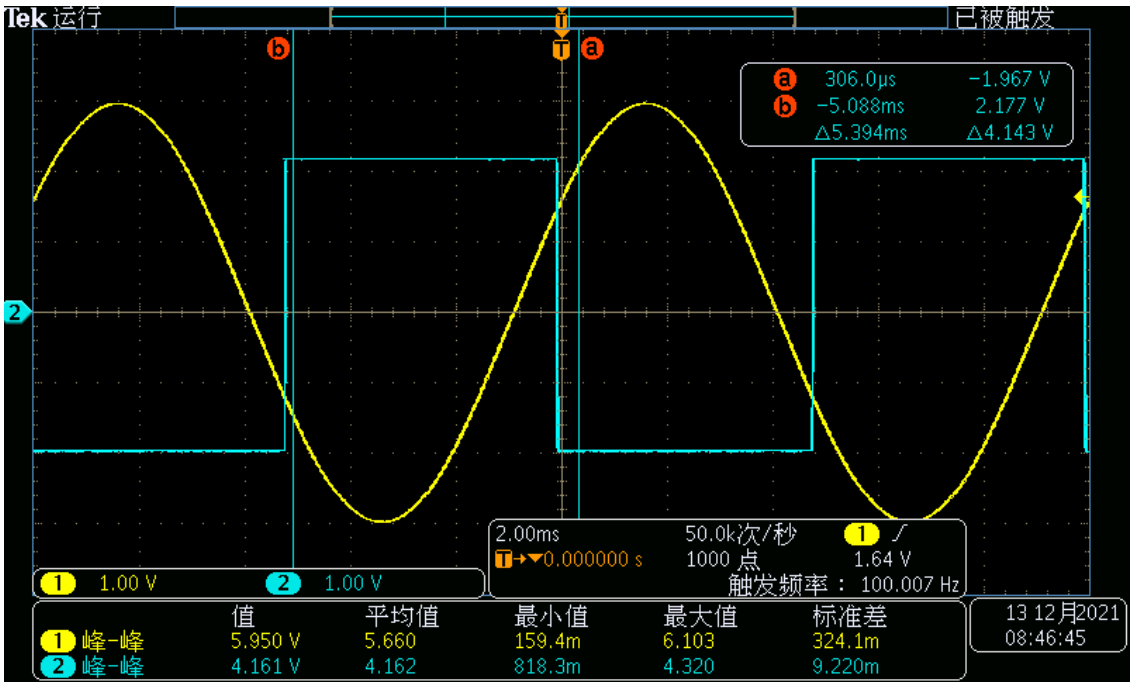
湿度控制电路的传输特性曲线

$U_{OH} \approx 2V$，$U_{OL} \approx -2V$，$U_{th+} \approx 1.8V, U_{th-} \approx -1.7V$

(3)湿度控制电路实验波形存图

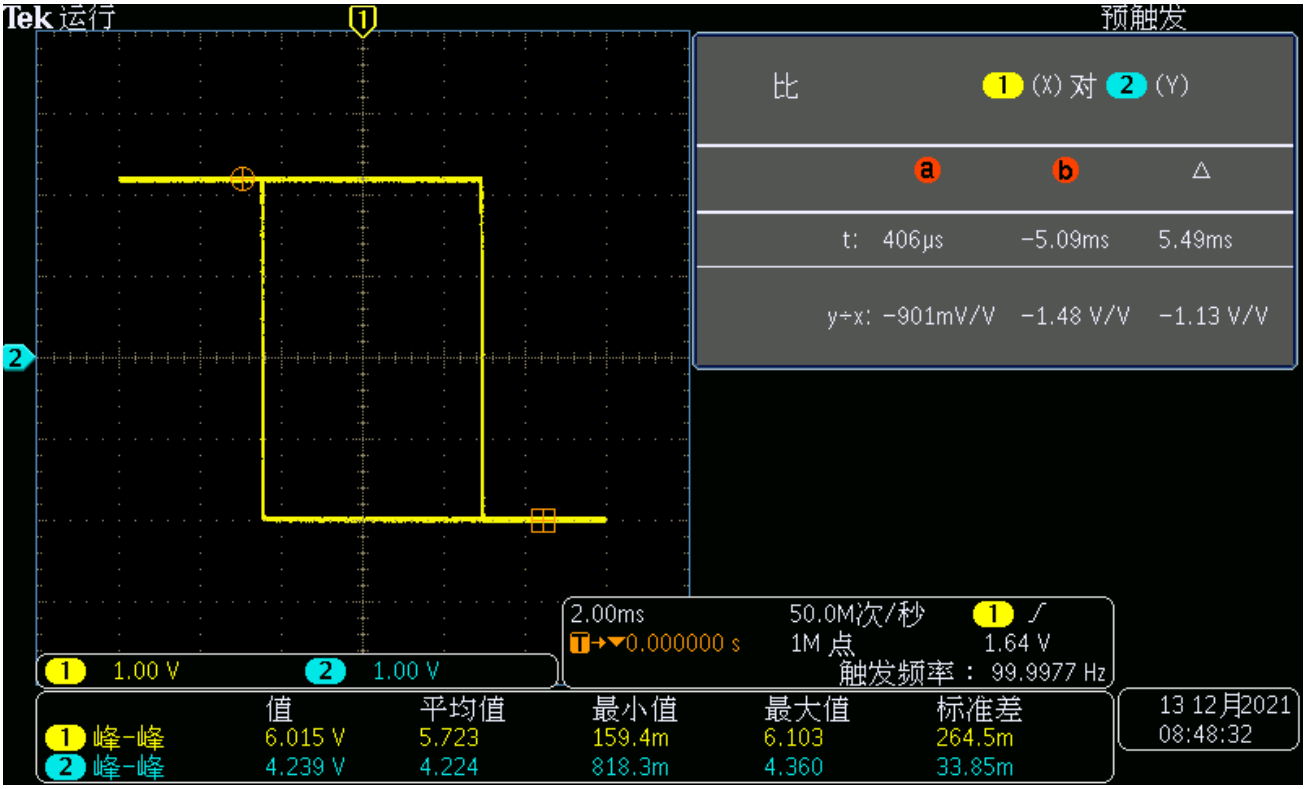
阻值测量：实物实验中，红灯亮时测得R_S阻值约为$30k\Omega$绿灯亮时的R_S阻值约为$80k\Omega$





由上图光标可读得

$$U_{OH} \approx 2V,\ U_{OL} \approx -2V,\ U_{th+} \approx 1.5\text{V}, U_{th-} \approx -1.2V$$



湿度控制电路的传输特性曲线

$U_{OH} \approx 2V$，$U_{OL} \approx -2V$，$U_{th+} \approx 1.5\text{V}, U_{th-} \approx -1.2V$

四、专用电压比较器

（1）设计验算过程

取$U_R = 0$，$U_{th+} = 400mV$

$V_{EE} = -5V$

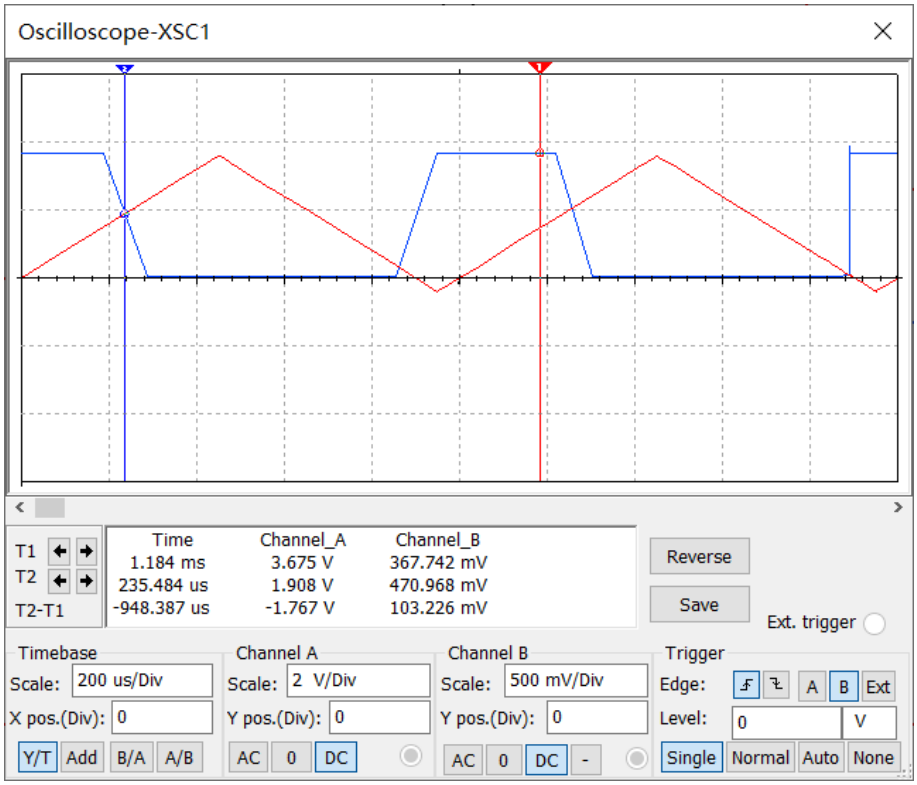
取$R_1 = R_2 = 2k\Omega$

$U_{th} = \frac{R_2}{R_2+R_3}(U_Z + U_D)$

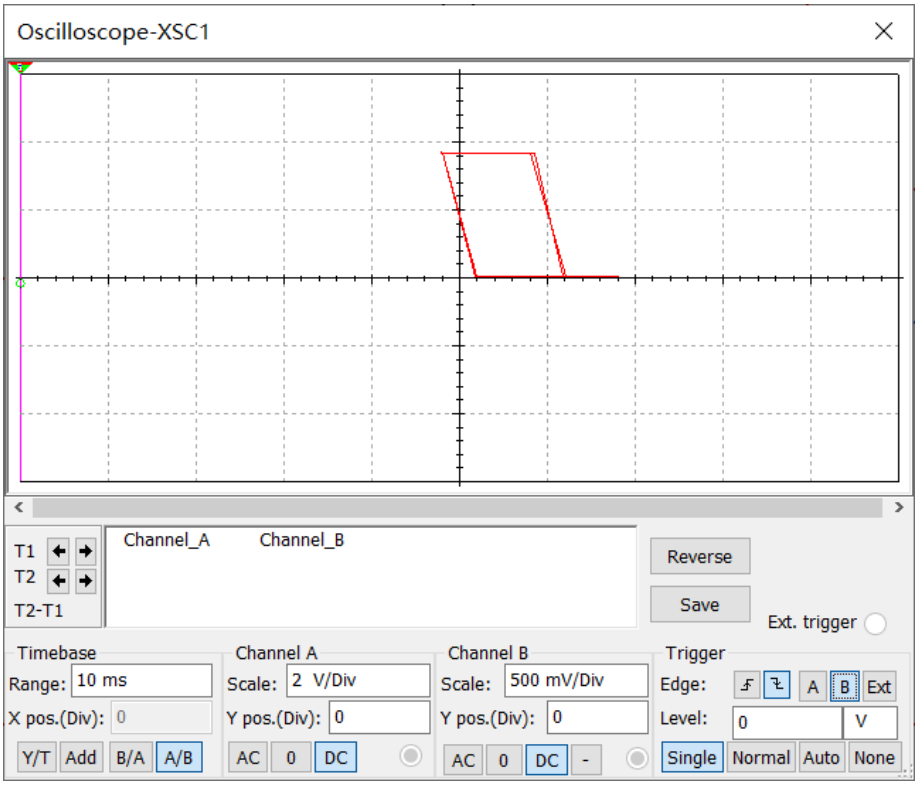
得$R_3 = 14k\Omega$

取上拉电阻$R = 2k\Omega$

（2）仿真结果



X-T 波形截图



专用电压比较器的传输特性曲线