

浙江工业大学
ZHEJIANG UNIVERSITY OF TECHNOLOGY



大学物理实验拓展思考

以示波器实验为例

2024.6



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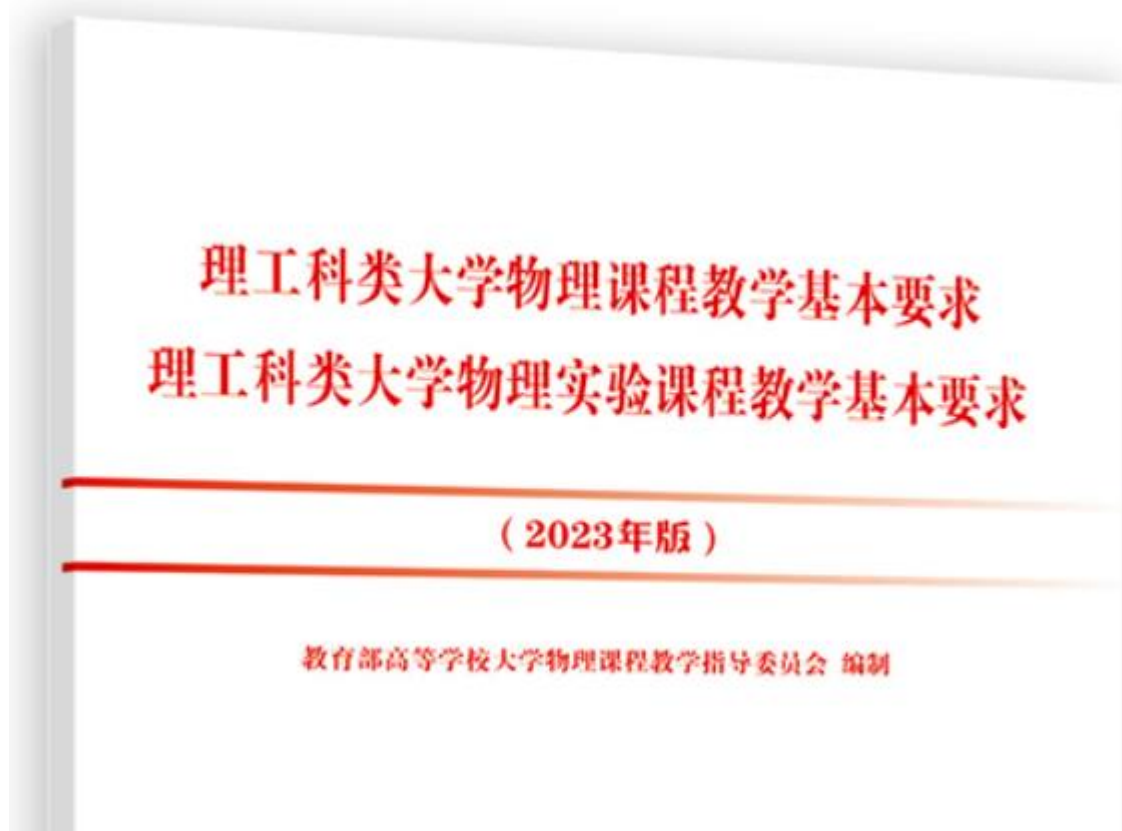
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—— 第一部分 ——

研究背景



分层次教学基本要求

1. 基础性实验
2. 综合性实验
3. 设计性实验
4. 研究性实验

- 对大学物理实验教学提出了高要求
- 基础、综合、设计、研究
- 基础(A)、提升(B)、进阶(C)、高阶(D)

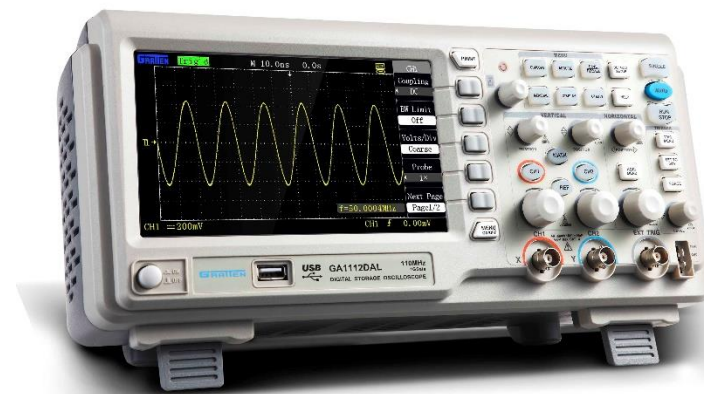
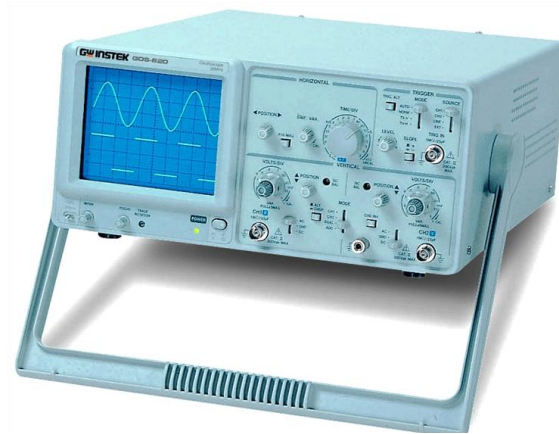
—— 第二部分 ——

教学探索

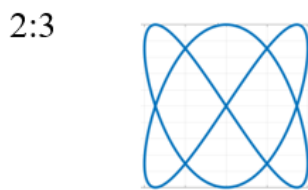
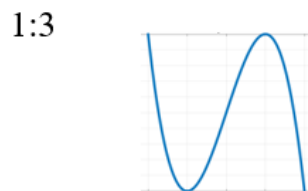
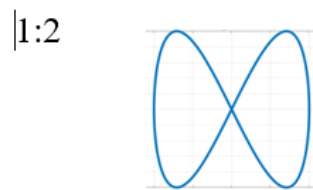
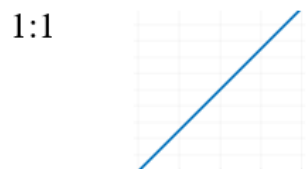


理工科类大学物理实验课程教学基本要求

- 1、示波器原理及应用
- 2、声速测量
- 3、电学元件伏安特性测量
- 4、RLC电路的暂态过程
- 5、弦上驻波实验
- 6、激光纵模测量



1、李萨如图形 $f_x:f_y$



2、相位改变

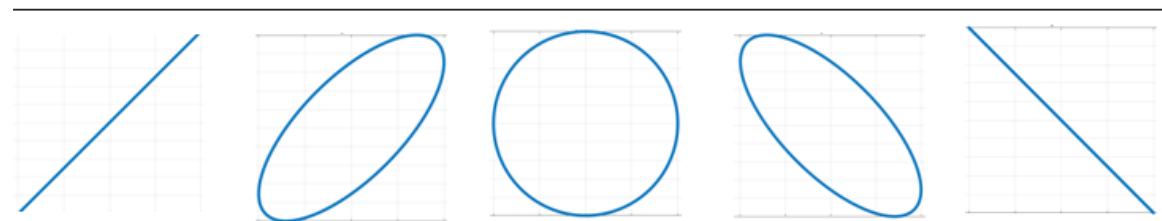
0

$\frac{1}{4}\pi$

$\frac{1}{2}\pi$

$\frac{3}{4}\pi$

π



示波器的XY模式如何拓展？

3、 测量伏安曲线

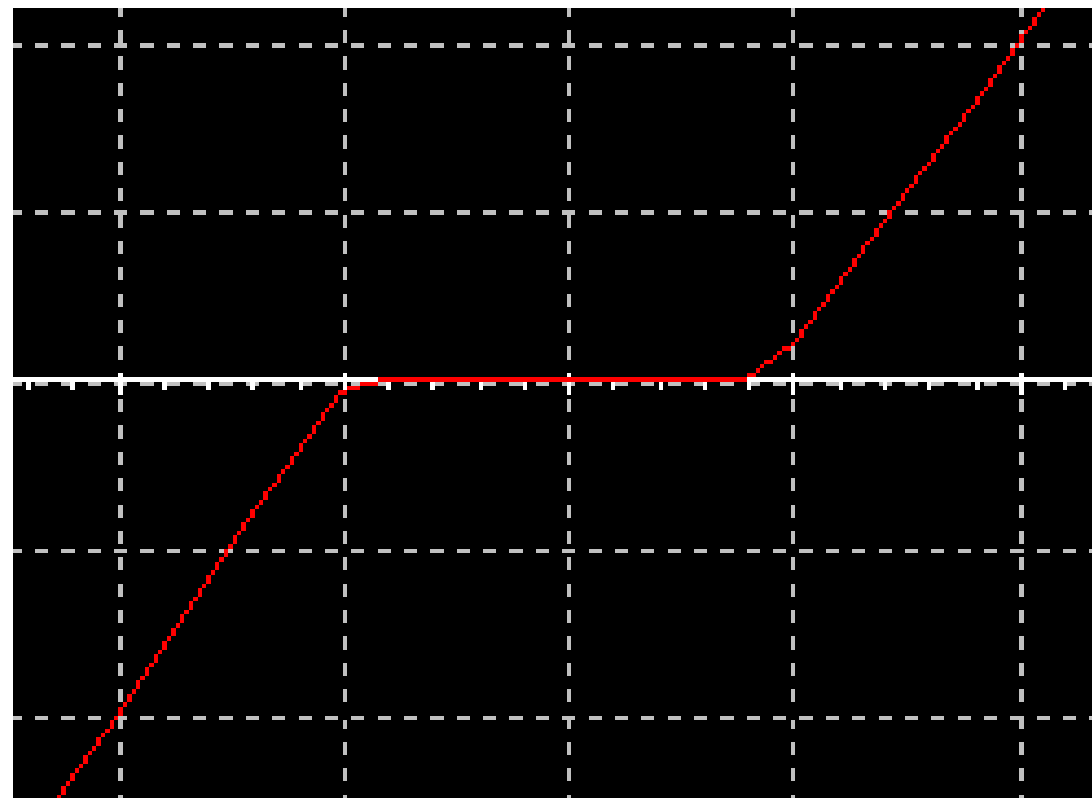
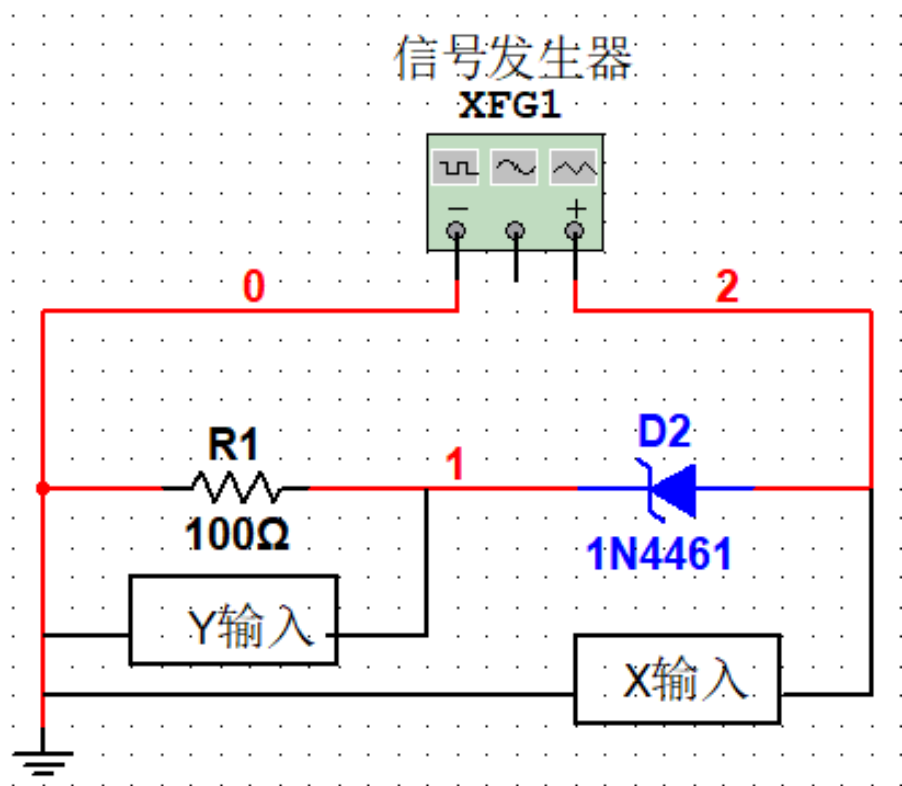
示波器应用

B	<ol style="list-style-type: none">1. 通过李萨如图测定未知正弦信号的频率和相位差；2. <u>测量二极管伏安特性曲线。</u>
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非线性元件伏安特性

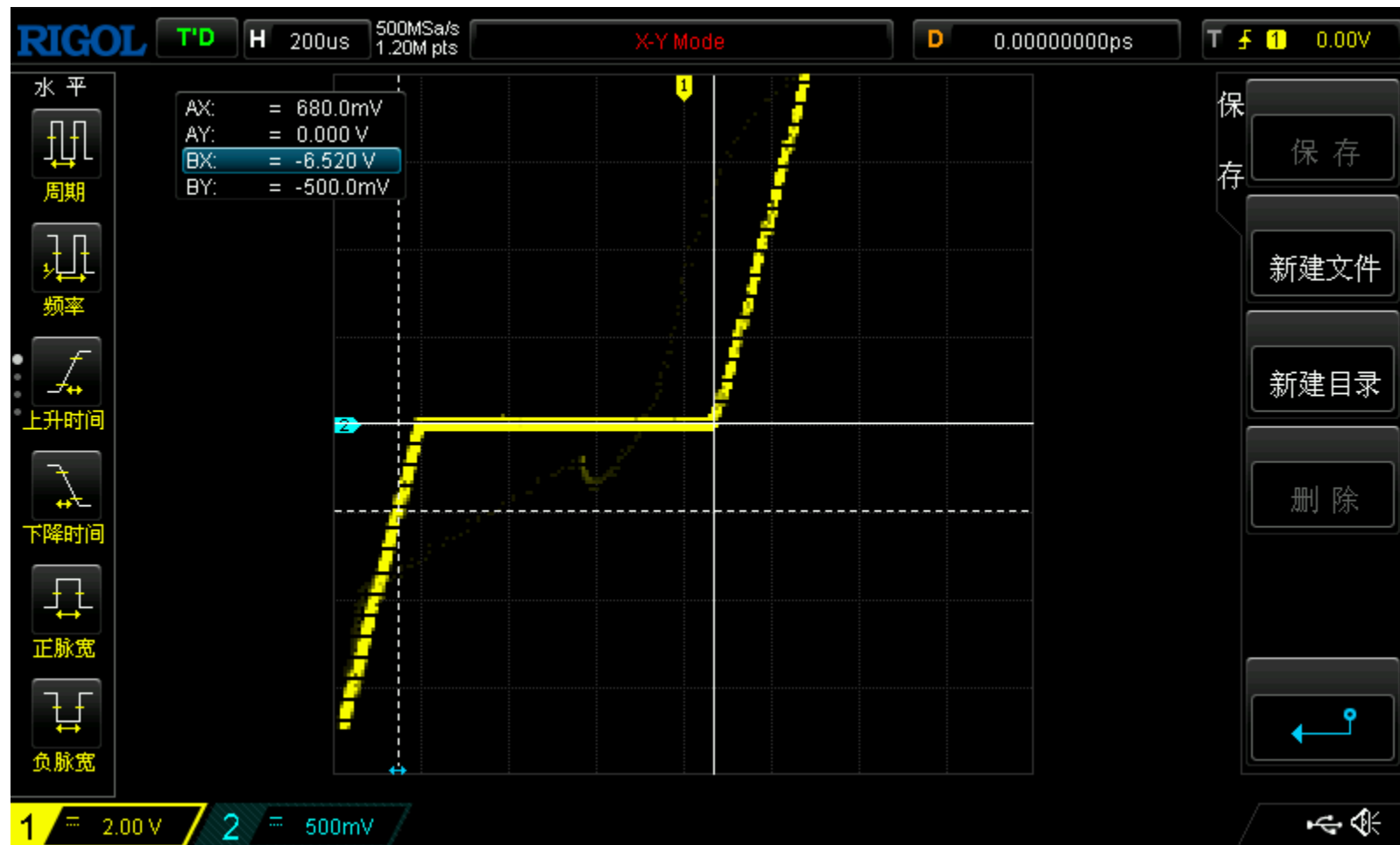
D	<ol style="list-style-type: none">1. <u>使用信号源与示波器对二极管伏安特性进行测量；</u>2. 设计并连接二极管整流滤波电路，用示波器测量整流前后的电压信号。
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3、测量伏安曲线



电路模拟结果

3、测量伏安曲线



如何理解 示波器XY模式

$$X(t) = A \sin(\omega_1 t + \phi_1)$$

$$Y(t) = A \cos(\omega_1 t + \phi_1)$$

$$f(X, Y) = X^2 + Y^2 = A^2$$

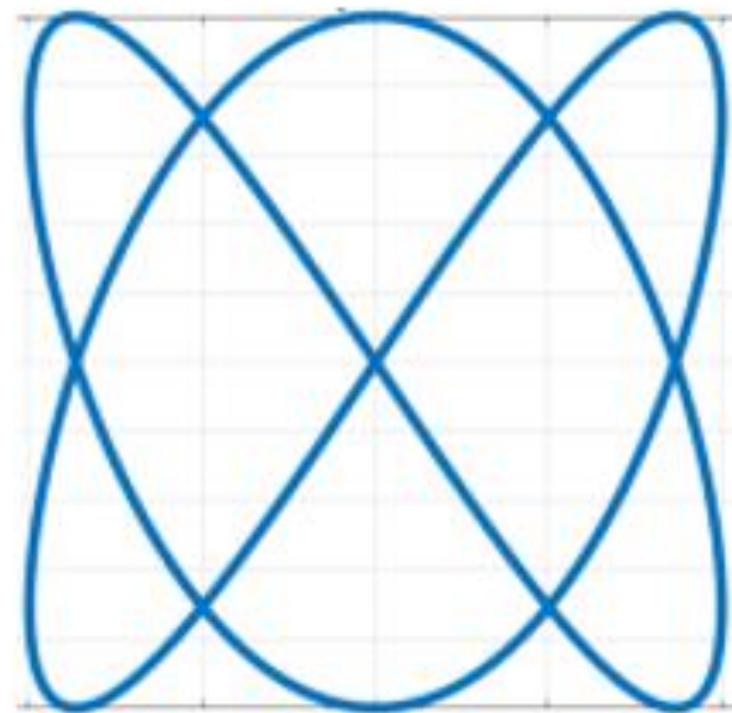


如何理解 示波器XY模式

$$X(t) = A \sin(2\omega_1 t + \phi_1)$$

$$Y(t) = A \cos(3\omega_1 t + \phi_1)$$

$$f(X, Y) = ?$$



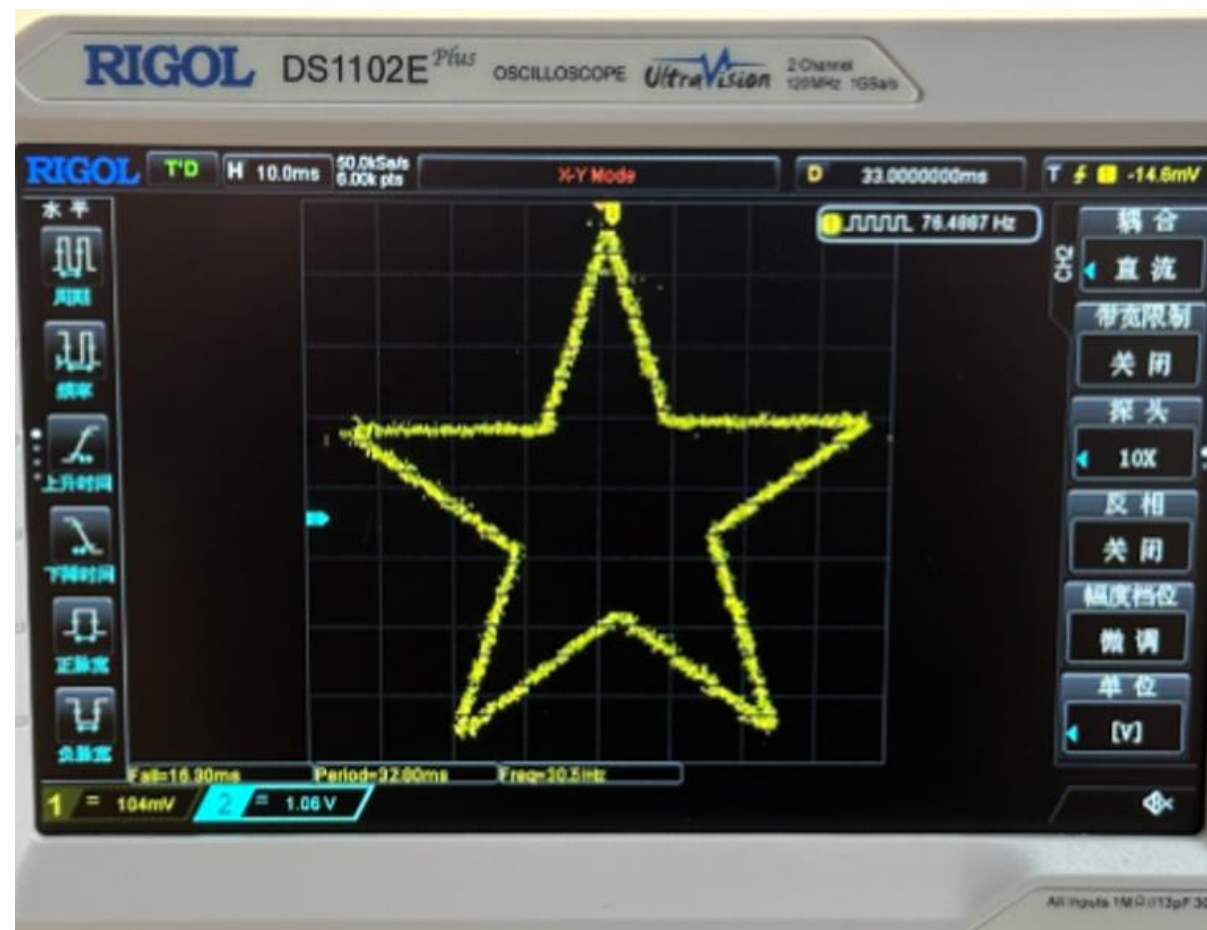
能不能从XY坐标角度去理解？

显示的图形是按照坐标关系点亮屏幕

显示的图形是轮廓线条

能否显示任意图形？

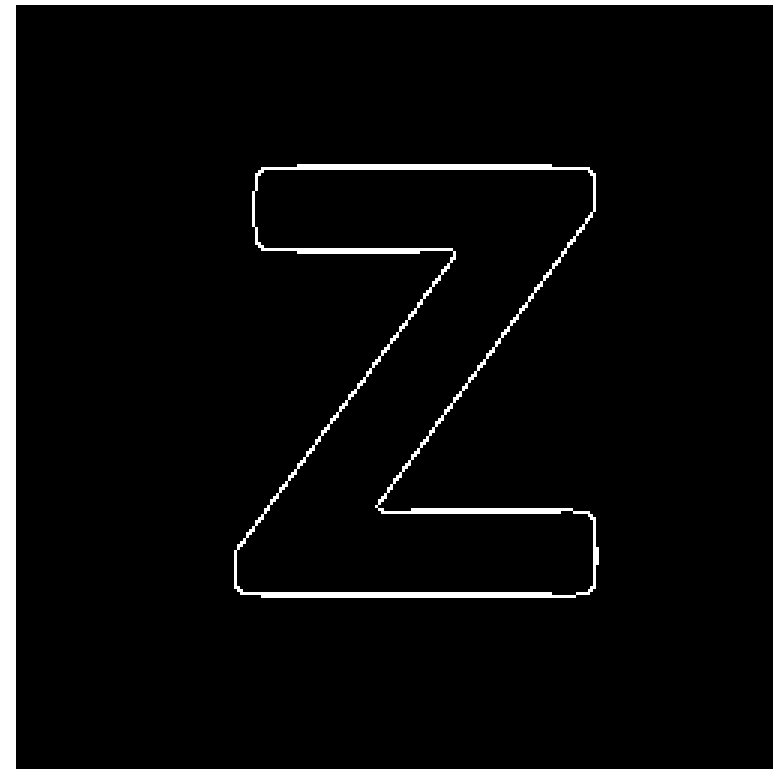
能否播放动画？



如何得到图形的轮廓线条

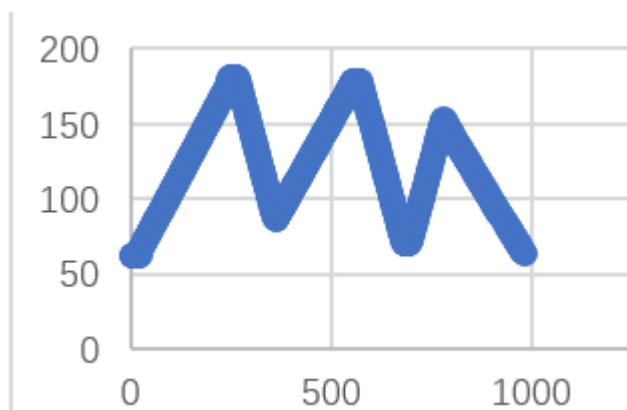
边缘提取

```
17     frameCount = 0;  
18     while hasFrame(video)  
19         frameCount = frameCount + 1;  
20         frame = readFrame(video);  
21         grayFrame = rgb2gray(frame);  
22         edges = edge(grayFrame, 'Canny');  
23  
24         % 获取边缘点的坐标  
25         [y, x] = find(edges);
```

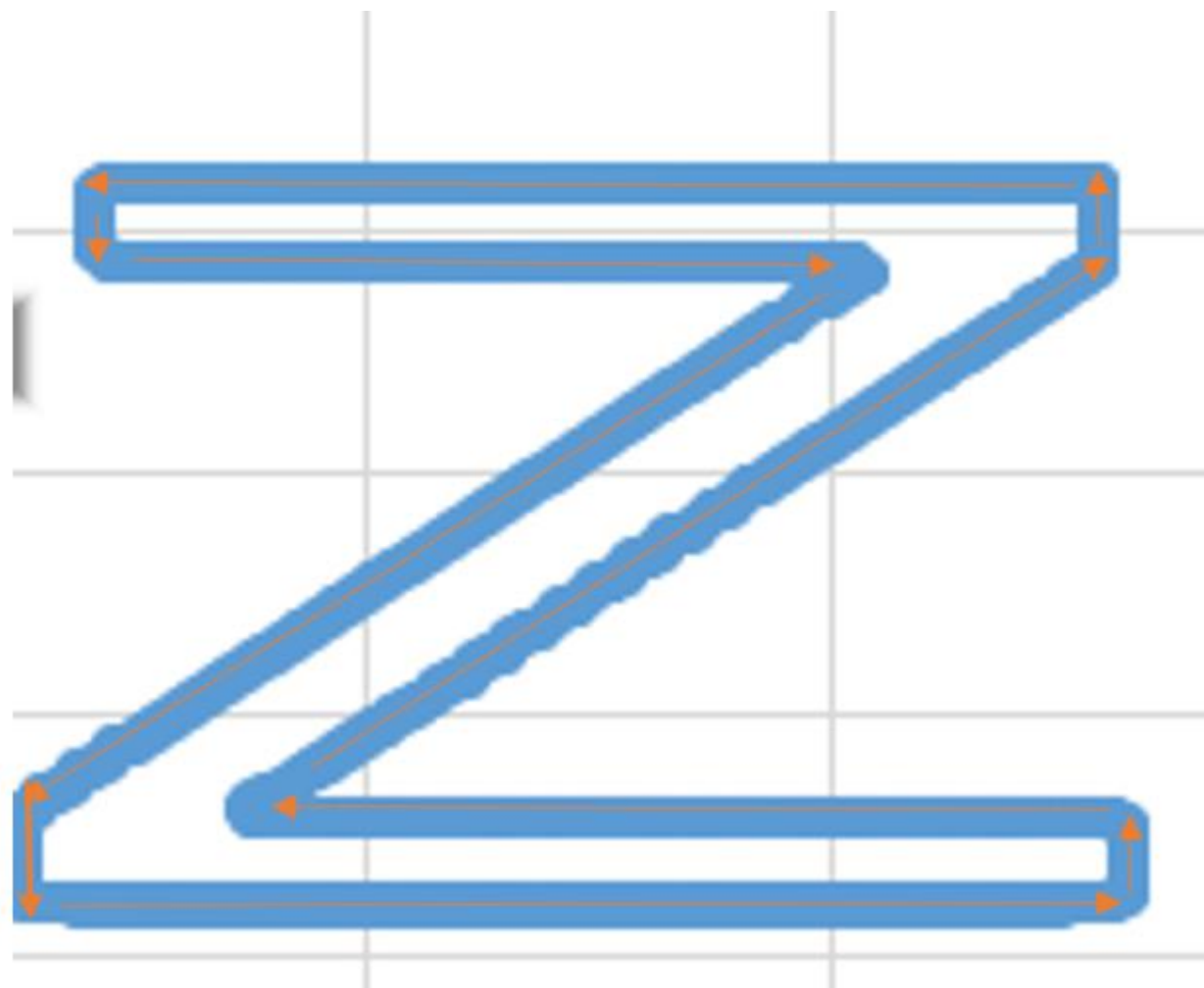


坐标排序

	A	B
1	74	183
2	74	184
3	74	185
4	74	186
5	74	187
6	74	188
7	74	189
8	74	190
9	74	191
10	74	192
11	74	193
12	74	194
13	74	195
14	75	181
15	75	182
16	75	195
17	75	196
18	76	180
19	76	181
20	76	196
21	76	197
22	77	179
23	77	180
24	77	197
25	78	177
26	78	178
27	78	197



X轴数据 画图



X-Y 画图

坐标数据如何输入到示波器的XY通道

1. 单片机DA转换后输出
2. 将坐标数据生成双声道音频文件播放后输入XY通道

坐标数据生成音频文件

% 将数组转换为行向量

```
frameLeft = frameLeft(:).';  
frameRight = frameRight(:).';
```

% 添加到最终音频信号，确保长度匹配

```
leftChannel = [leftChannel, frameLeft];  
rightChannel = [rightChannel, frameRight];
```

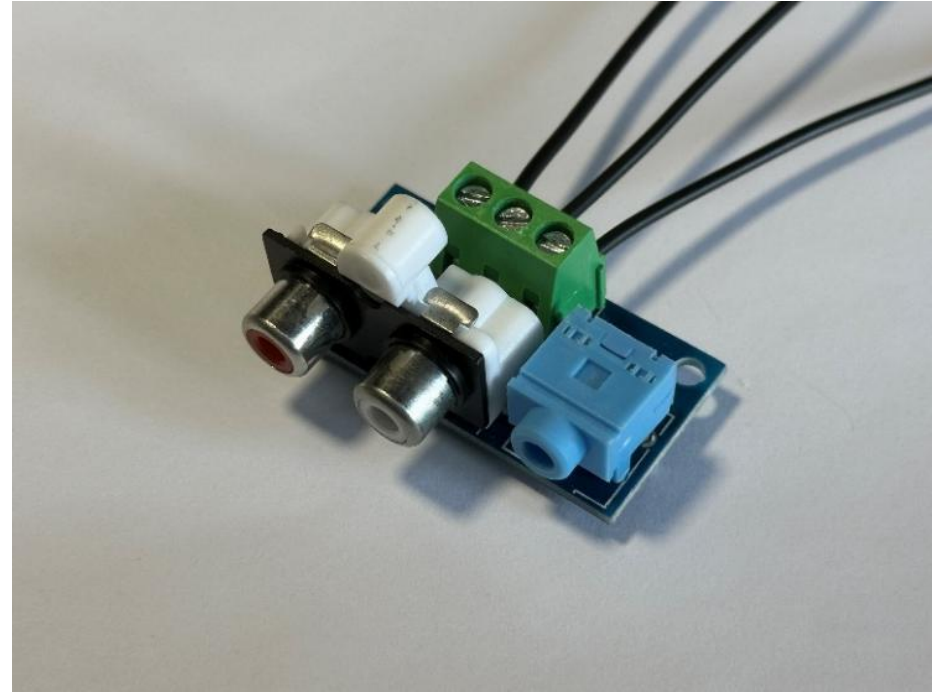
% 确保两个声道长度相等

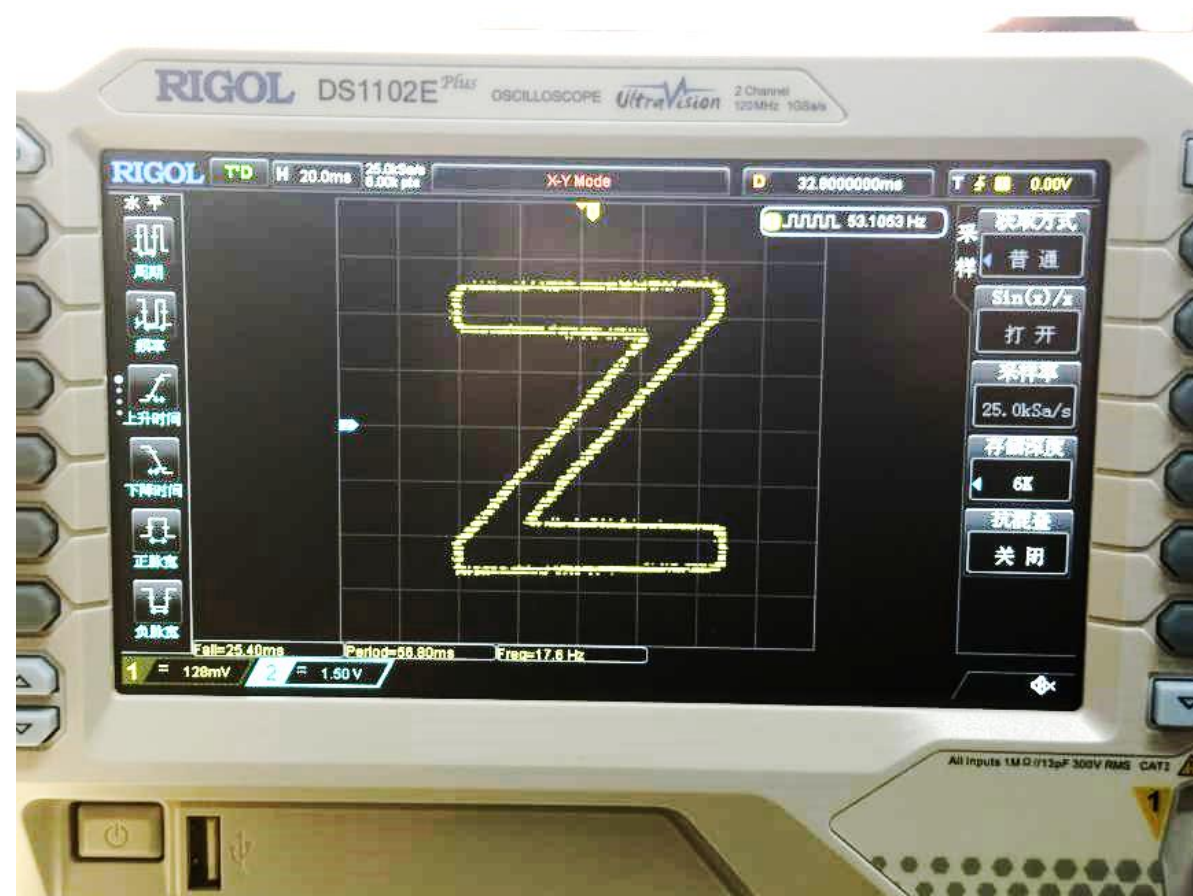
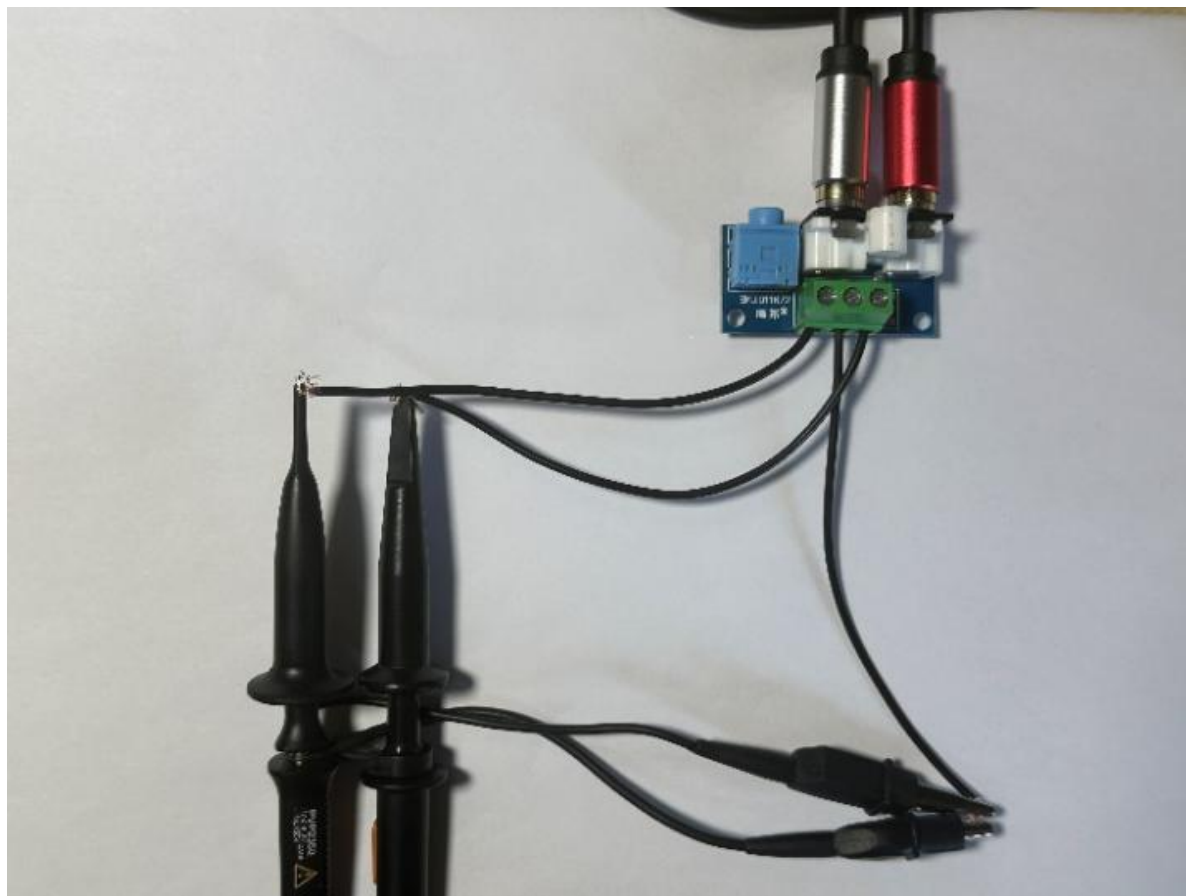
```
minLength = min(length(leftChannel), length(rightChannel));  
leftChannel = leftChannel(1:minLength);  
rightChannel = rightChannel(1:minLength);
```

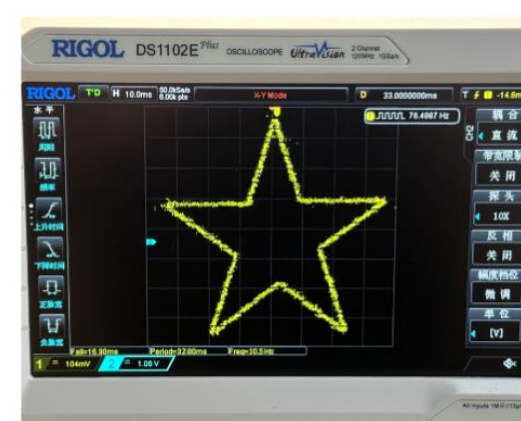
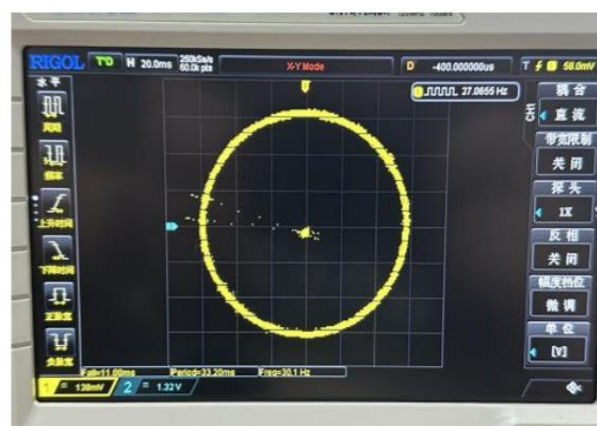
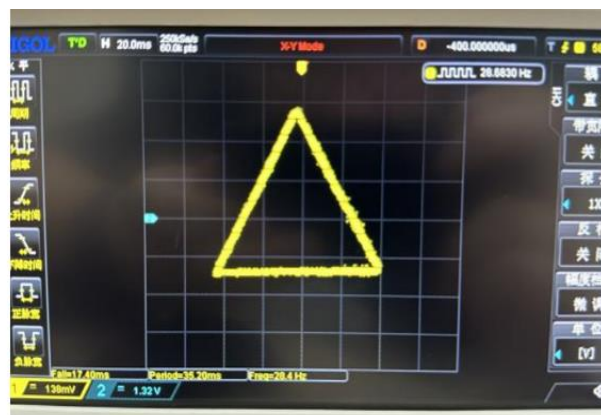
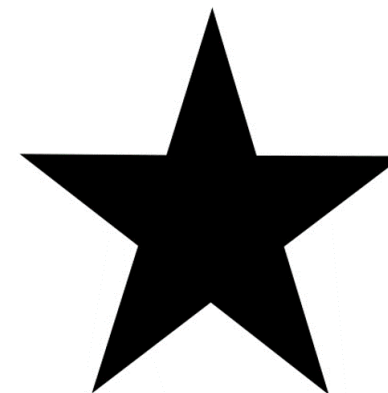
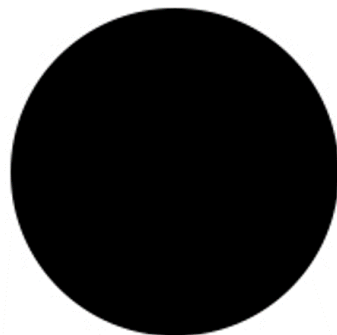
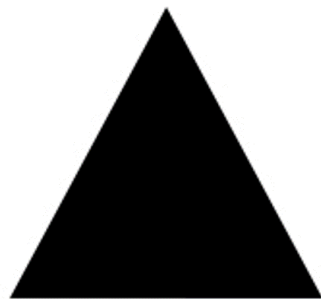
% 将音频信号写入文件

```
stereoSignal = [leftChannel; rightChannel].';  
dlmwrite('stereoSignal.txt', stereoSignal, 'delimiter', '\t', 'precision', '%.6f');  
audiowrite(audioFile, stereoSignal, sampleRate);
```

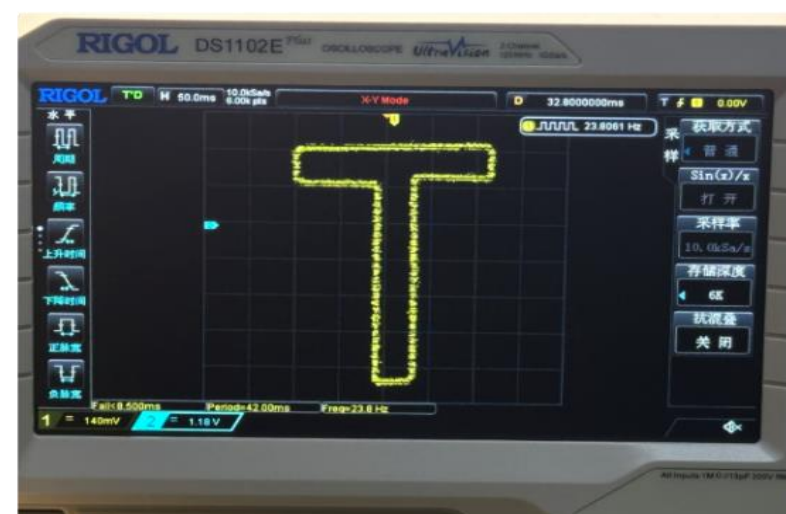
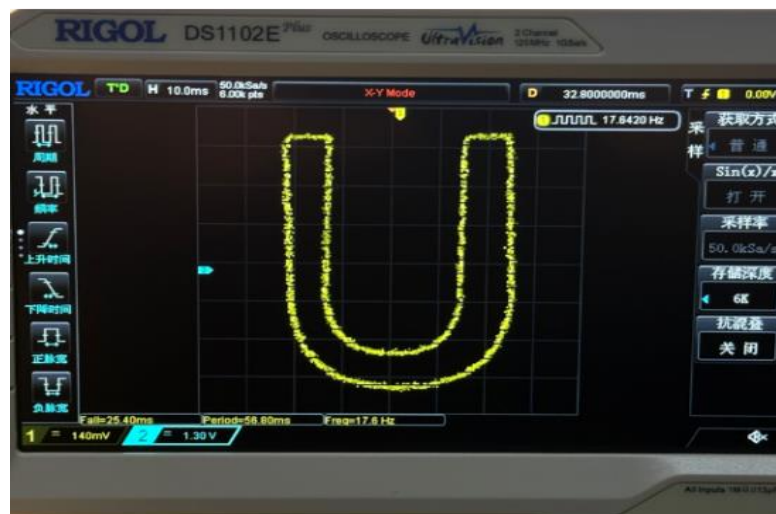
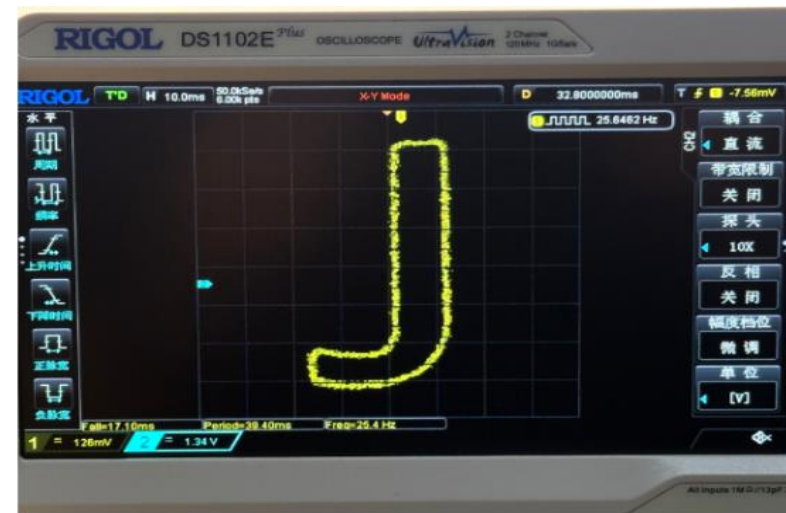
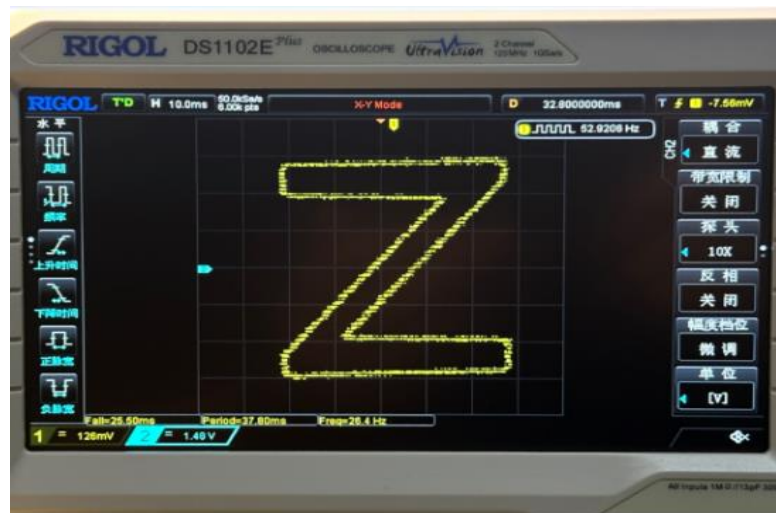
```
fprintf('音频文件已成功写入: %s\n', audioFile);
```





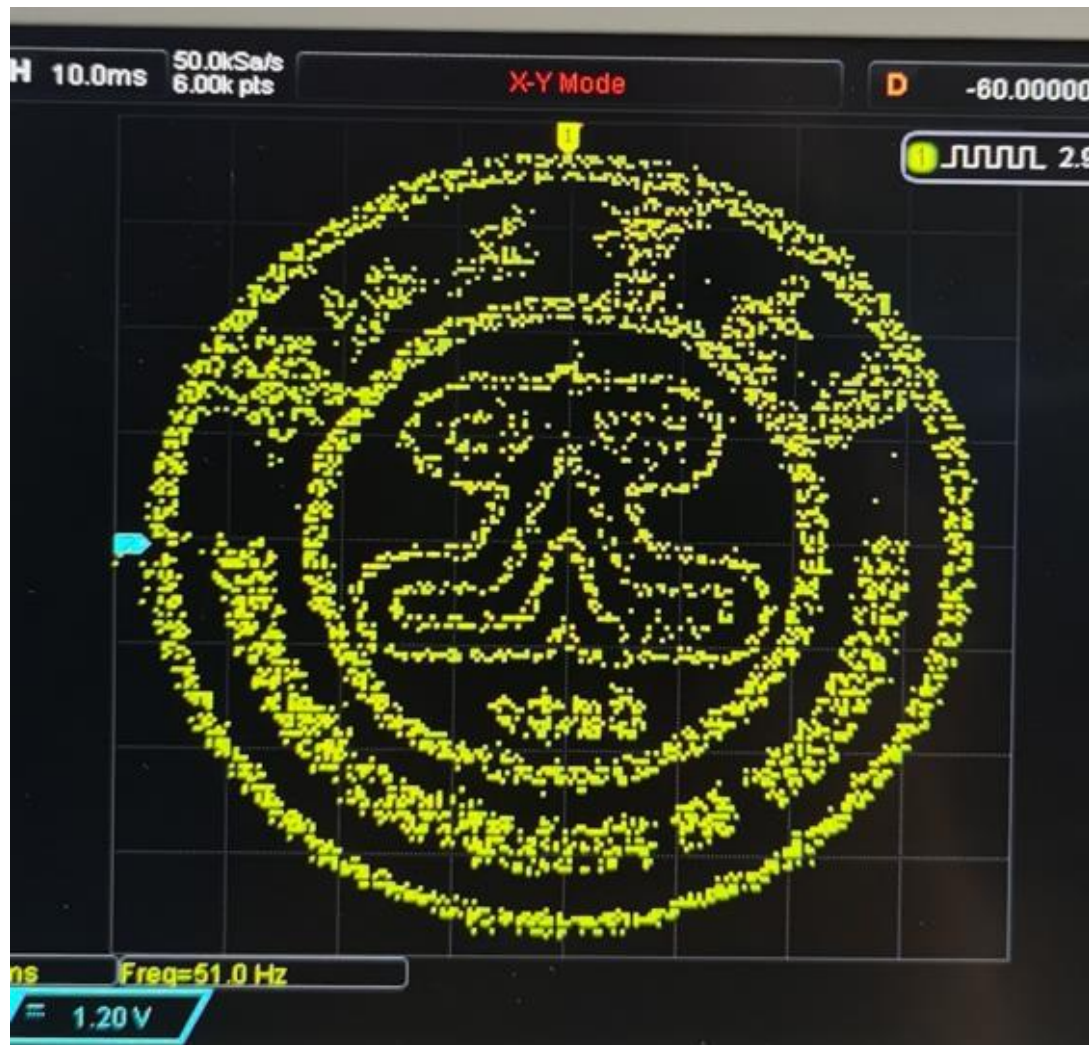


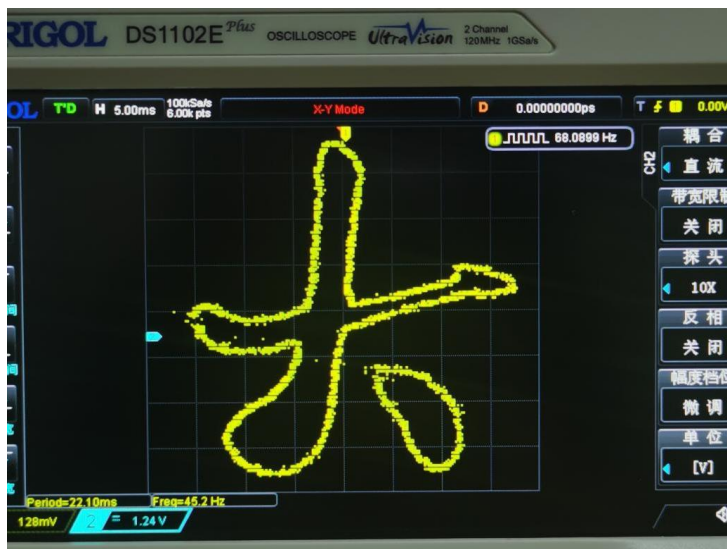
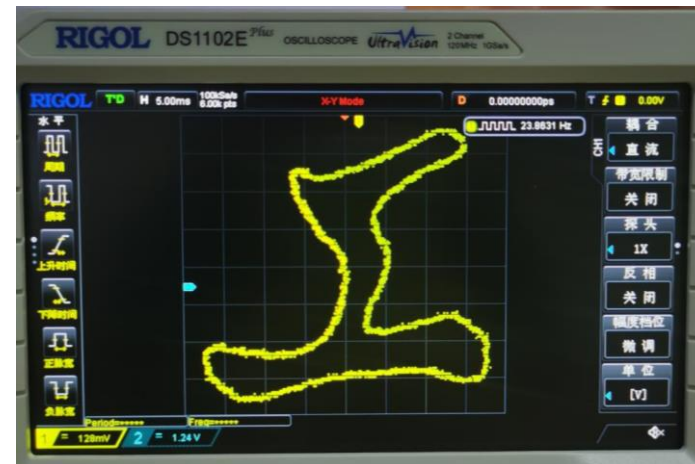
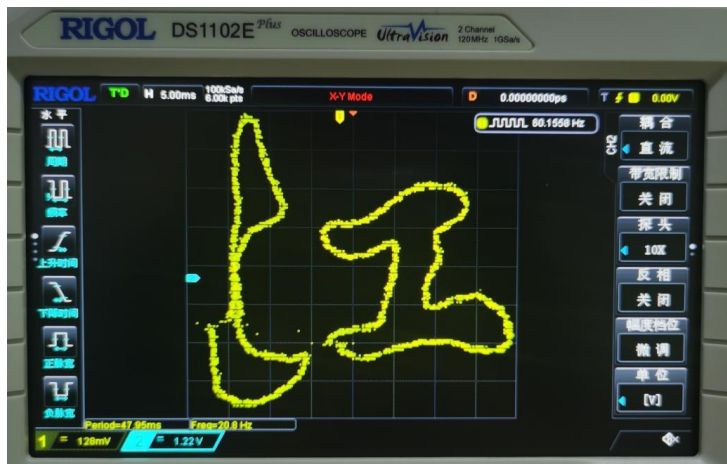
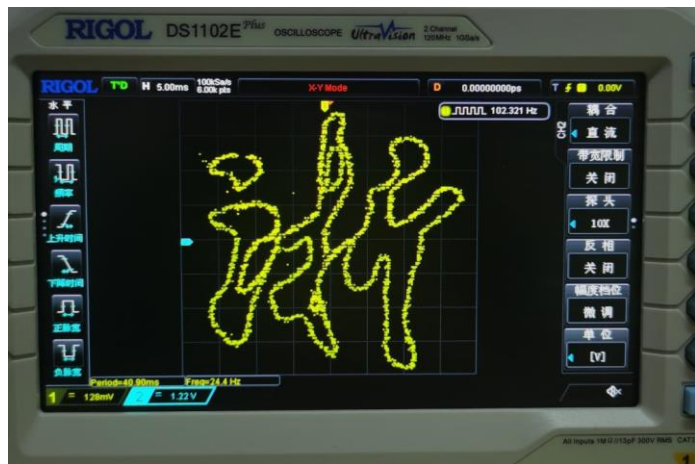
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群聊：示波器应用探索



THANKS
谢谢大家