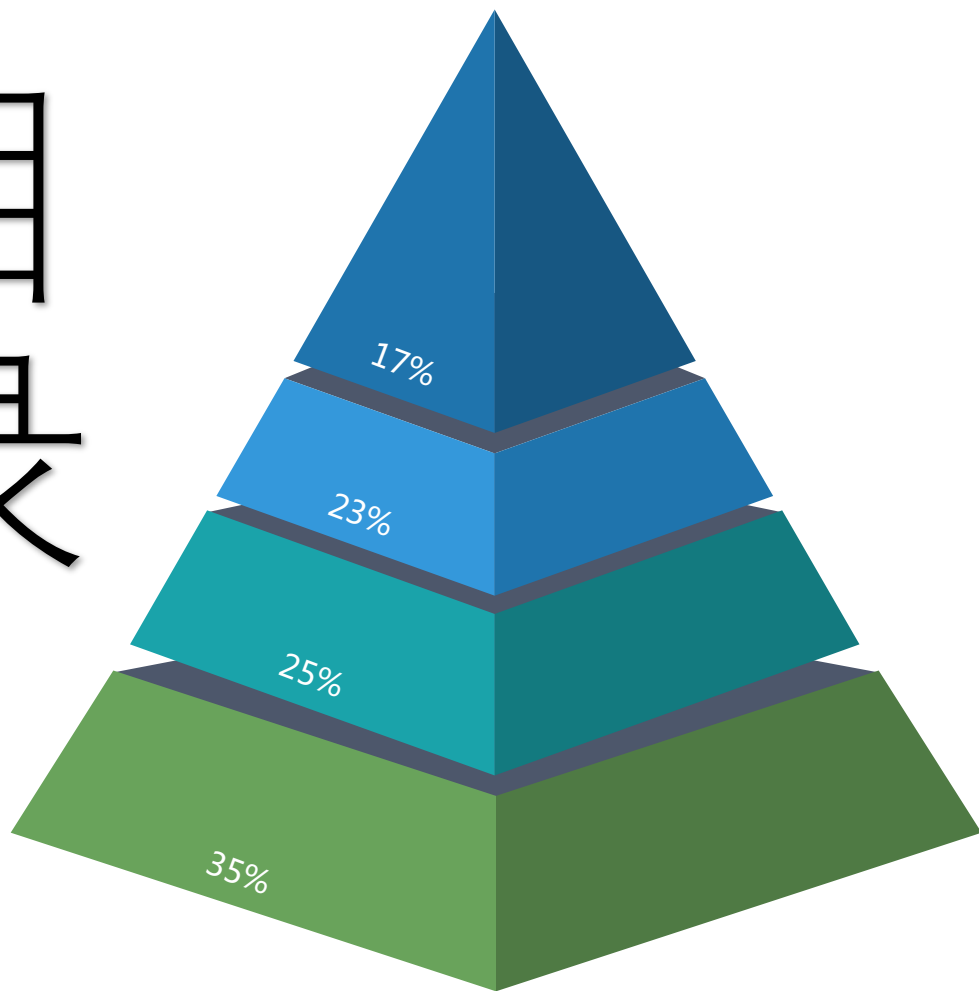


BeamMonitor原理样机读出 电子学测试报告

2021.10.14

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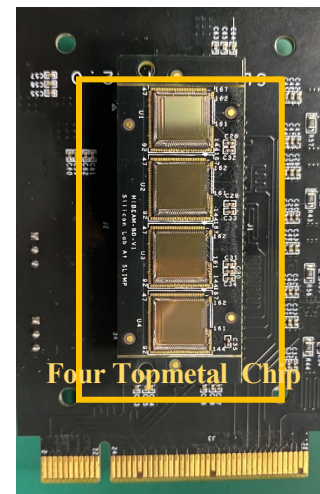
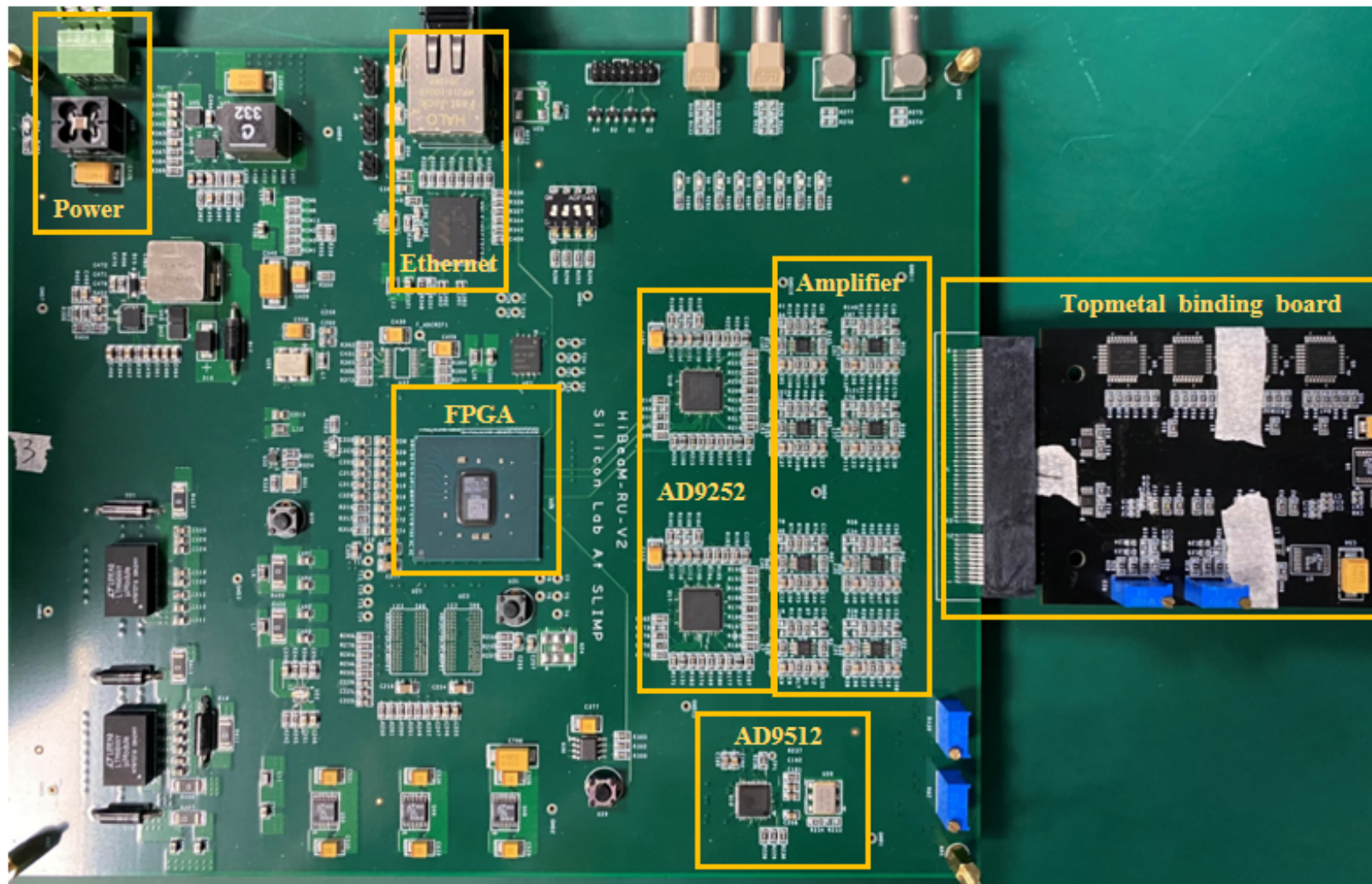
改上升衰减时间

01

电子学噪声测试



读出电子学实物图



高速ADC芯片AD9252

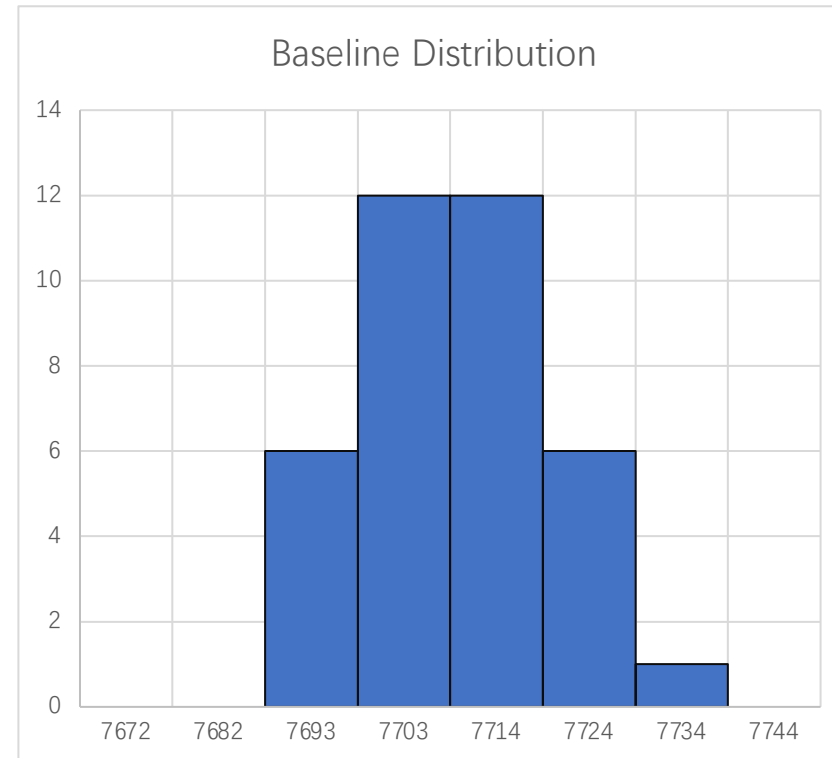
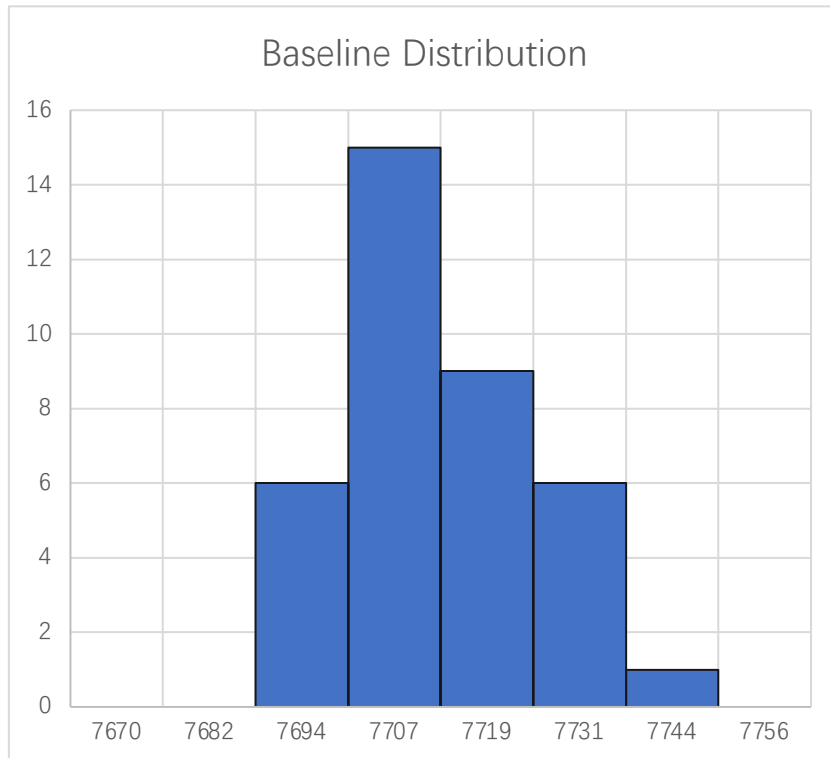
- 8通道ADC
- 单通道14bit
- 工作频率最高可达50MSPS

芯片噪声测试

使用的ADC芯片为AD9252: 14bit, $V_{ref}=1V$, $1bit=1/2^{14}=0.061mV$, $1mV=33e-$

使用新绑定的芯片, 1.25MHz下连续读出, 每次选择第四个像素, 测量两次, 每次37个点。

| | 信号基线 (ch) | 方差 (ch) | 噪声水平 (mV) | 噪声水平 (e-) |
|---|--------------|-------------|--------------|--------------|
| 1 | 7708 | 10.43325706 | 0.636 | 20.99e- |
| 2 | 7712 | 12.31255859 | 0.751 | 24.78e- |

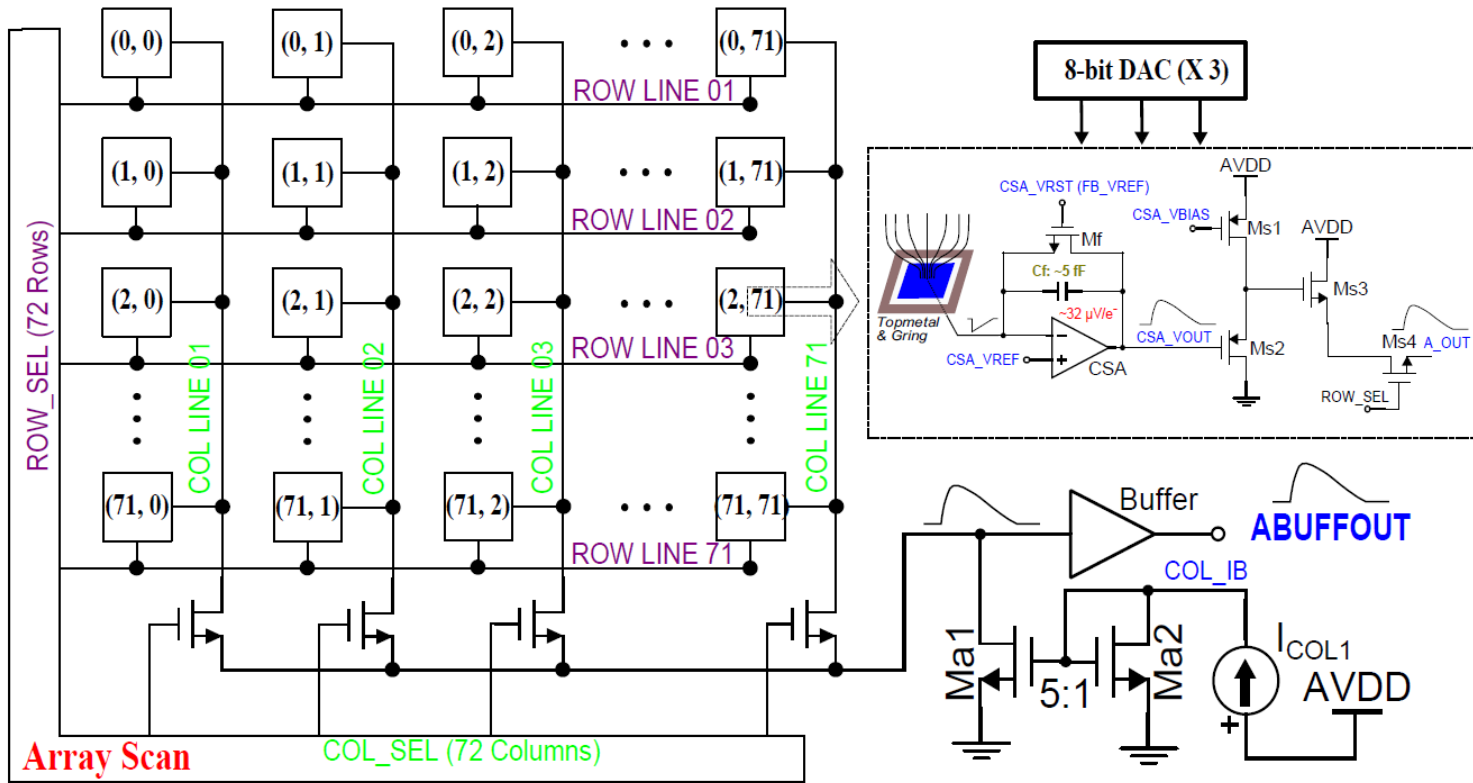


02

col_ib的影响

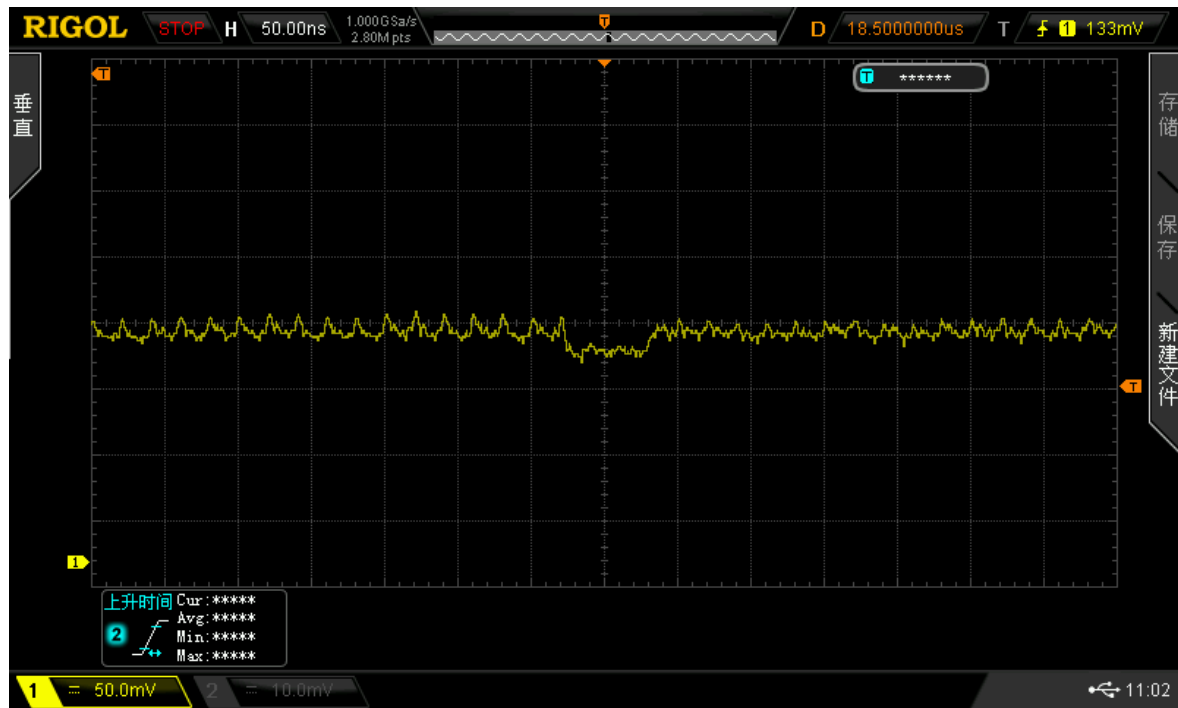


col_ib影响信号基线，驱动能力

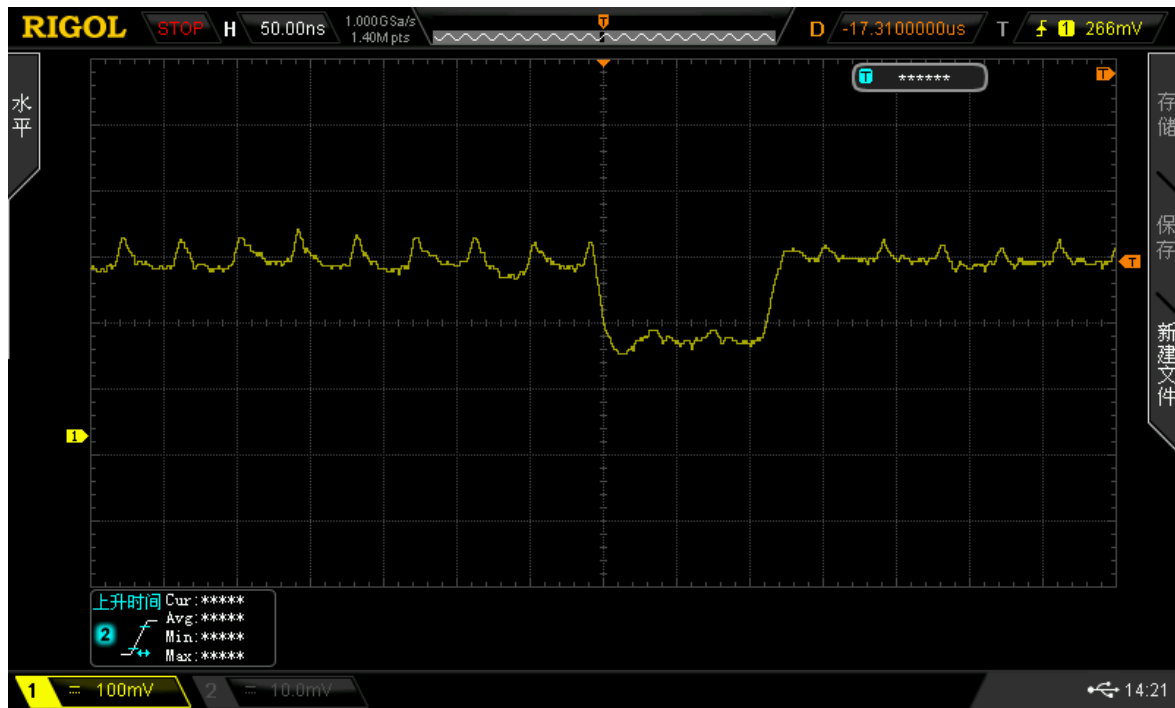


- 调整两级源跟随工作电流，进而调整扫描频率，增强驱动能力

示波器观察信号



接5.1k电阻



接10k电阻

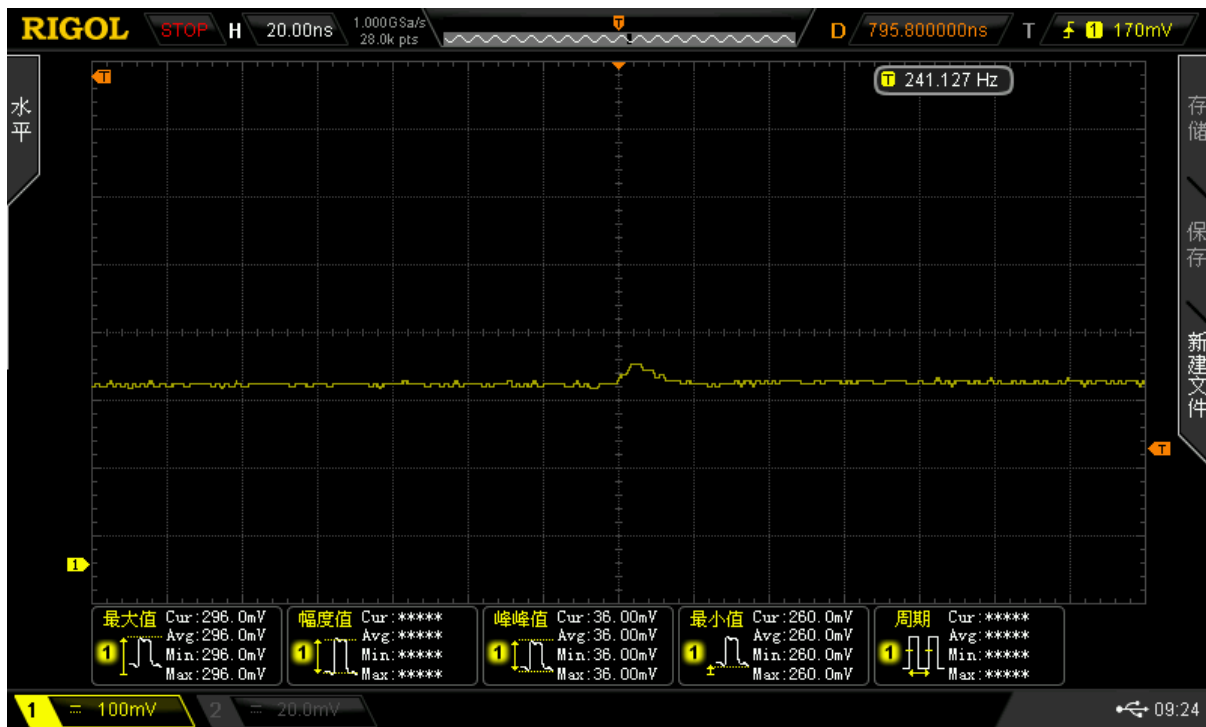
- 5.1k电阻与10k电阻驱动能力相当，10k电阻的稳定区更明显；
- 5.1k电阻信号的基线更低，前三个像素与正常像素区别很小；10k电阻信号基线较高，前三个像素与正常像素区别明显。

03

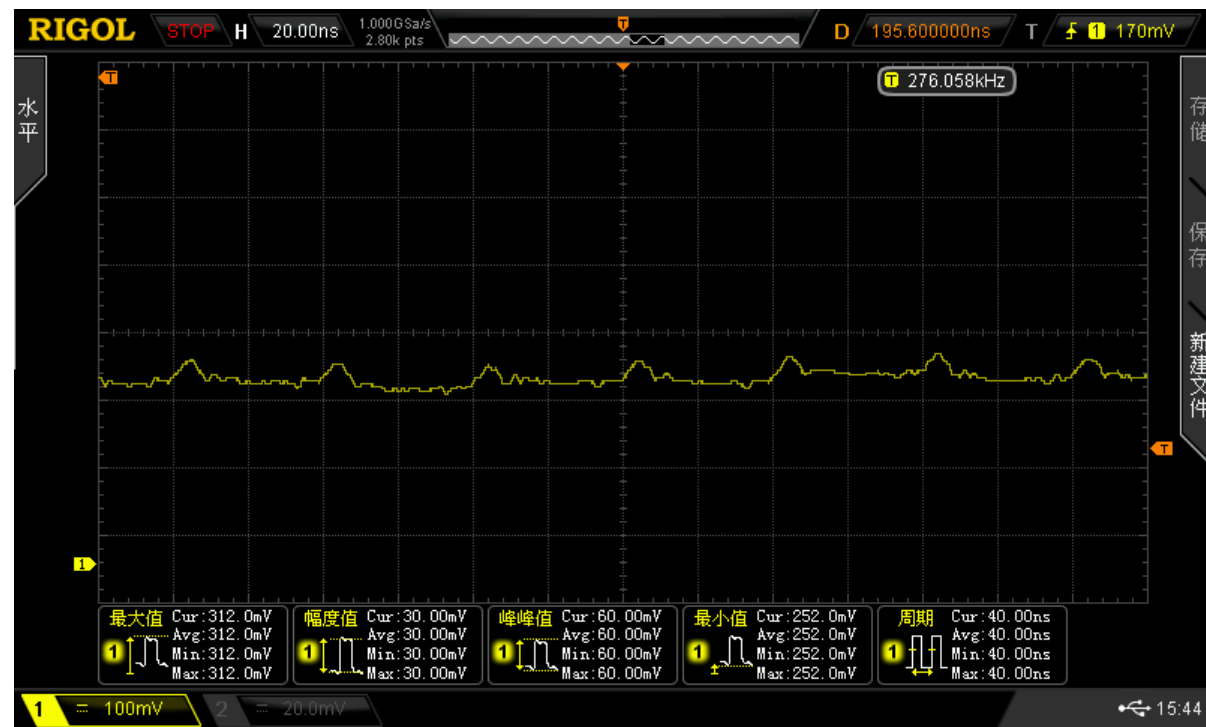
扫描时钟相位测试



像素切换时间



扫描频率1.25M



扫描频率25MHz

- 像素切换时间在扫描频率为1.25MHz与25MHz时差别不大，大约为20ns；
- 25MHz下减去像素切换时间后，真正像素值的时间只有20ns。

改变扫描时钟相位

➤ 扫描时钟：25M

➤ ADC采样时钟：25M

通过vivado自带的时钟核，改变扫描时钟相位，每个时钟间隔50°，基本能覆盖整个信号周期，通过一个mux选择输出。

Component Name: lm_clk_out

| Output Clock | Port Name | Output Freq (MHz) | | Phase (degrees) | | Duty Cycle (%) | | Drives | Use Fine PS | Max Freq. of buffer |
|--|-----------|-------------------|--------|-----------------|---------|----------------|--------|--------|--------------------------|---------------------|
| | | Requested | Actual | Requested | Actual | Requested | Actual | | | |
| <input checked="" type="checkbox"/> clk_out1 | clk_25_o1 | 25 | 25.000 | 50 | 50.000 | 50.000 | 50.0 | BUFG | <input type="checkbox"/> | 709.723 |
| <input checked="" type="checkbox"/> clk_out2 | clk_25_o2 | 25 | 25.000 | 100 | 100.000 | 50.000 | 50.0 | BUFG | <input type="checkbox"/> | 709.723 |
| <input checked="" type="checkbox"/> clk_out3 | clk_25_o3 | 25 | 25.000 | 150 | 150.000 | 50.000 | 50.0 | BUFG | <input type="checkbox"/> | 709.723 |
| <input checked="" type="checkbox"/> clk_out4 | clk_25_o4 | 25 | 25.000 | 200 | 200.000 | 50.000 | 50.0 | BUFG | <input type="checkbox"/> | 709.723 |
| <input checked="" type="checkbox"/> clk_out5 | clk_25_o5 | 25 | 25.000 | 250 | 250.000 | 50.000 | 50.0 | BUFG | <input type="checkbox"/> | 709.723 |
| <input checked="" type="checkbox"/> clk_out6 | clk_25_o6 | 25 | 25.000 | 300 | 300.000 | 50.000 | 50.0 | BUFG | <input type="checkbox"/> | 709.723 |
| <input checked="" type="checkbox"/> clk_out7 | clk_25_o7 | 25 | 25.000 | 350 | 350.000 | 50.000 | 50.0 | BUFG | <input type="checkbox"/> | 709.723 |

USE CLOCK SEQUENCING

| Output Clock | Sequence Number |
|--------------|-----------------|
| clk_out1 | 1 |
| clk_out2 | 1 |
| clk_out3 | 1 |
| clk_out4 | 1 |
| clk_out5 | 1 |
| clk_out6 | 1 |
| clk_out7 | 1 |

Enable Optional Inputs / Outputs for MMCMP/PLL

reset power_down input_clk_stopped Active High Active Low

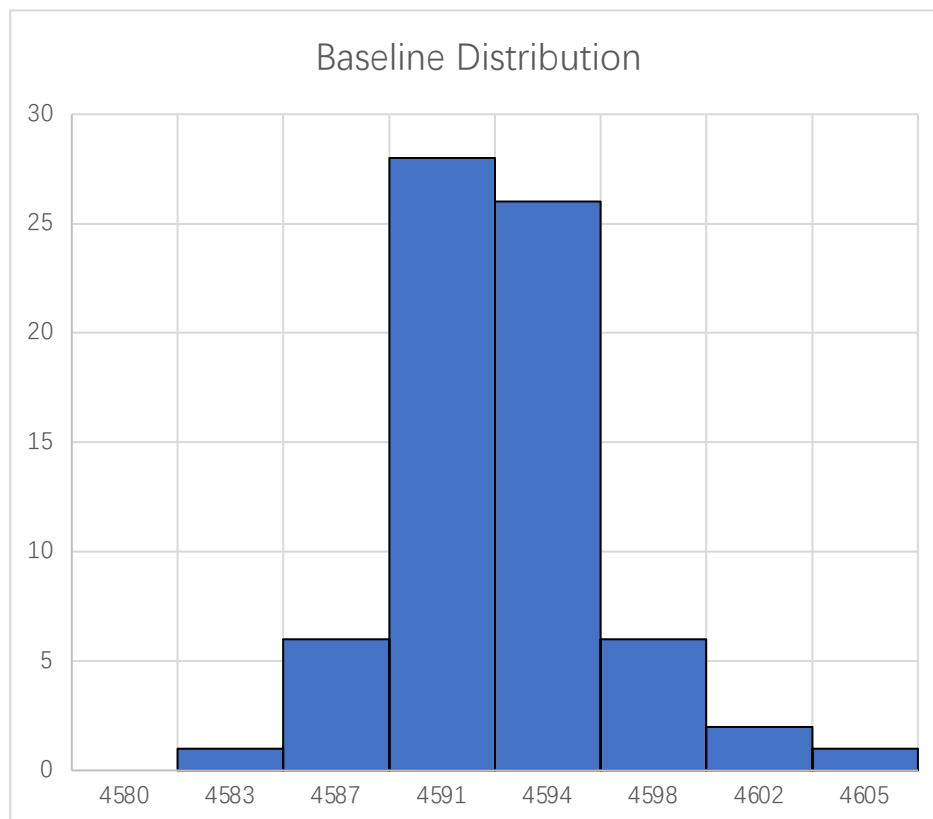
locked clkstopping

```
always @(posedge clk_200m or negedge reset)begin
    if(reset) begin
        clk_out <= 0;
    end
    else begin
        case (mux[2:0])
            8'd0: clk_out <= clk1;
            8'd1: clk_out <= clk2;
            8'd2: clk_out <= clk3;
            8'd3: clk_out <= clk4;
            8'd4: clk_out <= clk5;
            8'd5: clk_out <= clk6;
            8'd6: clk_out <= clk7;
            8'd7: clk_out <= clk_25m;
            default: clk_out <= clk_25m;
        endcase
    end
end
```

信号基线测试

增大col_ib后，芯片扫描时钟工作在25MHz，扫描时钟与ADC采样时钟相同，ADC一个像素只能采一个点，为了避免采到像素切换时的点，需要改变时钟相位，使ADC能恰好采到像素正常工作时的平台区。首先在1.25MHz下进行测试，得到信号的标准基线水平。

- 扫描时钟：1.25M
- ADC采样时钟：25M



选择芯片第六个像素
基线：4590
方差：3.89

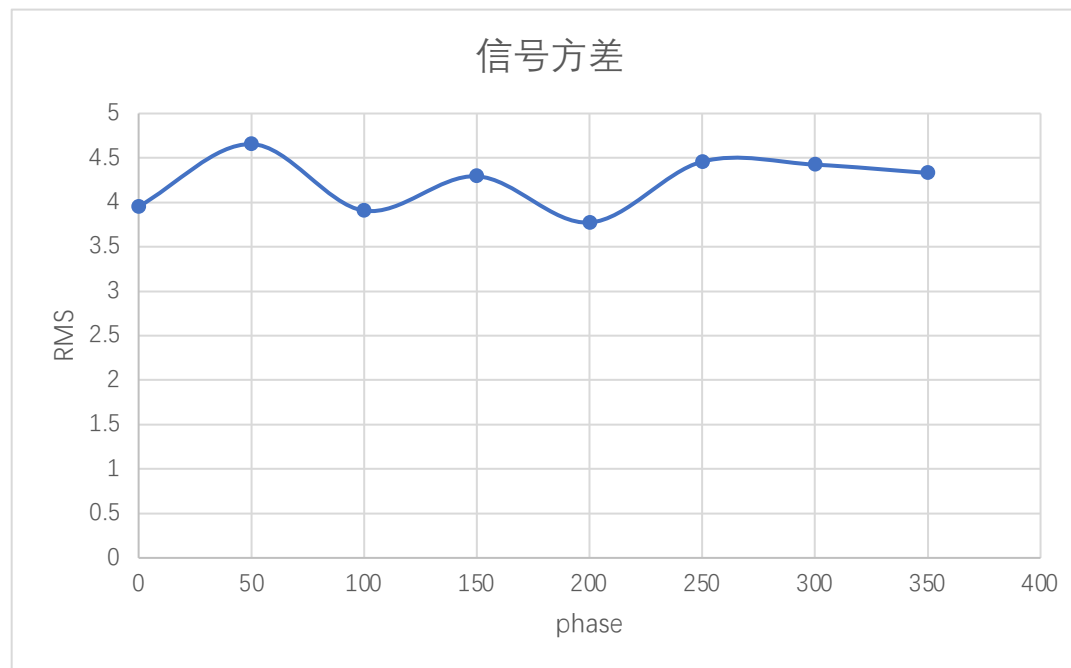
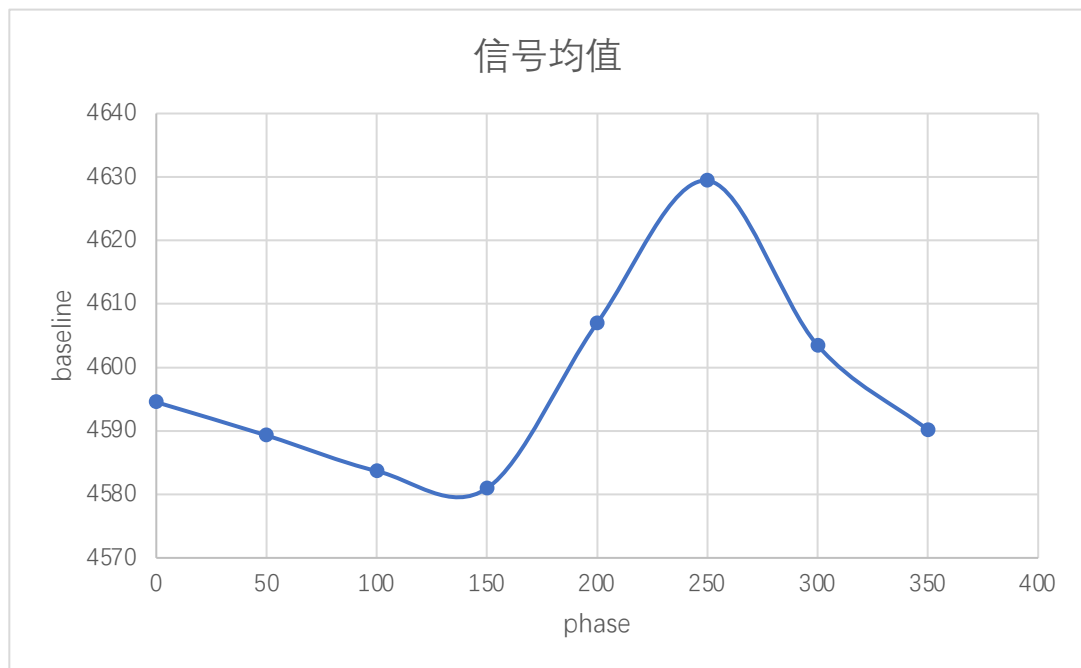
改变扫描时钟相位

➤ 扫描时钟：25M

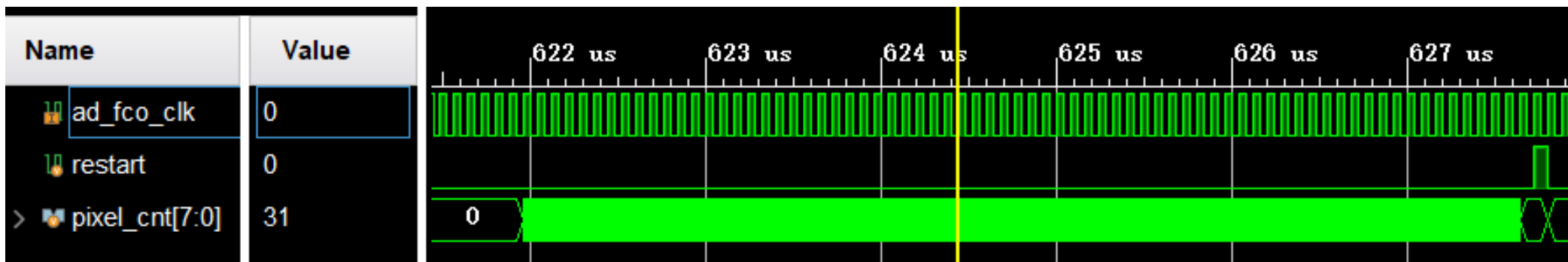
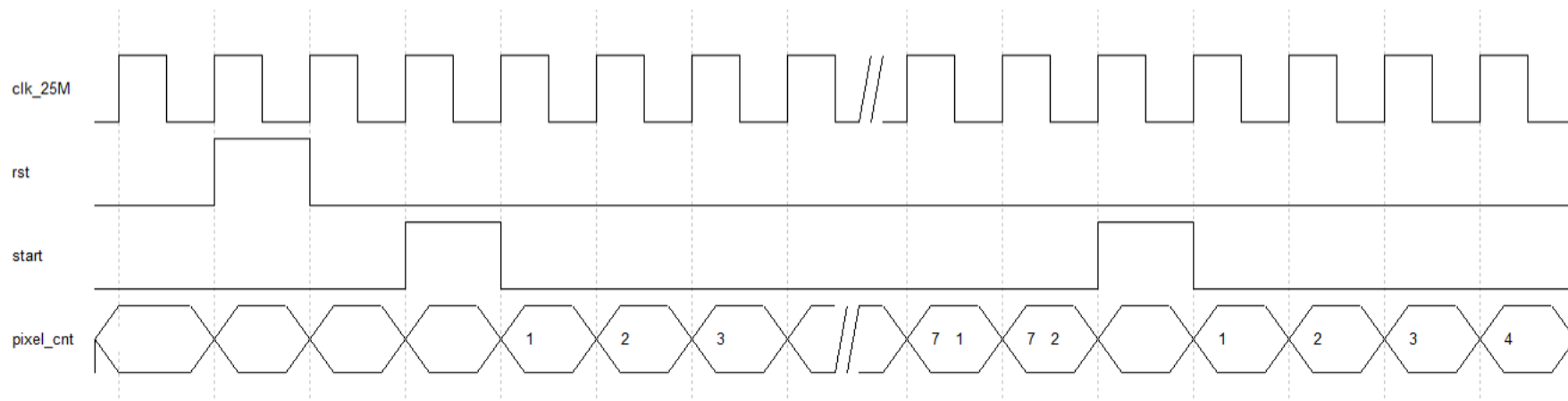
分别改变扫描时钟的相位，读出数据，画出芯片的第六个像素点的基线

➤ ADC采样时钟：25M

与方差分布图

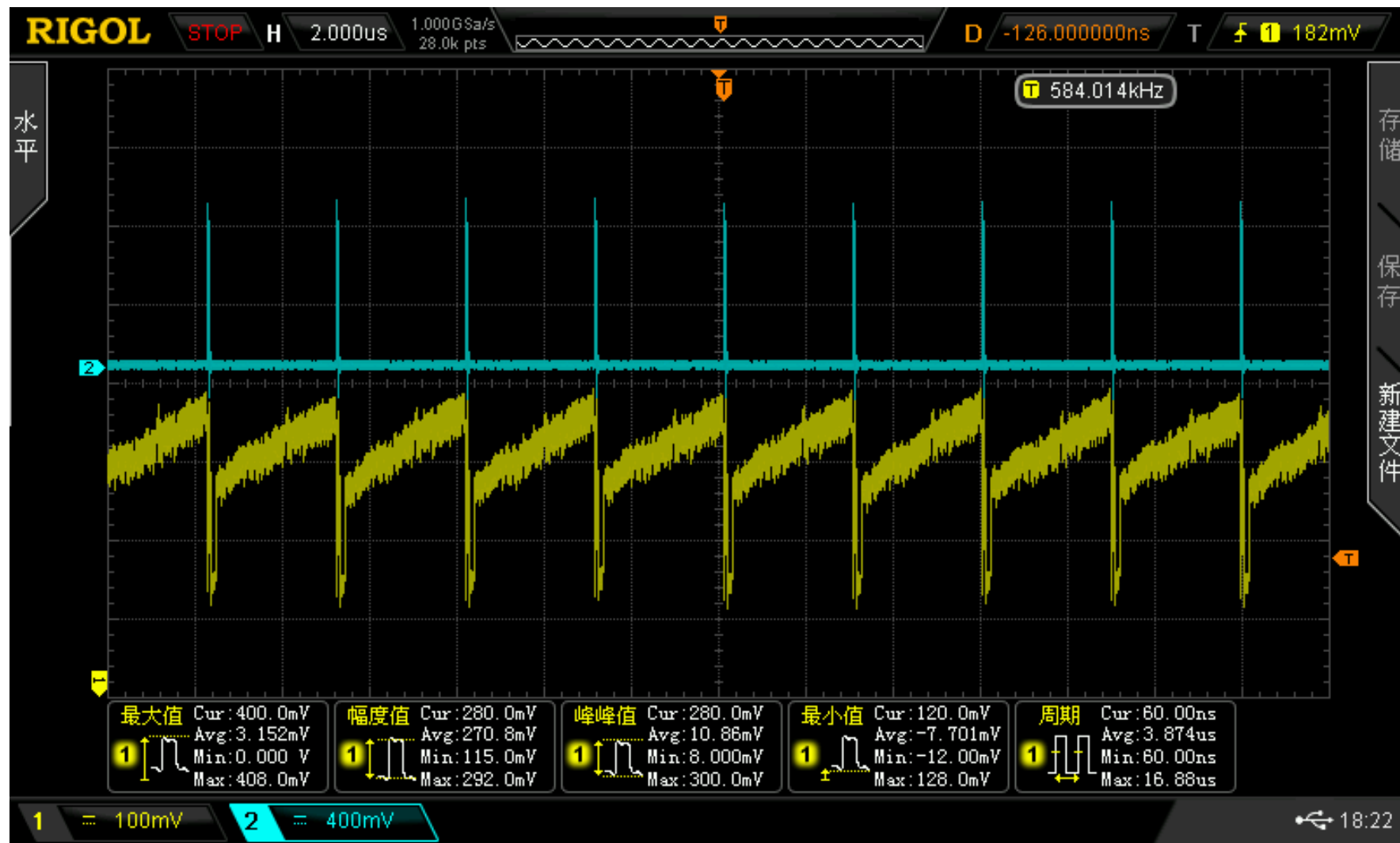


只读一行测时间分辨



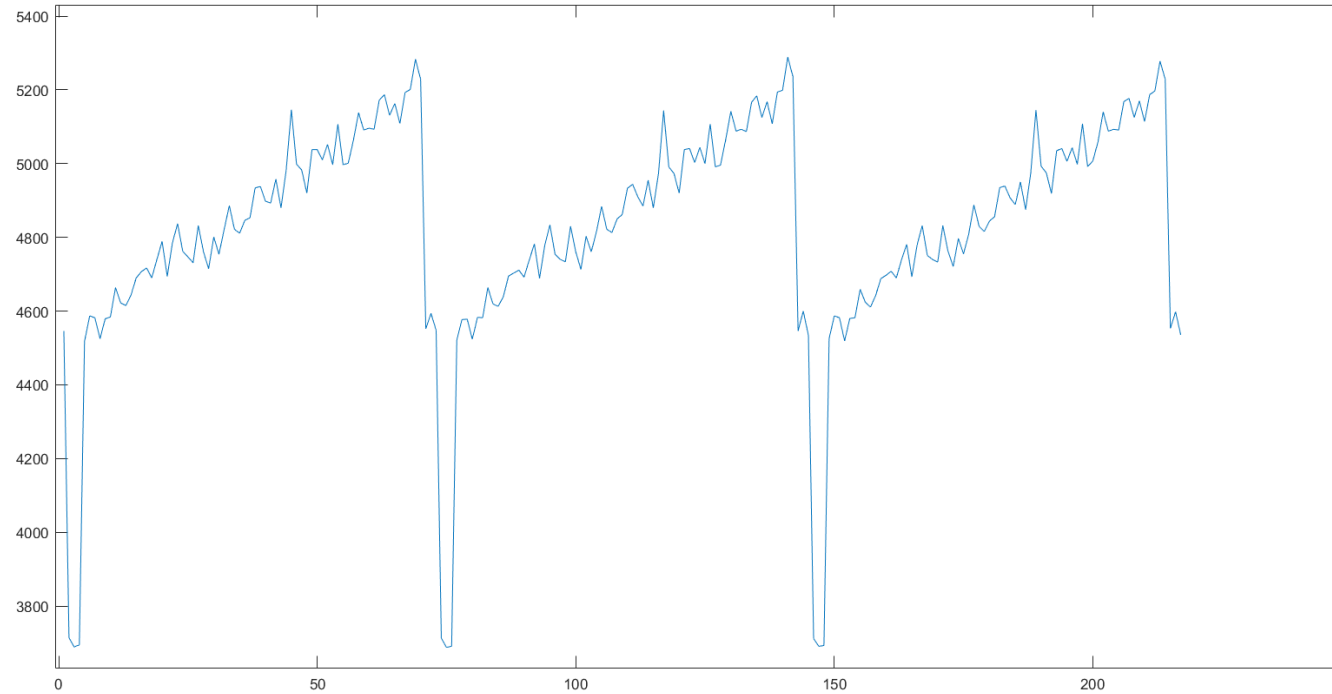
只读一行工作时序图

只读一行测时间分辨



实测波形图

只读一行测时间分辨



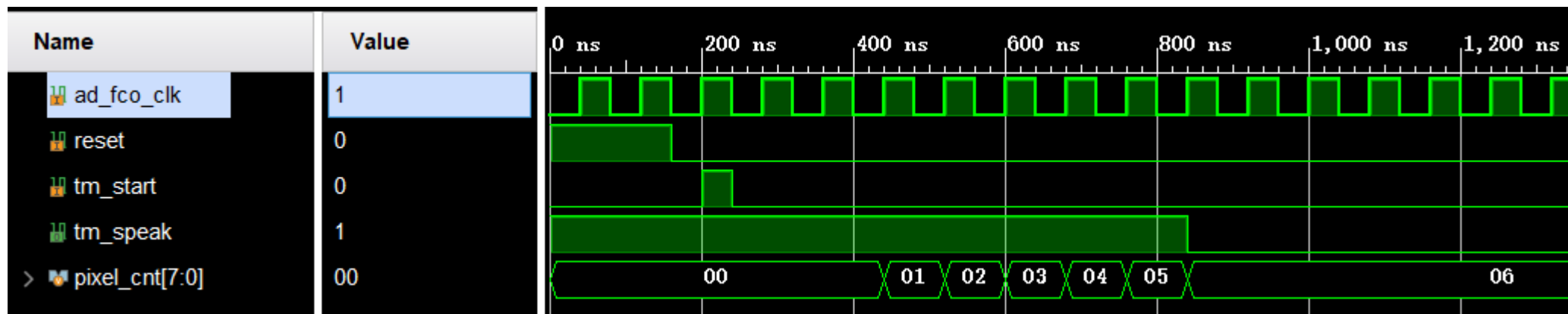
实测波形图

04

上升衰减时间测试



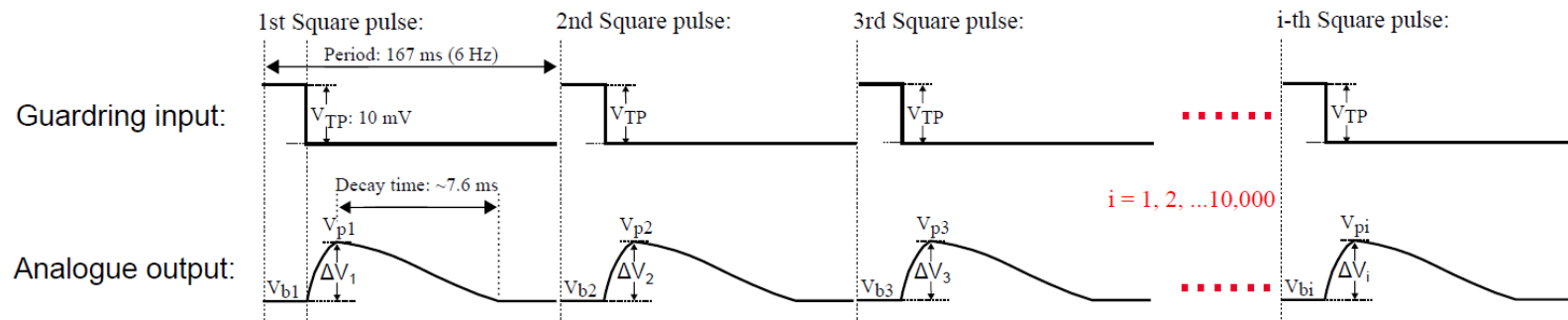
Topmetal-II- ArrayScan选择像素



ArrayScan停在某个像素

Topmetal-II- 单个像素模拟读出

测试方案

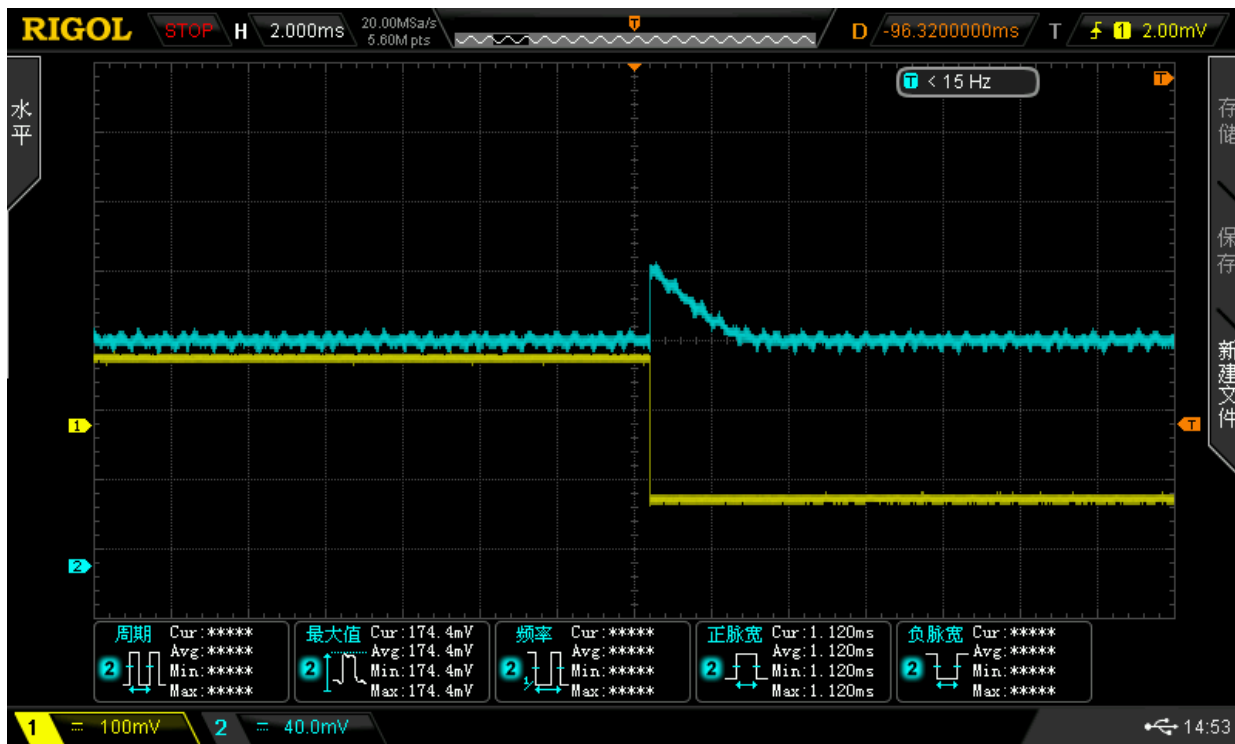


Guardring激励方波，注入电荷

$$V_o = V_p e^{-\frac{t}{\tau}}$$

$$\tau \propto 1/\Delta V$$

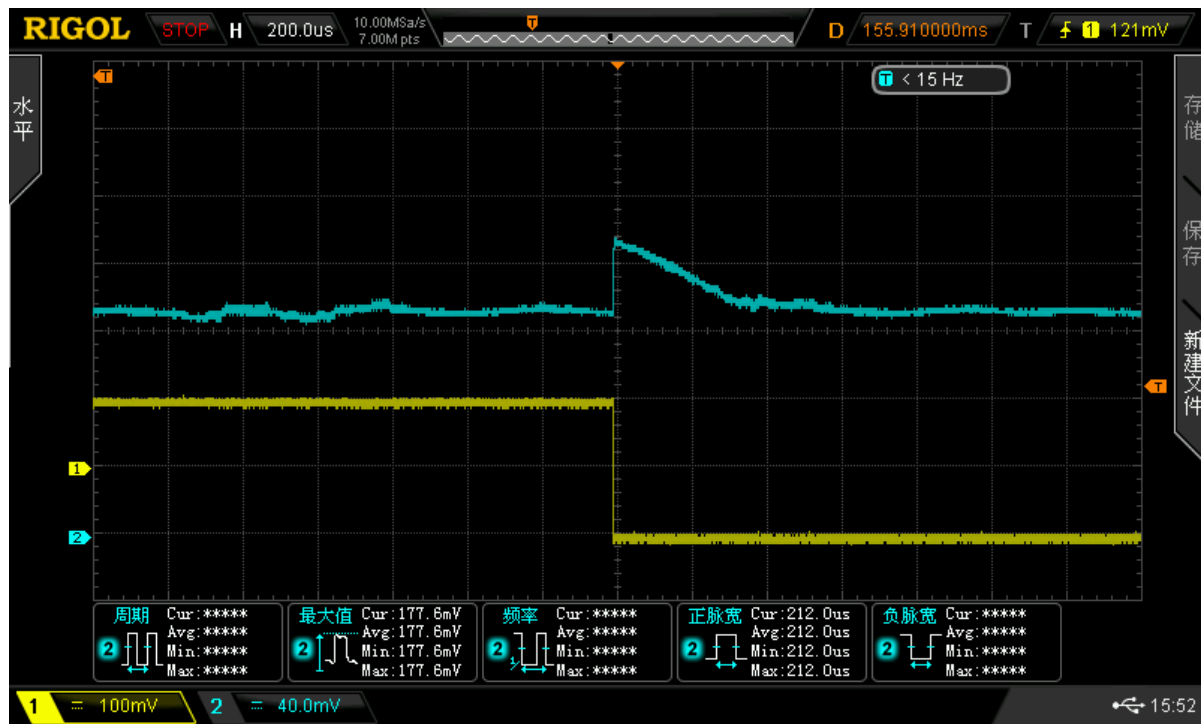
$$\Delta V = (V_{ARST_VREF} - V_{CSA_VREF})$$



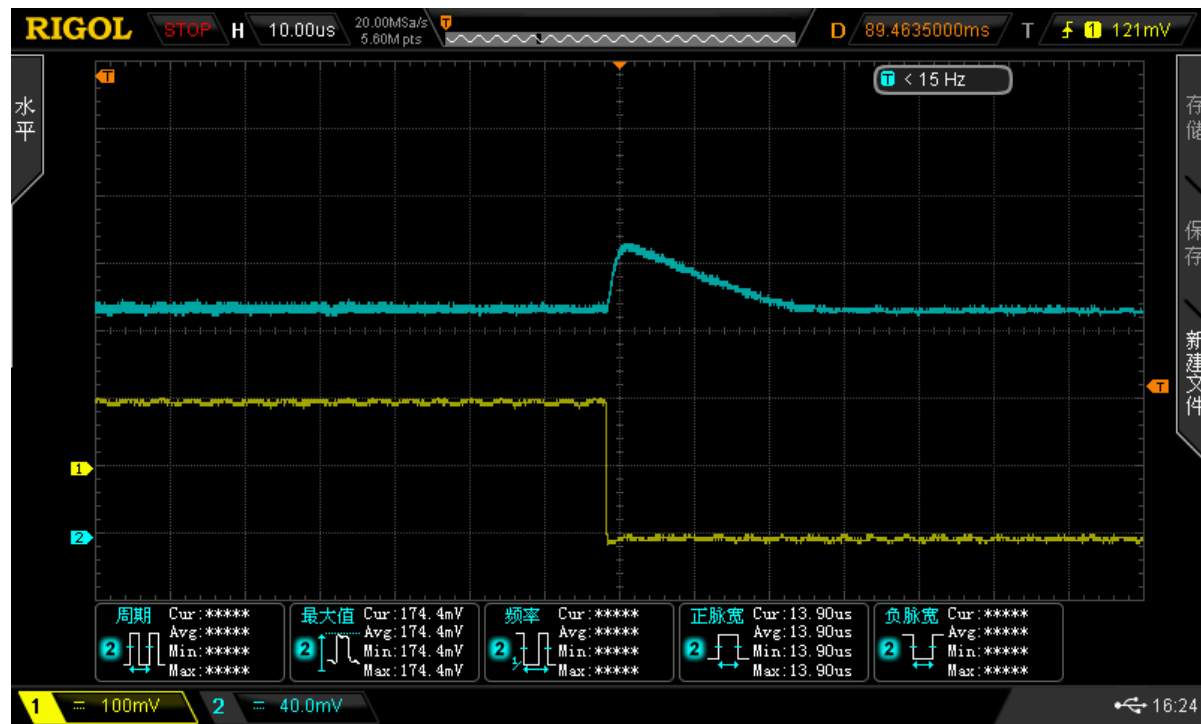
ARST_VREF=0.78V, CSA_VREF=0.62V, $\Delta V = 0.16V$, 输入幅度为200mV, 频率2Hz的方波信号, 用示波器直接观测输出模拟信号, 输出信号的上升时间大概4us, 下降时间大概4ms。

Topmetal-II- 单个像素模拟读出

输入幅度为200mV， 频率2Hz的方波信号， 用示波器直接观测单个像素输出的模拟信号

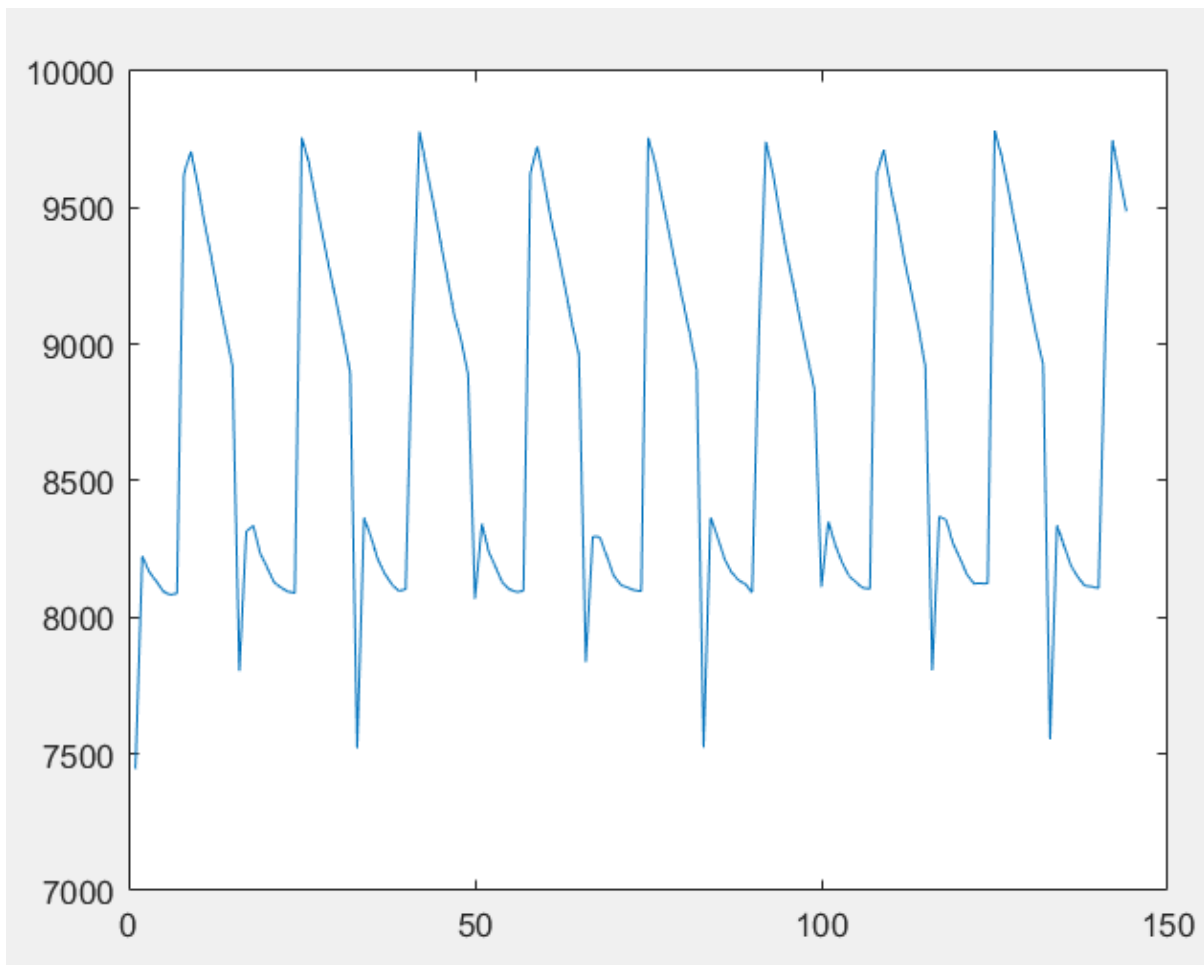


ARST_VREF=0.85V, CSA_VREF=0.62V, $\Delta V = 0.23V$
rise time: 3us, fall time: 350us

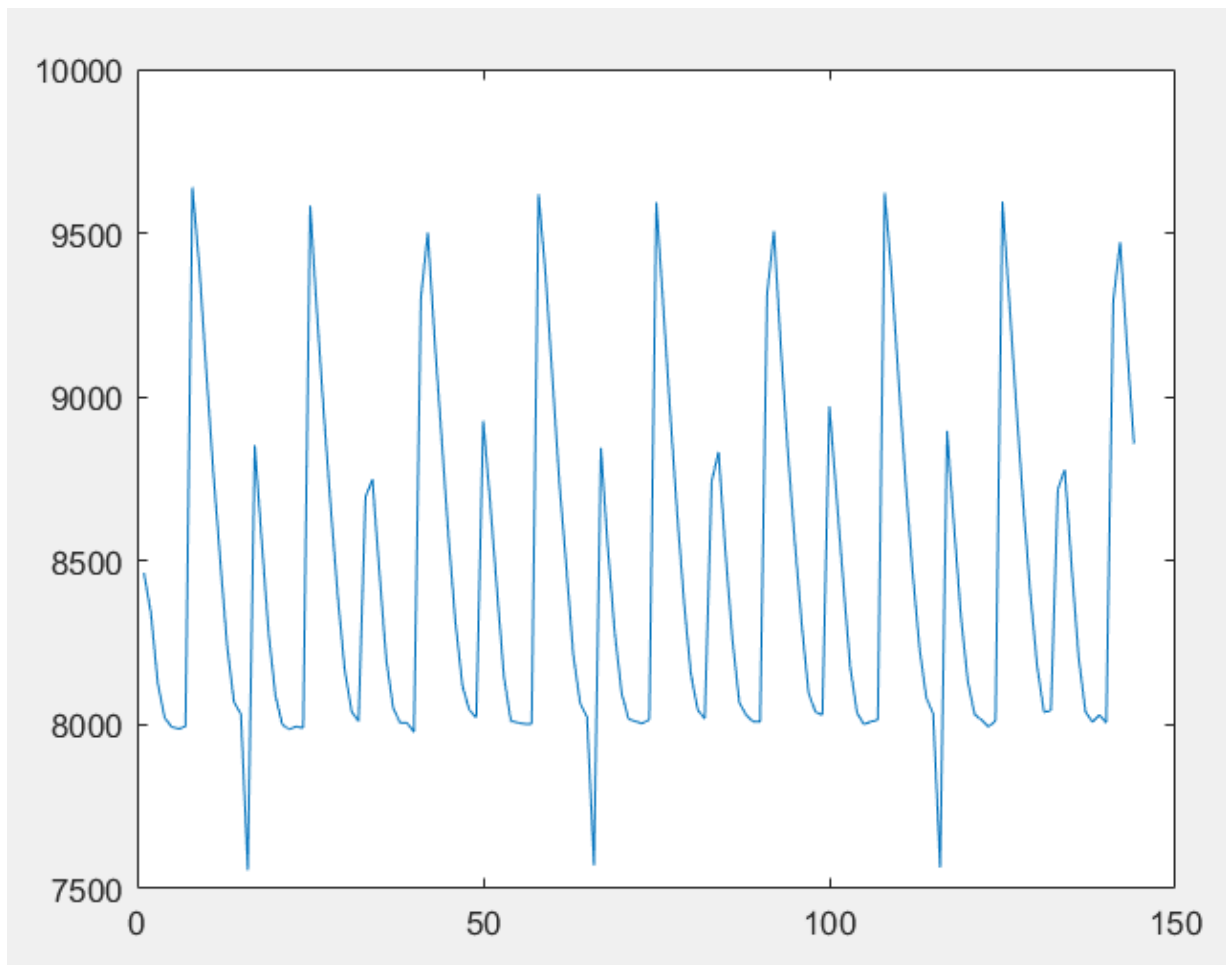


ARST_VREF=0.95V, CSA_VREF=0.62V, $\Delta V = 0.33V$
rise time: 2us, fall time: 20us

Topmetal-II- 像素不一致性



第五个像素



第六个像素