南京邮电大学
Nanjing University of Posts and Telecommunications

物理实验教学中心

Physics Experiment Center

Oscilloscope

Li Bin

NJUPT

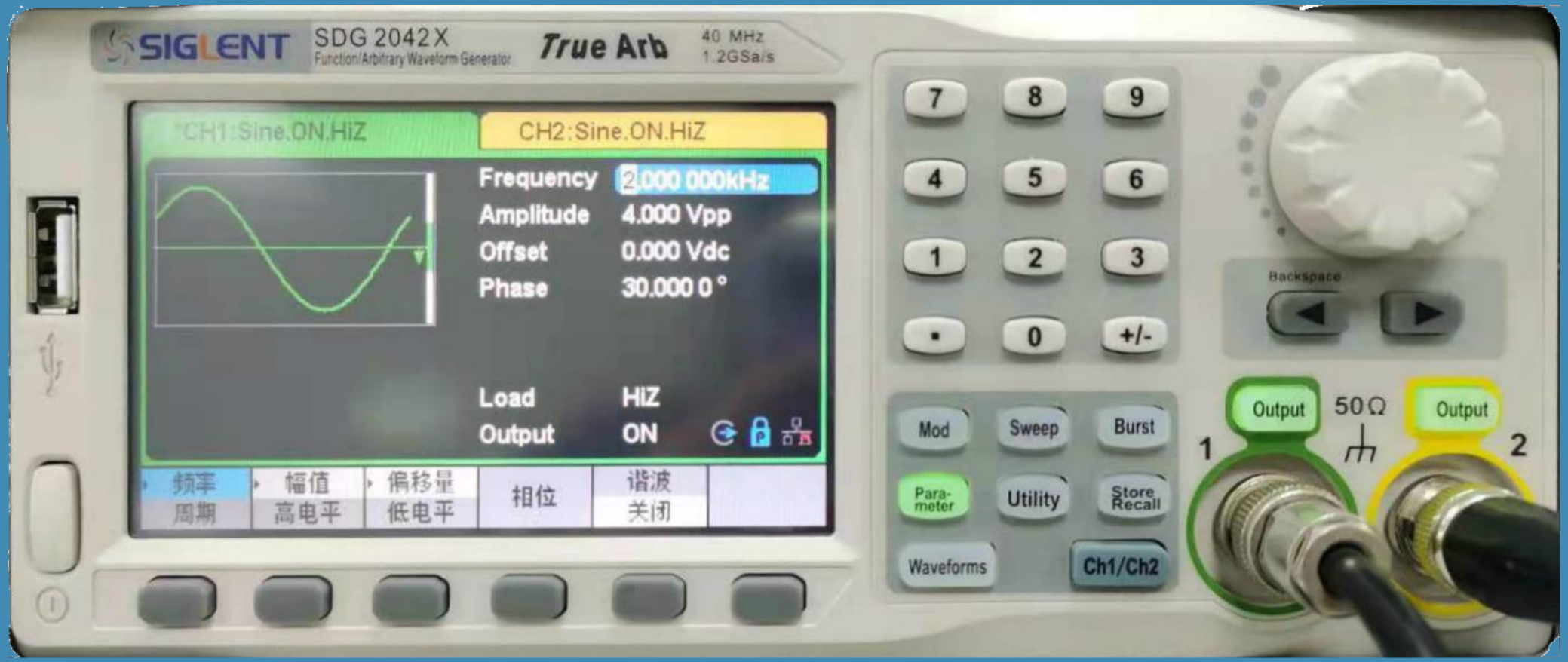
Experimental Goals

1. Adjustment and use of oscilloscope.

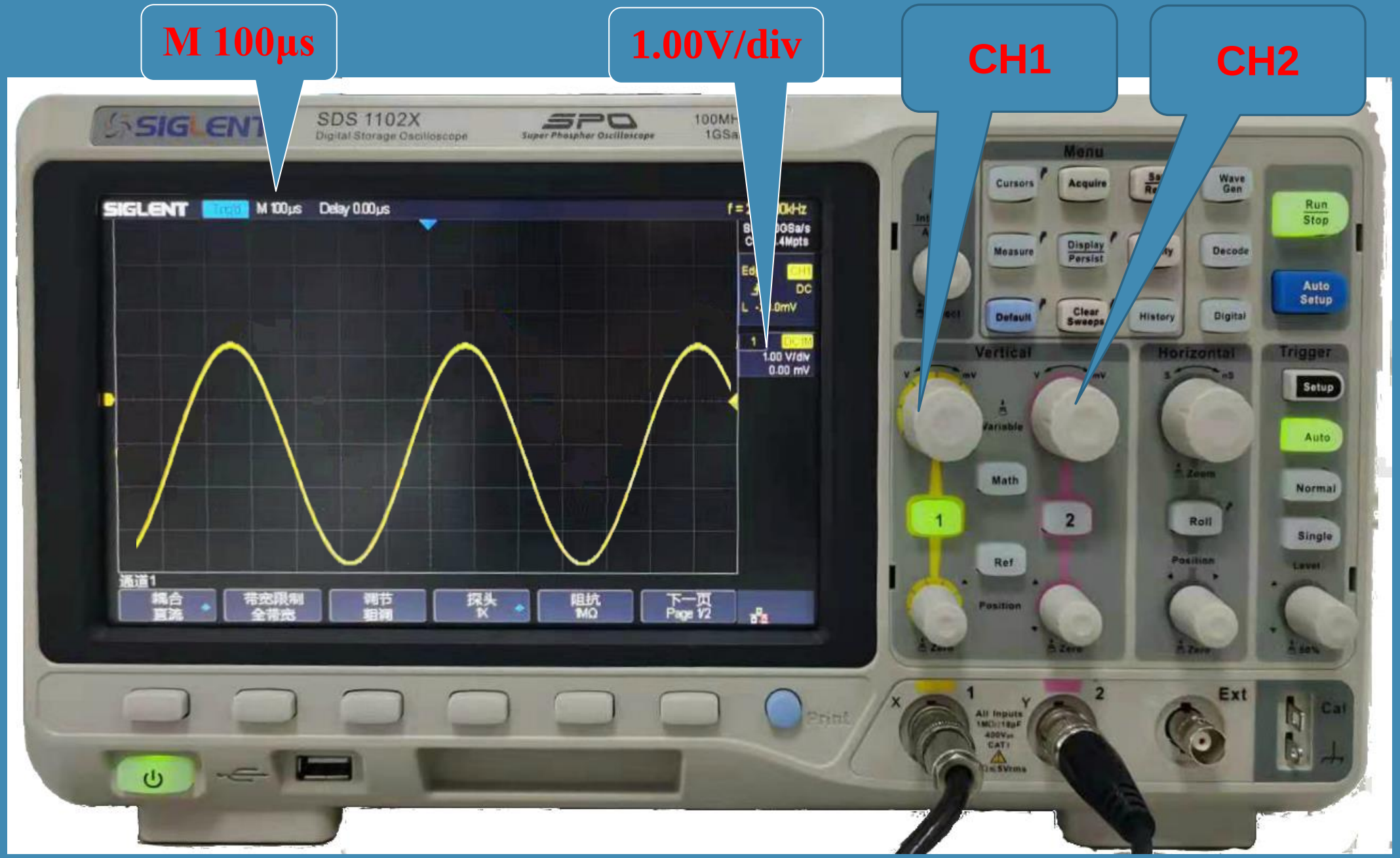
2. Learn to use oscilloscope to observe voltage waveform.

3. Observation of Lissajous figures.

SDG 2042X Signal generator



SDS 1102X Oscilloscope



Steps:

1. Settings of Signal generator:

Set CH1：
Frequence: 1.000000KHz;
Vpp/ Amplitute: 5.000V；
Phase:0.000。
output 1；

2. Observe voltage waveform on Oscilloscope

Power on → Channel 1→ Default (blue)→ Auto setup (blue)

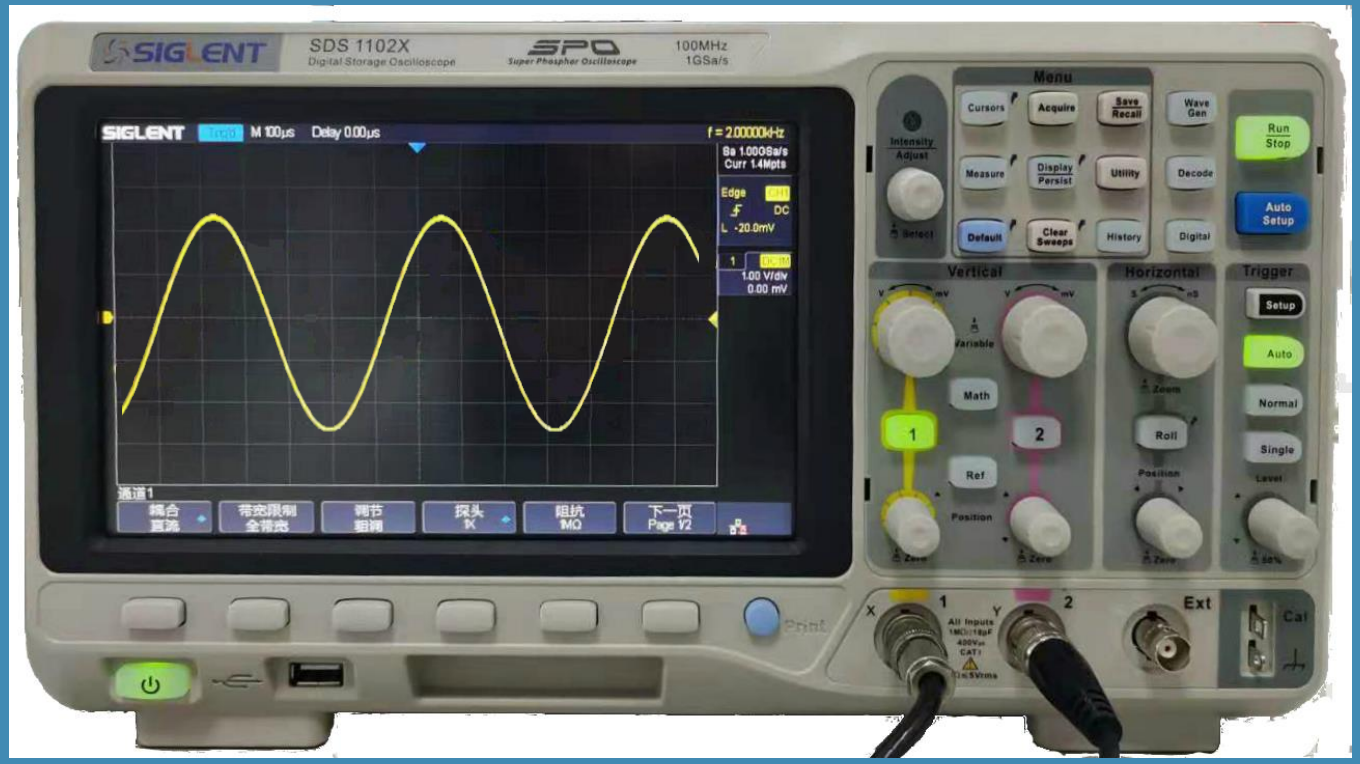
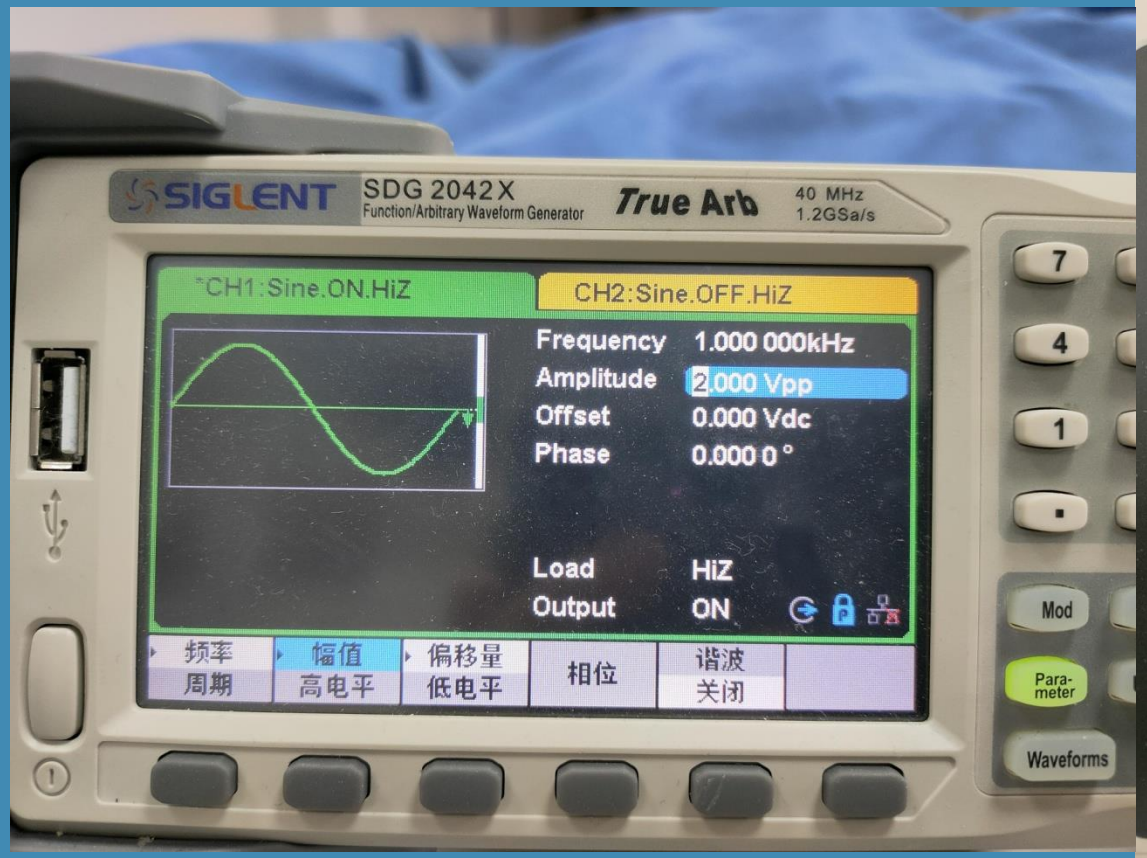


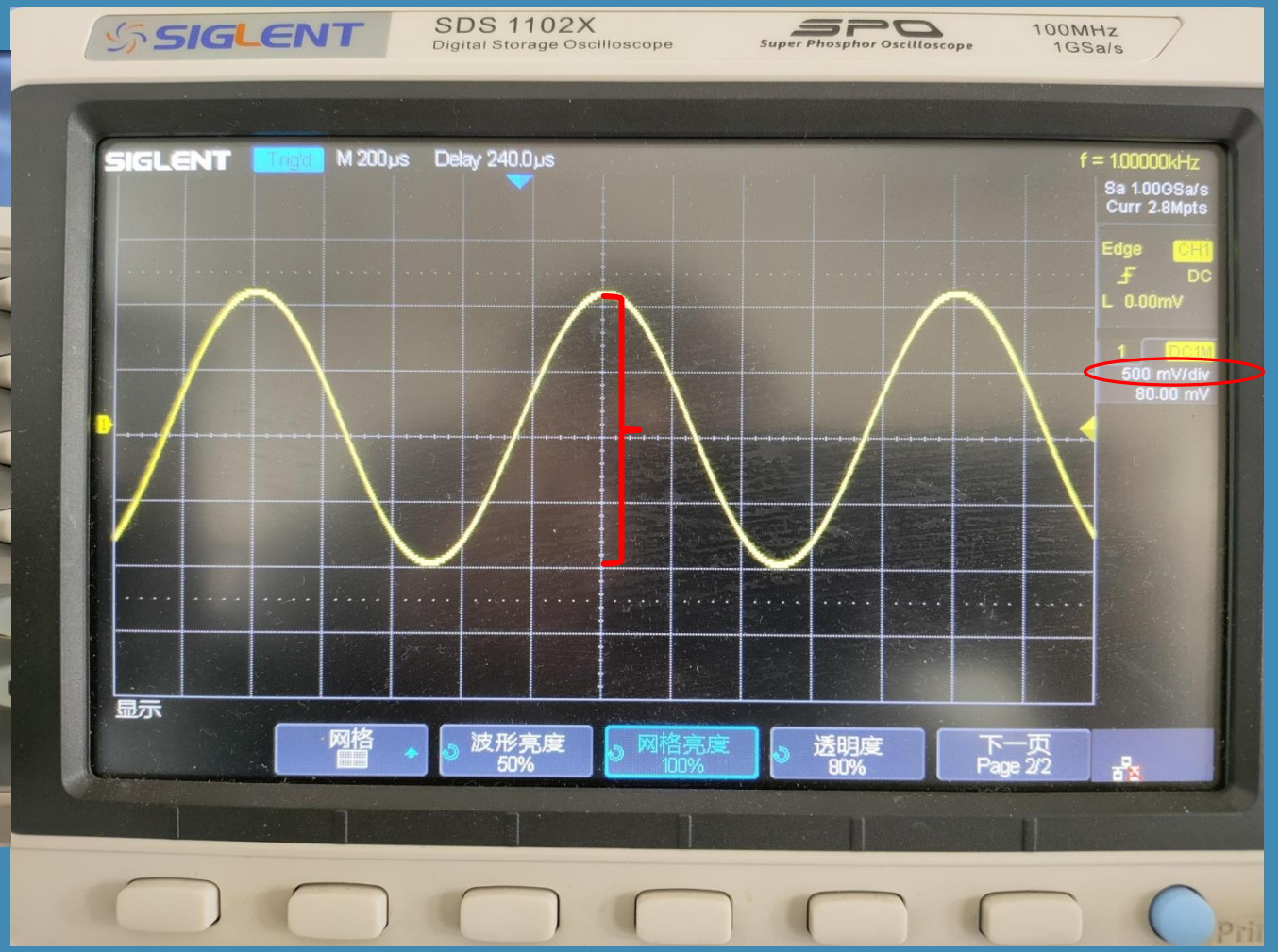
Table 1. The voltage of sinusoidal signals

NO.	Voltage (V)	Sensitivity of Y axis: S_y (V/div)	D_y(div)	U_{p-p}(v)	U_p(v)	U (v)
1	2.0					
2	3.5					
3	5.0					
4	8.0					

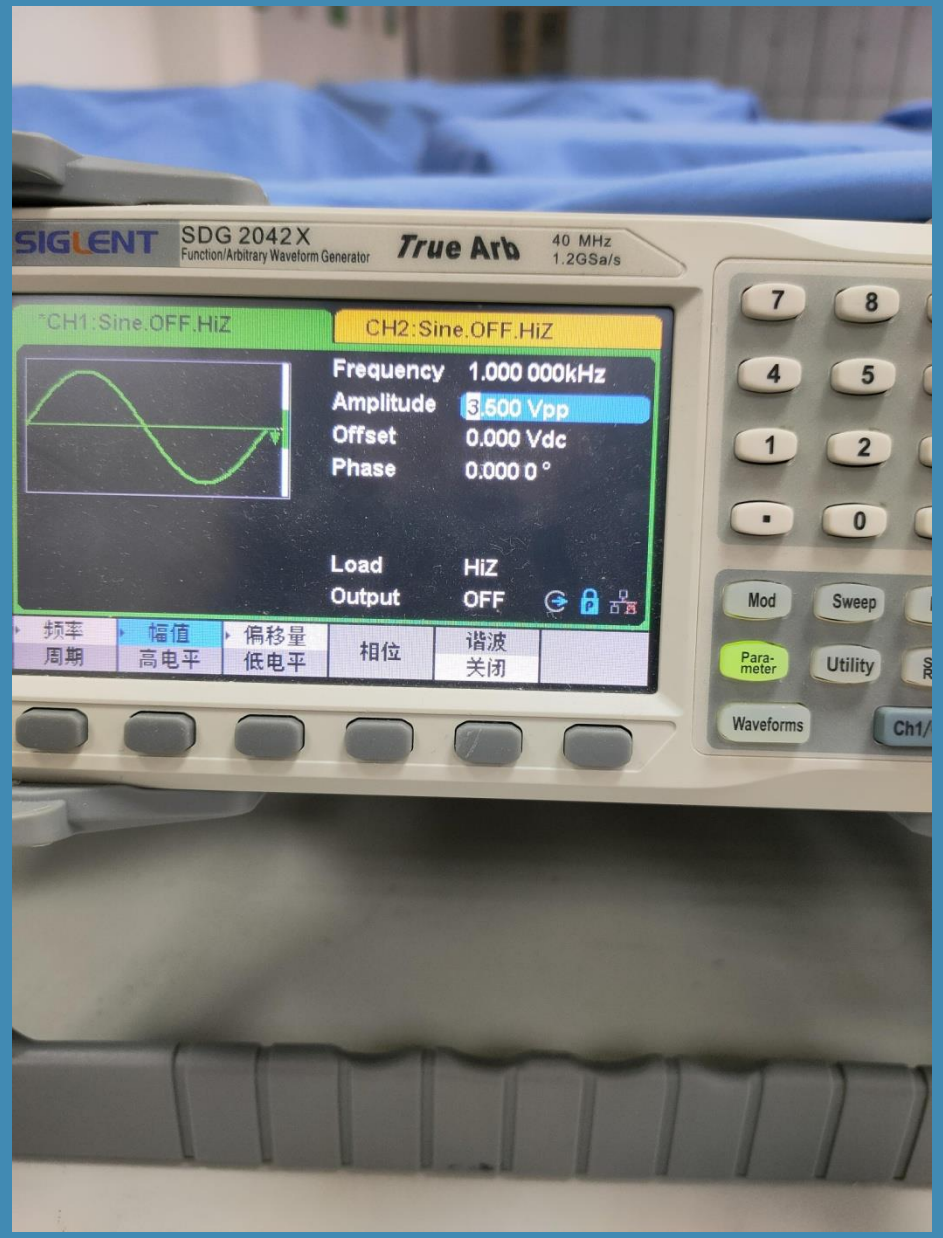
$S_y * D_y = \text{Voltage} = U_{p-p}$ $\quad U_p = \frac{1}{2} U_{p-p} = \sqrt{2}U$

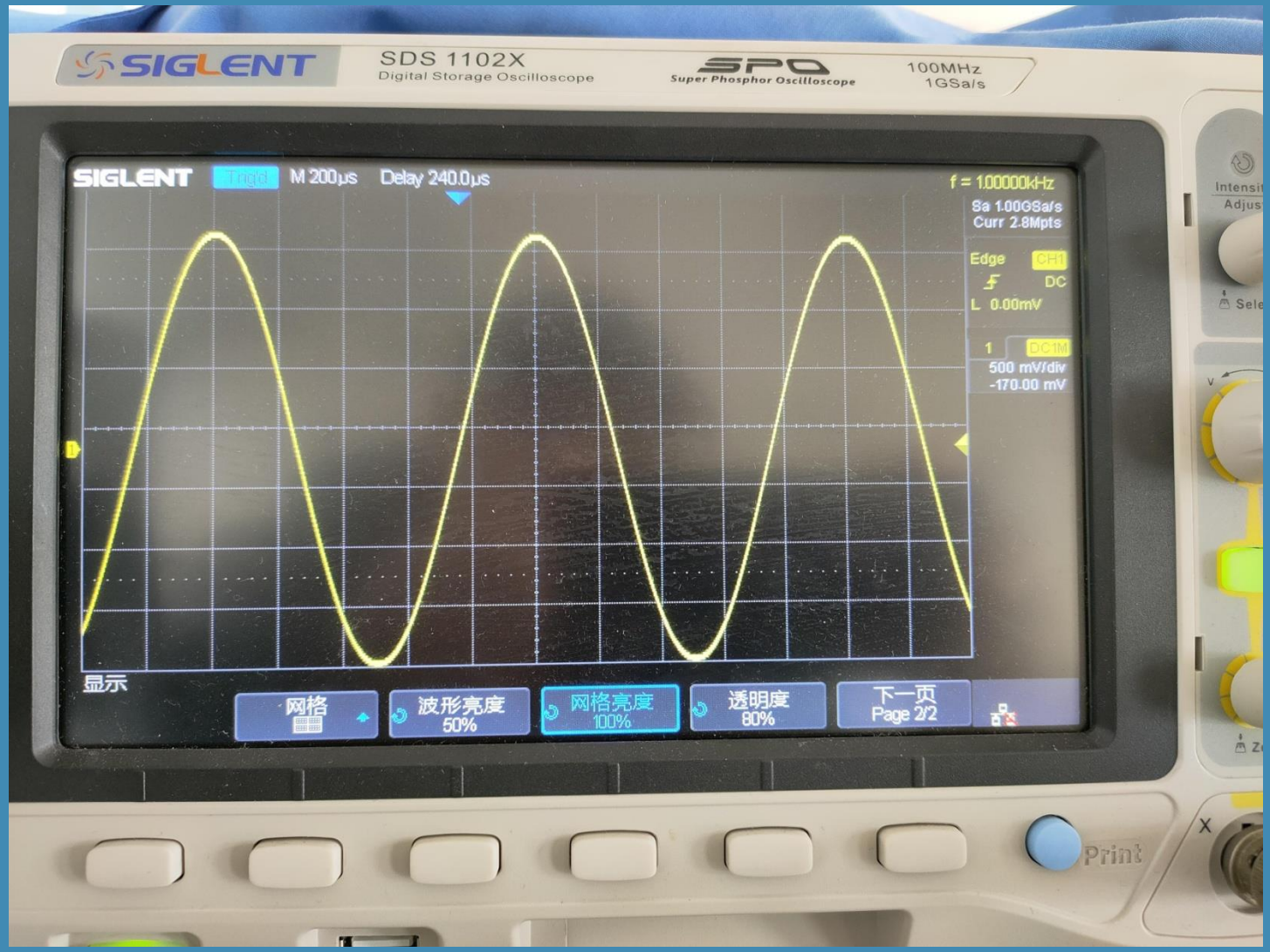
Voltage：2.0 V


SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
*CH1:Sine.ON.HiZ
CH2:Sine.OFF.HiZ
Frequency 1.000 000kHz
Amplitude 2.000 Vpp
Offset 0.000 Vdc
Phase 0.000 0 °
Load HiZ
Output ON
频率 周期
幅值 高电平
偏移量 低电平
相位
谐波 关闭
Mod
Para-meter
Waveforms

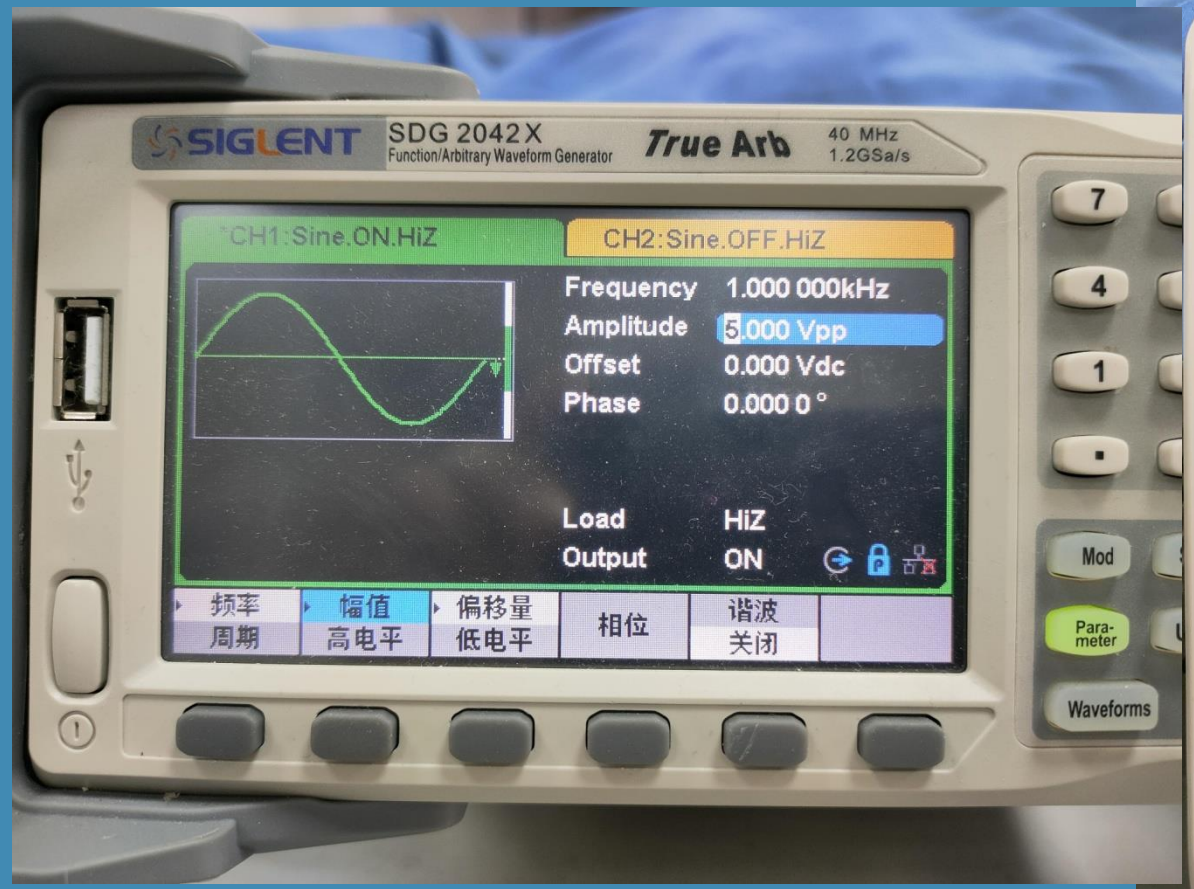

SIGLENT
SDS 1102X
Digital Storage Oscilloscope
SPO
Super Phosphor Oscilloscope
100MHz
1GSa/s
M 200µs
Delay 240.0µs
f = 1.00000kHz
Sa 1.00GSa/s
Curr 2.8Mpts
Edge
DC
L 0.00mV
500 mV/div
80.00 mV
显示
网格
波形亮度 50%
网格亮度 100%
透明度 80%
下一页 Page 2/2

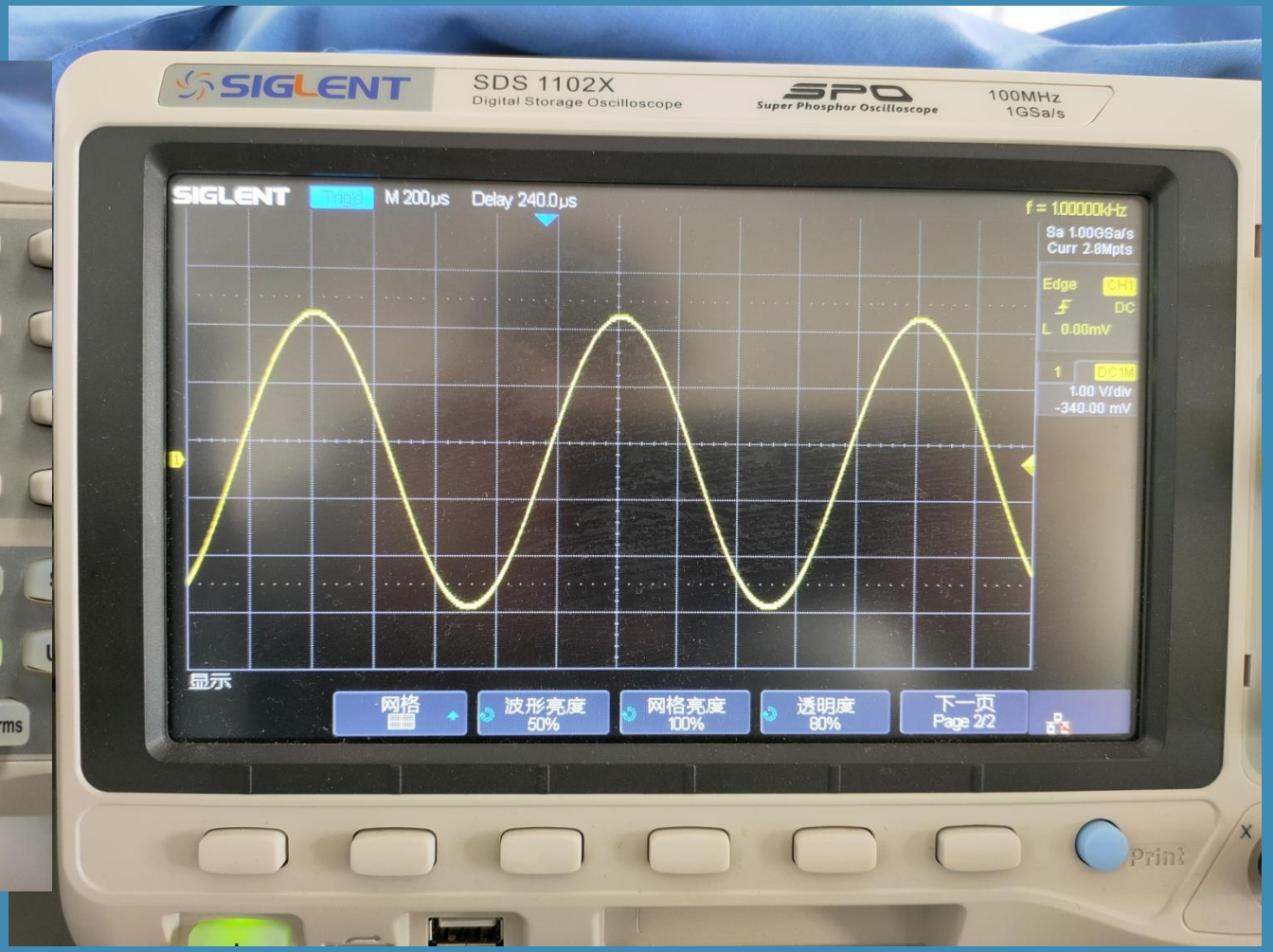
Voltage： 3.5 V


SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
CH1:Sine.OFF.HiZ
CH2:Sine.OFF.HiZ
Frequency 1.000 000kHz
Amplitude 3.500 Vpp
Offset 0.000 Vdc
Phase 0.000 0 °
Load HiZ
Output OFF
频率 周期
幅值 高电平
偏移量 低电平
相位
谐波 关闭
Mod
Sweep
Para-meter
Utility
Waveforms


SIGLENT
SDS 1102X
Digital Storage Oscilloscope
SPO
Super Phosphor Oscilloscope
100MHz
1GSa/s
SIGLENT
Trig'd
M 200µs
Delay 240.0µs
f = 1.00000kHz
Sa 1.00GSa/s
Curr 2.8Mpts
Edge
CH1
DC
L 0.00mV
1
DC1M
500 mV/div
-170.00 mV
显示
网格
波形亮度 50%
网格亮度 100%
透明度 80%
下一页 Page 2/2
Print

Voltage： 5.0 V


SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
CH1:Sine.ON.HiZ
CH2:Sine.OFF.HiZ
Frequency 1.000 000kHz
Amplitude 5.000 Vpp
Offset 0.000 Vdc
Phase 0.000 0 °
Load HiZ
Output ON
频率 周期
幅值 高电平
偏移量 低电平
相位
谐波 关闭
Mod
Para-meter
Waveforms


SIGLENT
SDS 1102X
Digital Storage Oscilloscope
SPO
Super Phosphor Oscilloscope
100MHz
1GSa/s
M 200µs
Delay 240.0µs
f = 1.00000kHz
Sa 1.00GSa/s
Curr 2.8Mpts
Edge
DC
0.00mV
1.00 V/div
-340.00 mV
显示
网格
波形亮度 50%
网格亮度 100%
透明度 80%
下一页 Page 2/2
Print

Voltage： 8.0 V


SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
CH1:Sine.ON.HiZ
CH2:Sine.OFF.HiZ
Frequency 1.000 000kHz
Amplitude 8.000 Vpp
Offset 0.000 Vdc
Phase 0.000 0 °
Load HiZ
Output ON
频率 周期
幅值 高电平
偏移量 低电平
相位
谐波 关闭
7
4
1
Mod
Para-meter
Waveform

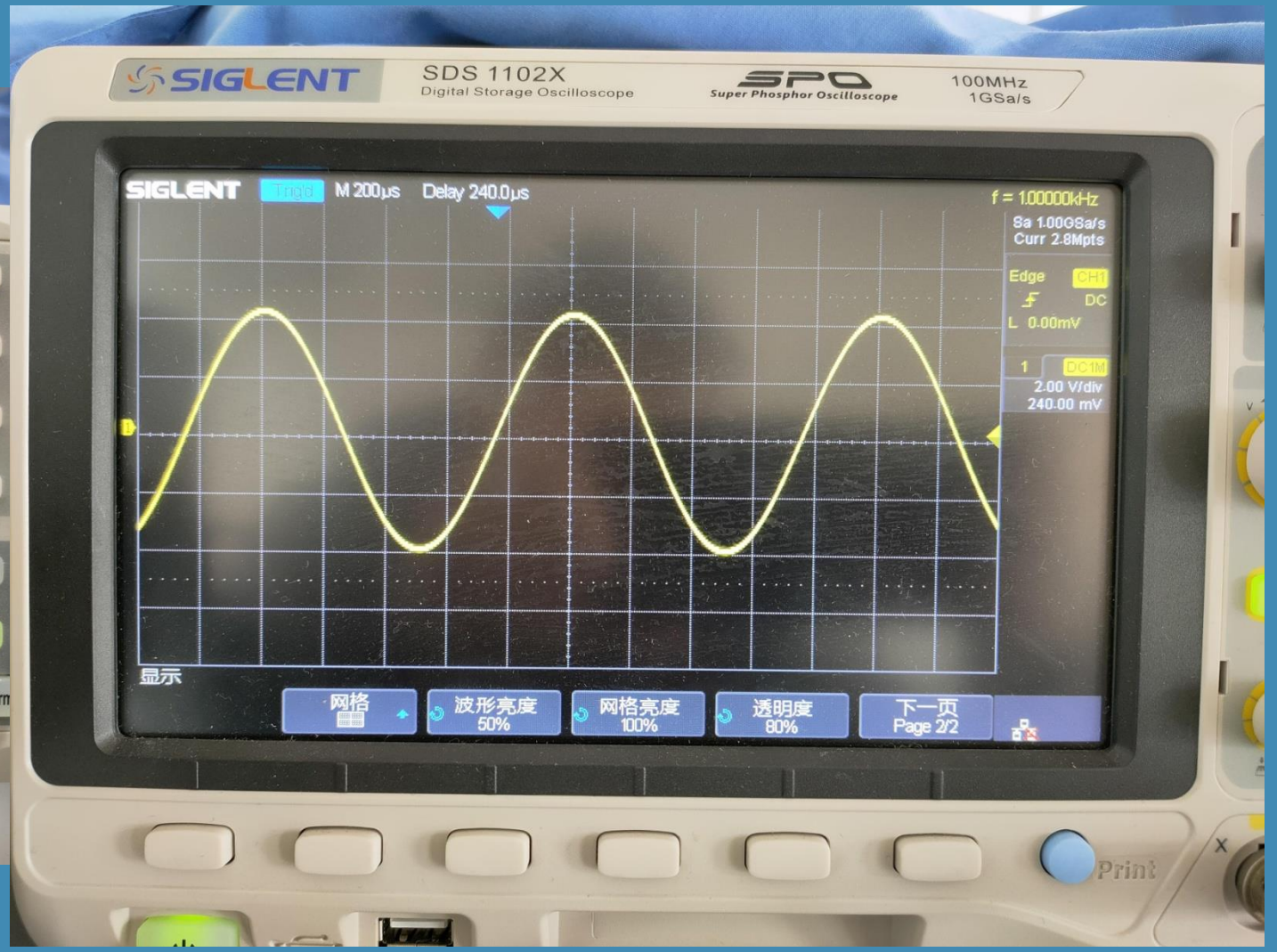

SIGLENT
SDS 1102X
Digital Storage Oscilloscope
SPO
Super Phosphor Oscilloscope
100MHz
1GSa/s
SIGLENT
Trig
M 200µs
Delay 240.0µs
f = 1.00000kHz
Sa 1.00GSa/s
Curr 2.8Mpts
Edge
CH1
DC
L 0.00mV
1
DC1M
2.00 V/div
240.00 mV
显示
网格
波形亮度 50%
网格亮度 100%
透明度 80%
下一页 Page 2/2
Print

Table 2. The period of sinusoidal signals

NO.	f（H_Z）	Sensitivity of X axis: S_x (us/div)	D_x (div)	T (us)
1	400			
2	2000			
3	8000			
4	15000			

$S_x * D_x = 1/f = T$

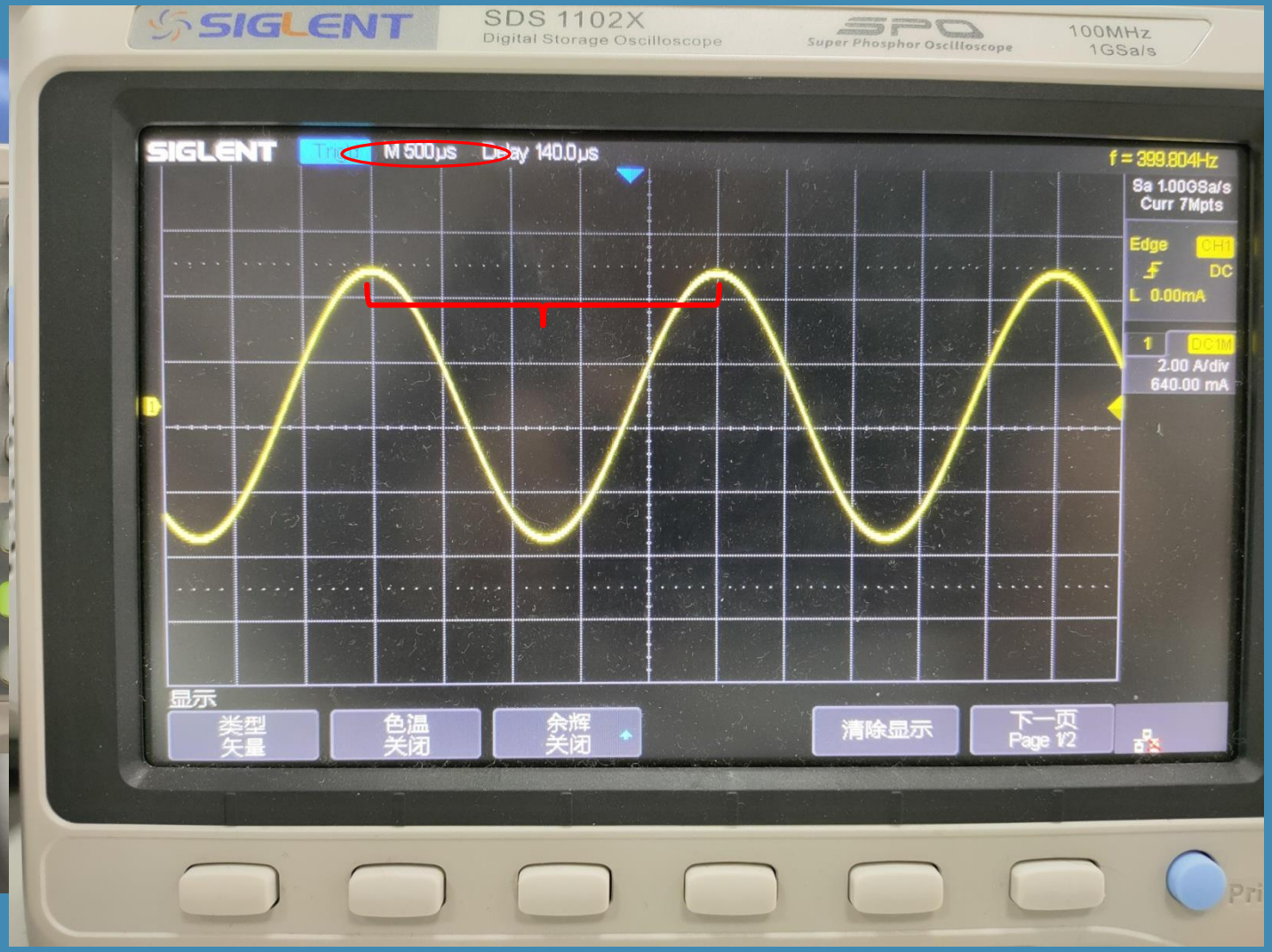
1 ms = 10^{-3} s

1 us = 10^{-6} s

1 Hz = 1 s^{-1}

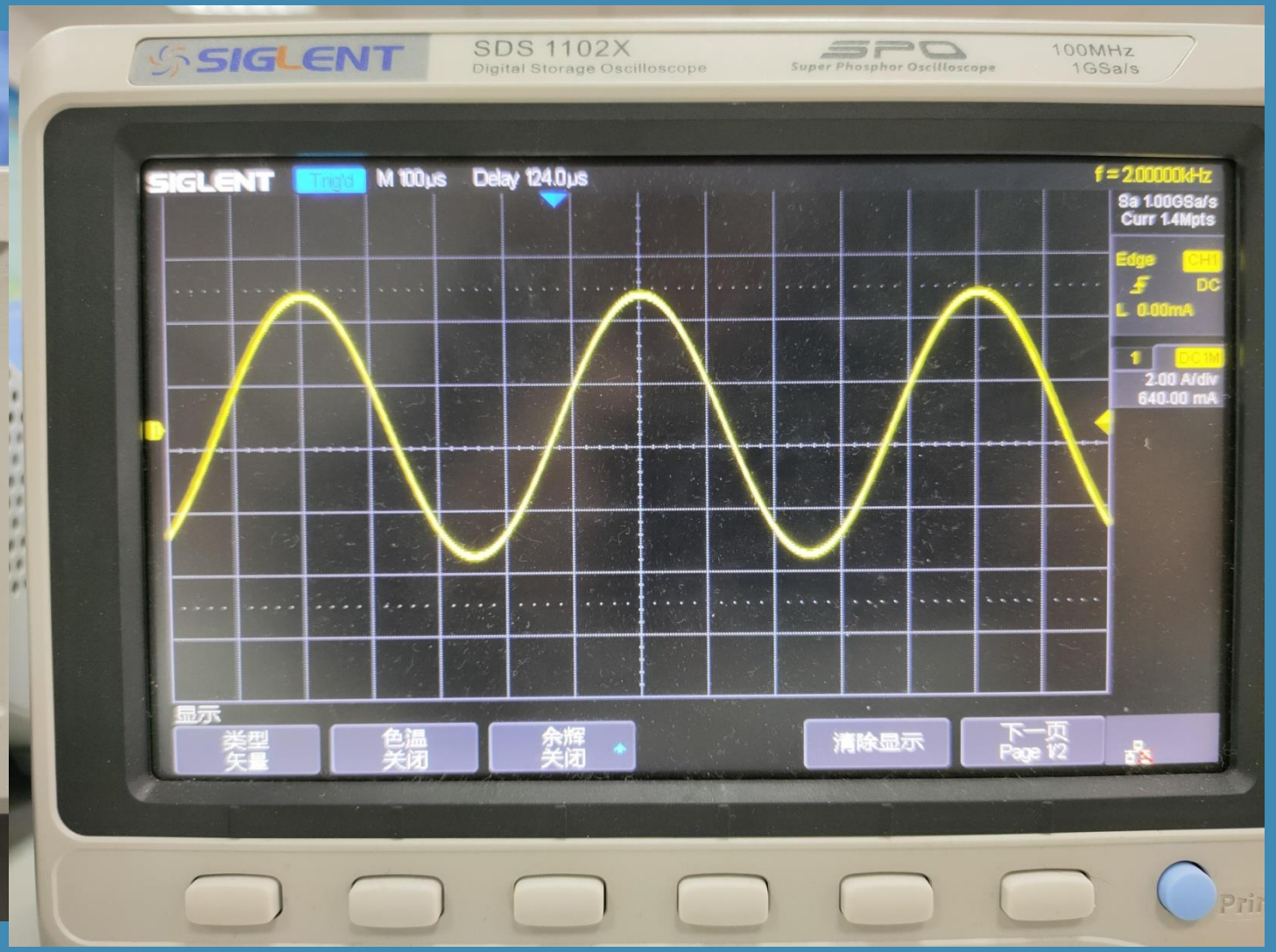
f: 400 Hz


SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
CH1:Sine.ON.HiZ
CH2:Sine.OFF.HiZ
Frequency 400.000 000 Hz
Amplitude 8.000 Vpp
Offset 0.000 Vdc
Phase 0.000 0 °
Load HiZ
Output ON
频率
周期
幅值
高电平
偏移量
低电平
相位
谐波
关闭


SIGLENT
SDS 1102X
Digital Storage Oscilloscope
Super Phosphor Oscilloscope
100MHz
1GSa/s
M 500µs
f = 399.804Hz
Sa 1.00GSa/s
Curr 7Mpts
Edge
DC
L 0.00mA
2.00 A/div
640.00 mA
显示
类型
矢量
色温
关闭
余辉
关闭
清除显示
下一页
Page 1/2

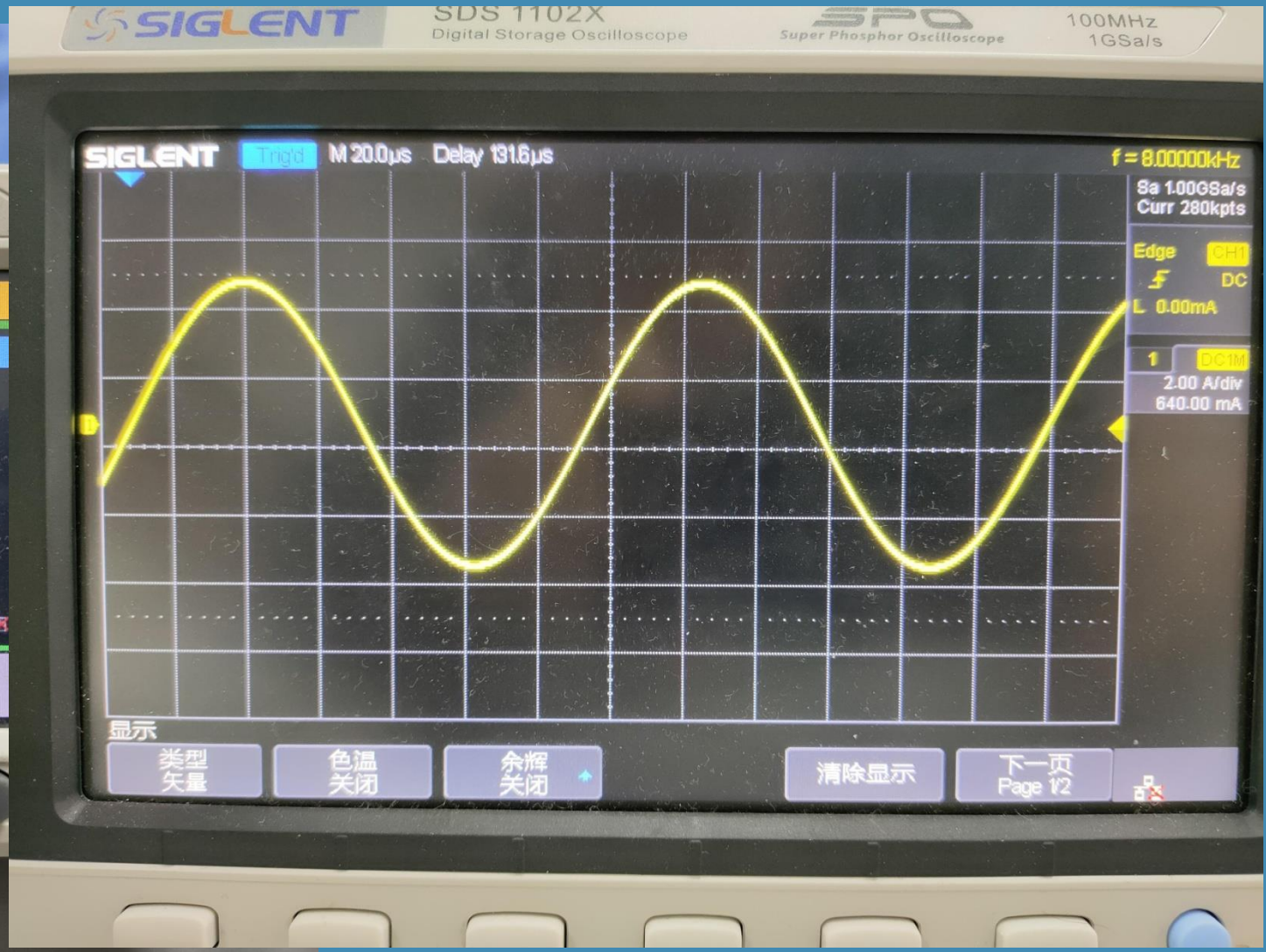
f: 2000 Hz


SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
*CH1:Sine.ON.HiZ
CH2:Sine.OFF.HiZ
Frequency 2.000 000kHz
Amplitude 8.000 Vpp
Offset 0.000 Vdc
Phase 0.000 0 °
Load HiZ
Output ON
频率
周期
幅值
高电平
偏移量
低电平
相位
谐波
关闭

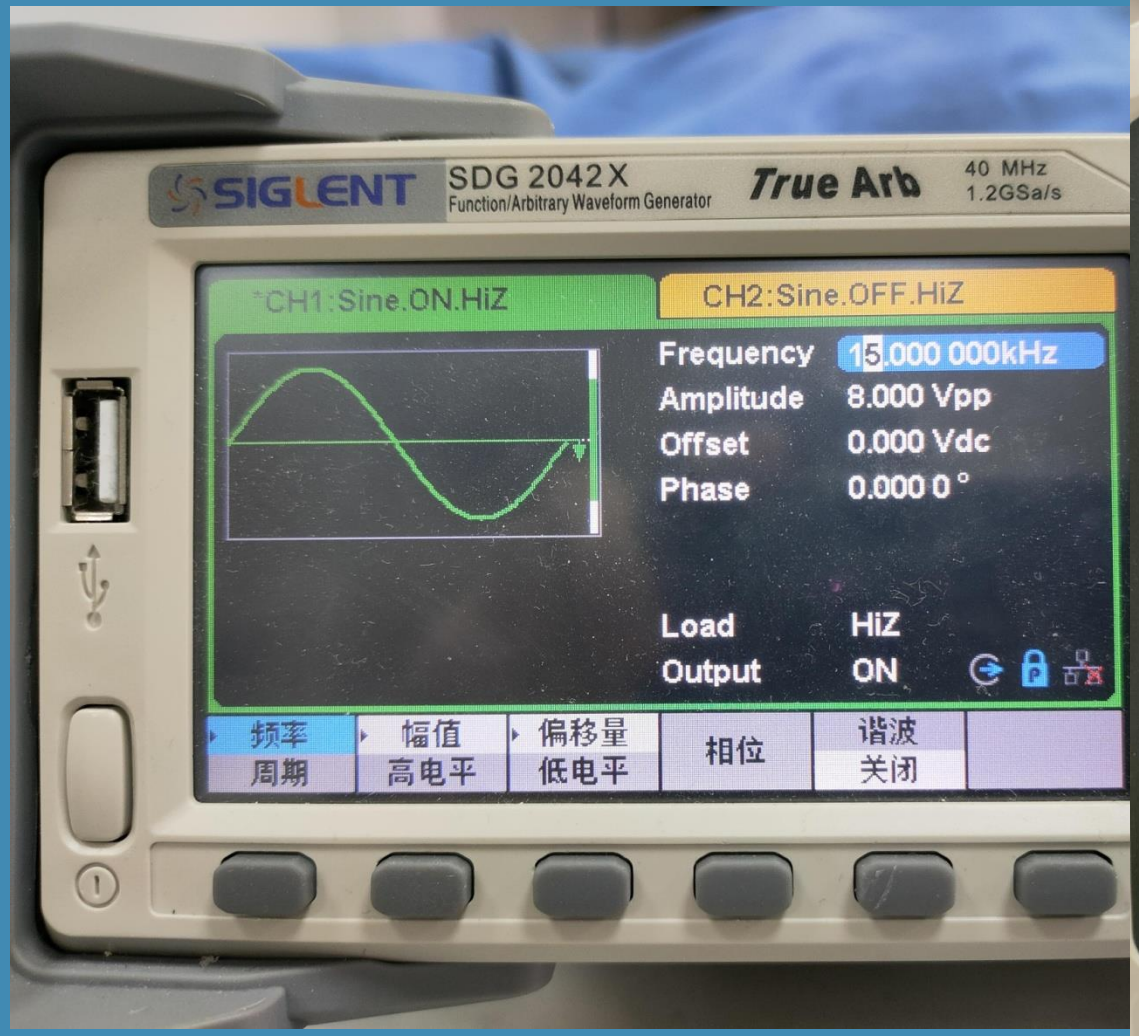

SIGLENT
SDS 1102X
Digital Storage Oscilloscope
SPO
Super Phosphor Oscilloscope
100MHz
1GSa/s
M 100µs
Delay 124.0µs
f=2.00000kHz
Sa 1.00GSa/s
Curr 1.4Mpts
Edge
DC
2.00 A/div
640.00 mA
显示
类型
矢量
色温
关闭
余辉
关闭
清除显示
下一页
Page 1/2

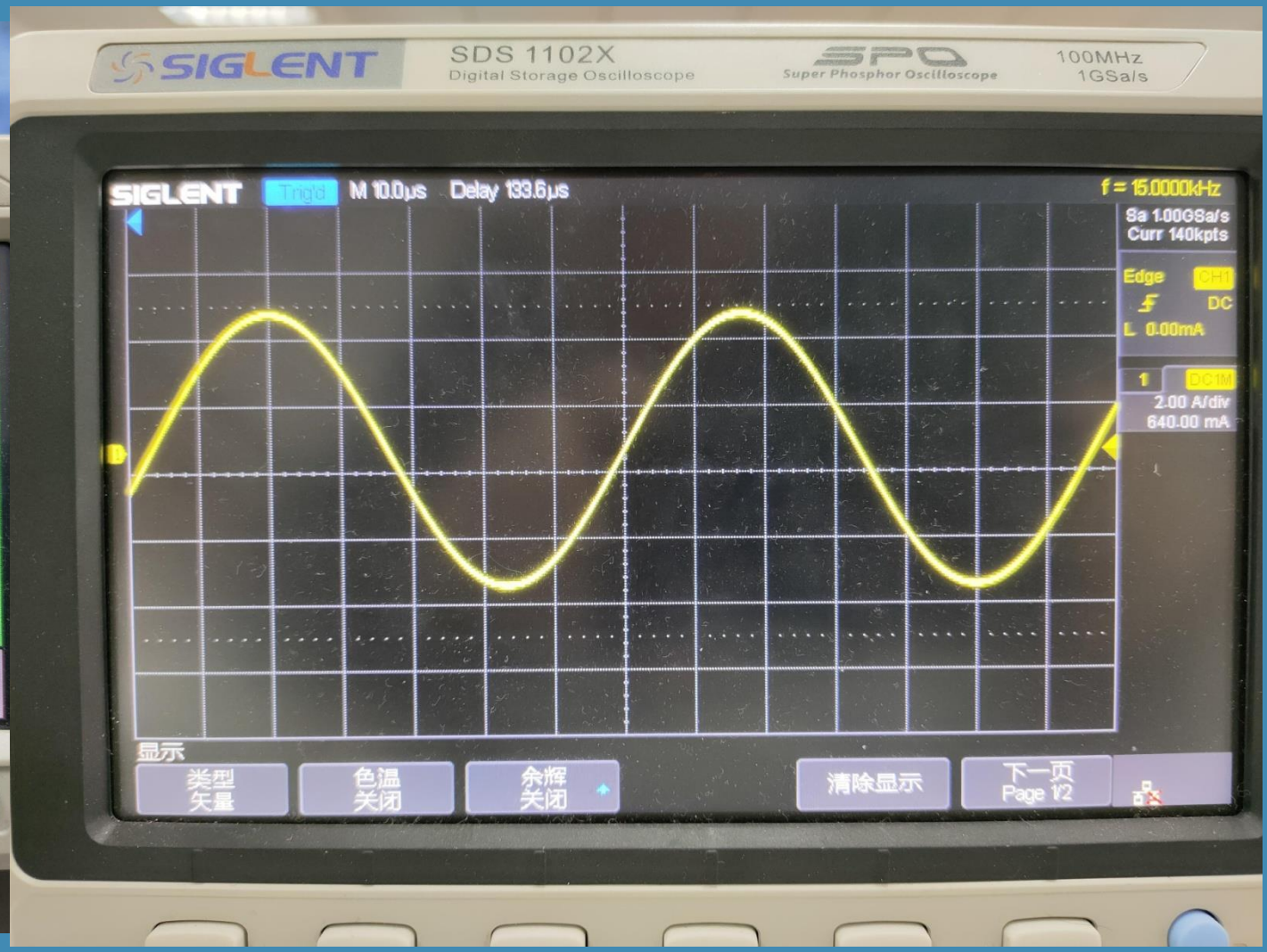
f：8000 Hz


SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
*CH1:Sine.ON.HiZ
CH2:Sine.OFF.HiZ
Frequency 8.000 000kHz
Amplitude 8.000 Vpp
Offset 0.000 Vdc
Phase 0.000 0 °
Load HiZ
Output ON
频率 周期
幅值 高电平
偏移量 低电平
相位
谐波 关闭

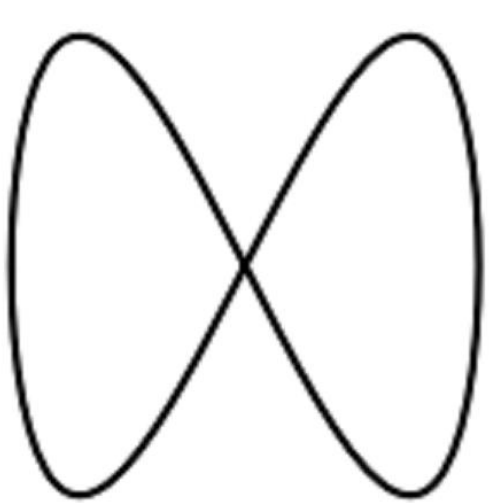

SIGLENT
SDS 1102X
Digital Storage Oscilloscope
Super Phosphor Oscilloscope
100MHz
1GSa/s
SIGLENT
Trig'd
M 20.0µs
Delay 131.6µs
f = 8.000000kHz
Sa 1.00GSa/s
Curr 280kpts
Edge
CH1
DC
0.00mA
1
DC1M
2.00 A/div
640.00 mA
显示
类型 矢量
色温 关闭
余辉 关闭
清除显示
下一页 Page 1/2

f：15000 Hz

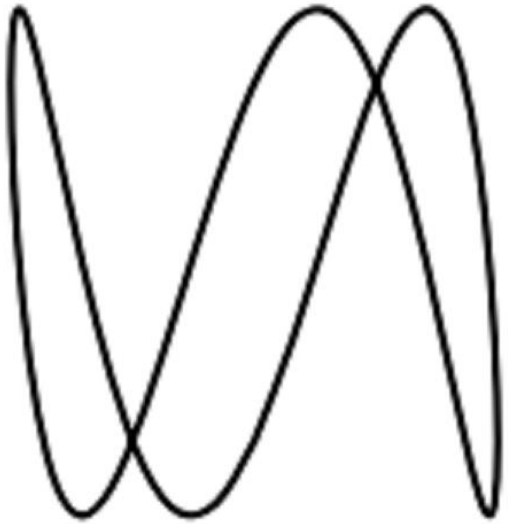

SIGLENT
SDG 2042X
Function/Arbitrary Waveform Generator
True Arb
40 MHz
1.2GSa/s
*CH1:Sine.ON.HiZ
CH2:Sine.OFF.HiZ
Frequency
15.000 000kHz
Amplitude
8.000 Vpp
Offset
0.000 Vdc
Phase
0.000 0 °
Load
HiZ
Output
ON
频率
周期
幅值
高电平
偏移量
低电平
相位
谐波
关闭


SIGLENT
SDS 1102X
Digital Storage Oscilloscope
SPO
Super Phosphor Oscilloscope
100MHz
1GSa/s
SIGLENT
Trig'd
M 10.0µs
Delay 133.6µs
f = 15.0000kHz
Sa 1.00GSa/s
Curr 140kpts
Edge
CH1
DC
0.00mA
2.00 A/div
640.00 mA
显示
类型
矢量
色温
关闭
余辉
关闭
清除显示
下一页
Page 1/2

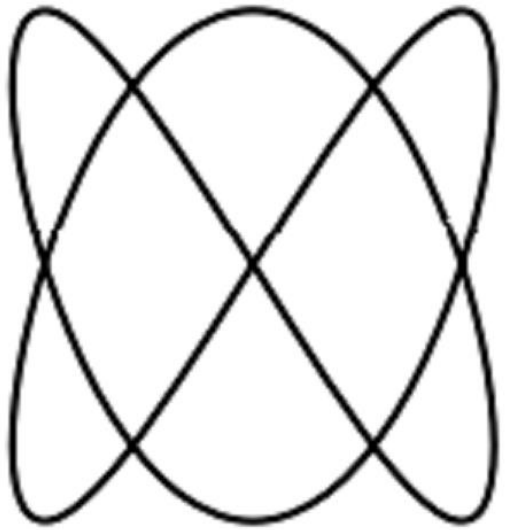
3. Lissajous figures



N_y：N_x=1:2



N_y：N_x=1:3



N_y：N_x=2:3

$$f_x : f_y = N_y : N_x$$

1 Signal generator：

Set：Ch1 and Ch2：

Ch1：3KHz，4V，0；

Ch2：6KHz，4V，0。

output 1 and 2

2 Oscilloscope

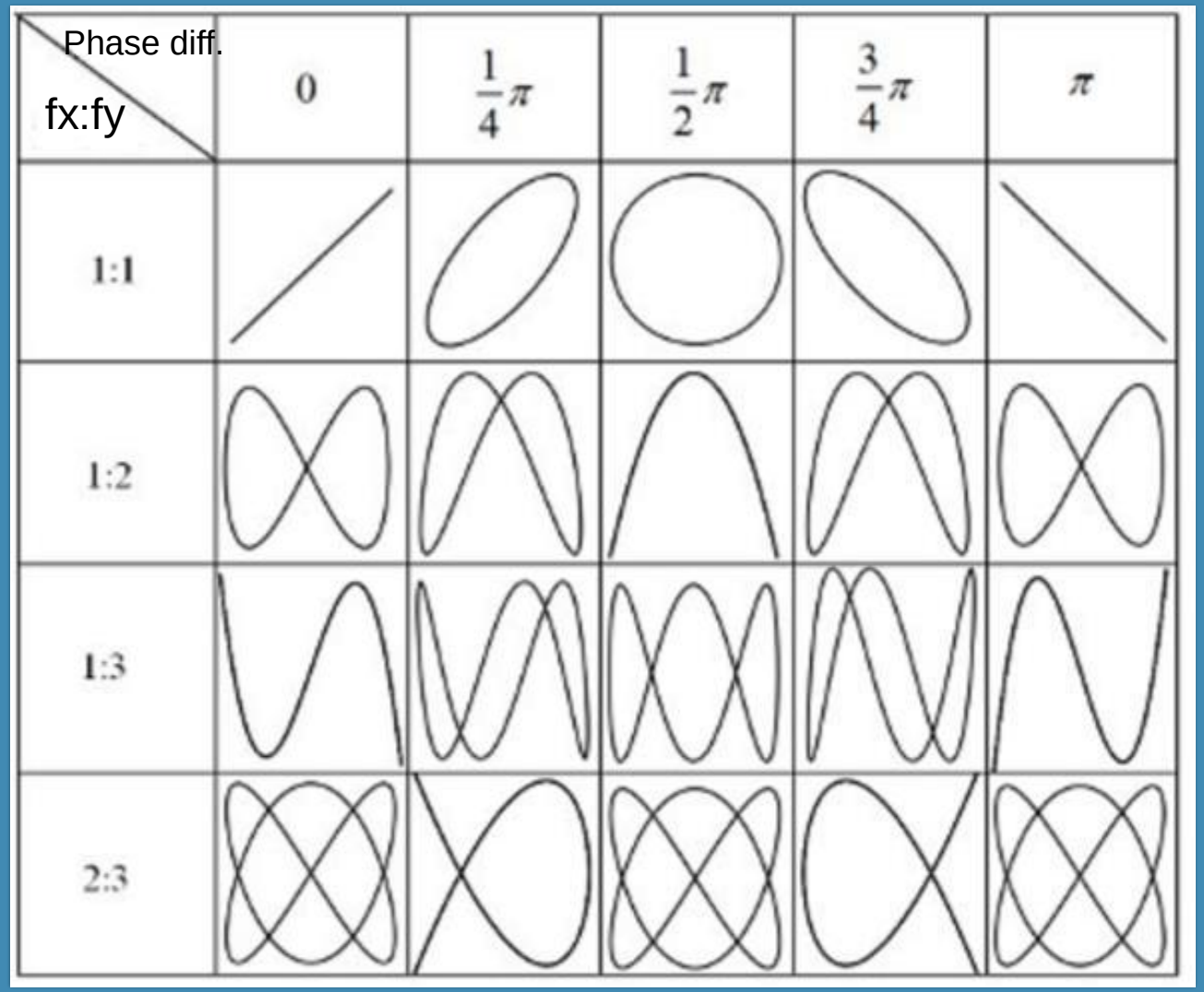
Open Ch1 and Ch2→Acquire→XY

Table 3. Plot Lissajous figures

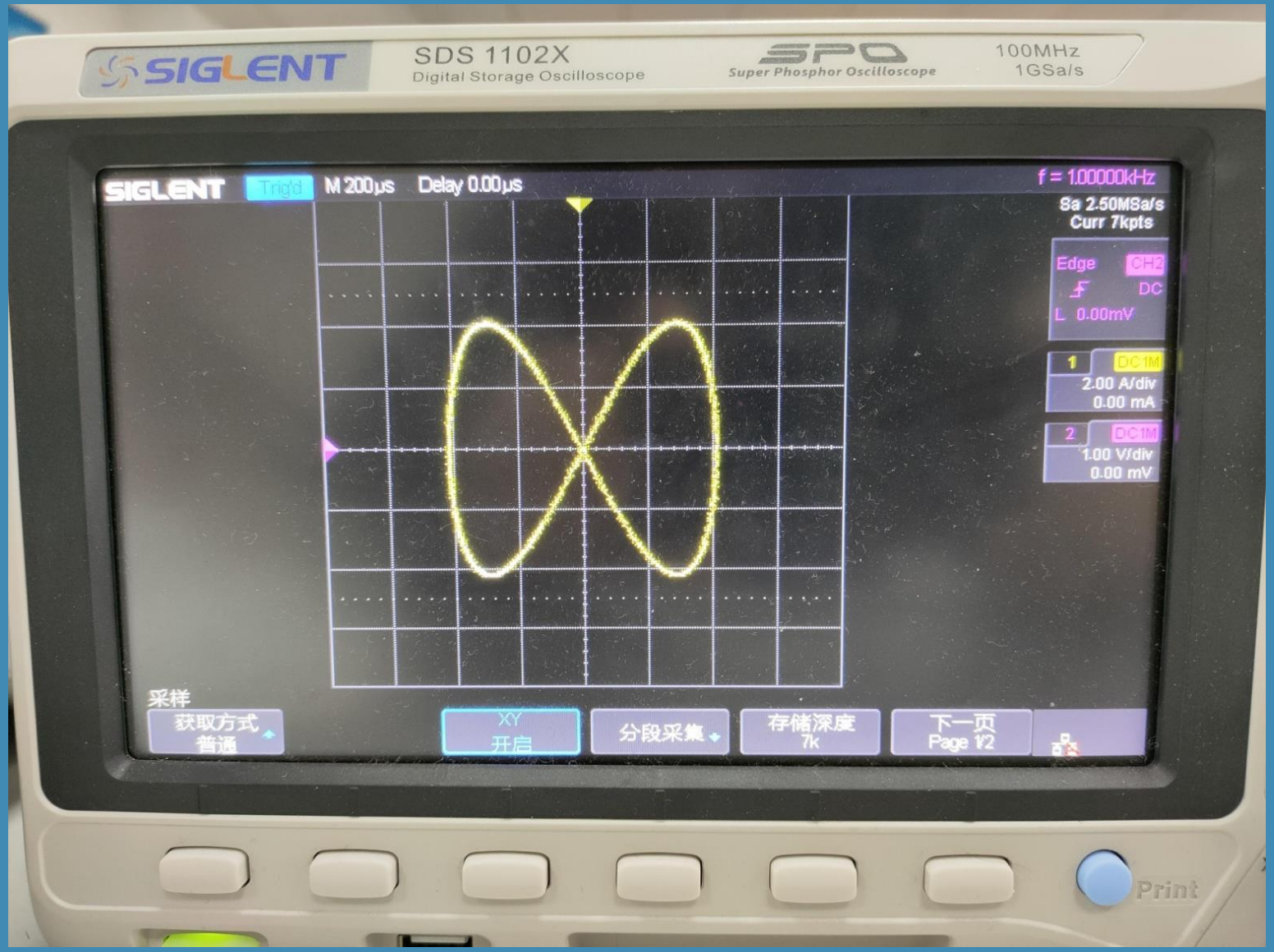
f_x= 3 kHz, f_y=6 kHz

Phase diff.	0°	45°	90°	135°	180°
Lissajous figures					

Some examples of Lissajous figures



Nx:Ny = 2:1, fx:fy=1:2




SIGLENT
SDS 1102X
True Arb

Here is the weblink of this slide:
https://github.com/bliseu/phylab/blob/master/Oscilloscope.pdf
Some useful links:
https://demonstrations.wolfram.com/LissajousFigures/
https://mathworld.wolfram.com/LissajousCurve.html
https://www.britannica.com/science/Lissajous-figure
https://github.com/bliseu/phylab/blob/master/LissajousCurveAnimation.m

1. Please calculate and finish the table on the slide,
2. Write a 500-word essay to describe the “The Oscilloscope”, and the “Lissajous curves”.

The DEADLINE is May 10, 2022.

END