Experiment 1—Experimental Report On The Use Of Common Electronic Instruments

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Course title：	Basic experiment of Logic and computer Design	Names of students in the same group：			
Experimental period：	2018-9-25	Experimental site：	Zijin Port East 4-509	Instructor：	Qijun Hong（洪奇军）

One. Purpose and requirements of the experiment

1.1 Understanding common electronic devices

1.2 Use of electronic instruments such as digital oscilloscope, digital signal generator (function signal generator), DC power supply, multimeter, etc.

1.3 Master the parameters of measuring pulse waveform, amplitude and frequency with digital oscilloscope

1.4 Master Digital Oscilloscope to measure the rising and falling edges, delay and other parameters of Pulse timing

1.5 Master multimeter to measure voltage, resistance and diode switching

Two. Experimental Content and Principle

2.1 Experimental Content

Recognition of Common Electronic Devices

Measurement of sinusoidal signal by oscilloscope

Measurement of output Voltage of YB1638 function signal Generator

DC Power supply in Measurement experiment Box

Measurement of One-way conduction characteristics of Diode

2.2 Experimental principles

2.2.1 Experimental Box Principle

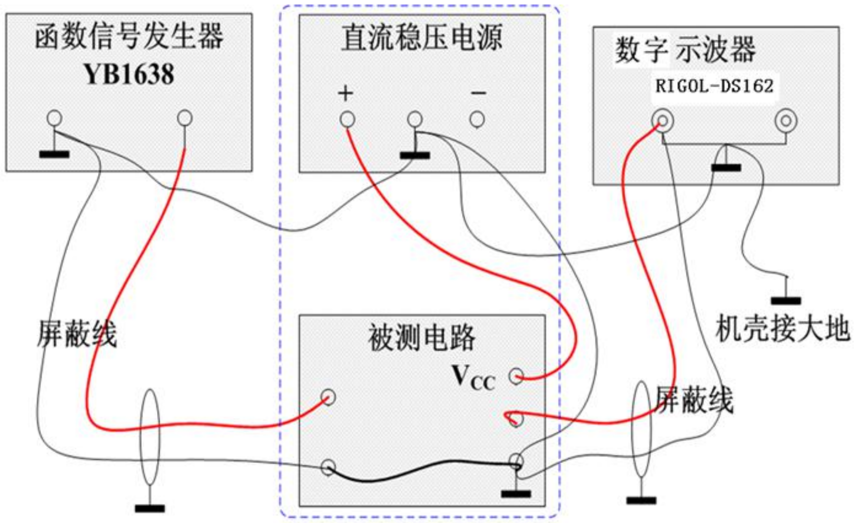


Figure 1 "DC Voltage stabilized Power supply Test Circuit" in the Experimental Box

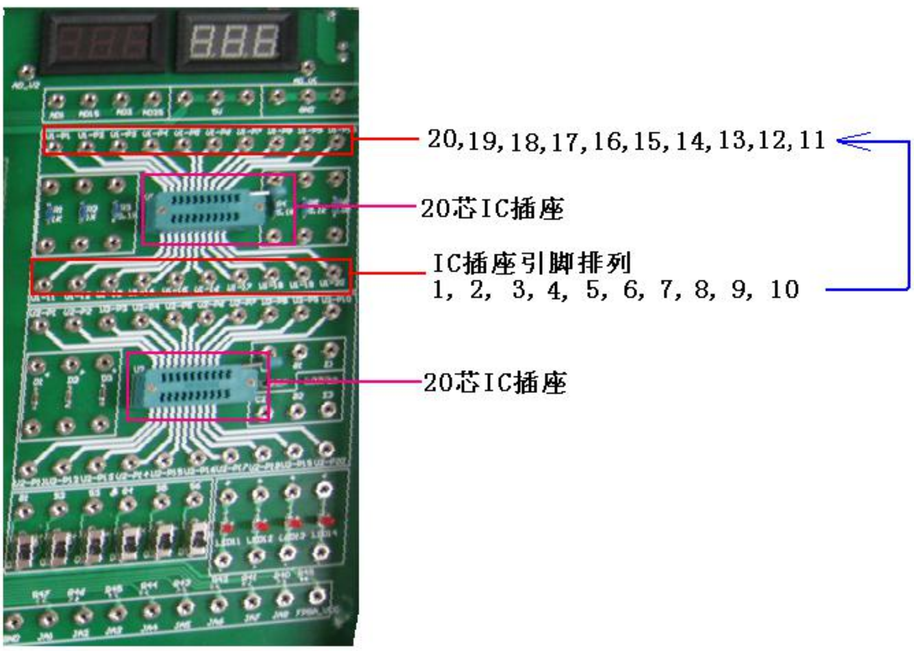
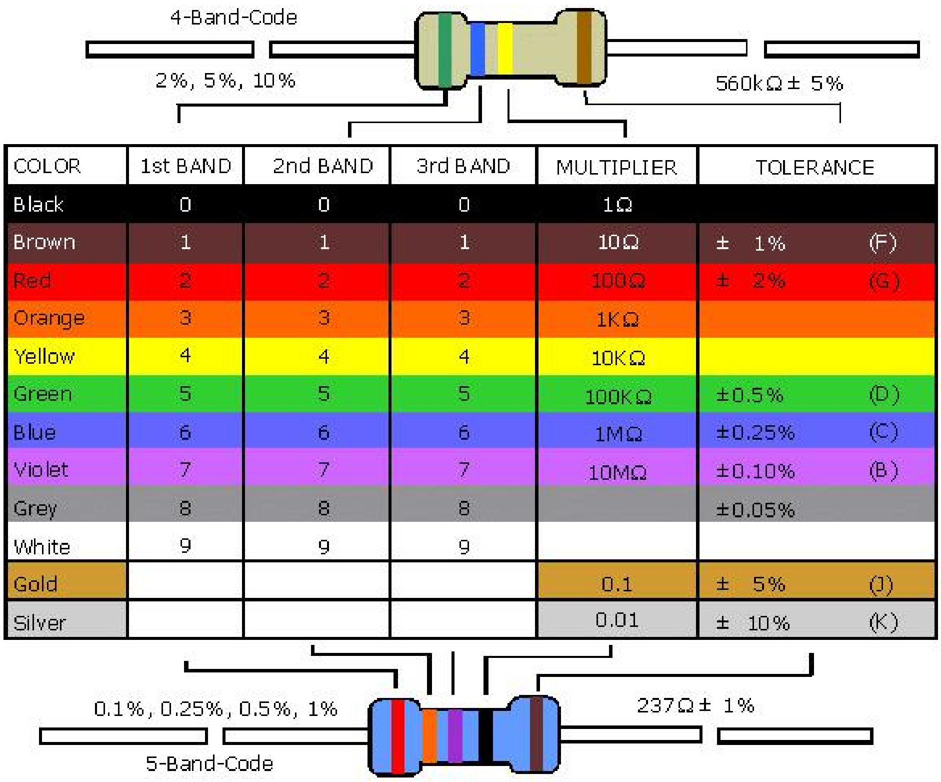


Figure 2 Circuit Design experiment Box

2.2.2 Resistance principle

Recognize resistance, identify resistance with color loop, measure resistance with multimeter



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	±0.5% (D)
Blue	6	6	6	1MΩ	±0.25% (C)
Violet	7	7	7	10MΩ	±0.10% (B)
Grey	8	8	8		±0.05%
White	9	9	9		
Gold				0.1	± 5% (J)
Silver				0.01	± 10% (K)

Figure 3 the corresponding chart of color ring and resistance value

·If there are four stripes： Section 1 / 2 indicates the resistance of the effective number, article 3 indicates the multiplier, and article 4 indicates the error.

·If there are five stripes： Article 1 / 2 / 3 represents the resistance of the effective number, article 4 indicates the multiplier, and article 5 indicates the error

2.2.3 Oscilloscope principle

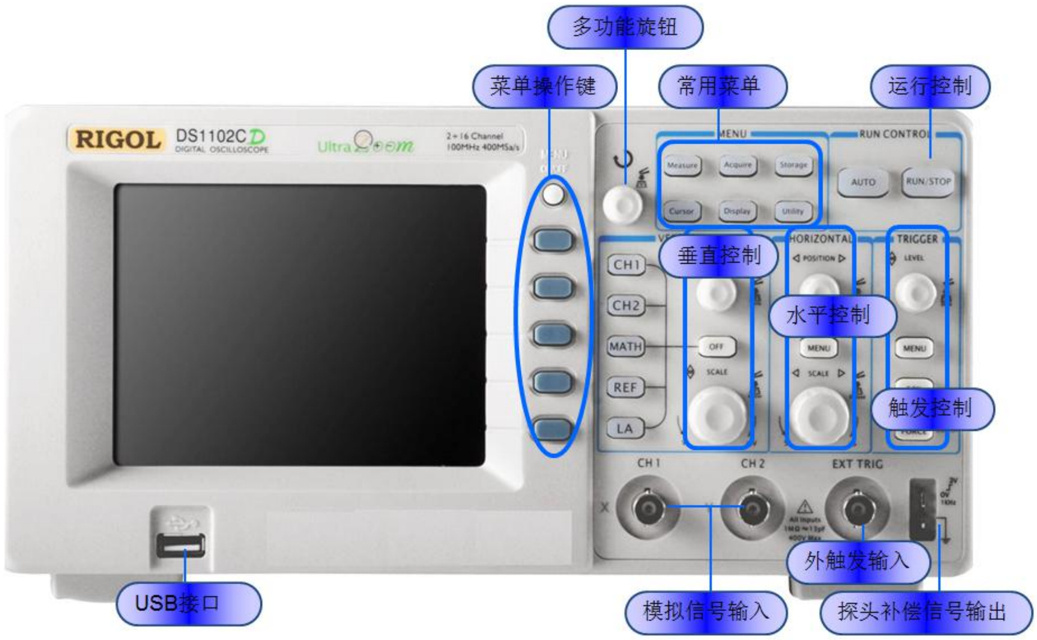


Chart 4 principle of oscilloscope

2.2.4 YB1638 signal Generator Panel structure

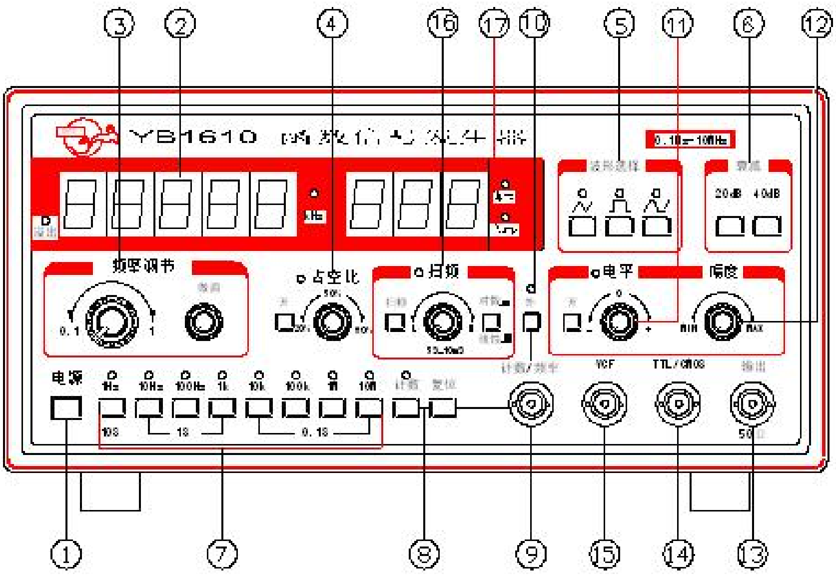


Fig. 5 YB1638 signal Generator Panel structure

1 is a power switch 2 is the display frequency value 3 is frequency fine-tuning. 5 is the output waveform selection

7 is the range of selected output frequencies 11 is the magnitude of the output.

13 is an outlet that can output three types of waveforms 14 is the output TTL logic level

2.2.5 Measurement of sinusoidal signals by oscilloscope

By selecting frequency range switch and frequency adjusting knob to make YB1638 function signal generator send out sinusoidal wave with frequency of 100Hz 10kHz and 100KHz respectively, the period and frequency of the above signal are measured by oscilloscope. And enter the data in the following table

	Function generator output	**Oscillograph reading**	**sensitivity**	**measured value**	
range		Div	V/Div	V	
Period / frequency	100 Hz	Div	ms/Div	ms	Hz
range		Div	V/Div	V	
Period / frequency	10 kHz	Div	μs/Div	μs	kHz
range		Div	V/Div	V	
Period / frequency	100 kHz	Div	μs /Div	μs	kHz

Figure 6 Experimental data fill in

2.2.6 Measurement of output Voltage of YB1638 signal Generator

- Let the signal generator output 1kHz 1 3V arbitrary sine wave signal, connect the output of the signal generator to the oscilloscope, and use the oscilloscope to measure the amplitude of the signal generator.
- Measuring the amplitude of a signal output from a signal Generator by using a Multimeter AC File
- Compare the converted effective value with the valid value read by the AC file in the multimeter

Function generator output frequency	**Oscilloscope reading value**		**Converted effective value**	**Multimeter read value**
1KHz	**div**	**V/div**	**V**	**V**

Chart 7 Experimental data fill in

- The output of the signal generator is connected to the multimeter, red positive, negative and negative. The multimeter is in the AC file, and the appropriate range is selected. By adjusting the amplitude knob, the multimeter can display 3V RMS.
- The output of the signal generator is connected to the oscilloscope to read the peak value.

$$有效值 = V_{P-P} / 2\sqrt{2}$$

2.2.7 DC power supply in measuring test box

- Insert red pen into V Ω mA Jack and black watch pen into COM Jack.
- The function switch range is placed in the DC range, the test pen is connected to the circuit to be tested, and the polarity of the end of the red meter pen is displayed on the display at the same time.
- Use oscilloscopes and multimeters to measure the output of a group of DC stabilized power sources on the experimental bench and record the results.

DC stabilized power output	Oscillograph reading	sensitivity	Oscilloscope conversion value	Multimeter reading
+5V	Div	V/Div	V	V

Figure 8 Experimental data fill in

2.2.8 One-way conduction characteristics of diodes measured by multimeter

- Insert the watch pen into the "COM" Jack, and the red meter into the "V Ω" Jack, where the red pen polarity is ".
- Put the multimeter function range switch in "position, connect the red and black meter pen to the two poles of the diode separately, if the display screen displays the number 0.6-0.7, the diode is forward conduction at this time, the number that displays is the voltage of the PN junction," The red-watch pen is connected to the positive pole of the diode, and the black-watch pen is connected to the negative pole. If the number displayed on the display is "1", the diode ends in reverse, the red pen is connected with the diode negative, and the black one is connected with the positive pole.

Three. Main instrument and equipment

1.	digital oscilloscope RIGOL-DS162	1 unit
2.	function generator YB1638	1 unit
3.	digital multimeter	1
4.	Circuit design test box	1 unit

Four. Operating methods and experimental steps

4.1 Measurement of sinusoidal signals by oscilloscope

Turn the frequency of the signal generator through the frequency band switch, and fine-tune the knob to 100 Hz,10 kHz and 100 kHz. The output signal line of the signal generator is connected with the signal of the oscilloscope, and the ground line is connected with the ground wire.

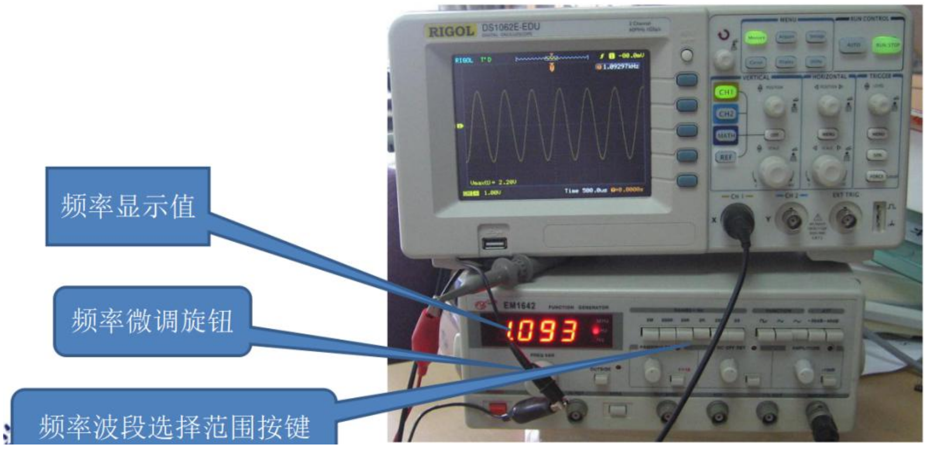


Figure 9 Connect physical diagram

4.2 Measurement of output Voltage of YB1638 function signal Generator

The output of the signal generator is connected to the multimeter, red positive, negative and negative, and the multimeter is in the AC file, and the appropriate range is selected. By adjusting the amplitude knob, the multimeter can display 3V effective value. The output of the signal generator is then connected to the oscilloscope to read the peak and the effective value is 1 / 2 / 2 of the reading.

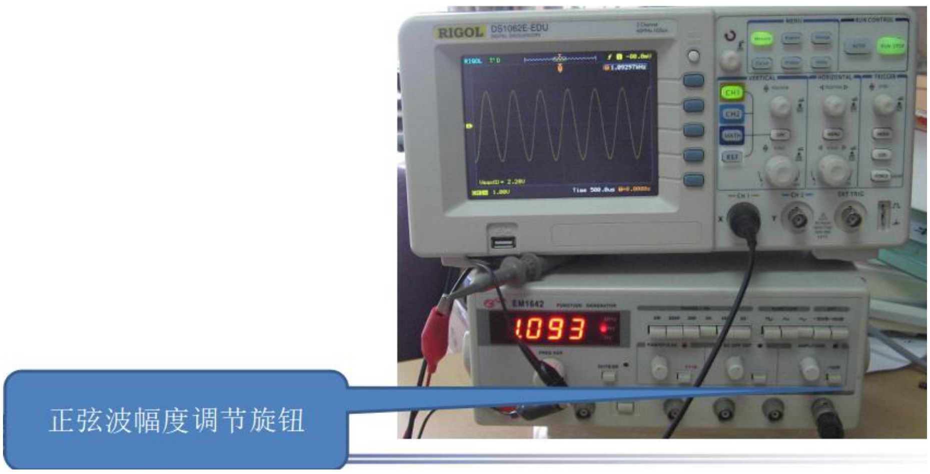


Figure 10 Connect physical diagram

4.3 DC power in multimeter measuring test box

Insert red pen into V Ω mA Jack and black watch pen into COM Jack. The function switch range is then placed in the DC range, the test pen is connected to the circuit to be tested, and the polarity of the red meter pen terminal is displayed on the display at the same time. Finally, the output of three groups of DC power supply on the test bench is measured by oscilloscope and multimeter, and the results are recorded.

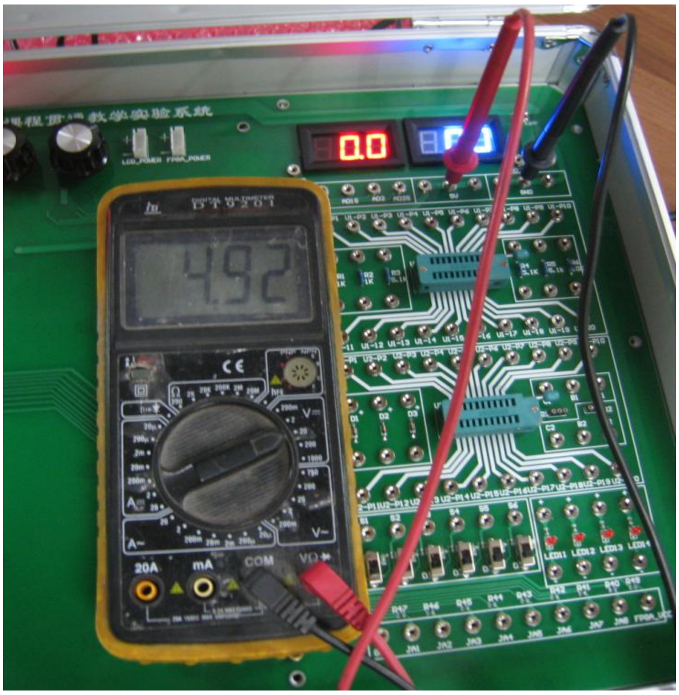


Figure 11 multimeter connection

4.4 Measurement of unidirectional conduction (on and off) characteristics of diodes by multimeter

Insert the table pen into the COM Jack and the red table into the V Ω Jack, where the polarity of the red watch pen is. The multimeter function range switch is placed in the position of the diode polarity judgment, and the red and black meter pen is connected to the two poles of the diode respectively. If the display screen displays a number of 0.6-0.7, then the diode is forward conduction, and the number displayed is the voltage of the PN junction. The red-watch pen is connected to the positive pole of the diode, and the black-watch pen is connected to the negative pole. If the number displayed on the display is 1, when the diode ends in reverse, the red pen is connected with the diode negative, and the black one is connected with the positive pole.

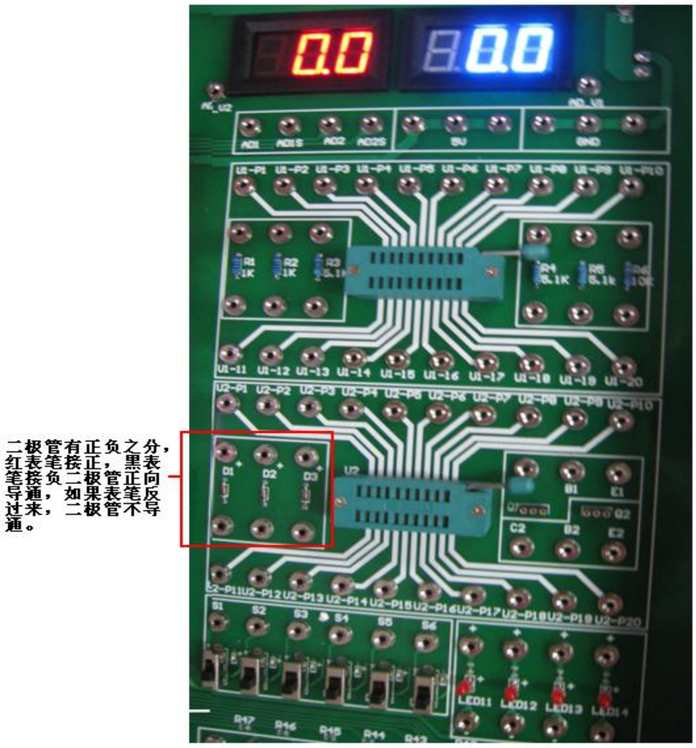


Figure 12 diode interface

Five. Experimental Results and Analysis

5.1 Measurement of sinusoidal signal by oscilloscope

	Function generator output	**Oscillograph reading**	**sensitivity**	**measured value**	
range		5.62 Div	1.00 V/Div	5.60 V	
Period / frequency	100 Hz	5.00 Div	2.000 ms/Div	9.96 ms	100.4 Hz
range		5.61 Div	1.000 V/Div	5.60 V	
Period / frequency	10 kHz	2.00 Div	50 µs/Div	100.0µs	10.01 kHz
range		5.60 Div	1.00 V/Div	5.60 V	
Period /	100 kHz	2.10 Div	5.000 µs /Div	10.00µs	100.6

frequency					kHz

Chart 13 Experimental data recording

It can be seen from the experimental data that the measured value is basically consistent with the output of the function generator. Compared with the theoretical value, the experimental error is less than 5 ‰ (5/1000), which is caused by the loss of the connection between the oscilloscope and the function generator, and the unstable reading of the oscilloscope.

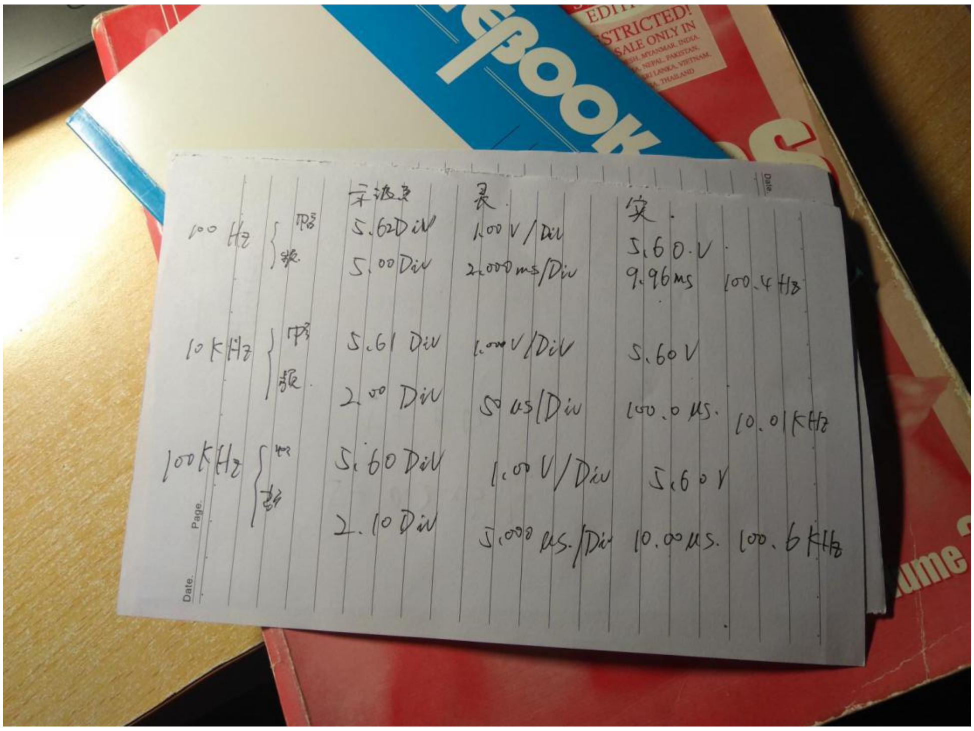


Figure 14 Data recording table

5.1.2 Measurement of output Voltage of YB1638 function signal Generator

Function generator output frequency	Oscilloscope reading value		Converted effective value	Multimeter read value
1 kHz	4.35 Div	2.00 V / Div	3.07 V	3.00 V

Chart 15 Experimental data recording

The error of output voltage of the function generator measured by the above table data, oscilloscope reading and multimeter is 2.3, and the error is within the range allowed by the experiment. The reason of the error is that the reading error of oscilloscope is large, at the same time, the oscilloscope also has the loss in connection with the function generator.

5.1.3 DC Power supply in Multimeter Measurement Test Box

DC stabilized power output	Oscillograph reading	sensitivity	Oscilloscope conversion value	Multimeter reading
+15 V	5.10 Div	1.00 V / Div	5.10 V	4.98 V

Chart 16 Experimental data recording

From the data of the above table we can see that the output error of DC steady voltage power supply measured by oscilloscope and multimeter is 2.3 and the error is less than 5 in the range of experiment. The error is partly due to errors in oscilloscope readings, and partly to losses in the connection of multimeters, oscilloscopes and experimental boxes.

5.1.4 Measurement of unidirectional conduction (on and off)characteristics of diodes by multimeter

	Universal representation number
Diode forward conduction	0.681
Diode reverse cut-off	1

Figure 17 Experimental data recording

From the data measured by the multimeter, when the data displayed by the multimeter is between 0.6 and 0.7, the diode is forward conduction, and the experimental data is 0.681, so the diode is positive conduction at this time. When the multimeter is shown at 1, the diode is inversely switched on.

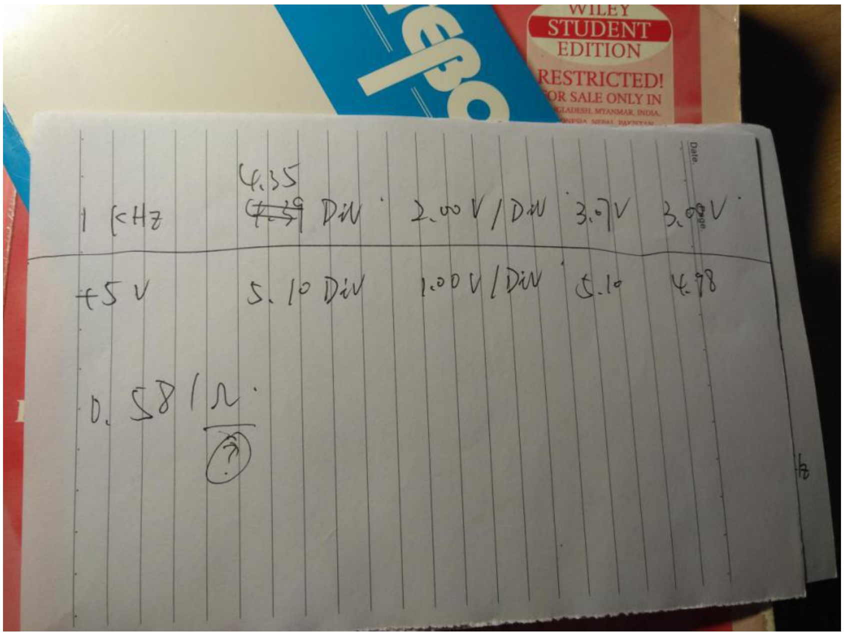


Figure 18 data recording table

Six. Discussion and Experience

Since I did a physical experiment on oscilloscope in my freshman year, I used the oscilloscope more smoothly and accepted it more quickly. However, because no equipment of this kind has been used before, so when we get the test box, we can see the dense interface on it. We don't know how to work. However, after listening to the teacher, plus the actual operation, I have a general understanding of the experimental box. At the same time, in the course of the teacher's explanation, I also learned various methods and techniques of measurement, and also realized the rigor of digital logic experiment.

Experiment 2--Experimental Report On Basic Switching Circuit

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Experimental period：	2018-9-25	Experimental site：	Zijin Port East 4-509	Instructor：	Qijun Hong（洪奇军）

One. Purpose and Requirements Of the Experiment

1.1 Master the basic structure of logic switch circuit

1.2 Master the concepts of diode conduction and cutoff

1.3 A simple Logic Gate Circuit composed of Diode and Triode

1.4 Master the simplest logic gate structure

Two. Experimental content and Principle

2.1 Experimental content

- The positive logic and gate are realized by diode, the input and output voltage parameters are measured, and its logic function is analyzed.
- The positive logic or gate is realized by diode, the input and output voltage parameters are measured, and its logic function is analyzed.

- The positive logic non-gate is realized by the reverse characteristic of Triode, the input and output voltage parameters are measured, and its logic function is analyzed.
- The input and output voltage parameters are measured and its logic function is analyzed by using the front gate and non-gate realization and non-gate.

2.2 Experimental principle

2.2.1 Diode Construction and Gate Circuit

The output F is low level when the three diodes are grounded, and the output F is low level as long as there is grounding in AZB BU C.

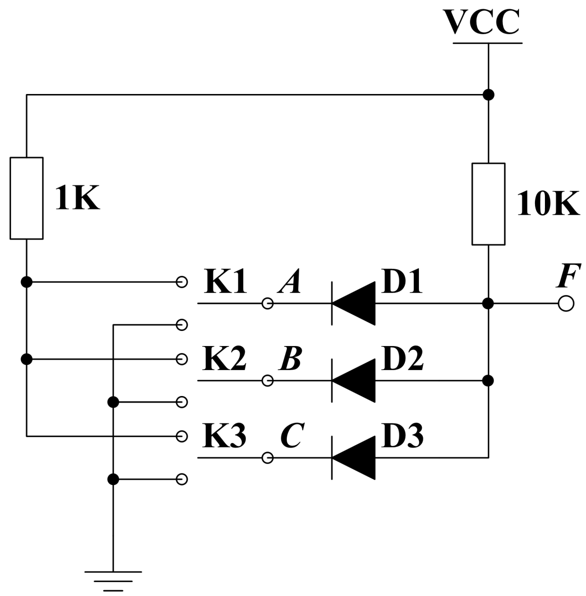


Figure 1 and Gate Circuit Diagram

- **Common logic level standard**

逻辑电平	V_{CC} / V	V_{OH} / V	V_{OL} / V	V_{IH} / V	V_{IL} / V	Explain
TTL	**5.0**	**≥ 2.4**	**≤ 0.4**	**≥ 2.0**	**≤ 0.8**	**The input foot is suspended by default to a high level**
LVTTL	**3.3**	**≥ 2.4**	**≤ 0.4**	**≥ 2.0**	**≤ 0.8**	

LVTTL	**2.5**	**≥ 2.0**	**≤ 0.2**	**≥ 1.7**	**≤ 0.7**	
CMOS	**5.0**	**≥ 4.45**	**≤ 0.5**	**≥ 3.5**	**≤ 1.5**	
LVCMOS	**3.3**	**≥ 3.2**	**≤ 0.1**	**≥ 2.0V**	**≤ 0.7**	**Input impedance is very large**
LVCMOS	**2.5**	**≥ 2.0**	**≤ 0.1**	**≥ 1.7**	**≤ 0.7**	
RS232	**±12~15**	**−3 ~ −15**	**3 ~ 15**	**−3 ~ −15**	**3 ~ 15**	**negative logic**

Figure 2 Logic level Standard

2.2.2 Diode composition or gate circuit

The output F is a low level when the input AZB C is grounded, and the output F is a high level as long as there is a high level in the AZB C.

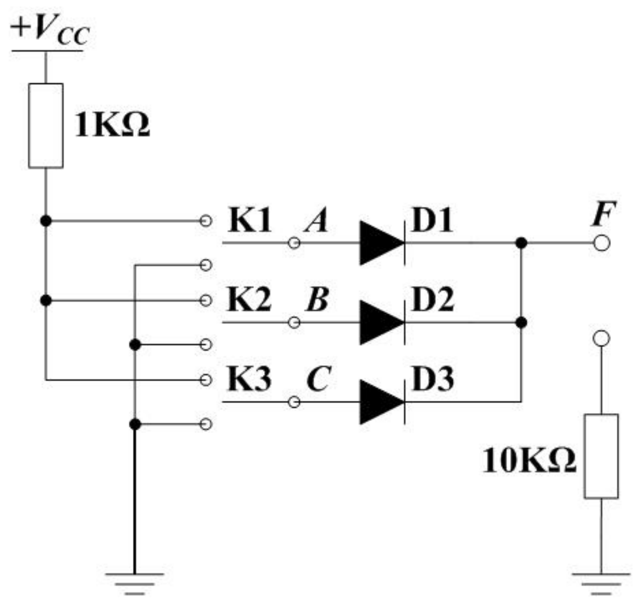


Figure 3 or gate circuit diagram

2.2.3 Triode consists of non-gate circuit

When A point is connected with high level, the transistor T 1 is saturated, VCE ≈ 0.3 V, and the output F is low level saturation. When A point is connected with low voltage, there is almost no voltage drop on IB = 0 C, the transistor T 1 is in cut-off state, and the output F voltage is close to VCC as high level.

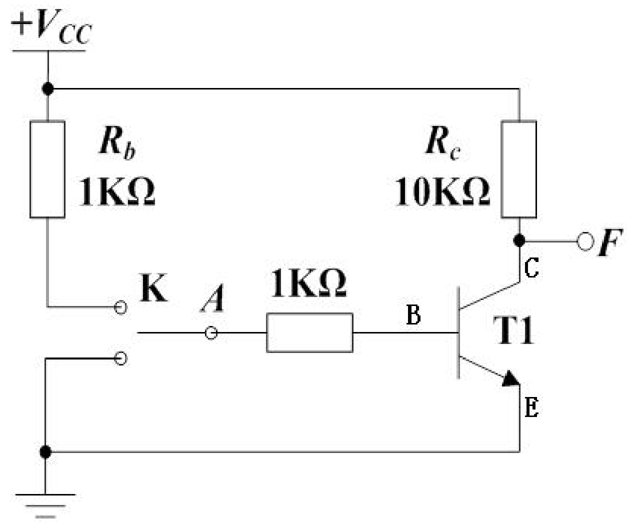


Figure 4 Non-gate circuit diagram

2.2.4 Diode and Triode composition and Non-gate Circuits

When the input AZB C is connected to the high level, F1 is high, and the T 1 transistor enters the state of saturation conduction.

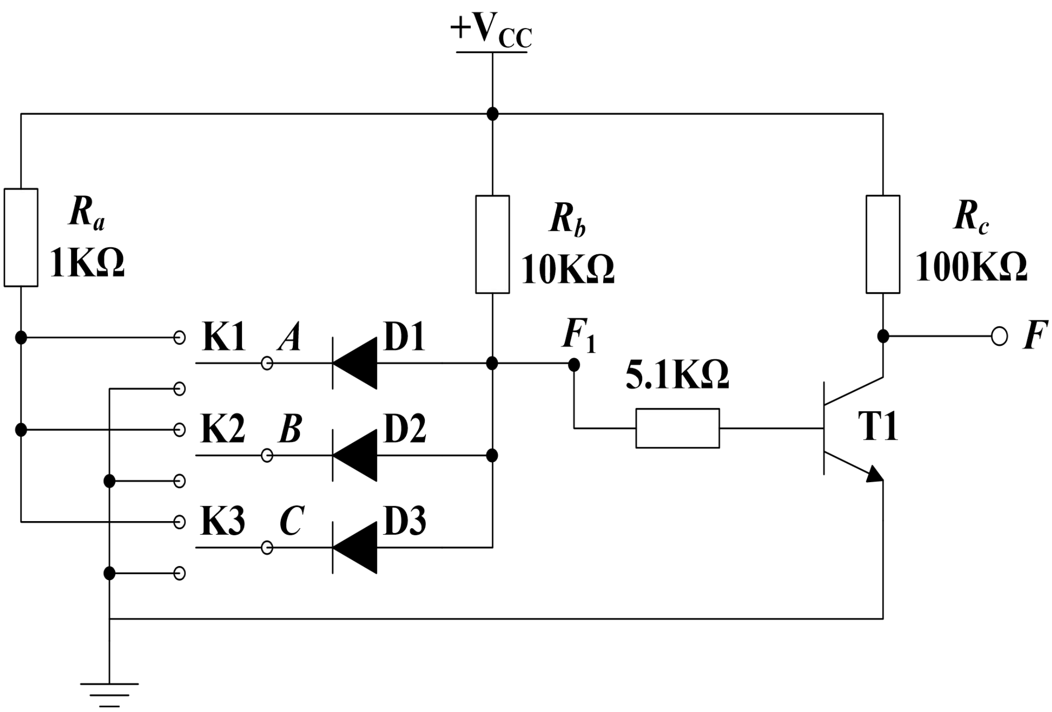


Figure 5 and non-gate circuit diagram

2.2.5 Triode polarity measurement

The multimeter red meter pen is inserted into V Ω mA Jack, and the black meter pen is inserted into COM Jack. First, it is determined whether the transistor is PNP or NPN type, and the base electrode b is determined. Put the function range in the hFE position, insert the transistor into the Triode test socket on the panel, the base electrode b should be plugged in, the collector c and emitter e are plugged in. Read the hFE approximate value from the display screen, if the value is large, it shows that the three-level transistor che e pole corresponds to the che e pole on the socket. If the value is very small it indicates that the transistor che e pole is inserted in reverse at this time, and the ccae pole should be switched in and read again. HFE value.

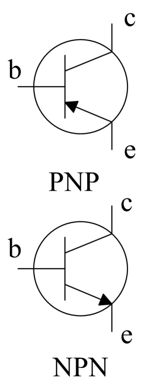


Figure 6 Triode legend

Three. Main instrument and equipment

Digital oscilloscope RIGOL-DS162	1 unit
function generator YB1638	1 unit
digital multimeter	1
Circuit design test box	1 unit

Four. Operating methods and Experimental steps

4.1 Diode Construction and Gate Circuit

Connect circuit by wire in test box, check diode, power supply voltage and polarity, resistance value, etc. Vcc connection test box 5 V DC power supply. The input level is generated by switching S1/S2. Input the different level combinations of AMOB and measure the voltage value of AZB and the corresponding output F with the DC voltmeter in the multimeter or the test box.

4.2 Diode composition or gate circuit

Connect circuit by wire in test box, check diode, power supply voltage and polarity, resistance value, etc. Vcc connection test box 5 V DC power supply. The input level is generated by switching S1/S2. Input the different level combinations of AMOB and measure the voltage value of AZB and the corresponding output F with the DC voltmeter in the multimeter or the test box.

4.3 Triode consists of non-gate circuit

Connect circuit through wire in the test box, check whether the transistor and power polarity, resistance value are connected correctly. The 5 V DC power supply is connected to the Vcc terminal. High and low levels of input A are generated by switching S1/S2. The voltage values corresponding to A and F are measured.

4.4 Diode and Triode composition and Non-gate Circuits

Connect the circuit to the test box to check whether the diode, transistor and power polarity, resistance value are correct. The 5 V DC power supply is connected to the Vcc terminal. The high and low levels of the input ADA B terminal are generated by switching S1/S2. The voltage values corresponding to AZB and output F were measured.

4.5 Triode polarity measurement

The multimeter red meter pen is inserted into V Ω mA Jack, and the black meter pen is inserted into COM Jack. First, it is determined whether the transistor is PNP or NPN type, and the base electrode b is determined. Put the function range in the hFE position, insert the transistor into the Triode test socket on the panel, the base electrode b should be plugged in, the collector c and emitter e are plugged in. Read the hFE approximate value from the display screen, if this value is large, it shows that the three-level transistor che e pole corresponds to the che e pole on the socket; if the value is very small, it means that the transistor che e pole should be interleaved inversely at this time. Then read the hFE value.

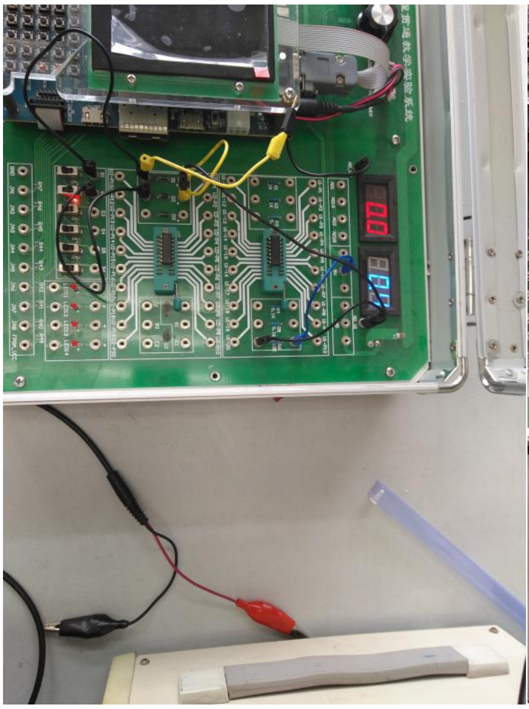
Five. Experimental results and Analysis

5.1 Diode Construction and Gate Circuit

Va/V	Vb/V	Vf/V	F logic data
4.6	0.0	0.8	L
4.7	4.7	4.7	H
0	4.6	0.4	L
0	0.0	0.4	L

Figure 7 and Gate data Records

The results show that the output F is high when the input AZB is high, and the output F is low level as long as there is a grounding in AZB, which conforms to the logic relation with the gate.



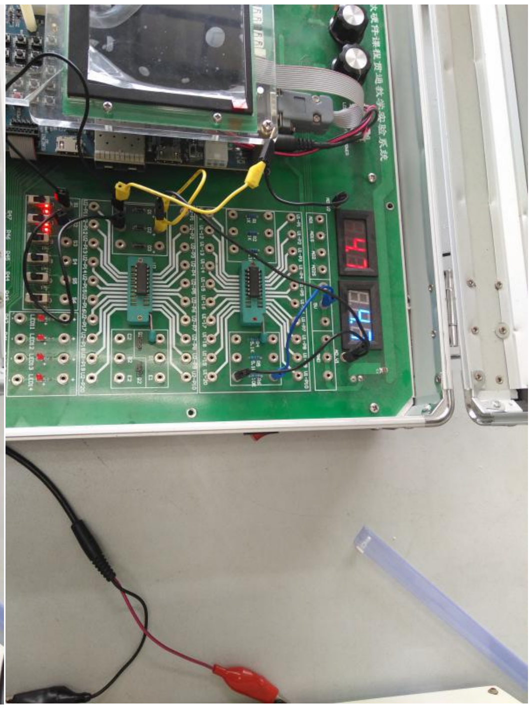


Figure 8 and gate display data (a low b high)

Figure 9 and gate display data (a high b high)

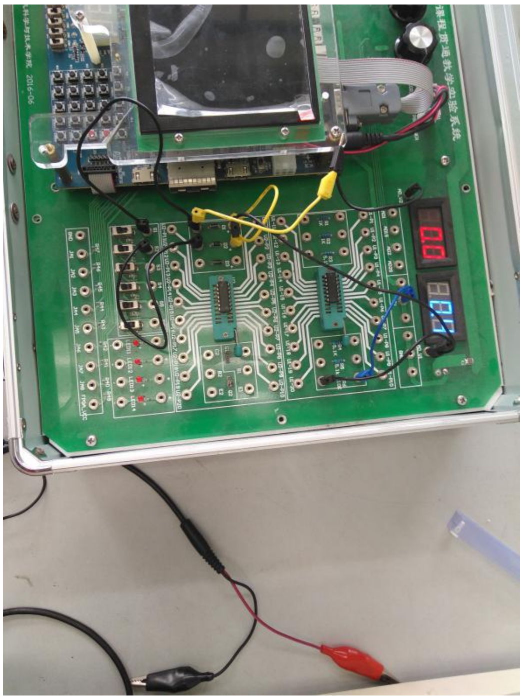


Figure 10 and gate display data (a low b low)

5.2 Diode composition or gate circuit

Va/V	Vb/V	Vf/V	F logic data
4.1	0.0	4.4	H
0.0	4.4	4.4	H
4.1	4.5	4.3	H
0.0	0.0	0.0	L

Figure 11 or Gate data record

It can be seen from the experimental data that the output F is low level when the input AZB is grounded, and the output F is high level as long as there is a high level in AHB, which accords with the logic relation of OR gate.

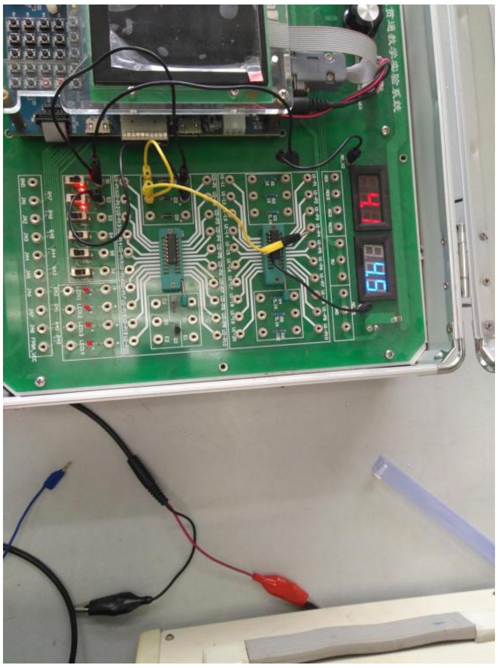


Figure 12 or gate showing data (a high b high)

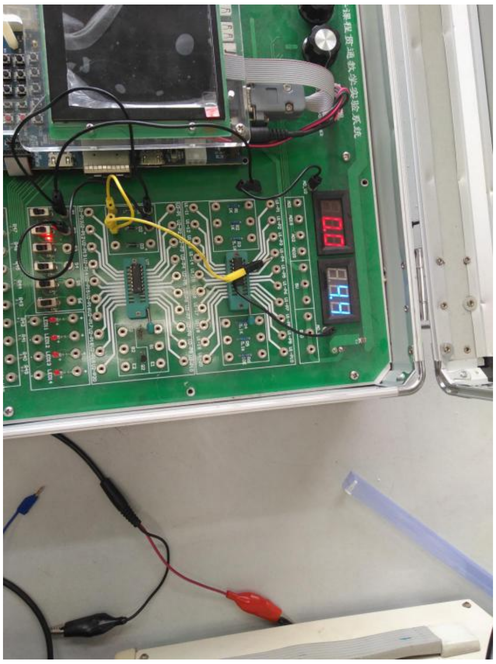


Figure 13 or gate showing data (a low b high)

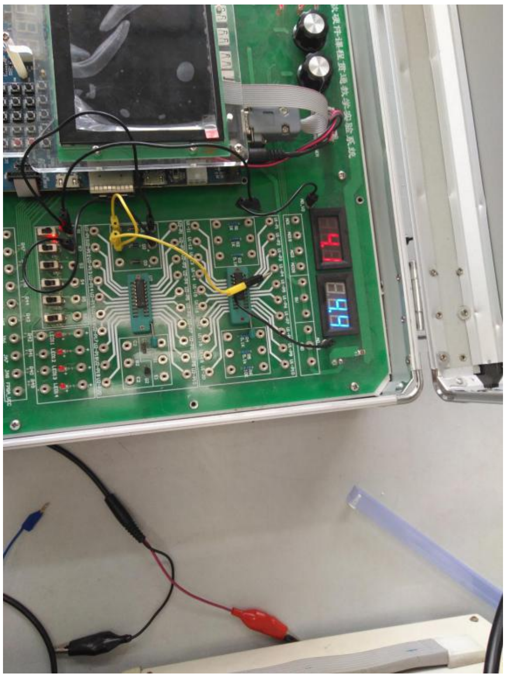


Figure 14 or gate showing data (a high b low)

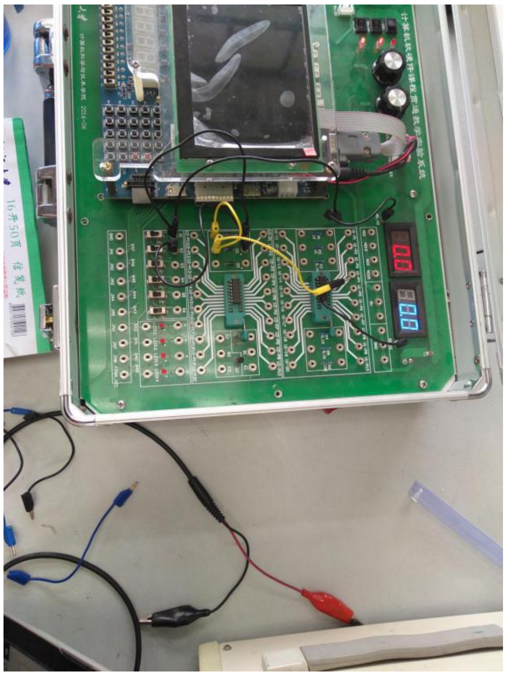


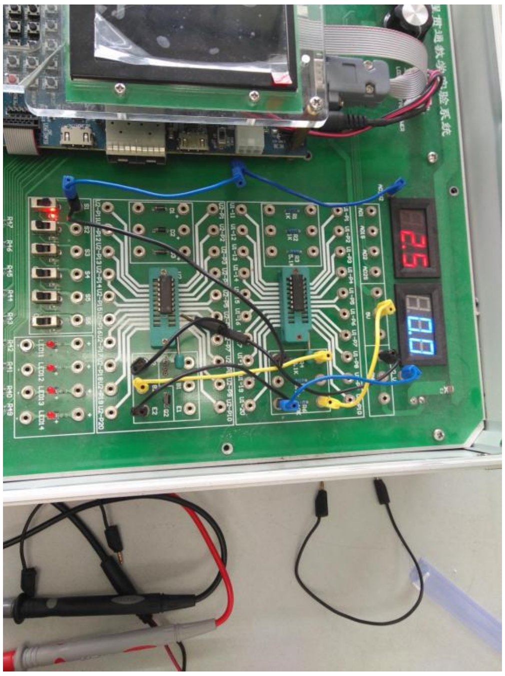
Figure 15 or gate showing data (a low b low)

5.3 Triode consists of non-gate circuit

Va/V	Vf/V	F logic data
0	4.7	H
3.7	0	L

Figure 16 Non-gate data recording

When A point is connected with high level, output F is low level, and when A point is connected with low voltage, output F voltage is high level, which conforms to non-gate logic.



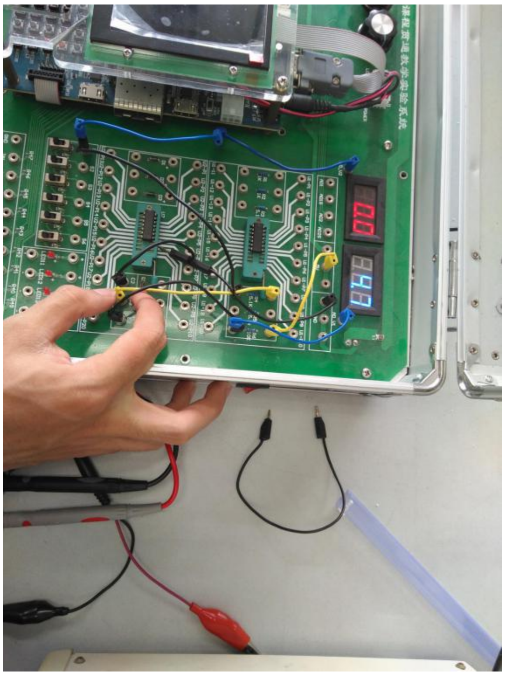


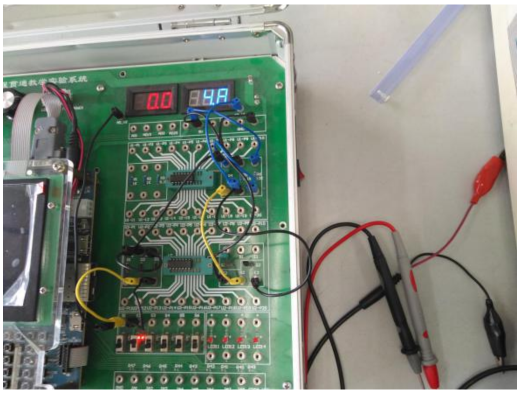
Figure 17 Transistor composition non-gate (a high b low) **Figure 18 Transistor consists of non-gate (a low b high)**

5.4 Diode and Triode composition NAND gate Circuits

Va/V	Vb/V	Vf/V	F logic data
4.4	4.4	0.2	L
4.4	0.0	4.7	H
0.0	4.3	4.8	H
0.0	0.0	4.7	H

Chart 19 NAND gate data recording

F is low when input AHB is connected to high level. As long as there is one ground in AHB, F is high level, which conforms to the logic gate of non-gate.F is low when input AHB is connected to high level. As long as there is one ground in AHB, F is high level, which conforms to the logic gate of non-gate.



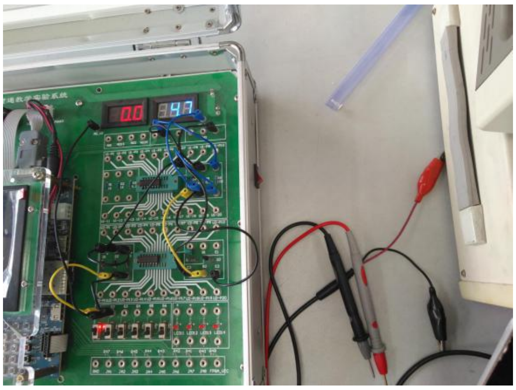
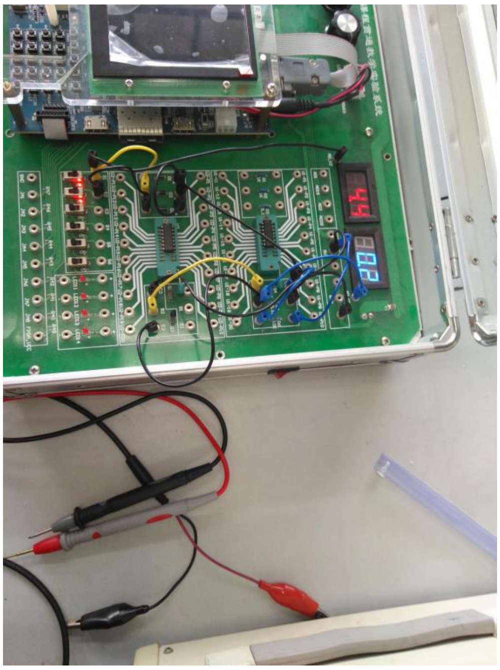


Figure 20 NAND gate displays data (a low b high)

Figure 21 NAND gate display data (a high b low)



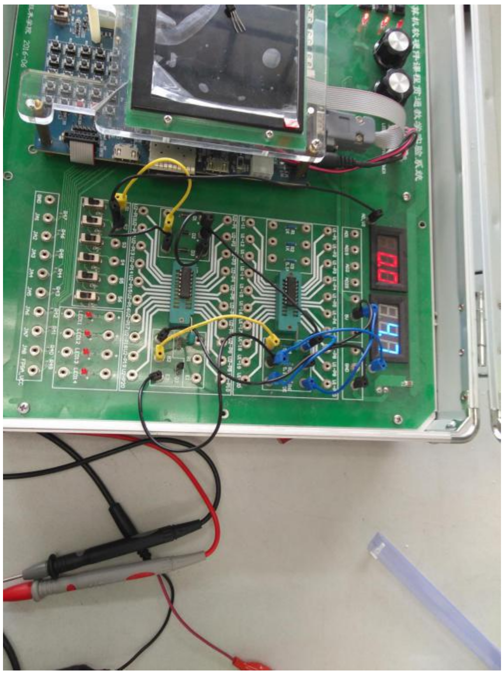


Figure 22 NAND gate display data (a high b high)

Figure 23 NAND gate display data (a low b low)

5.5 Triode polarity measurement

By multimeter measurement, the transistor is NPN type, and the base electrode b.

	HFE approximation
Test one	167
Test Two	014

Figure 24 hFE data record

According to the experimental results, if the hFE value is large, about 170, it is shown that the three-stage transistor che e pole corresponds to the che e pole on the socket, and if the value is very small, it is shown that the transistor che e pole is inversely inserted at this time.

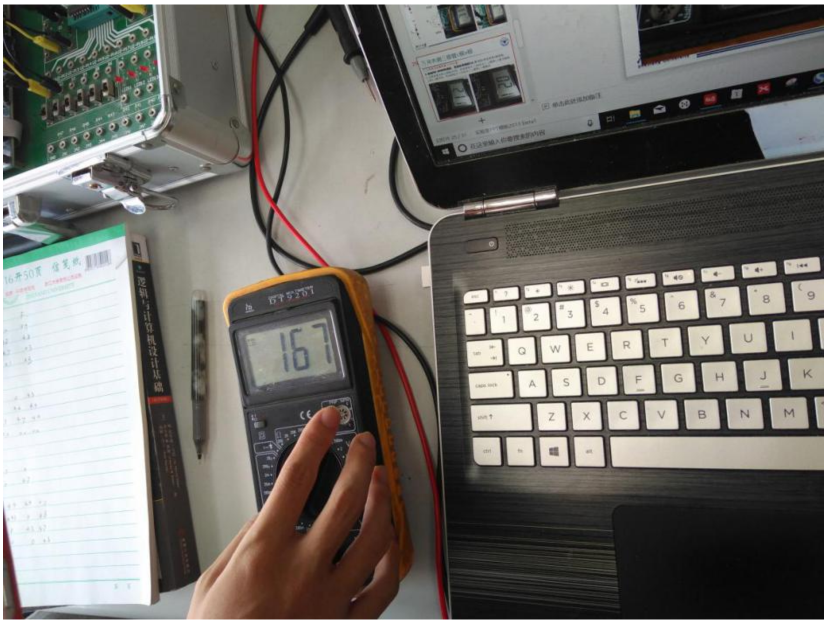


Figure 25 testing hFE values to determine polarity

Six. Discussion and Experience

In the second experiment, I learned about the three independent logic gates, the gate, the non-gate, or the gate, as well as the characteristics and usage of the simple and non-gate circuits and transistors. In the experiment, I deepened my understanding of the oscilloscope, the experimental box, and the multimeter. Diode and Triode understanding, more skilled operation. Since it is the first time to connect and detect the circuit in the experimental box, although the circuit is relatively simple, it takes a little time to familiarize itself with the instrument.

Experiment 3--Experimental report on function and Parameter Test of Integrated Logic Gate

Name:	Kai Yu(余凯)	Student ID ：	3170105062	major：	software engineering

Course title：	Basic experiment of Logic and computer Design	Names of students in the same group：	Chongyang Song（宋重阳）

Experimental period：	2018-10-9	Experimental site：	Zijin East 4-509	Port	Instructor：	Qijun Hong（洪奇军）

One.Purpose and requirements of the experiment

Familiar with basic logic gate function, external electrical characteristics and special purpose of logic function.

Familiar with TTL and non-door and MOS or non-door packaging and pin functions.

Master the main parameters and static characteristics of the test method to deepen the understanding of the meaning of each parameter.

The concept of time delay in signal transmission is further established.

Further familiar with the use of oscilloscope, function generator and other instruments.。

Two. Experimental content and principle

2.1 Experimental content

- Verify the Logic function of Integrated Circuit 74LS00 "and not" Gate
- Verify the logic function of integrated circuit CD4001 "or non-gate"
- Measurement of Transmission delay time tpd for Integrated Circuit 74LS00 Logic Gate
- Measurement of Transmission delay time tpd for Integrated Circuit CD4001 Logic Gate
- Measurement of 74LS00 Transmission characteristics and Open / close level VON and VOFF in Integrated Circuits

2.2 Experimental principle

2.2.1 Digital integrated circuit basic parameters

1. Fan out coefficient No

2. Output high level VoH

3. Output low level VoL

4. Voltage transmission characteristic

5. Closing level VOFF

6. Door level VON

7. Noise tolerance

8. Average transmission delay time (tpd)

9. Low level input current IiL

10. High level input current IiH

11. No-load on-power PON

12. No-load cut-off power POFF

2.2.2 Fan out coefficient (load capacity)

Fan-out coefficient is a parameter used by digital logic device to measure its output load capacity, which represents the rated output capacity of the device. Logic device is a binary quantization device. Its output load capacity can be converted into the number of logic gates of the same type. In the rated output voltage range, the number of the same type gate driven by the device is called fan-out factor.

- 74LS00 and non-gate input circuit
    - When input A and B are high, T1 cutoff and drive current are very small.
    - Input A or B is low-current, T1 conduction, driving current is large

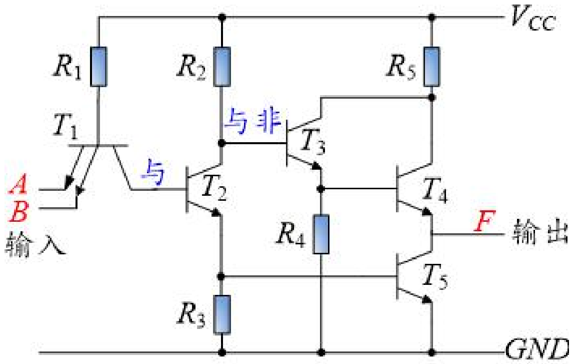


Figure 1 74LS00 and non-gate input circuits

2.2.3 Measurement of output coefficient of 74LS00 and Non-door Fan

- TTL fan-out drive as long as the measuring output is rated low-current, the output can absorb how much current. This current is generally measured when the output terminal voltage reaches the maximum allowable value (≤ 0.4 V), also known as the maximum filling current IoLmax. The fan out coefficient of TTL can be obtained by dividing this current from the low level input current IiL.
- $N_o = I_{oL\max} \;/ I_{iL}$
- IoLmax measurement of maximum perfusion current: when the input side AZB is suspended or connected to a high level and W is adjusted to make the meter reading 0.4 V, the reading on the ammeter is either IoLmax; or can be calculated by the formula IoLmax = (VCC 0.4) / (R RW).
- Then substitute the above formula to calculate the fan out coefficient No

Maximum Infusion current IoLmax: F output low potential (≤ 0.4 V) low potential impending Point A and B is high potential.

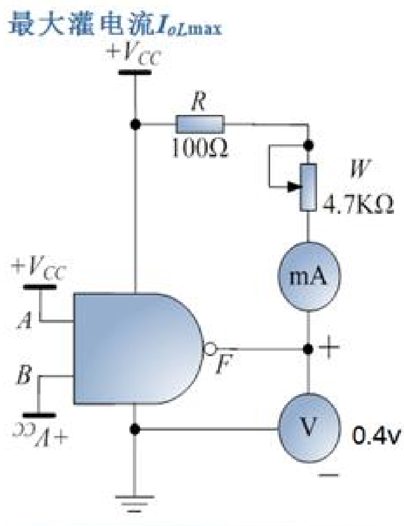


Figure 2 maximum current circuit diagram

2.2.4 Low level input current IiL

- Low level input current (IiL) is the current flowing through the input terminal when the input is connected to the ground, also known as the input short circuit current, which can be used to measure the characteristics of the low level input resistance.
- In 74LS00, the current that flows from the input when one input is connected and the other is suspended

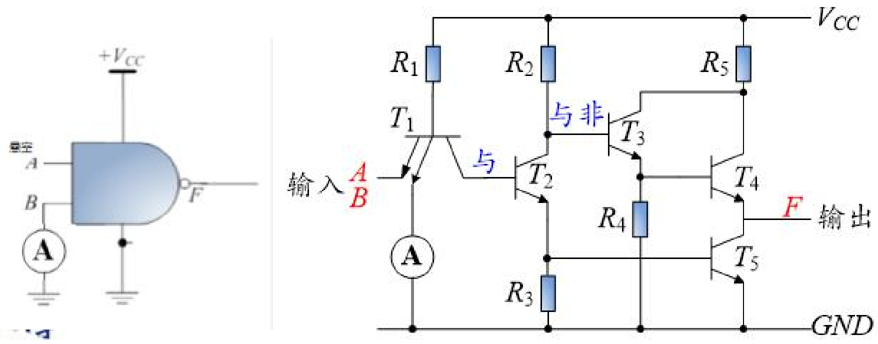


Figure 3 low level input circuit diagram

2.2.5 Output high level VoH

- Output high level VoH refers to the voltage when the output is high, generally greater than 2. 4 V, which can measure the high level load characteristics of the output.
- The VoH of 74LS00 refers to the output level measured when the input terminal is connected to the ground or when the output is low, and the output terminal is high and the output is 400 μ A current.
- When ionomer is 400 μ A
- V_{oH}= Corresponding output level

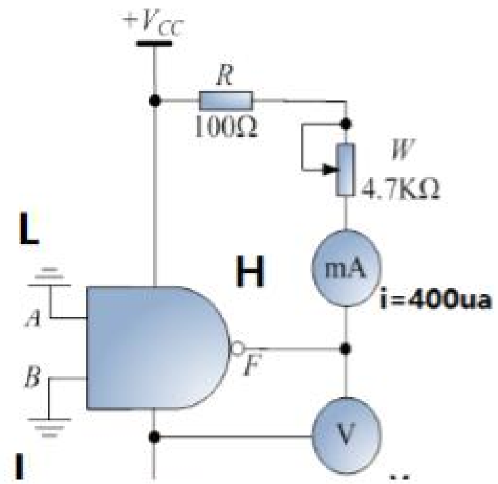


Figure 4 output high level circuit diagram

2.2.6 Output low level VoL

- Output low level VoL is the output voltage when the output terminal is low voltage, generally less than 0. 4 V, which can measure the low level load characteristics of the output terminal.
- The VoL of 74LS00 is the output level measured when the input terminal is connected to a high level and the output terminal is a low level and the 4mA current is filled in.

(1) 74LS00 output low level

(2) the output end is filled with 4mA current.

(3)VoL output level

(3)

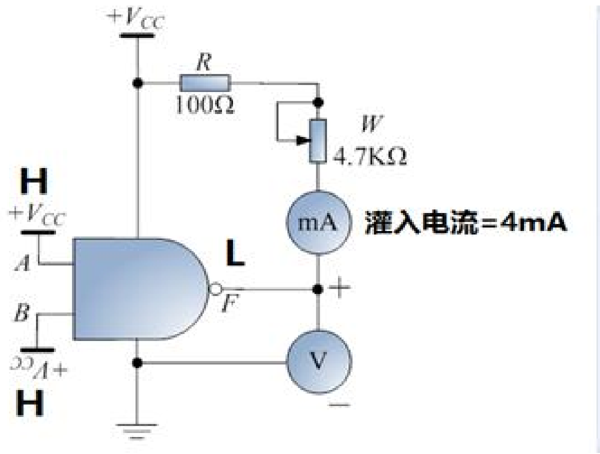


Figure 5 output low level circuit diagram

Three. Main instrument and equipment

Experimental installation

digital oscilloscope RIGOL-DS162	1 unit
digital multimeter	1
Circuit design test box	1 unit

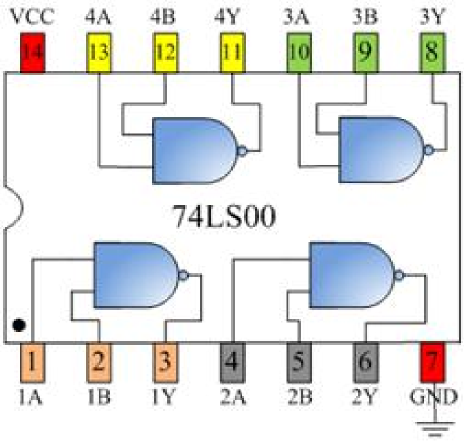
Guinea-pig

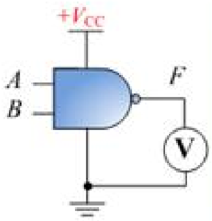
Two-input NAND gate74LS00	1 piece
Two input "NOR" gatesCD4001	1 piece
resistance	
4.7KΩpotential device	1
100Ω /1KW	1

Four. Operating methods and experimental steps

4.1Verification 74LS00 “NAND” gate logic function

1. Insert the chip into the IC socket of the test box and pay attention to the direction of the chip
2. Press the right diagram to connect the circuit, VCC connection voltage 5V, ground wire
3. High and low level generated by S14/S15/S16/S17 Dial-up switch
4. Traverse all combinations of input AZB in truth table order, measure AZB and output F voltage and enter right table





V_B(V)	V_A(V)	V_F(V)

Figure 6 validates 74LS00 "NAND " gate logic functionality

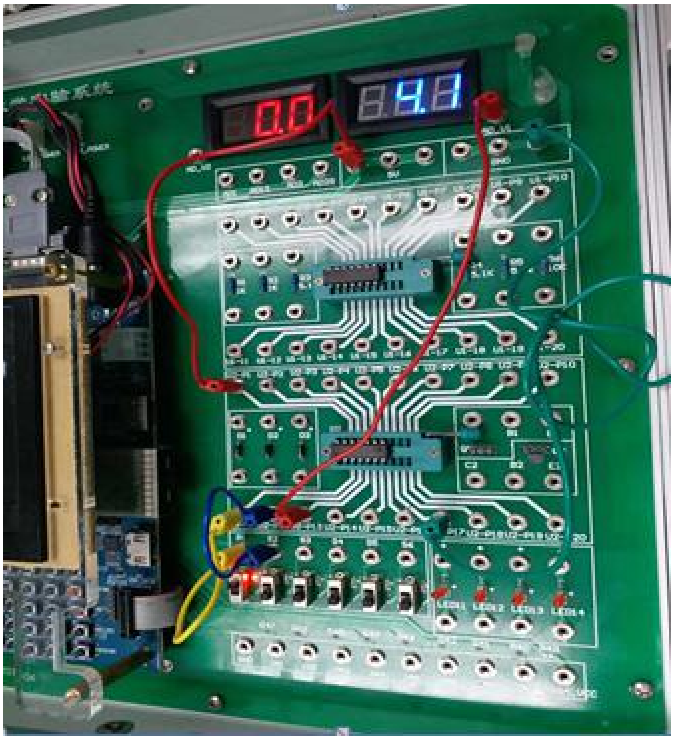
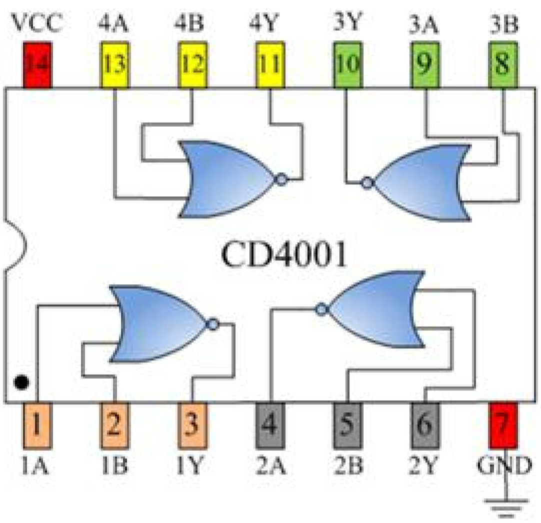
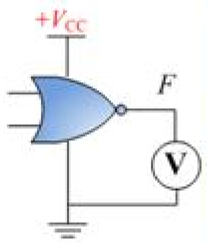


Figure 7 74LS00 test wiring diagram

4.2Verify CD4001 " NOR " gate logic functionality

1. Insert the chip into the IC socket of the test box
2. Connect circuit according to right diagram, VCC connect DC 5V voltage, ground wire
3. High and low level generated by S14/S15/S16/S17 Dial-up switch
4. Traversing all the input AZB combinations in truth table order, measuring the voltage values of the input AHB and the output side F, recording the right table.
5. Repeat step 3, step 4, measure the logic of the other 3 gates and judge the gates





V_B(V)	V_A(V)	V_F(V)

Figure 8 validates CD4001 "NOR" gate logic functionality

4.3 Measurement of Transmission delay time tpd for 74LS00 Logic Gate

1. Insert the chip into the IC socket of the test box and pay attention to the chip direction
2. Connect circuit according to figure, VCC connect 5V power supply, ground wire
3. Connect an oscilloscope to any of the input or output terminals of the oscillator
4. Adjust the frequency knob, measure the Vo waveform, read the period T and calculate the transmission delay time (30-60ns)

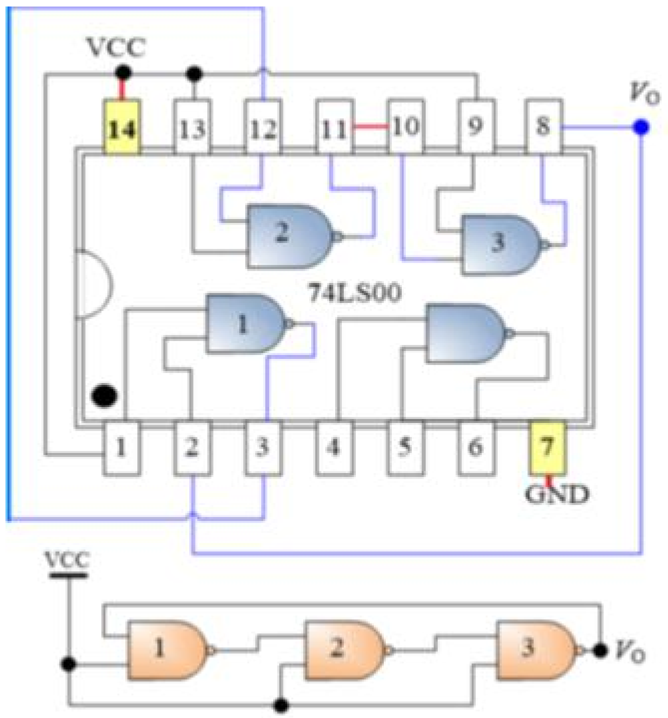


Figure 9 Measurement of Transmission delay time tpd for 74LS00 Logic Gate

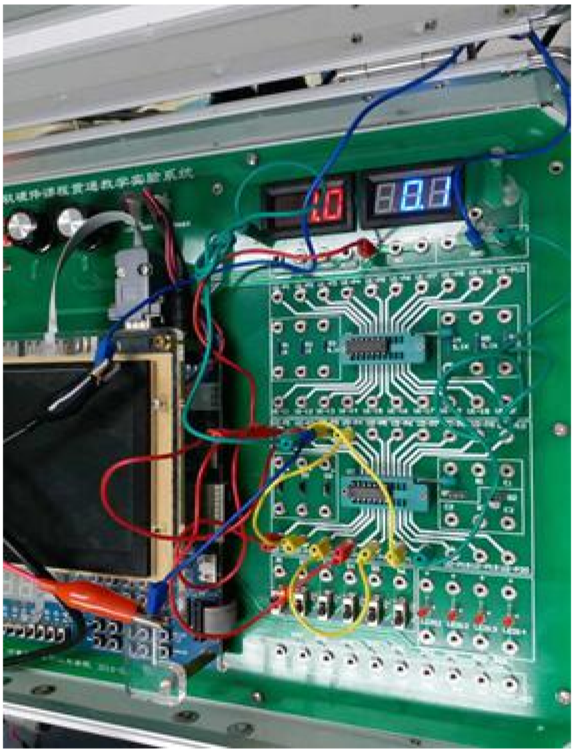


Figure 10 Measurement of 74LS00 Transmission delay wiring Diagram

4.4 Measurement of Transmission delay time tpd for CD4001 Logic Gate

1. Insert the chip into the IC socket of the test box and pay attention to the chip direction

2. Connect circuit according to figure, VCC connect 5V power supply, ground wire
3. Connect the oscilloscope to the input or output end of the oscillator
4. Adjust the frequency knob, measure the Vo waveform, read the period T and calculate the transmission delay time (500-1000ns)

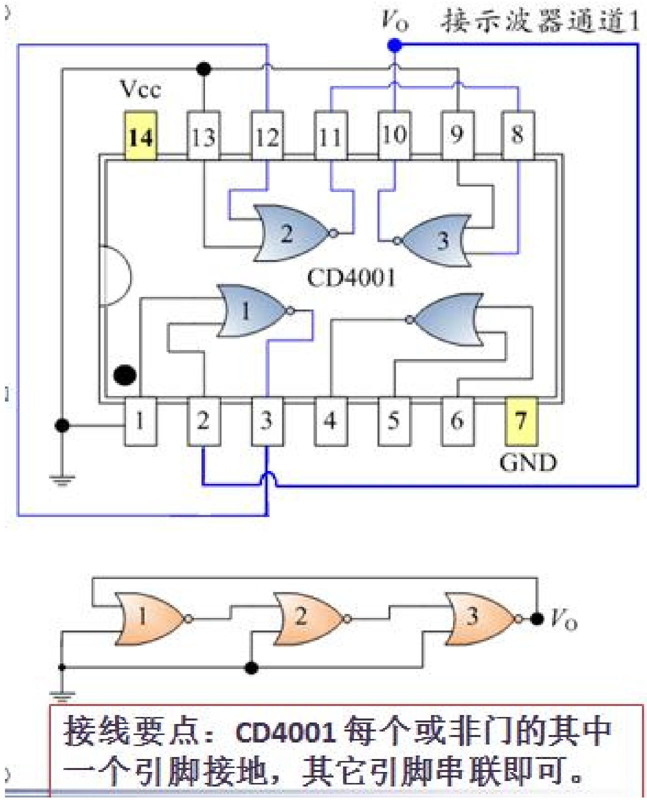


Figure 11 Measurement of Transmission delay time tpd for CD4001 Logic Gate

4.5 Measurement of 74LS00 Transmission characteristics and Open / close level VON and VOFF

1.Insert the chip into the IC socket of the test box

2.Connect circuit by figure (see next page)

3.Connect the DC meter to the A end and the output 2Y end to the non-gate, respectively.

4.Slowly adjust the potentiometer Wfrom the b end to the a end, observe the reading of the Vi, Vo two voltmeters, and record the data in the form.

5.Draw curves based on table data and find VON and VOFF

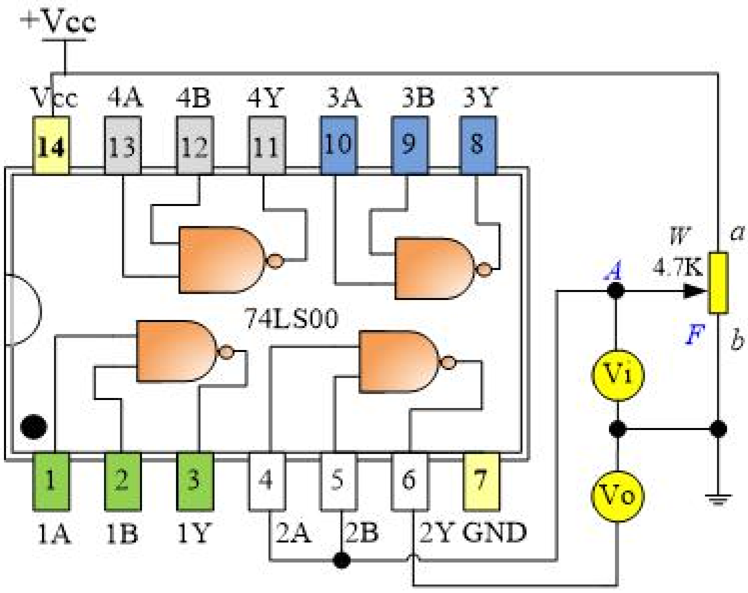


Figure 12 Measurement of 74LS00 Transmission characteristics and Open / close level VON and VOF

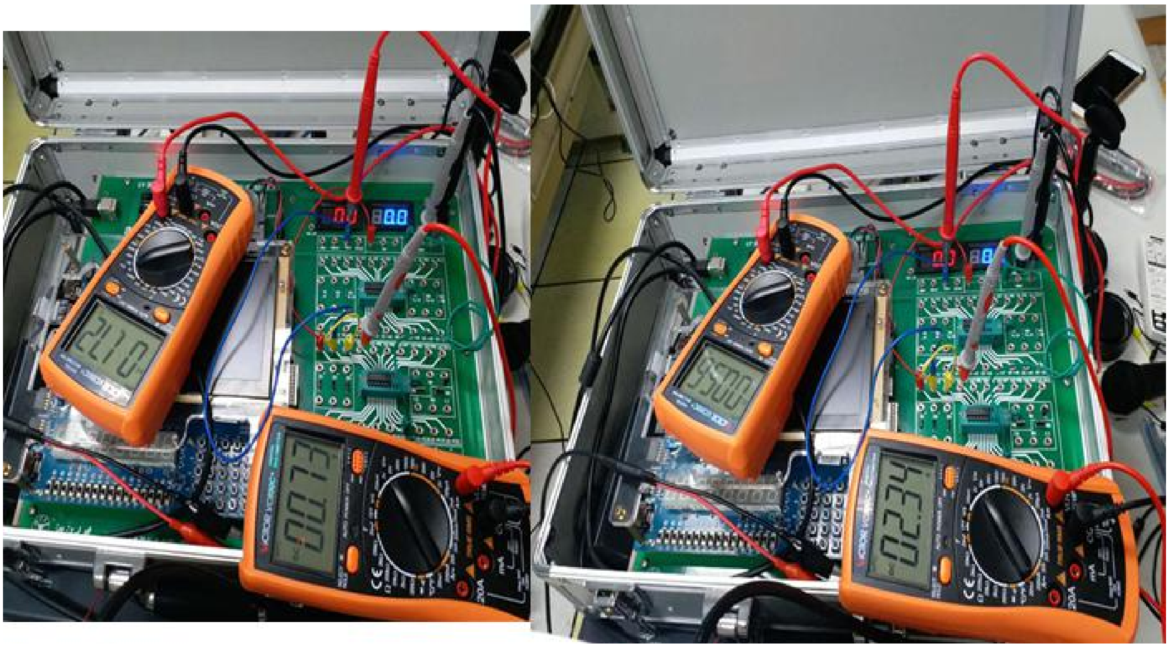


Figure 13 connection diagram for measuring 74LS00 transmission characteristics

Five.Experimental results and analysis

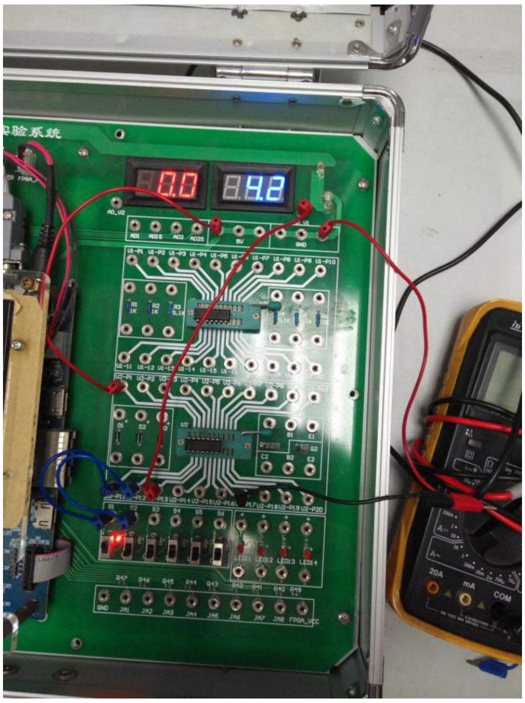
5.1Verification 74LS00 “NAND” gate logic function

V_B	V_A	V_F

0.0	0.0	4.2
0.0	4.7	4.2
4.7	4.7	0.1
4.7	0.0	4.2

Figure 14 validates 74LS00 "and non-" gate logic function data records

F is a low level when input AZB is connected with high level, and F is high level as long as there is one grounding in AHB, which conforms to the logic relation with non-gate.



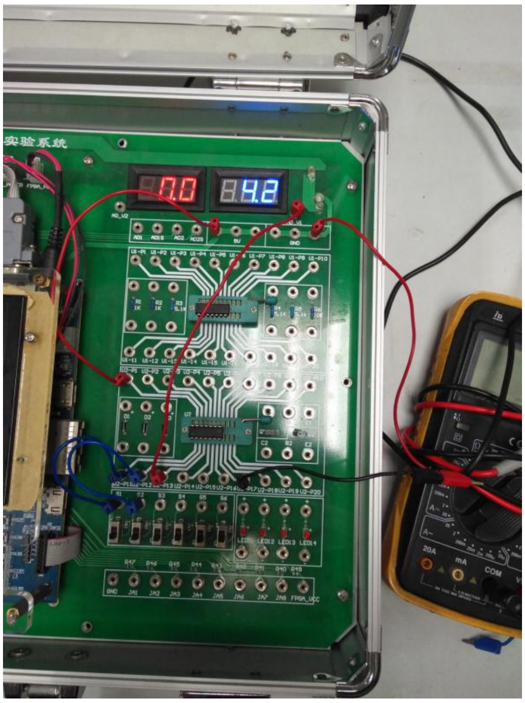
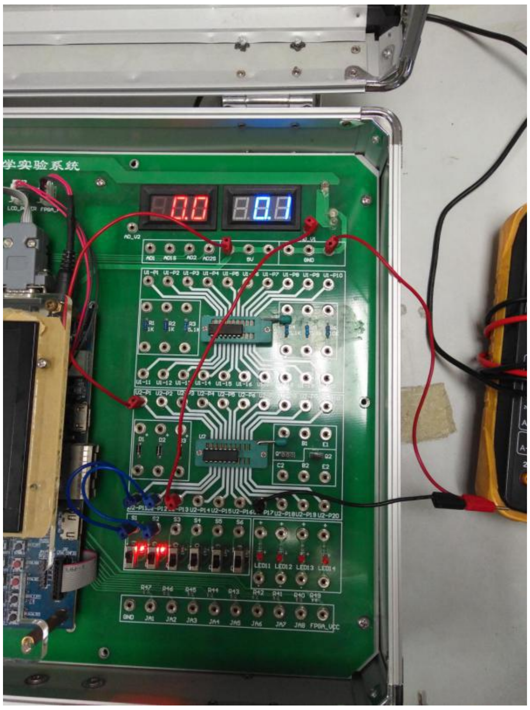


Figure 15 74LS00 and non-gate display data (a high b low) Figure 16 74LS00 and non-gate display data (a low b low)



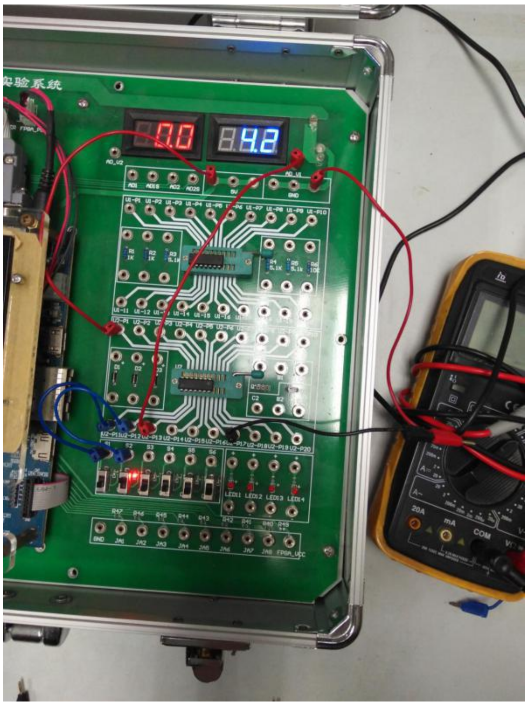


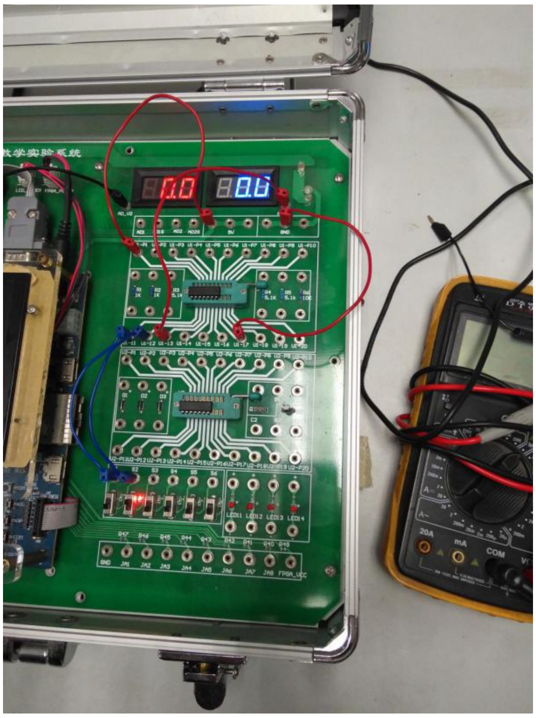
Figure 17 74LS00 and non-gate display data (a high b high)Figure 18 74LS00 and non-gate display data (a low b high)

5.2Verify CD4001 “ NOR ” gate logic functionality

V_B	V_A	V_F
0.0	0.0	4.8
0.0	4.7	0.0
4.7	0.0	0.0
4.7	4.7	0.0

Figure 19 validates CD4001 "NOR" gate logic function data records

When the input AHB is connected with low power, F is high level; in other cases, F is low level, accord with or not gate logic relation.



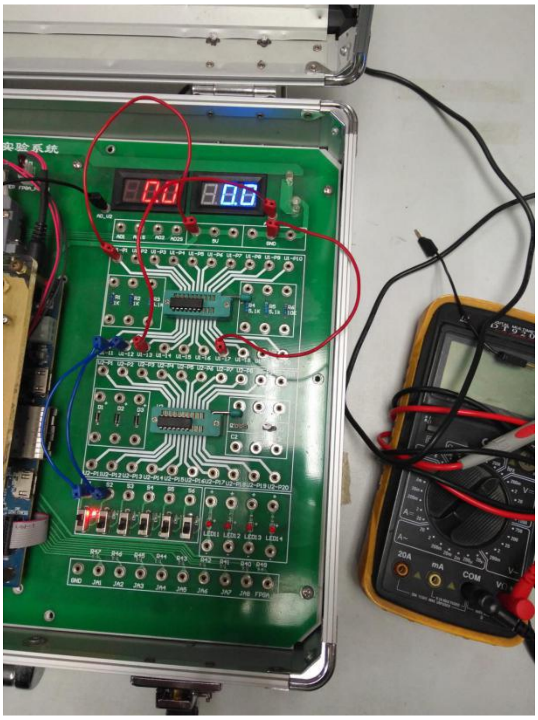
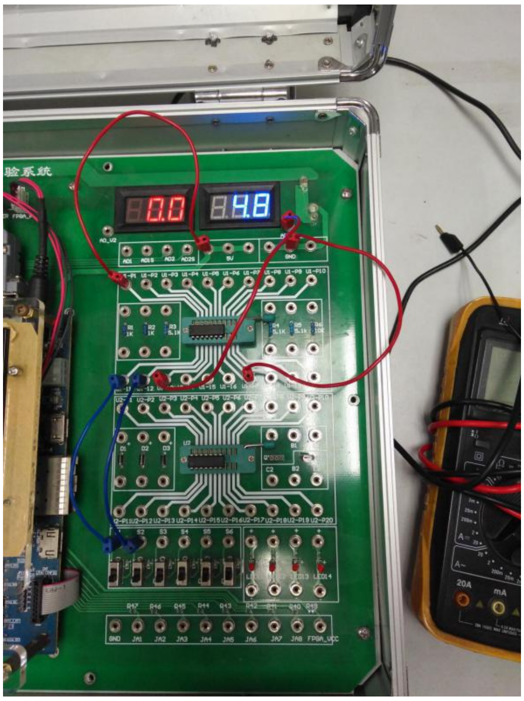


Figure 20 CD4001 NOR gate display data (a low b high)   Figure 21 CD4001 NOR gate display data (a high b low)



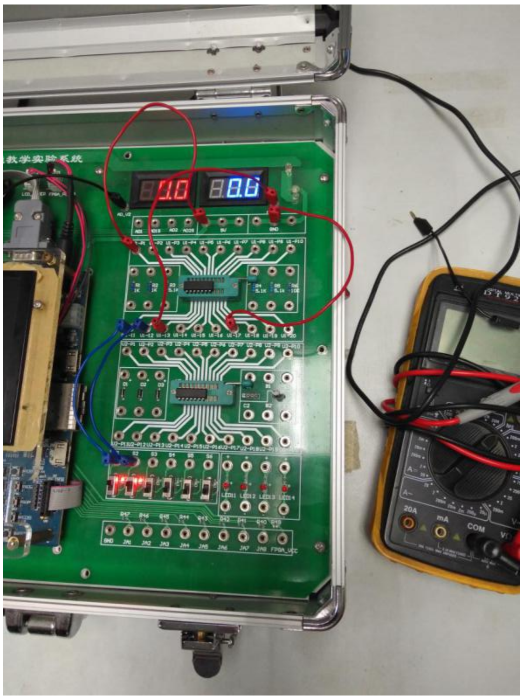


Figure 22 CD4001 NOR gate display data (a low b low)   Figure 23 CD4001 NOR gate displays data (a high b high)

5.3Measurement of Transmission delay time tpd for 74LS00 Logic Gate

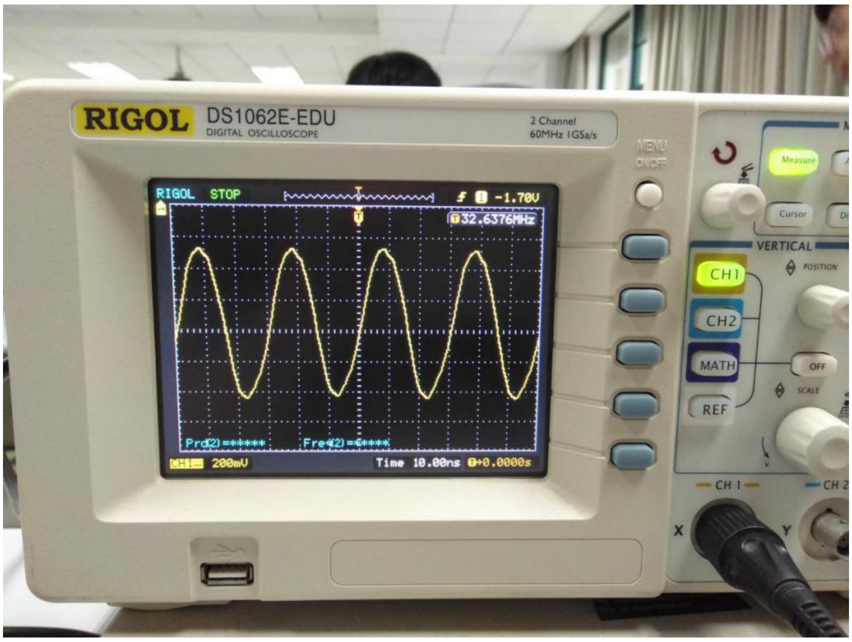


Figure 24 oscillograph

Indication 3.0div，10.00μs/div，T=3.0*10.00=30.00μs

5.4Measurement of Transmission delay time tpd for CD4001 Logic Gate

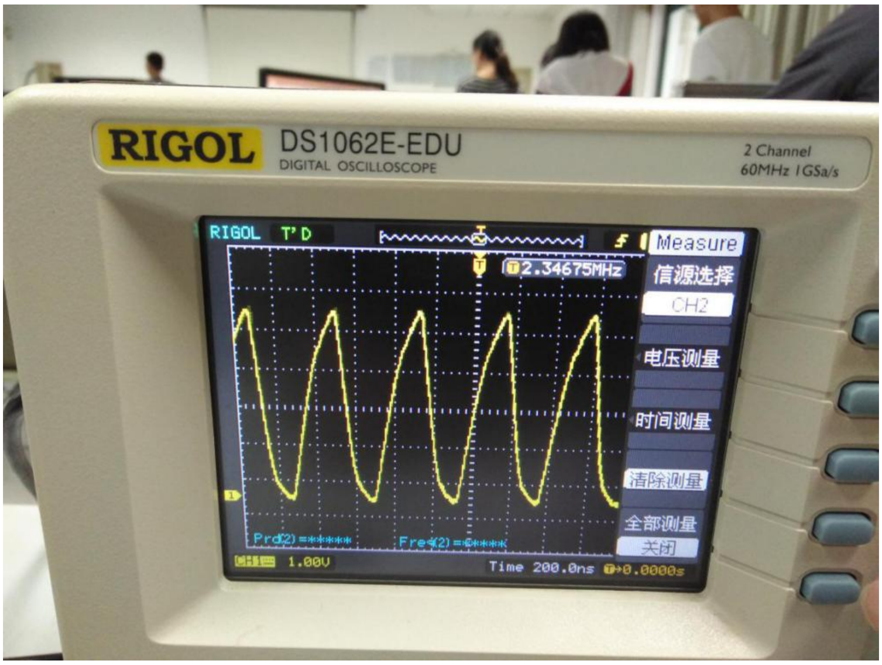


Figure 25 Oscilloscope Diagram

Indication 2.1div，200.0μs/div，T=2.1*200.0=420.0μs

5.5 Measurement of 74LS00 Transmission characteristics and Open /

close level VON and VOFF

V_i	0.007	0.20	0.40	0.60	0.80	0.85	0.90	0.95	1.00	1.05
V_o	4.61	4.61	4.60	4.57	4.40	4.29	4.10	3.66	2.01	1.47
V_i	1.10	1.15	1.20	1.25	1.30	1.40	1.60	1.80	2.50	3.00
V_o	1.13	0.68	0.23	0.17	0.12	0.12	0.12	0.12	0.12	0.12
V_i	3.50	4.00	4.50	4.90						
V_o	0.12	0.12	0.12	0.12						

Figure 26 74LS00 transmission characteristic data

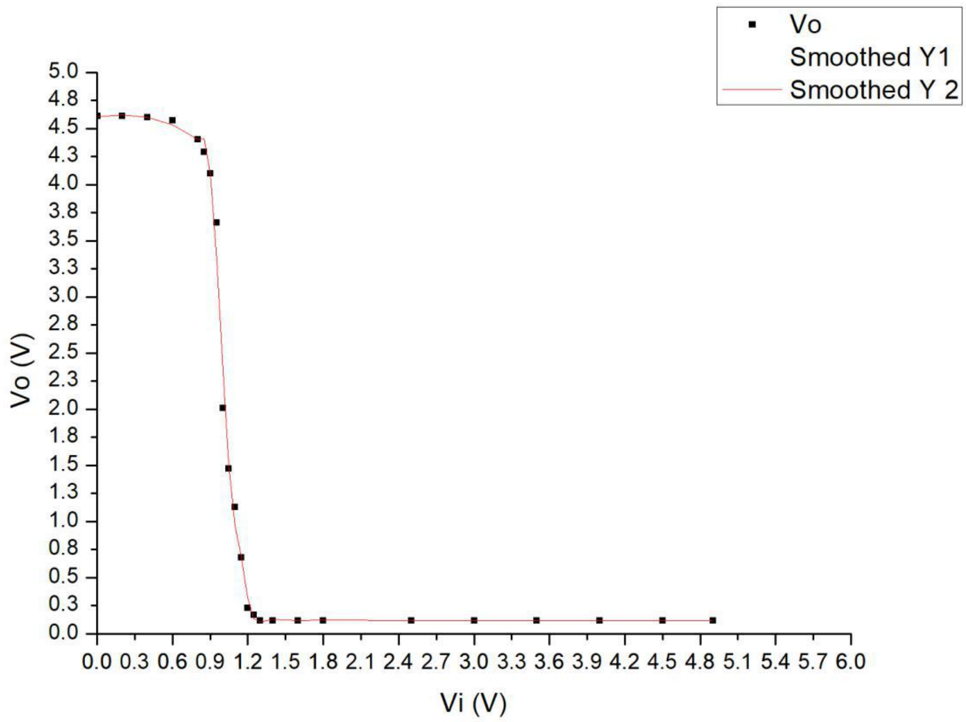


Figure 27 74LS00 transmission characteristic curve

It can be counted that V_{ON}=0.95V， V_{OFF}=1.30V

Six. Discussion and experience

Through this experiment, I have known and personally verified the 74LS00 instrument NAND gate logic’ and CD4001 instrument NOR gate logic, and also understood and tested the transmission delay and transmission characteristics of voltage. Based on the operation of experiment 1 and experiment 2, the operation of this experiment is more skillful, and the operation of various instruments is stabilized in this experiment. In the verification of the logic gates of the two chips, because of the complexity of the circuits, a wrong line was connected at the first connection, which caused the test data to be inconsistent with the theoretical value, but the error was found and corrected in the later operation. At the same time, when using oscilloscopes, The waveform displayed on the oscilloscope is not a standard sinusoidal function, and it is difficult to adjust the waveform to a certain extent. After asking the teacher, we learned that waveform is not the focus of the experiment, delay period is what we should pay attention to. The waveform is likely to be interfered with by factors such as wire connections.