LAB 1-3　Report

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Ⅰ Purposes And Requirements Of The Experiment

1.1　The use of commonly used electronic instruments

1.1.1 Know common electronic instruments

1.1.2 Learn the use of digital oscilloscopes, digital signal generators (function signal generators), DC stabilized power supplies, multimeters and other instruments.

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

1.1.4 Master the parameters of measuring the rising and falling edges of the pulse timing, delay and other parameters with a digital oscilloscope

1.1.5 Master the multimeter to measure the voltage, resistance and diode on and off

1.2　Basic switch circuit

1.2.1 Master the basic structure of the logic switch circuit

1.2.2 Master the concept of diode conduction and cutoff

1.2.3 Use a diode and a triode to form a simple logic gate

1.2.4 Master the simplest logic gate structure

1.3　Integrated logic gate circuit function and parameter test

1.3.1Familiar with the basic logic gate function, external electrical characteristics and special functions of logic function

1.3.2Familiar with TTL NAND gate and MOS or NOT gate package and pin function

1.3.3Master the test methods of main parameters and static characteristics, deepen Understanding the meaning of each parameter 4. Further establishing the concept of time delay for signal transmission 5. Further familiarity with the use of instruments such as oscilloscopes and function generators

Ⅱ The Content And The Principle Of The Experiment

2.1 The use of commonly used electronic instruments

2.1.1 Experimental content

2.1.1.1 Understanding of common electronic devices

2.1.1.2 Measuring an Sine Wave Signal with an Oscilloscope

Use a digital oscilloscope to measure the frequency (period) and amplitude from the function signal generator. By selecting the frequency range button and the frequency adjustment knob, the function signal generator emits sine waves with frequencies of 100 Hz, 10 kHz, and 100 kHz, respectively, and the period and frequency of the above signals are measured by a digital oscilloscope to verify the correct rate of the signal generated by the function signal generator.

2.1.1.3 Measuring the output voltage of the YB1638 function signal generator

Let the signal generator output a sine wave with a frequency of 1KHz (50hz) and any effective value of 1-3V (measuring the effective value with the digital multimeter AC), measure its amplitude with an oscilloscope, and calculate and compare the effective voltage value.

2.1.1.4 Measuring the DC power supply in the test box with a multimeter

Insert the black test lead into the COM jack, the red test lead into the “VΩ” jack, and then set the function switch to the DC range.

Connect the test pen to the circuit to be tested, the polarity of the red test pen will be displayed on the display at the same time, and finally use the oscilloscope and multimeter to measure the output of the three sets of DC stabilized power supply on the test bench.

2.1.1.5 Measuring the unidirectional conduction (on-off) characteristics of a diode with a multimeter

Insert the black test lead into the COM jack and the red test lead into the “VΩ” jack. Place the multimeter function switch on the diode

The position of the polarity is judged, and the red and black test leads are respectively connected to the two poles of the diode, if the display shows 0.6-0.7, at this time the diode is conducting, the red meter is connected to the positive pole, and the black meter is connected to the negative pole.

If on the display ,the number is 1. When the diode is reversed, the red meter is connected to the negative pole of the diode, and the black meter is connected to the second.The pole of the pole tube is positive.

2.2.2 Experimental principle

2.2.2.1Wiring diagram of DC regulated power supply and tested circuit in experimental box

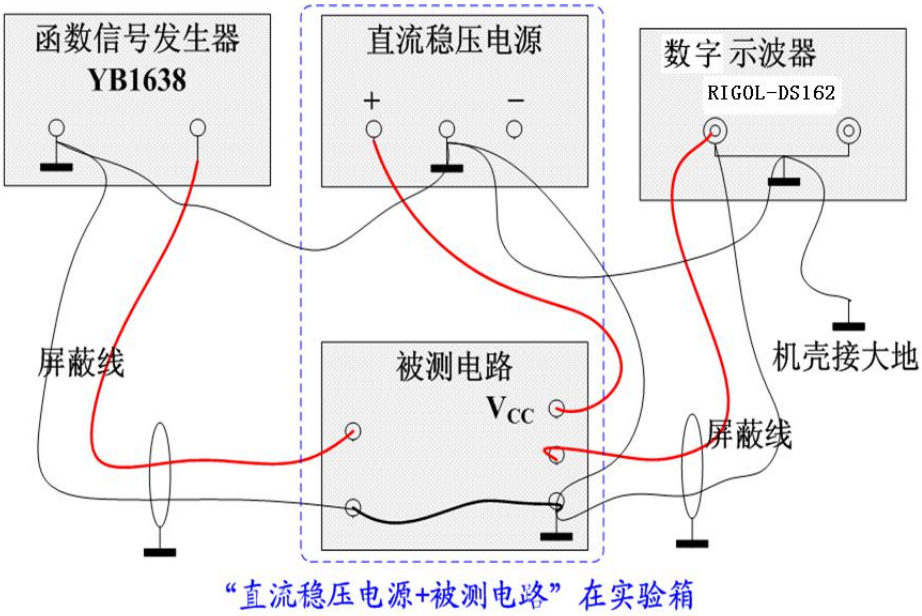


Chart 1 "DC regulated power supply + tested circuit" in the experimental box

2.2.2.2 Circuit design experiment box panel structure

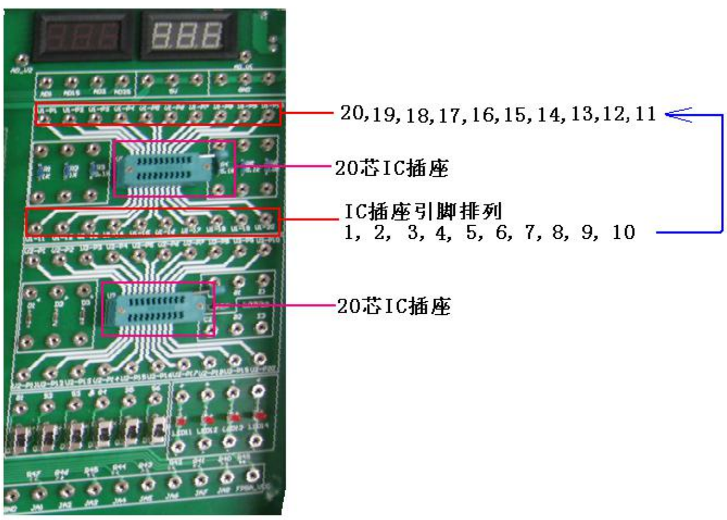
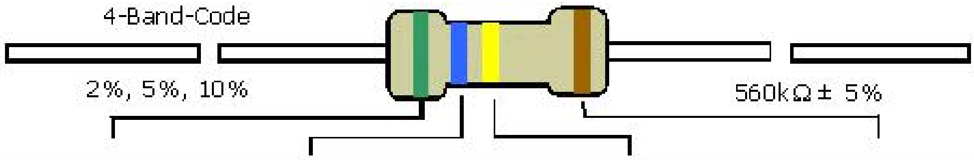


Chart 2 experiment box for circuit design

2.2.2.3 Recognition of resistance structure and color ring



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)

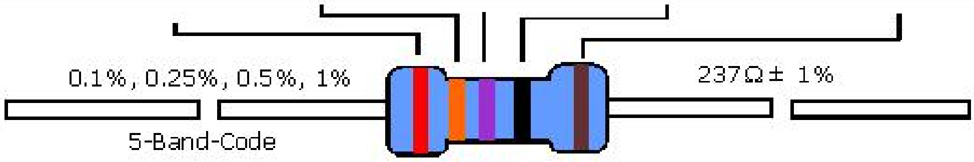


Chart 3 the corresponding chart of color ring and resistance value

2.2.2.4 Panel structure of digital oscilloscope

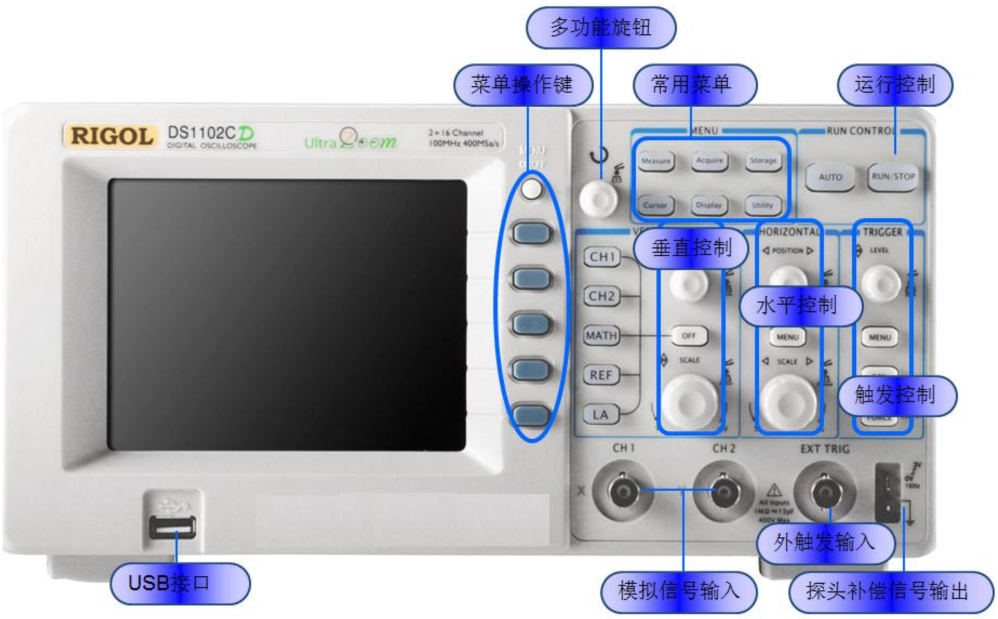
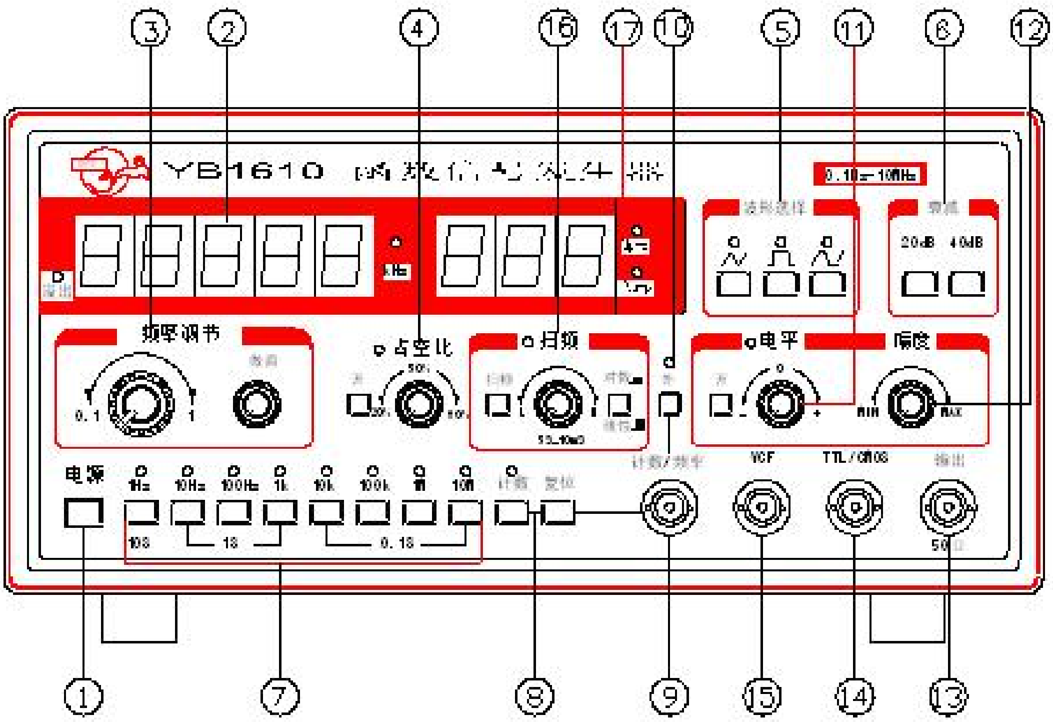


Chart 4 oscilloscope principle

2.2.2.5 YB1638 signal generator panel structure



1 是电源开关　2 是显示频率值　3 是频率微调　5 是输出波形选择　7 是选择输出频率的范围,

11 是输出幅度大小　13 是输出口可以输出三种类型波形　14 是输出 TTL 逻辑电平

Chart 5 YB1638 signal generator panel structure

2.2.2.6 The structure and function of multimeter

Chart6　　multimeter

2.2 Basic open circuit switch

2.2.1 The content of the experiment

2.2.1.1 The positive logic and gate are realized by diode, and the input and output voltage parameters are measured, and the logic functions are analyzed.

2.2.1.2 Use diodes to implement positive logic or gates, measure input and output voltage parameters, and analyze their logical functions

2.2.1.3 Using the reverse characteristic of transistor to realize positive logic non-gate, the input and output voltage parameters are measured, and the logic function is analyzed.

2.2.1.4 Uses the front and the gate and the non-gate realization and the non-gate, measures the input and output voltage parameters, analyzes its logic function

2.2.1.5 Polarity measurement of the triode

2.2.2 The principle of the experimen

2.2.2.1 Common logic level standard

逻辑电平	*VCC / V*	*VOH / V*	*VOL / V*	*VIH / V*	*VIL / V*	说明
TTL	**5.0**	**≥ 2.4**	**≤ 0.4**	**≥ 2.0**	**≤ 0.8**	输入脚悬空时默认为高电平
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**	输入阻抗非常之大
LVCMOS	**3.3**	**≥ 3.2**	**≤ 0.1**	**≥ 2.0V**	**≤ 0.7**	
LVCMOS	**2.5**	**≥ 2.0**	**≤ 0.1**	**≥ 1.7**	**≤ 0.7**	
RS232	**±12~15**	**−3 ~ −15**	**3 ~ 15**	**−3 ~ −15**	**3 ~ 15**	负逻辑

Chart7 common logic level standard

2.2.2.2 Uses diode to realize positive logic and gate.

When the A, B and C are grounded, the 3 diodes are in positive conduction and the output F is low level; as long as A, B, C exist, the output F is low. When the input A, B, C input are all high, the diodes are all cut off and the output F is high.

By logical logic, the level H and L in the table are replaced by logical values 1 and 0 respectively.The relationship between F and A, B and C is F =ABC.

C	*B*	*A*	*F*
L	L	L	L
L	L	H	L
L	H	L	L
L	H	H	L
H	L	L	L
H	L	H	L
H	H	L	L
H	H	H	H

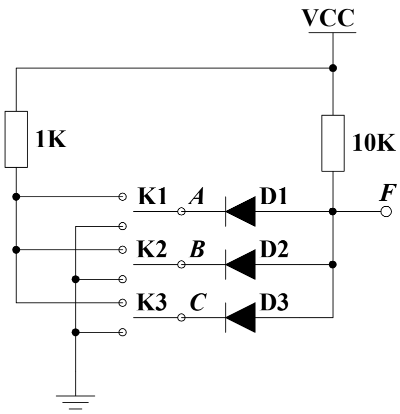


Chart7 positive logic and gate circuit diagram

2.2.2.3Using diode to realize positive logic or gate

When the input A, B, C are grounded, the output F is low as long as A, B, C.It has a high level and the output F is high.

According to the positive logic principle, the logical relationship between output F and A, B and C can be obtained as F=A+B+C.

C	*B*	*A*	*F*
L	L	L	L
L	L	H	H
L	H	L	H
L	H	H	H
H	L	L	H
H	L	H	H
H	H	L	H
H	H	H	H

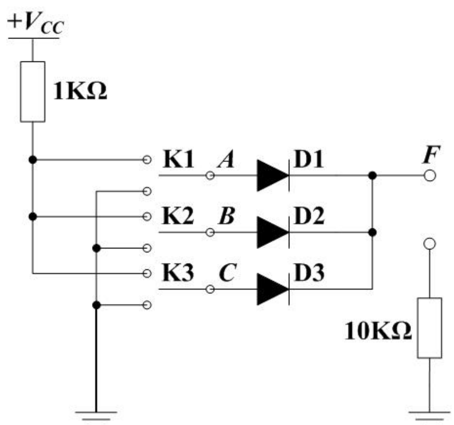
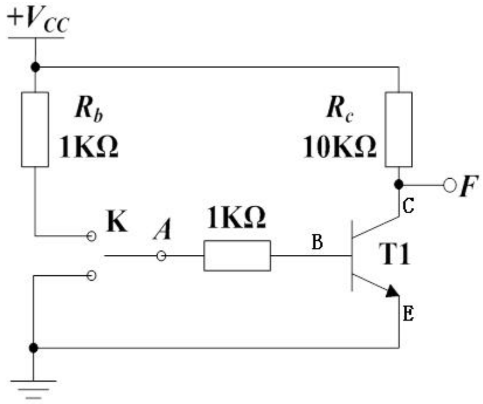


Chart8 positive logic or gate circuit diagram

2.2.2.4Using diode to realize positive logic non gate

When point A is connected to high level, the transistor T1 is saturated, VCE_0.3V, and the output F is low level saturated.

When point A is connected to low level IB = 0, there is almost no voltage drop on RC, the triode T1 is in cut-off state, and the output F voltage is close to VCC.



A	*F*
L	**H**
H	**L**

Chart9 positive logic non gate circuit diagram

2.2.2.5Using diode to realize positive logic NAND gate

When input A, B and C are all connected to high power, F1 is high and transistor T1 is saturated.

The logical relationship between F and A, B and C is "non": F = ABC.

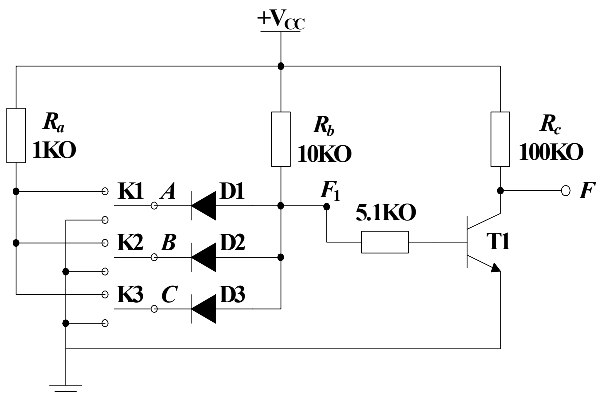


Chart10 positive logic NAND gate circuit diagram

C	*B*	*A*	*F*
L	**L**	**L**	**H**
L	**L**	**H**	**H**
L	**H**	**L**	**H**
L	**H**	**H**	**H**
H	**L**	**L**	**H**
H	**L**	**H**	**H**
H	**H**	**L**	**H**
H	**H**	**H**	**L**

2.2.2.6 Polarity measurement of triode

The red multimeter pen is inserted into the V mA Jack and the black meter pen is inserted into the COM jack.

Place the function range in the position of hFE, insert the transistor into the test socket of the transistor on the panel, insert the base b, collector C and emitter E.

The approximate value of hFE is read from the display screen, if the value is large, it means that the three-stage transistor c, e pole corresponds to the c, e pole on the socket; if the value is small, it means that the transistor c, e pole interpolation at this time should be adjusted to read the value of hFE.

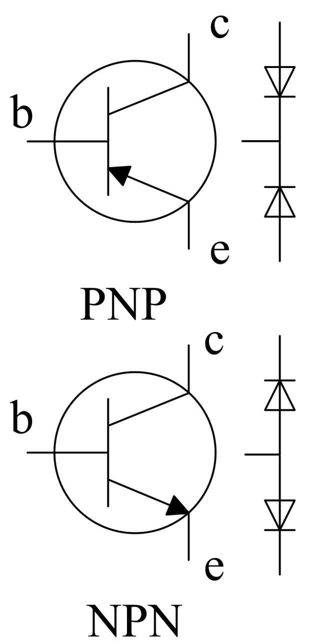


Chart11 triode

2.3 Integrated logic gate circuit function and parameter test

2.3.1 Experimental content

2.3.1.1Verify the logic functions of the 74LS00 "and non" gates of the integrated circuit

2.3.1.2Verify the logic functions of the integrated circuit CD4001 "or non" gates.

2.3.1.3Measure the transmission delay time TPD 4 of the logic gates of the integrated circuit 74LS00.

2.3.1.4Measure the transmission delay time TPD 5 of the logic gates of the integrated circuit CD4001.

2.3.1.5Measure the transmission characteristics and switching gates of the integrated circuit 74LS00 Level VON and VOFF

2.3.2 Experimental principle

2.3.2.1Basic parameters of digital integrated circuits

2.3.2.2Fan out coefficient (load capacity) N0

Fan-out coefficient is a parameter used to measure the output load capacity of digital logic devices and characterize the rated output capacity of devices. Logic devices are binary quantization devices whose output load capacity can be converted into the number of gates of the same type. In the range of rated output voltage, the number of the same type door that can be driven by the device is called fanout coefficient.

2.3.2.3Measurement of fanout coefficient of 74LS00 NAND gate

TTL fan out drive, as long as the output is rated at low power, how much current the output terminal can absorb. This current is generally measured when the output voltage reaches a maximum allowable value (<0.4V), which is also called the maximum injection current IoLmax. The fanout coefficient of TTL can be obtained by dividing the current from the low level input current IiL.

2.3.2.4Low level input current

Low-level input current IiL refers to the current flowing through the input when the input is grounded, also known as input short-circuit current, which measures the characteristics of low-level input resistance.

In 74LS00, an input terminal is grounded, and the current at the input end is suspended when another input is suspended.

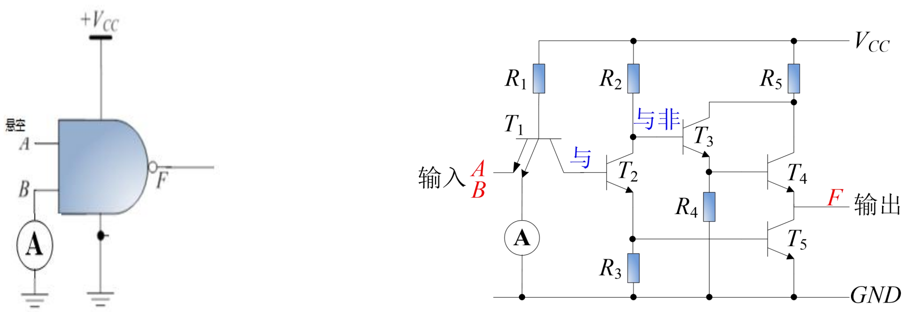


Chart12 Low level input current

2.3.2.5Common logic level standard

2.3.2.6Voltage transmission characteristics

The characteristic of voltage transmission is the relationship between output voltage and input voltage. It can fully display the logic characteristics of the input and output of the gate, and can reflect the binary quantization and the transition of the gate switch is a continuous transition process.

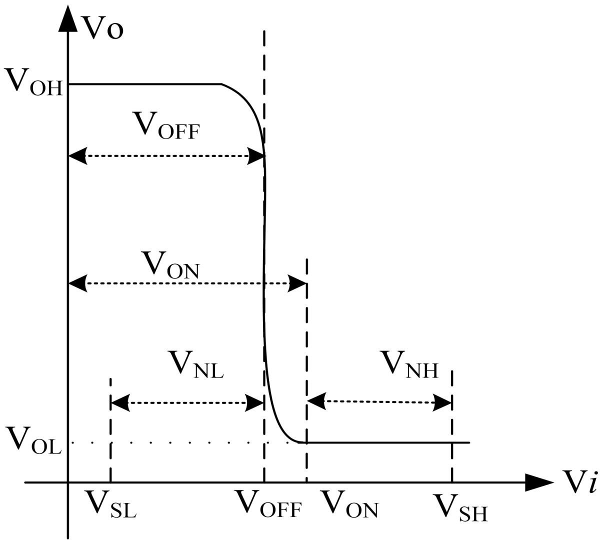


Chart13 voltage transmission characteristics

2.3.2.7Noise Margin

Noise tolerance refers to the maximum external noise voltage that is applied to the normal input value and does not produce unpredictable variations in the output of the circuit.

Set the rated input high level to VIH, rated input low level VIL, low level noise tolerance.

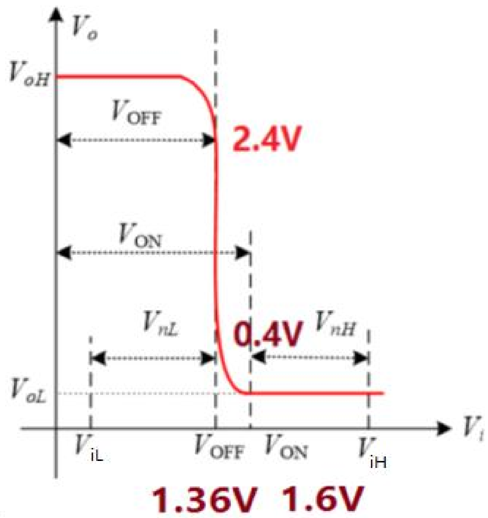


Chart14 noise margin

2.3.2.8Average transmission delay time tpd

The average transmission delay time TPD is a dynamic parameter, which is a parameter that the output signal lags behind the input signal for a certain time due to the charge-discharge time of PN-section capacitance, distributed parasitic capacitance and load capacitance of the transistor.

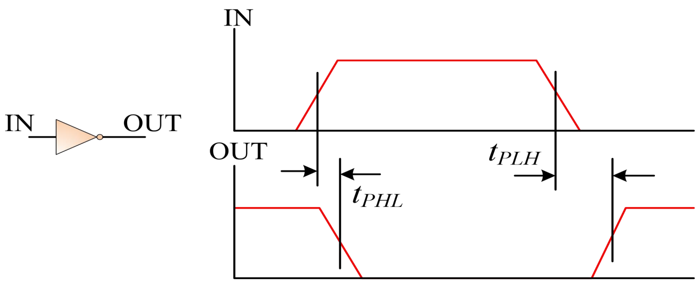


Chart15 average transmission delay time tpd

III Main Instrument

3.1 The use of commonly used electronic instruments

3.1.1 Experimental equipment

■Digital oscilloscope RIGOL-DS162 1
■Function generator YB1638 1
■Digital Multimeter 1
■Circuit design experiment box 1

3.1.2 Experimental materials

■Several commonly used electronic devices some

3.2 Basic switching circuit

3.2.1Experimental equipment

■Digital oscilloscope RIGOL-DS162 1
■Function generator YB1638 1
■Digital Multimeter 1
■Circuit design experiment box 1

3.2.2Experimental materials

■Diode IN4001 3
■Triode 9013 1
■Light-emitting diode 1
■Resistance

☑10KΩ 5
☑5.1KΩ 3
☑1KΩ 5

3.3 Integrated logic gate circuit function and parameter test

3.1.1 Experimental equipment

■Digital oscilloscope RIGOL-DS162 1
■Digital Multimeter 1
■Circuit design experiment box 1

3.2.2Experimental materials

■Two input NAND gate 74LS00 1
■Two input or non gate CD4001 1
■Resistance
■1 4.7K potentiometers 1
■100 Omega /1KW 1

IV Operation Method And Experimental Procedure

4.1 Measuring sine wave signal with oscilloscope

4.1.1 Frequency (Period) Measurement: YB1638 function signal generator sends out sinusoidal waves with frequencies of 100Hz, 10KHz and 100KHz by selecting frequency range switch and frequency adjusting knob. The period and frequency of the above signals are measured by oscilloscope, and the data are recorded.

4.1.2 The frequency of the signal generator is adjusted to the desired frequency through the frequency band switch, and the fine-tuning knob, which is displayed on the digital tube. The output signal line of the signal generator is connected with the signal of the oscilloscope, and the ground wire is connected with the ground wire.

4.2 Measure the output voltage of YB1638 signal generator

4.2.1 Let the signal generator output 1KHz, 1-3V arbitrary sine wave signal, the output of the signal generator to the oscilloscope, using the oscilloscope to measure the amplitude. The amplitude of the signal output by the signal generator is measured with the multimeter AC file. The converted valid value is compared with the effective value of the reading value of the AC reading meter in the multimeter.

4.2.2 The output of the signal generator is connected to the multimeter, red positive 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, and the peak value is read. Transformation formula: $\text{有效值} = V_{P-P} / 2\sqrt{2}$

4.3 Use the multimeter to measure DC power in the test box

4.3.1 Inserts the red pen into the V mA socket, and the black pen is inserted into the COM socket.

4.3.2 Place the function switch range in the DC range, connect the test pen to the circuit to be tested, and the polarity of the end of the red pen will be displayed on the display at the same time.

4.3.3 An oscilloscope and a multimeter are used to measure the output of a group of DC regulated power supplies on the test bench and record the measurement results.

4.4 Measuring the unidirectional conduction characteristic of diode with multimeter

4.4.1 Insert the pen into the COM Jack and the red table into the V_jack. The polarity of the red pen is +.

4.4.2 Place the multimeter function range switch in the "" position and connect the red and black pen to the diode's poles. If the display screen shows the number of 0.6-0.7, The diode is on, the number is the voltage of the PN junction, the red pen is connected to the positive diode, the black pen is connected to the negative electrode. If the number on the display is "1", the diode is turned off in reverse, the red meter pen is connected with the diode negative electrode, and the black meter pen is connected with the positive electrode.

4.5 Use diode to realize positive logic and gate

4.5.1 According to the circuit diagram in the experimental box through the wire connection circuit, check the diode, power supply voltage and polarity, resistance value, etc. are connected correctly.

4.5.2 VCC is connected to the +5V DC power supply in the experiment box.

4.5.3 Input level is generated by switch S1/S2/S3/S4/S5/S6. Input A, B different level combinations, with a multimeter or test box in the DC voltmeter to measure A, B and the corresponding output F voltage values and fill in the table to determine whether the logic and.

4.6 Use diode to realize positive logic or gate

4.6.1 Connect the circuit in the test box according to the circuit diagram, check whether the diode, power supply voltage and polarity, resistance value are connected correctly.

4.6.2 Input level is generated by switch S1/S2/S3/S4/S5/S6. Input A, B different level combinations, with a multimeter or test box in the DC voltmeter to measure the input A, B and the corresponding output F voltage values and fill in the table. Finally, determine whether logical values satisfy logic or.

4.7 Use diode to realize non gate

4.7.1 Connect the circuit on the test box according to the right diagram, check whether the triode and the polarity of the power supply, resistance value are connected correctly.

4.7.2 Connect +5V DC power to VCC terminal.

4.7.3Input the high and low level of the A terminal with switch S1/S2/S3/S4/S5/S6. Measure the voltage value corresponding to A and output F and fill in the form. Determine whether a logical relationship satisfies a non gate.

4.8 Realization of NAND gate with triode

4.8.1Connect the circuit on the test box to check the diode, triode and power polarity, resistance value and so on.

4.8.2 Connects +5V DC power to VCC

4.8.3Input A, B terminal high and low level are generated by switch S1/S2/S3/S4/S5/S6. Measure the voltage values corresponding to A, B and output F, and fill in the form. Determine whether logical relations satisfy logic and non - compliance.

4.9 Polarity measurement of triode

4.9.1 Insert the red multimeter pen into the V mA Jack and the black meter pen into the COM jack. First determine whether the triode is PNP or NPN type and set the base B.

4.9.2 Place the function range in the position of hFE, insert the transistor into the test socket of the transistor on the panel, insert the base B into the pair, and insert the collector C and emitter e freely.

4.9.3 Read the approximate value of hFE from the display screen, if the value is large, indicating that the third-level transistor c, e pole corresponds to the socket c, e pole; if the value is small, indicating that at this time the transistor c, e pole interpolation, should be adjusted to read the value of hFE

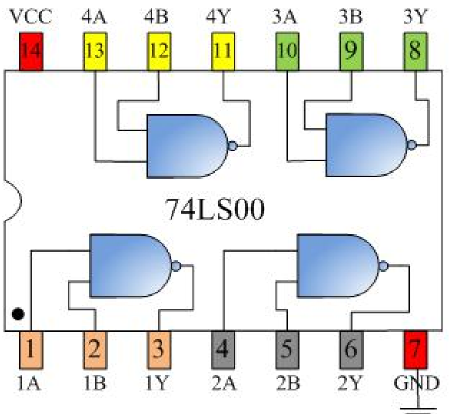
4.10 Verify the logic function of "74LS00" and "non" gates

4.10.1Insert the chip into the IC socket of the experimental box, and notice the direction of the chip.

4.10.2Connect the circuit according to the right picture, VCC connect voltage 5V, ground end grounding wire.

4.10.3The high and low level is generated by the S14/S15/S16/S17 switch.

4.10.4Traverse the input A and B combinations in real value table, measure A, B and output F voltage and record them in the right table.



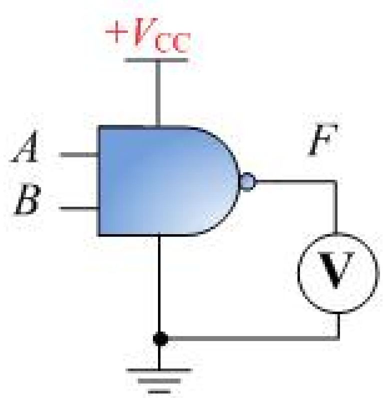


Chart16 non gates

4.11 Verify CD4001 "or not" gate logic function

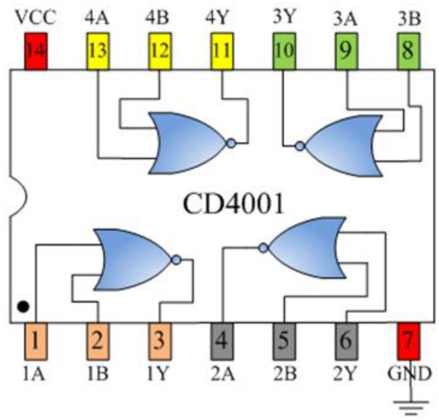
4.11.1Insert the chip into the IC socket of the experiment box.

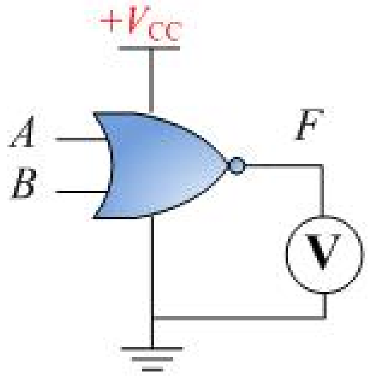
4.11.2Connect the circuit according to the right picture, VCC connect DC 5V voltage, ground end grounding wire.

4.11.3The high and low level is generated by the S14/S15/S16/S17 switch.

4.11.4Traverse all combinations of input A and B in order of truth table, measure voltage values of input A, B and output F, record right table

4.11.5Repeat step 3~4 to measure the logical relationship between the other 3 gates and determine whether the door is good or bad.





4.12 Measure the transmission delay time of 74LS00 logic gates TPD

4.12.1Insert the chip into the IC socket of the experiment box, pay attention to the chip direction.

4.12.2Connect the circuit according to the diagram, connect the VCC to the 5V power, and ground the ground wire.

4.12.3The oscilloscope is connected to any input or output terminal of the oscillator.

4.12.4Adjust the frequency knob, measure the waveform of Vo, read out the cycle T and calculate the transmission delay time (30-60ns).

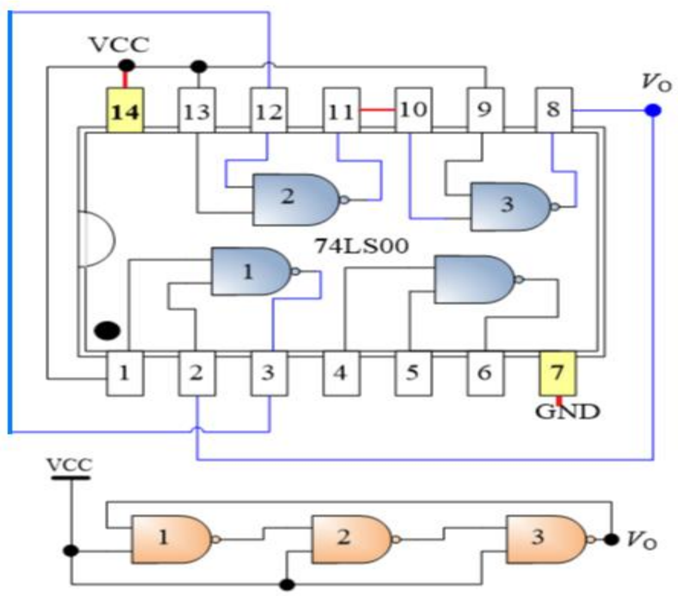


Chart17 74LS00 logic gates TPD

4.13 Measure the transmission delay time of CD4001 logic gates TPD

4.13.1Insert the chip into the IC socket of the experiment box, pay attention to the chip direction.

4.13.2Connect the circuit according to the diagram, connect the VCC to the 5V power, and ground the ground wire.

4.13.3The oscillograph is connected to the input or output end of the oscillator.

4.13.4Adjust the frequency knob, measure the waveform of Vo, read out the cycle T and calculate the transmission delay time. (500-1000ns)

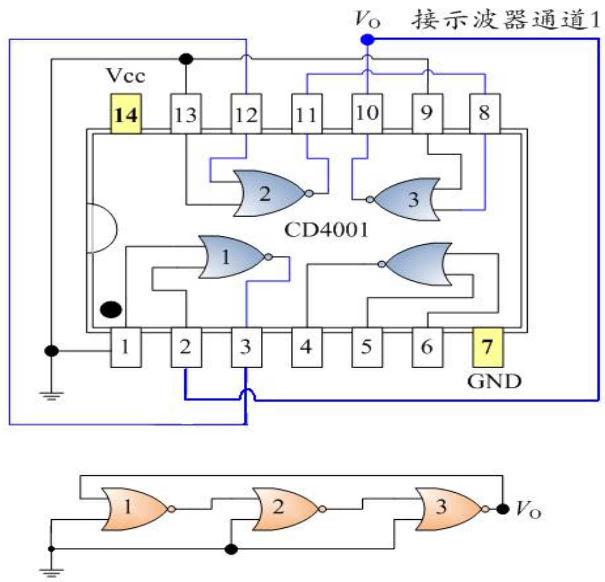


Chart18 CD4001 logic gates TPD

4.14 Measuring 74LS00 transmission characteristics and opening and closing levels VON and VOFF

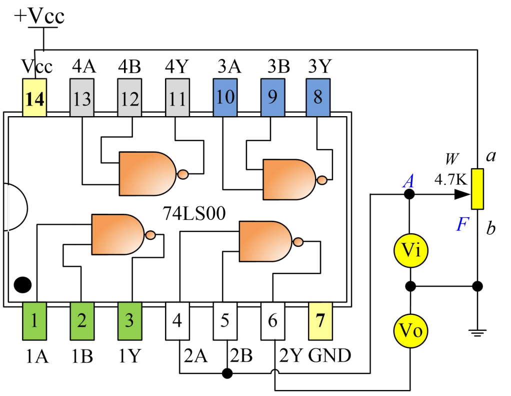
4.14.1Insert chip into IC socket of experiment box

4.14.2Connect circuit according to diagram (see next page)

4.14.3The DC meter is connected to the A terminal and the NAND gate output 2Y terminal respectively.

4.14.4Slowly adjust the potentiometer W from end B to end A. Observe the readings of Vi and Vo voltmeters and record the data to fill in the form.

4.14.5Draw a graph based on the tabular data and seek VON and VOFF.



V_i/V	V_o/V	V_i/V	V_o/V
0		:	⋮
0.2		:	
0.4		:	
0.6		:	
0.8		2.0	
:	:	2.5	
:	V_{OFF}	3.0	
:	⋮	3.5	
:		4.0	
:	V_{ON}	4.5	
:	:	5.0	

Chart19 Von and Voff

V Experimental results and analysis

LAB1

5.1 Measure sine wave signal with oscilloscope

	Function generator output	Oscilloscope reading	Sensitivity	Measured value	
Range		4.7Div	2.0V/Div	4.7*2/2=4.7V	
Cycle / frequency	97Hz	2.2Div	5ms/Div	11ms	96.0Hz
Range		4.8Div	2.0V/Div	4.8*2/2=4.8V	
Cycle / frequency	8.7KHz	2.4Div	50μs/Div	120μs	8.77kHz
Range		4.7Div	2.0V/Div	4.7*2/2=4.7V	
Cycle / frequency	100.8KHz	2Div	5μs/Div	10μs	100.00KHz

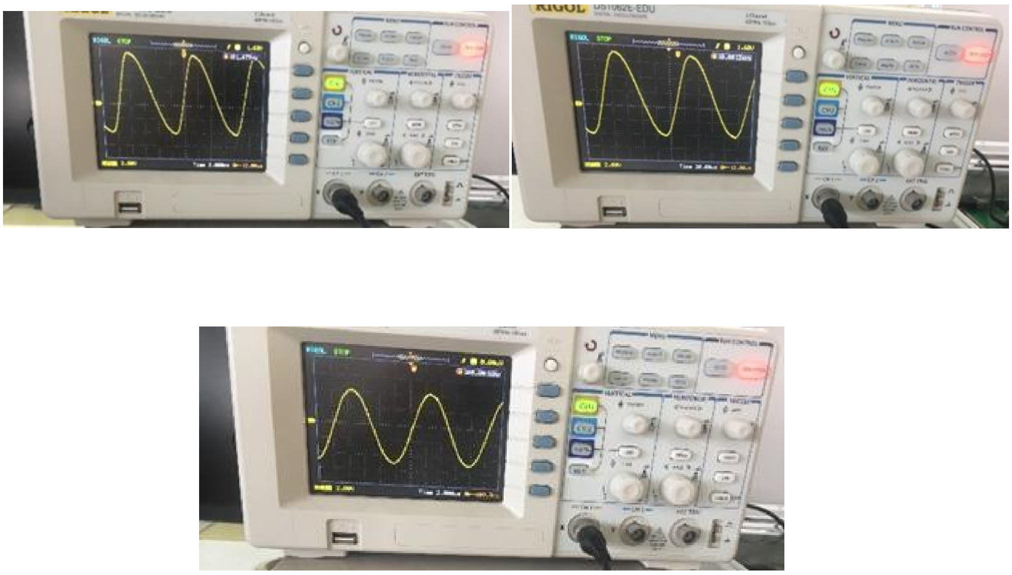


Chart20 sine wave signal with oscilloscope

Analysis: From the experimental data, we can see that there is a certain error between the voltage value read from the oscilloscope and the actual measured value, which is mainly due to the measurement error of the instrument itself, visual error of human eye reading, voltage loss and so on. On the other hand, the output frequency of the function generator is different from the measured frequency. The error comes from external signal interference, inadequate accuracy of the instrument, reading error and so on. But the error of the experimental data is within the scope of the experiment.

5.2 Measure the output voltage of the YB1638 function generator.

Function generator output	Oscilloscope reading		Converted effective value	Oscilloscope reading
1KHz	4.7Div	2V/Div	3.32V	3.14V

Chart21 output voltage of the YB1638 function generator

Analysis: According to the experimental data, there is a certain error between the oscilloscope reading and the output voltage of the function generator measured by the multimeter, but the error is within the allowable range of the experiment.

5.3 Use the multimeter to measure the DC power in the

experimental box

DC regulated power output	Oscilloscope reading	Sensitivity	Oscilloscope converted value	Multimeter reading
+5V	2.5Div	2V/Div	5.0V	4.96V

Chart22 DC power in the experimental box

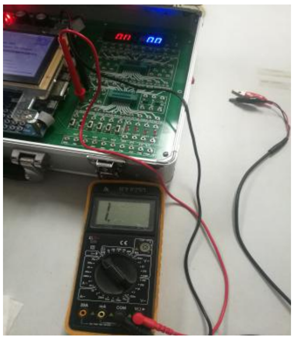
Analysis: According to the experimental data, the display value of the oscilloscope is close to the reading value of the multimeter, but not completely equal. There are errors, but the errors are within the allowable range of the experiment.

5.4 Measure the unidirectional conduction (on-off) characteristics of diode with multimeter

Multimeter reading	D1	D2	D3
Diode forward conduction	0.594	0.667	0.600
Diode reverse cut-off	1	1	1

Chart23 the unidirectional conduction characteristics

Analysis: the experimental data prove that the diode's forward current is switched on and the reverse current is cut off.



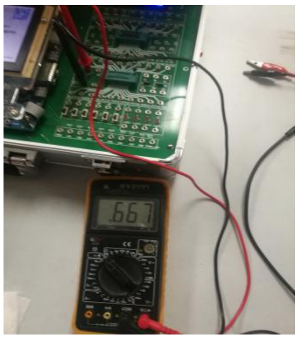


Chart24 multimeter reading

LAB2

5.5 Use diode to realize positive logic "and gate"

VA/V	VB/V	VF/V	F Logical value
4.7	0.0	0.2	L
0.0	4.8	0.2	L
0.0	0.0	0.2	L
4.7	4.7	4.96	H

Chart25 positive logic “and” gate

Analysis: when VA and VB are both high, VF is high. As long as one of them is low, the F will be low. The experimental data conform to the logical relationship between "gate" and "gate".

5.6 Use diode to realize positive logic "or gate"

VA/V	VB/V	VF/V	F Logical value
4.7	0.0	4.64	H
0.0	4.7	4.64	H
4.7	4.7	4.71	H
0.0	0.0	0.0	L

Chart26 positive logic ”or” gate

Analysis: when one of VA and VB is high power, the output F is high. Only when both are low, the output is low. The experimental data conform to the logic of "or gate".

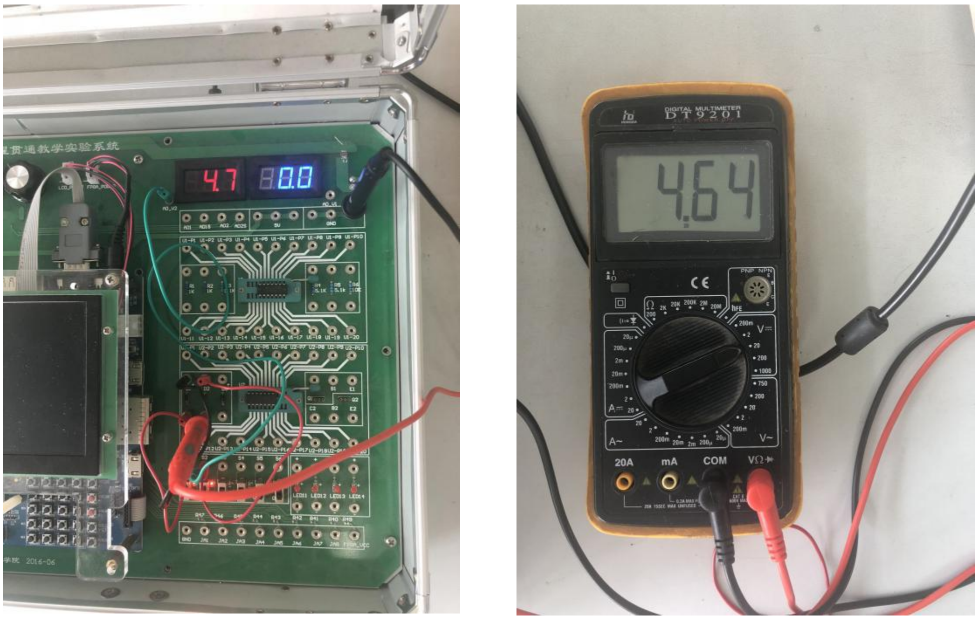


Chart27 multimeter reading

5.7 Use diode to realize positive logic "non gate"

VA/V	VB/V	F Logical value
0	4.96	H
3.73	0.04	L

Chart28 positive logic “non” gate

Analysis: when VA is high, the output F is low; when VA is low, the F is high. The experimental data accord with the logical relationship of "non gate".

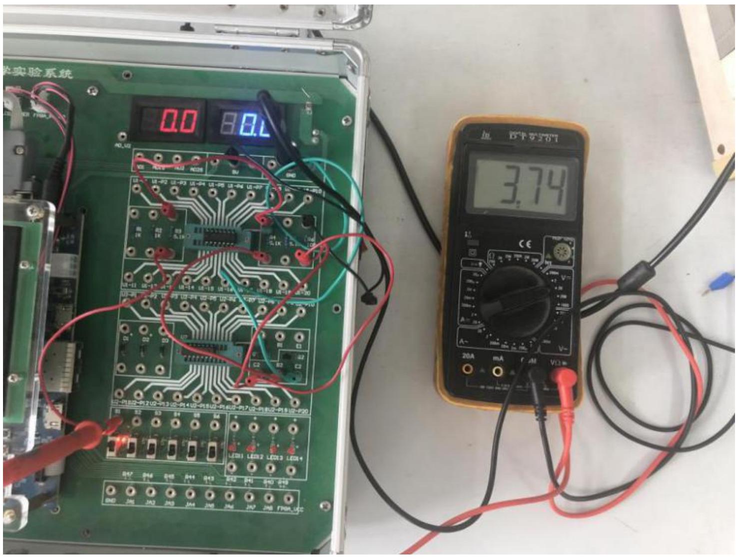


Chart29 multimeter reading

5.8 Use diode to realize positive logic “NAND gate”

VA/V	VB/V	VF/V	F Logical value
4.97	0.02	4.90	H
4.97	4.96	0.04	L
0.02	4.97	4.90	H
0.02	0.02	4.92	H

Chart30 NAND gate

Analysis: F is low if and only if VA and VB are at high power. Compared with the experimental results of "and gate" circuits, we can see that there is a non logical relationship between them. The experimental data conform to the logical relationship between "NAND gate".

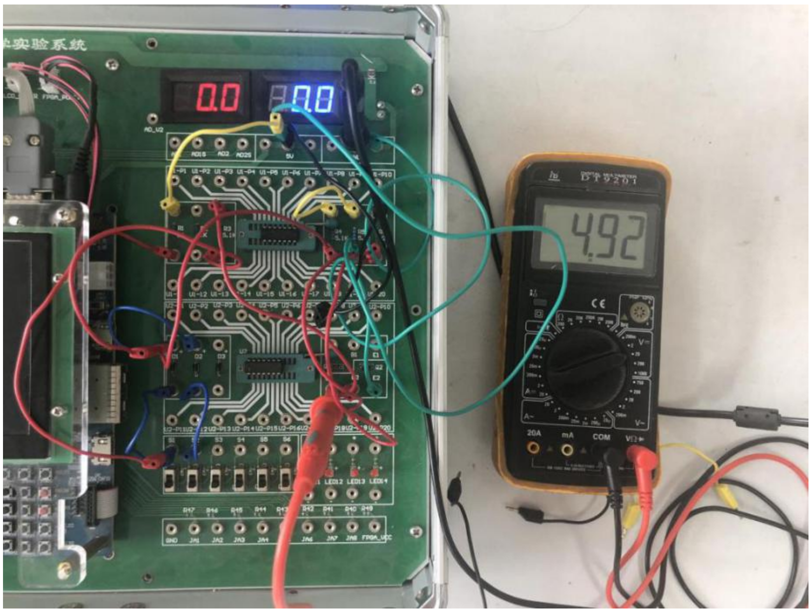


Chart31 multimeter reading

5.9 Polarity measurement of triode

	hFE approximate value
Test 1	202
Test 2（change c&e）	21

Chart31 hFE value

Note: the transistor provided by the laboratory is NPN type.

Analysis: if the value of hFE is large, then the c, e pole of the transistor and the c and e of the multimeter socket are very corresponding. If the hFE value is small, the c and e poles of the transistor are inserted.Following the instrument, we can judge the transistor is NPN then we find the reading would be 202 when bases are correctly used while the reading would be 021 when it is wrong. In the testing, the triode must be pressed hard enough to get stable reading. Deviation might come from not pressing hard enough and not choosing the right B pin.

Chart32 multimeter reading

LAB3

5.10 Verify the logic of the integrated circuit 74LS00 NAND gate.

VB(V)	VA(V)	VF(V)
0.0	0.0	4.2
4.8	0.0	4.2
0.0	4.8	4.2
4.8	4.8	0.1

Chart33 74LS00 NANDgate

Analysis：When the input A, B are connected to high level, F is low level; as long as there is a ground in A, B, F is high level, in accordance with the non-gate logic relationship.

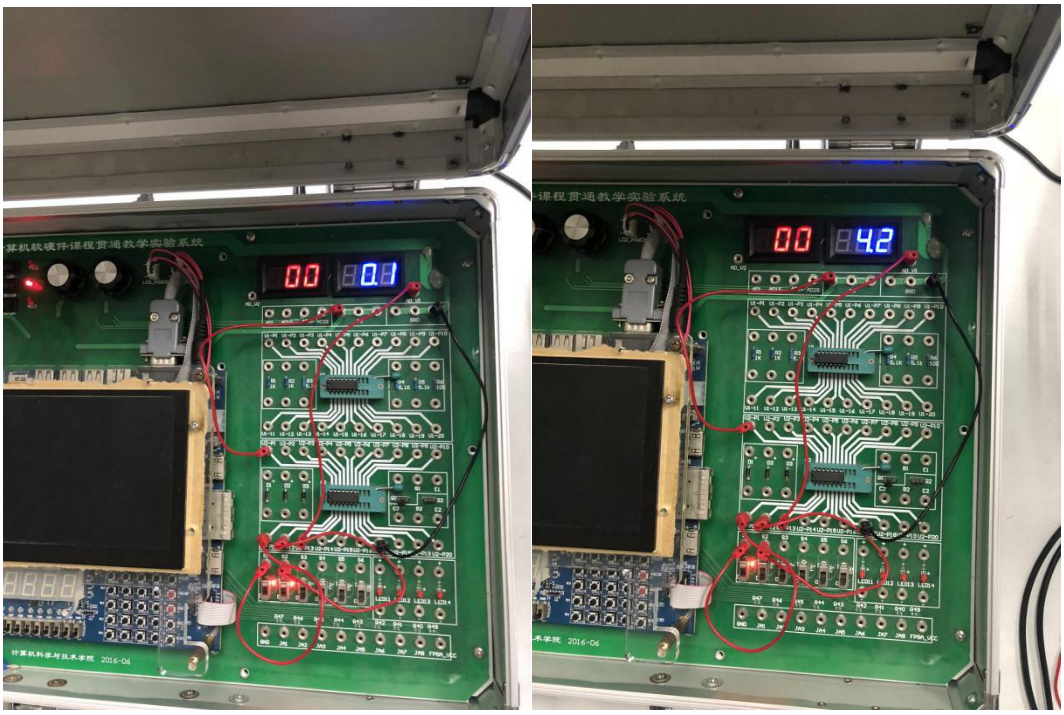


Chart34　reading

Analysis：When the input A, B are connected to high level, F is low level; as long as there is a ground in A, B, F is high level, in accordance with the non-gate logic relationship.

5.11 Verify the logic function of the integrated circuit CD4001 NOR gate.

VB(V)	VA(V)	VF(V)
4.8	4.8	0.0
0.0	4.8	0.0
4.8	0.0	0.0
0.0	0.0	4.8

Chart35 CD4001 NOR gate

Analysis：When input A, B are connected to low level, F is high level; other cases F is low level, conform to or non-gate logic relationship.

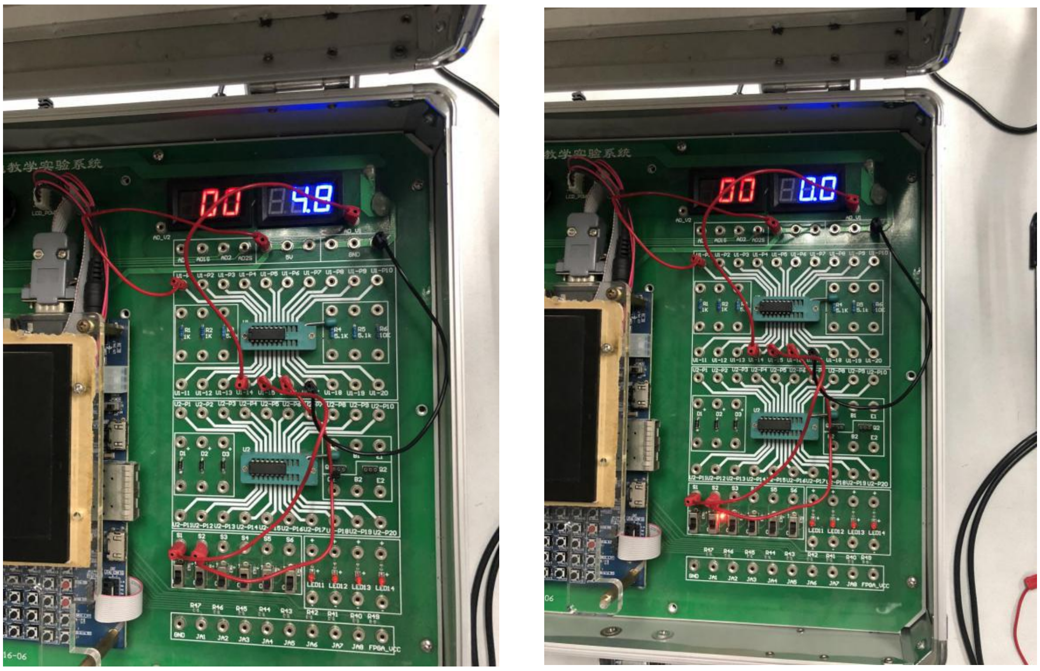


Chart36 reading

5.12 Measure the transmission delay time tpd of the integrated circuit 74LS00 logic gate.

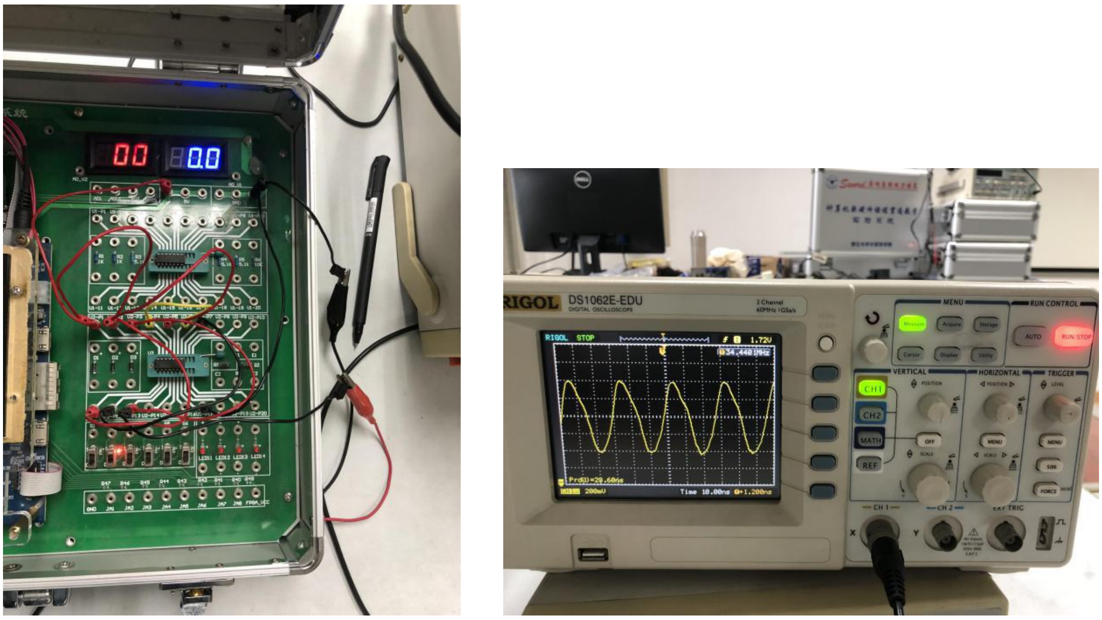


Chart37 connection and reading

f=34.4401MHz

T=1/f=28.60ns

t_{pd}=T/6=4.77ns

Analysis: Using the oscilloscope we can measure the frequency of total NAND gates. Because $t_{pd}=(t_{PHL}+t_{PLH})/2$, and there are three NAND gates, so t_{pd}=T/6=1/6f.

5.13 Measure the propagation delay time tpd of the integrated circuit CD4001 logic gate.

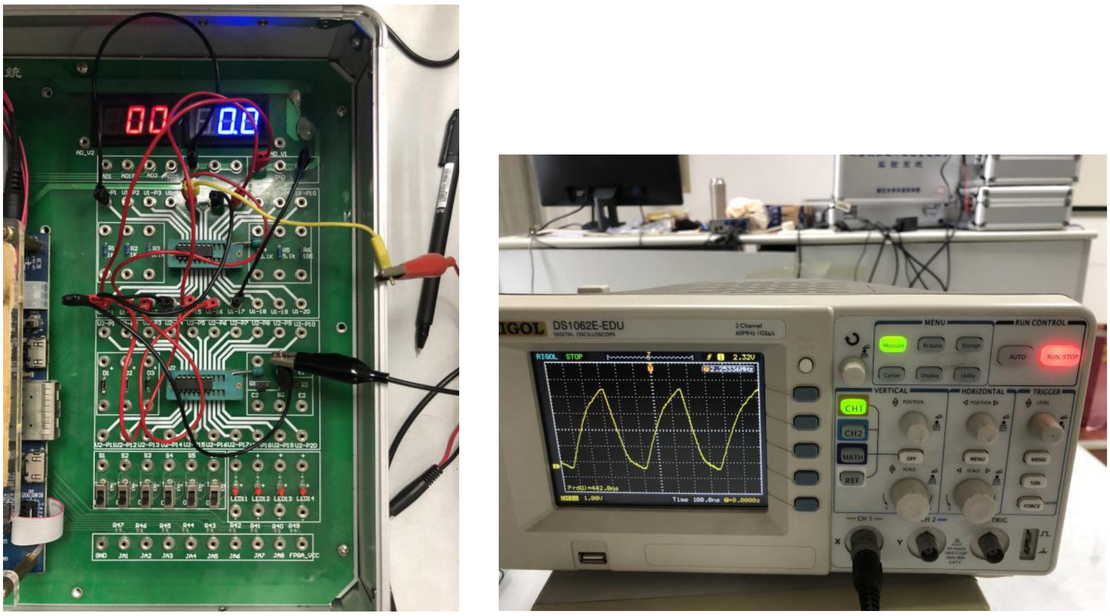


Chart38 connection and reading

f=2.25336MHz

T=1/f=442.0ns

t_{pd}=T/6=73.67ns

Analysis: Using the oscilloscope we can measure the frequency of total NORgates. Because $t_{pd}=(t_{PHL}+t_{PLH})/2$, and there are three NOR gates, so t_{pd}=T/6=1/6f.

5.14 Measure the integrated circuit 74LS00's transmission characteristics and switch gate level VON and VOFF.

Vi/V	V0/V	Vi/V	V0/V
0.07	4.50	0.99	2.06
0.20	4.51	1.00	1.97
0.40	4.51	1.10	0.74
0.60	4.49	1.11	0.62
0.70	4.37	1.12	0.49
0.80	4.29	1.13	0.25
0.90	4.05	1.14	0.21
0.95	3.01	1.15	0.19
0.96	2.71	1.20	0.18
0.97	2.43	2.00	0.15
0.98	2.39	4.42	0.15

Chart39 the value of V0 and Vi

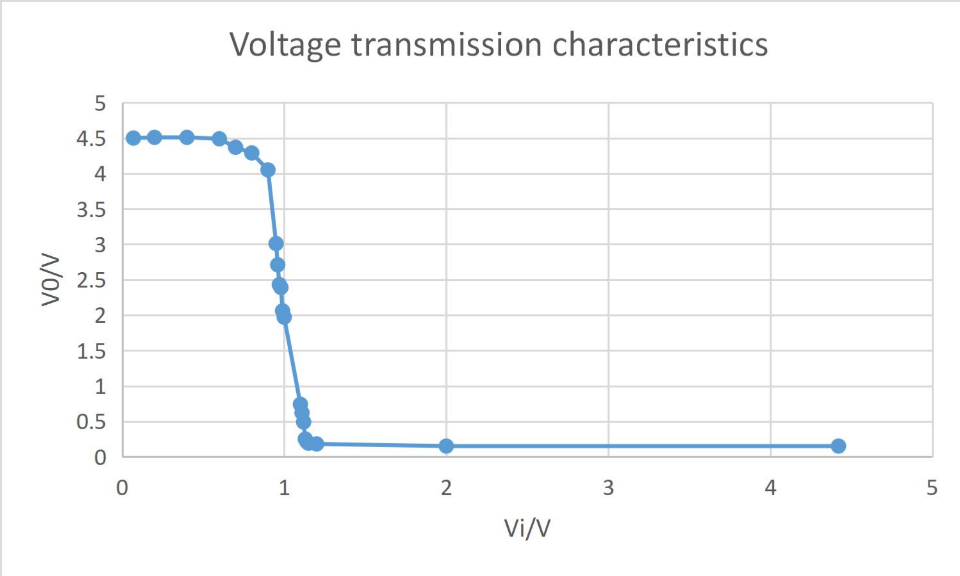
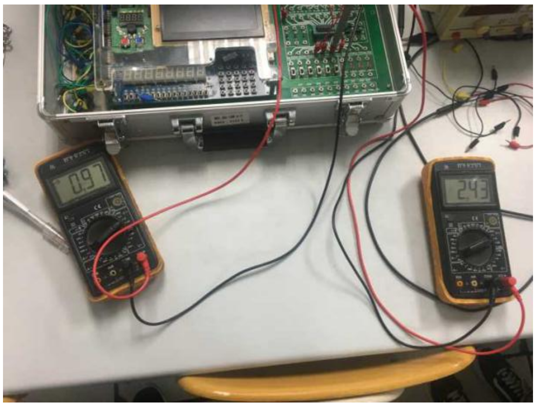


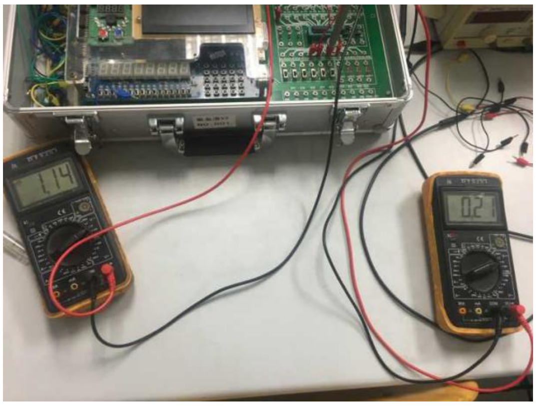
Chart40　　line chart

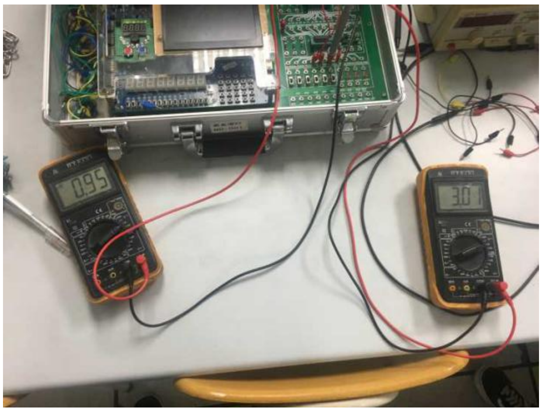
Analysis: Use multimeter to measure the data of V_i and V_0, then draw the picture about transmission characteristics. From the graph, we got that

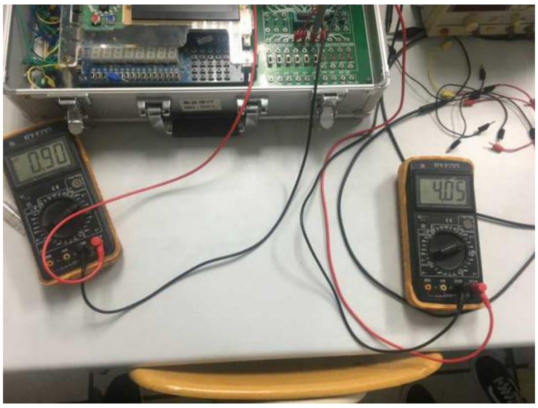
V_{ON}=1.25V

V_{OFF}=0.88V









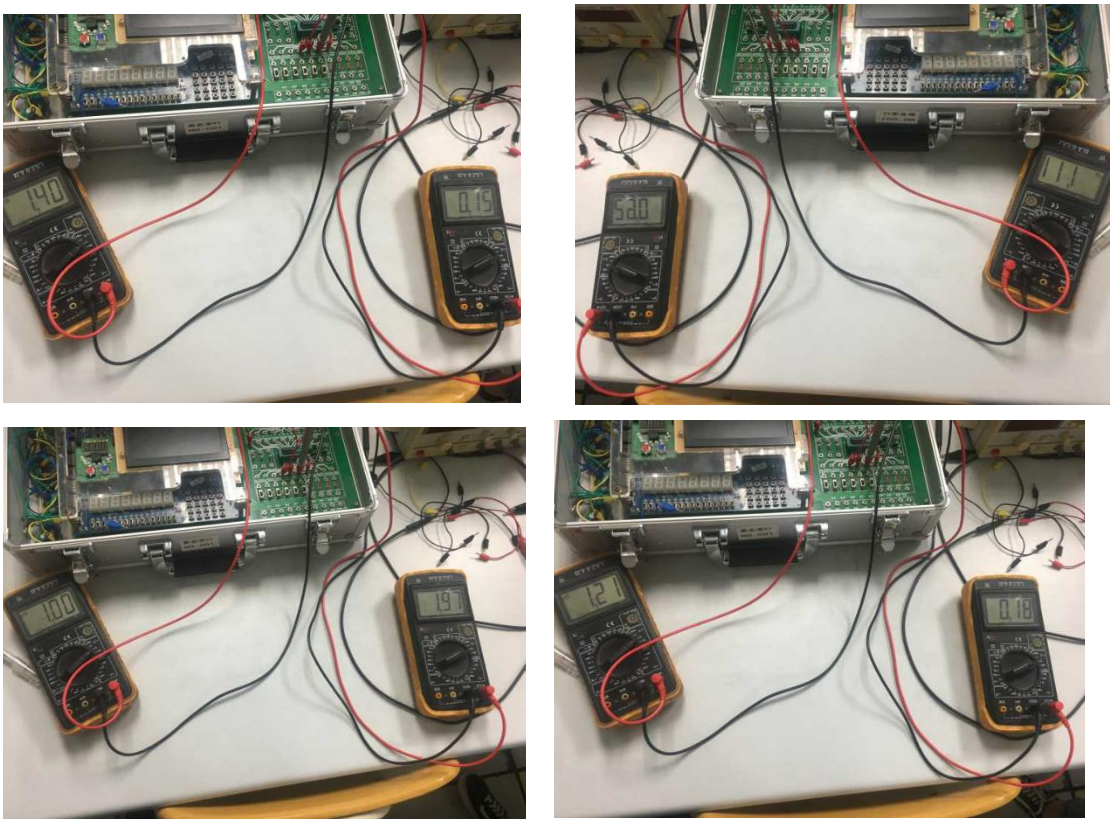


Chart41　multimeter reading

VI　Discussion and Understanding

Overall, three experiments have helped me to understand the common instruments and a series of basic operations of digital logic design experiments, as well as the process and some principles of the experiments, which has increased my hands-on ability. Next, I will make specific analysis based on the problems and feelings encountered in the experiment.

Experiment 1 is not difficult as a whole. The key point is to

understand the operation requirements of oscilloscope, multimeter and function generator. When I operated a digital oscilloscope to measure pulse waveform, amplitude and frequency, I found that there would be a big error if I directly used eyes to judge the number of cells. Later, my teammate pointed out that the cursor could be used to operate it accurately. This reminds us that before the experiment, you'd better have a clear and comprehensive understanding of various functions of the instrument.

On the basis of experiment 1, the basic structure of logic switching circuit , the operation of diode and triodes are introduced in experiment 2. In this experiment, the hardest part for me is the connection of the circuit. At first, I didn't really understand the meaning of the holes on the circuit board. The connection process was not smooth. Then I calmed down and analyzed the symbolic meaning of the holes by comparing the circuit diagram and the connection mode given by the ppt. All the connections were successfully completed finally.

Experiment 3 goes further, we were taught to test the functions and parameters of the logic gate circuit. With the experience of Experiment 2, the difficulty of connecting circuits was removed, but the difficulty of dealing with data followed. In the process of measuring Von and Voff, we found that the data of the multimeter

could not be stable at some input voltage values. After discussion, we decided to select the stable points as possible. For the unstable points, we estimated and analyzed the data by combining the displayed indicators and the adjacent point indicators.

To summarize, I got numerable experience from the experiments.Although the episodes appear now and then, I believe I am making progress all the time.Hope a better performance next time, thanks for my instructor's guidance and my group mates' help.