Power Transmission and Distribution Experiment System

P.N.:GTET-1023

Operation manual&

Experiment manual

Note: please read the manual carefully before operating the equipment and operate in strict accordance with the requirements of the manual. If the equipment is damaged due to wrong operation, it is not within the scope of the GTEE's warranty.

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Content

Chapter 1 Product introduction

1. Product composition and function

This equipment mainly consists of three-phase 380VAC power module, three-phase transformer module, ground fault module, DC voltage control module, voltage and current measurement module, inverter module, power meter module, leakage circuit breaker module, three-phase AC contactor module and transmission line capacitor module, analog switch module, digital meter module, capacitive load module, resistive load module, inductive load module and transmission line module. The system describes the working principle of power transmission. By using this equipment, students can deeply understand and master the power transmission. the electrical connection properties and working principle of the system.

Note: Above picture is only for reference, the actual products may be different.

2. Product specification

Supply voltage: three-phase 380V AC

Size: 1440x 815 x 1780mm

Weight: about 100kg

3. Precaution

3.1. Please read this manual carefully and understand the instructions before operating the equipment.

3.2. The person responsible for the equipment should be aware of the operation of the

equipment and the hazards that may occur before using the equipment.

3.3. Please check and confirm whether the running status of the equipment is fine before training.

3.4. Disassembling the device is prohibited if it is not necessary.

3.5. Please pay attention to general safety requirements such as leakage, disconnection and overload.

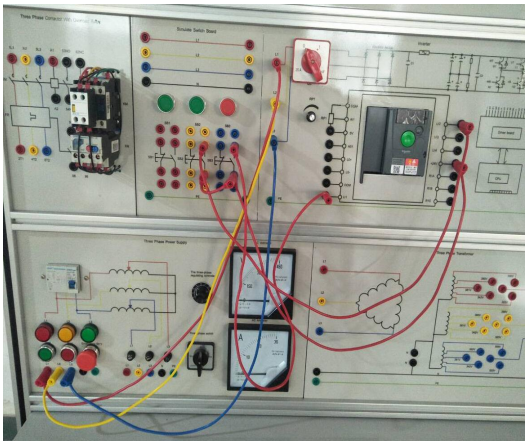
3.6. Please turn off the power before checking or repairing the equipment.

3.7. Please cut off power when connecting the experimental circuit

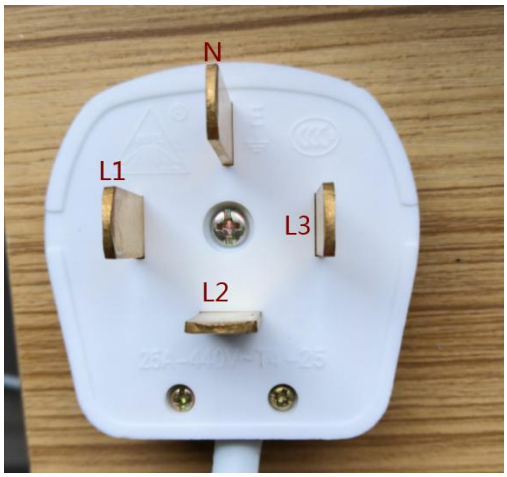
Chapter 2 Basic operation

Operation procedure

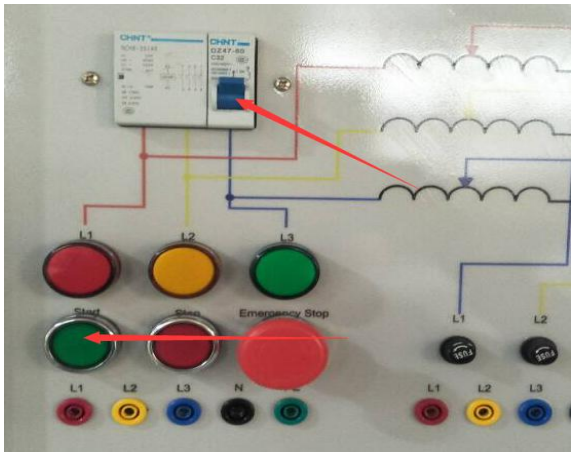
1.1. Connect the basic experimental circuit diagram according to the circuit schematic diagram. (Note: When connecting the experimental circuit, it is better to use different color line connection circuits to facilitate the circuit inspection and beware of circuit connection errors. In addition, all switches are required to be closed when wiring.



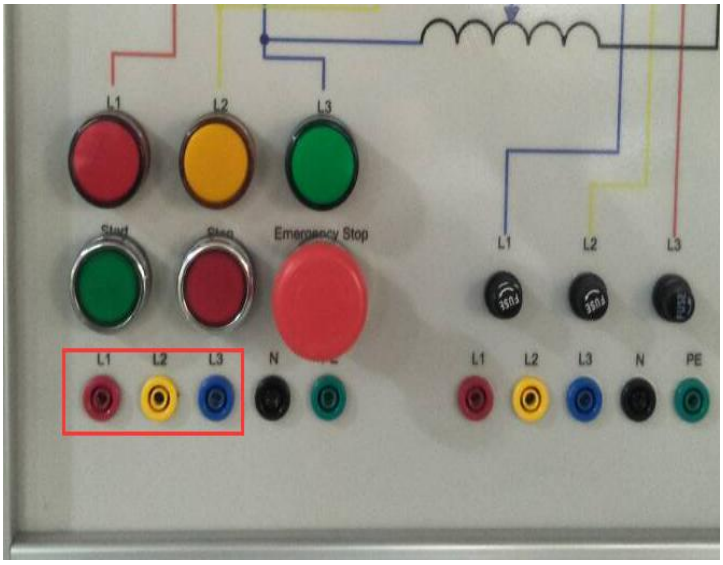
1.2. After the experimental circuit is connected, connect the power plug of the device to the three-phase 380V AC.



1.3 Turn on the main power switch



1.4 After turning on the main power switch, use a multimeter to measure the voltage of the three-phase voltage output. If the voltage between the two terminals is 380V, it shows that the voltage output is normal. If the voltage of one of the outputs does not reach 380V, it shows that voltage input is abnormal, it is necessary to check whether the neutral line of the three-phase electrical socket is consistent with the zero line of the trainer. If it is inconsistent, it needs to be changed to be consistent.

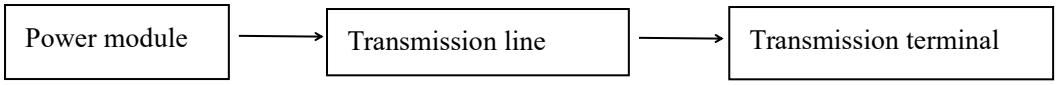


1.5 After the system is powered on, perform the corresponding experiment according to the experimental content.

Chapter 3 System structure and working principle

1. System working principle

The system mainly consists of three-phase 380VAC power module, three-phase transformer module, ground fault module, DC voltage control module, voltage and current measurement module, inverter module, power meter module, leakage circuit breaker module, three-phase AC contactor module and transmission line capacitor module, analog switch module, digital meter module, capacitive load module, resistive load module, inductive load module and transmission line module, its working principle is mainly to transmit power through transmission line to realize the function of module power transmission over long distance. The system block diagram is shown below.

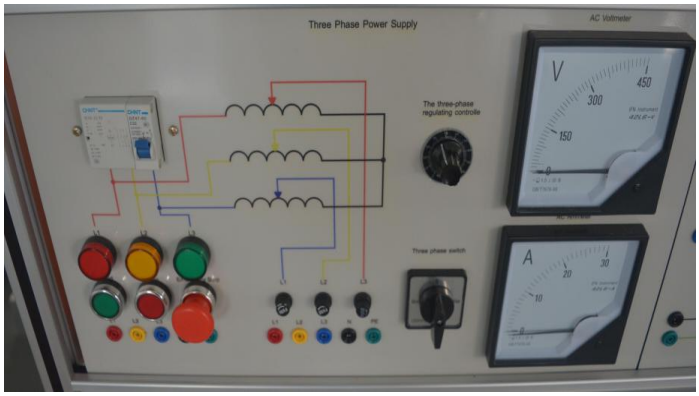


System diagram

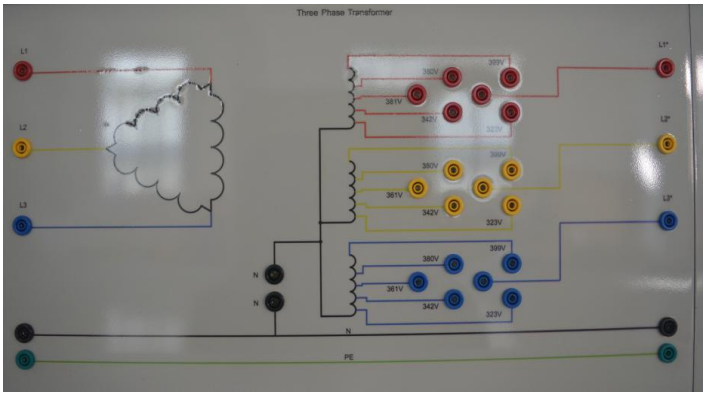
2. System structure

2.1. Power module

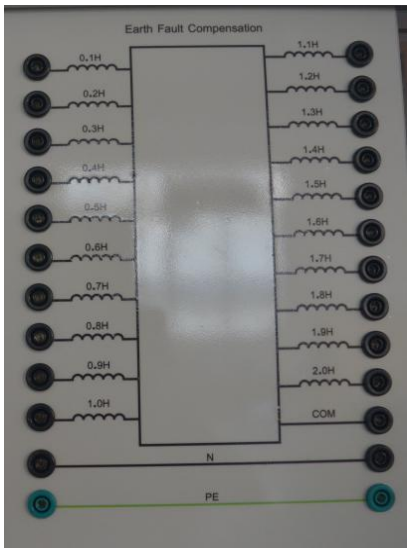
It is mainly used to supply power to the trainer. The input voltage is 380V/AC and the output is 380V/AC.



2.2. Three-phase transformer

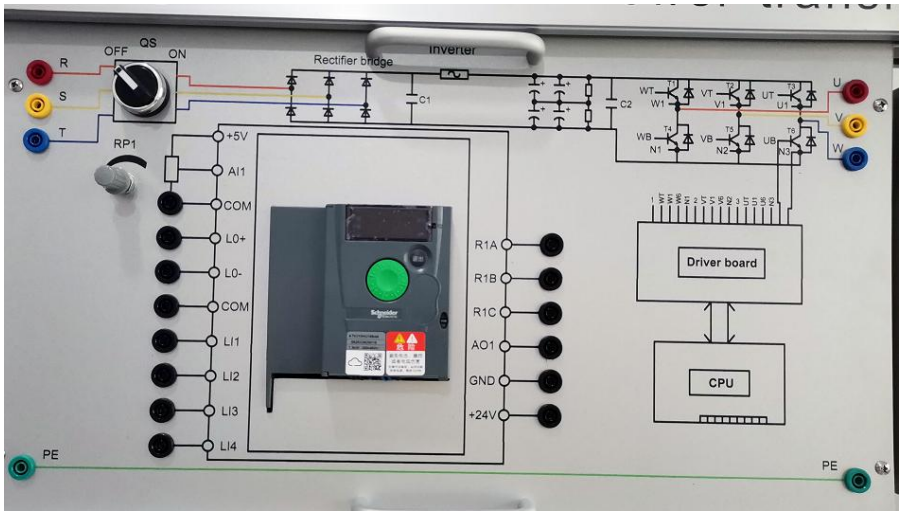


2.3.Earth Fault Compensation

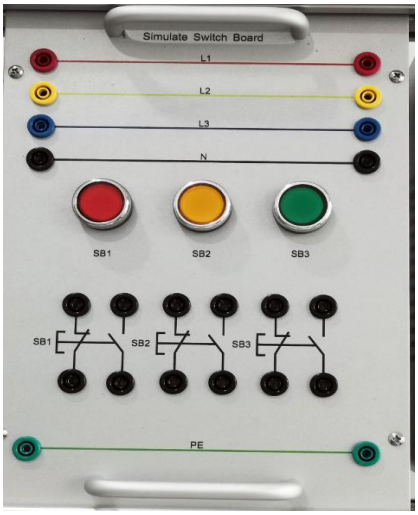


2.4.AC Voltmeter &AC Ammeter

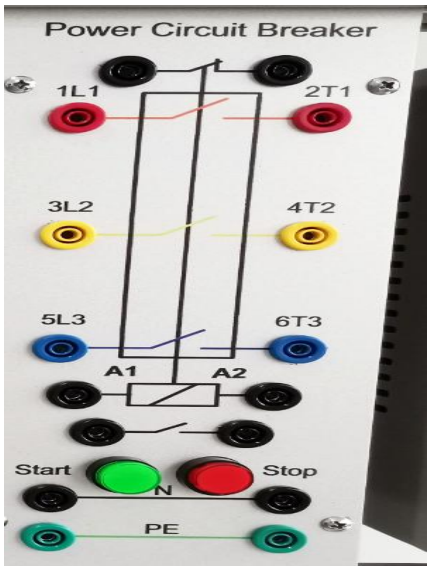
2.5.Inverter



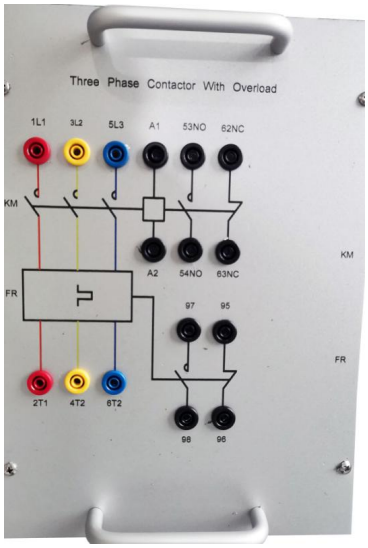
2.6.Simulate switch board



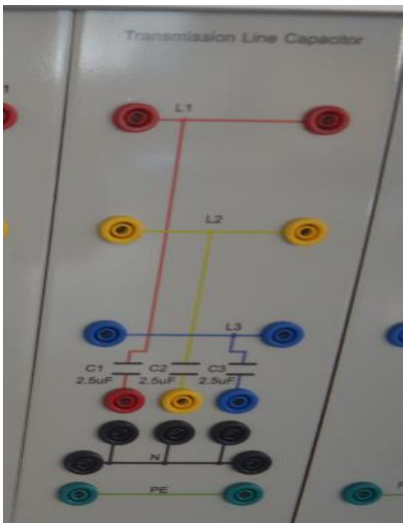
2.7.Power circuit breaker



2.8.Three Phase Contactor



2.9.Transmission line capacitor

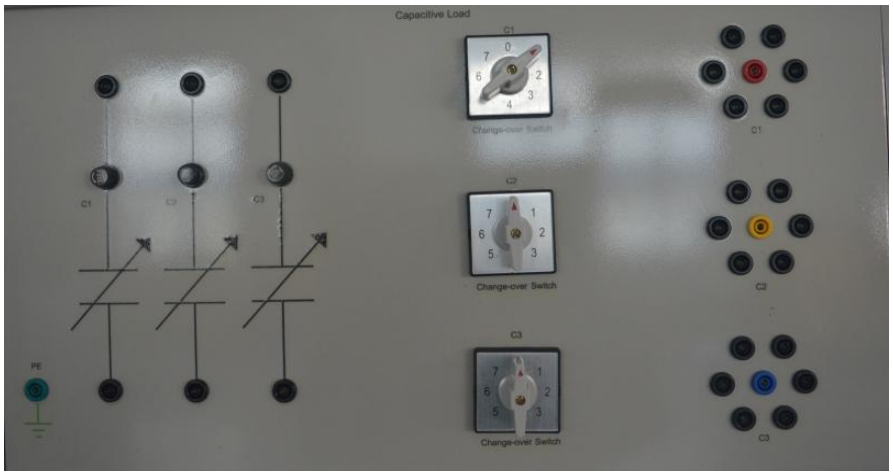


3.0.Kilowatt hour meter

3.1.Electrical meter

3.2.Capacitor Load

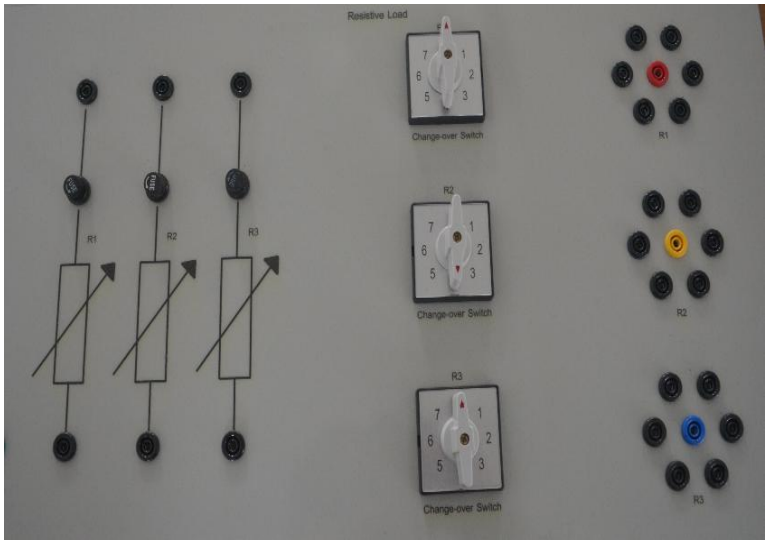
The voltage resistance of each group of capacitors is 450V



3.3.Excitation Voltage controller

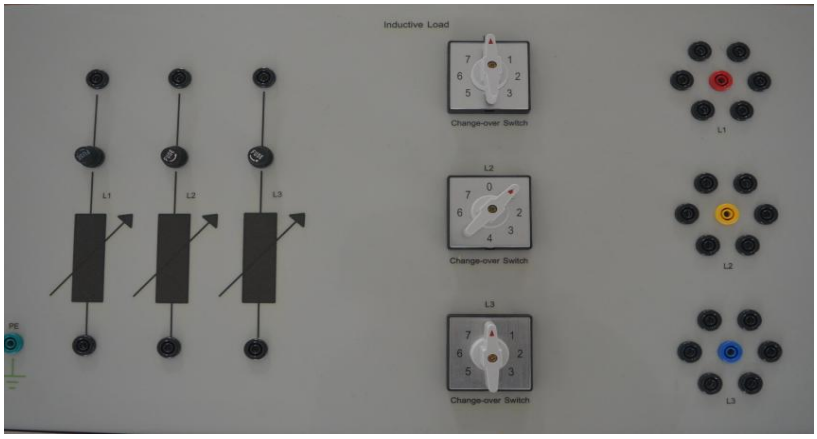
3.4.Resistance Load

The power of each set of resistors is 50W



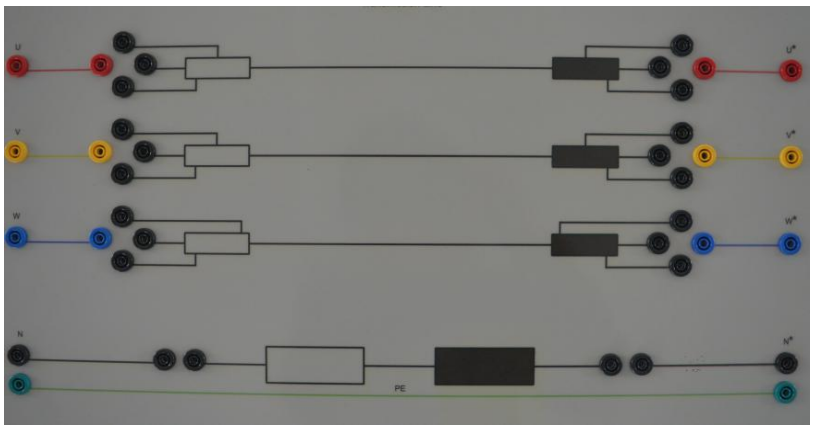
3.5.Inductive Load

Each group of inductors has a withstand voltage of 500V



3.6 Inductive Load

The internal circuit diagram of each group of transmission lines is shown in Figure 3.6.



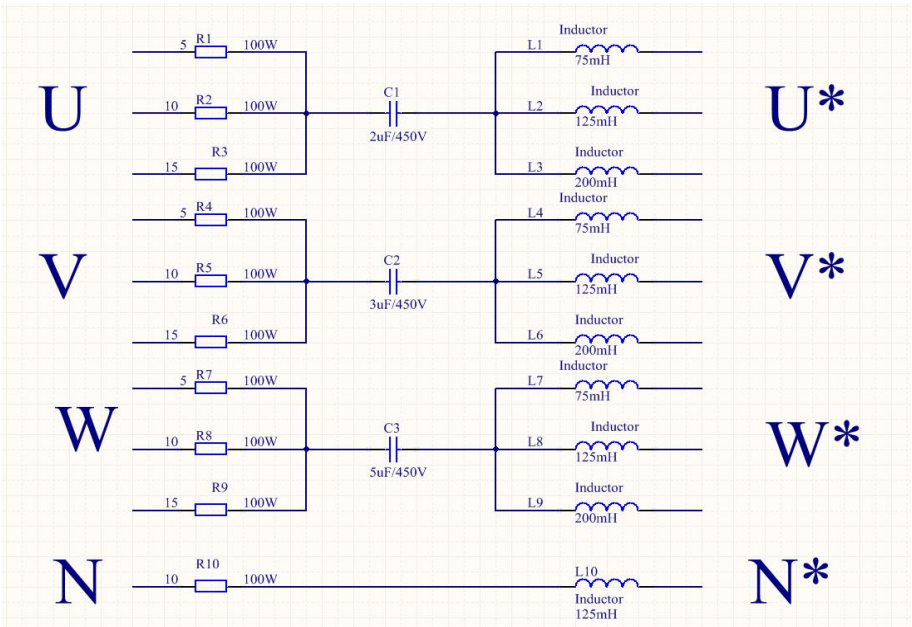


Fig 3.6

3.7.Three-phase asynchronous motor

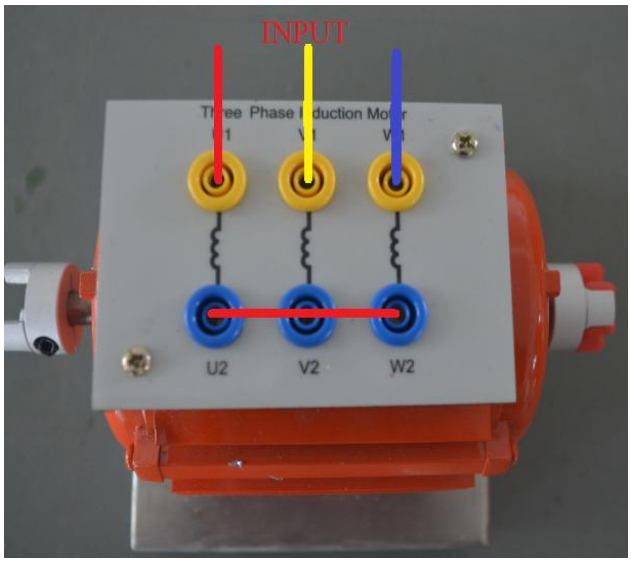
Power: 370W

Voltage: 415V/AC

Current: max 0.85 A

Speed: 1500 rpm

Connection: ∆&Y



3.8.Three phase synchronous generator

Power: 300W

Voltage: 415VAC

Current: 0.85A, max

Excitation voltage: 12 VDC

Excitation current: maximum 1.5A

Speed: 1500 rpm

Connection: Y

3.9.Single phase synchronous generator

Power: 300W

Voltage: 220 ~ 240VAC

Current: 0.85 A max

Speed: 1500 rpm

Chapter 4 Basic experiment and operation

1. Experiment content

1) Three-phase asynchronous motor jog control circuit
2) Three-phase asynchronous motor self-locking control circuit
3) Three-phase alternator drive
4) Use Inverter to drive three-phase AC motor
5) Measurement of three-phase electric power
6) Application of RC circuit in transmission line
7) Application of RL circuit in transmission line
8) Application of RLC circuit in transmission line
9)Single phase synchronous generator drive

2. Specific experiment operation

Experiment 1: Three-phase asynchronous motor jog control circuit

1.1 Experiment purpose

1) Understand working principle of three-phase AC contactor.
2) Master three-phase AC asynchronous motor star and triangle wiring mode.
3) Master control principle of the three-phase asynchronous motor jog control circuit

1.2 Experimental tools

1) Three-phase AC380V power supply
2) Three-phase asynchronous motor
3) Three-phase AC contactor module
4) Analog switch module

1.3 Experimental circuit connection

1) The wiring diagram of the three-phase asynchronous motor jog control circuit is shown in Figure 1.1.1.

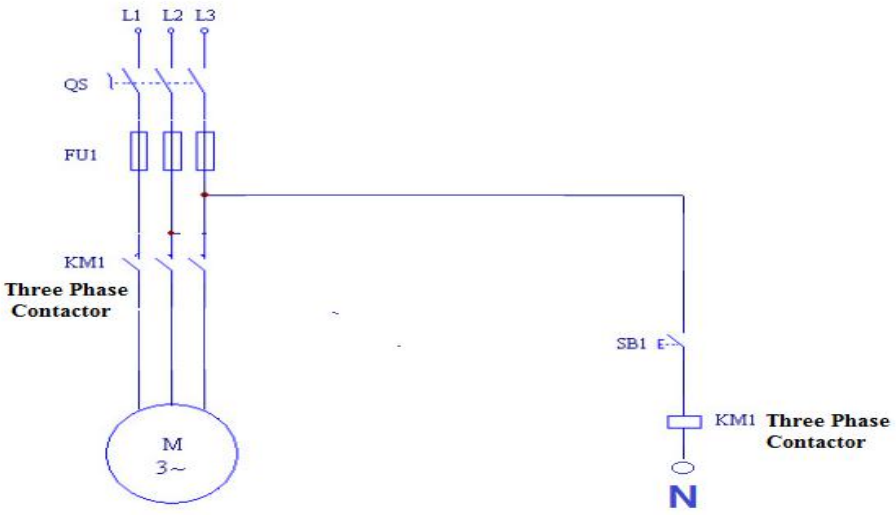
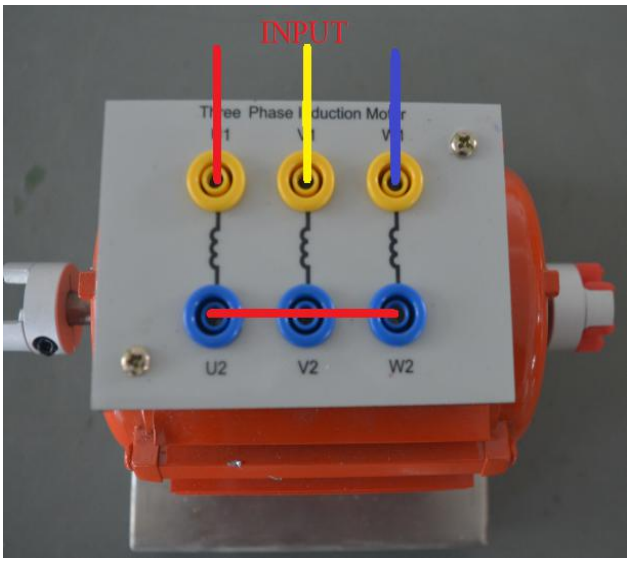


Fig.1.1.1

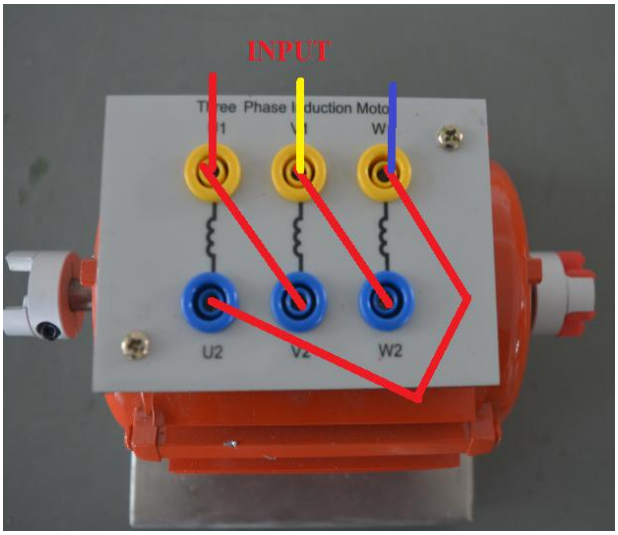
2) Three-phase asynchronous motor star connection

U2, V2, W2 are connected together, U1, V1, W1 are inputs



3) Three-phase asynchronous motor delta connection

U1 is connected with V2, V1 is connected with W2, W1 is connected with U2, and U1, V1, W1 are input terminals.



1.4 Experimental steps

1) Recognize the structure, graphic symbols and wiring methods of each electrical appliance.

2) Connect the three-phase AC motor in star or in triangle first, and then connect according to Figure 1.1.1.

3) After the wiring is completed, it can be energized after being inspected by the instructor

and allowed.

4) Observe the experimental phenomenon.

1.5 Experimental phenomenon

1) Press the SB1 switch, the three-phase AC contactor is closed, and the motor rotates.

2) Release the SB1 switch, the three-phase AC contactor is disconnected, and the motor stops.

Experiment 2: Three-phase asynchronous motor self-locking control circuit

1.1 Experiment purpose:

1) Master the working principle of the three-phase AC contactor.

2) Master the control principle of the self-locking control circuit.

1.2 Experimental tools

1) Three-phase AC380V power supply

2) Three-phase asynchronous motor

3) Three-phase AC contactor module

4) Analog switch module

5) Several security cables

1.3 Experiment content

The wiring diagram of the self-locking control circuit of the three-phase asynchronous motor is shown in Figure 1.1.2

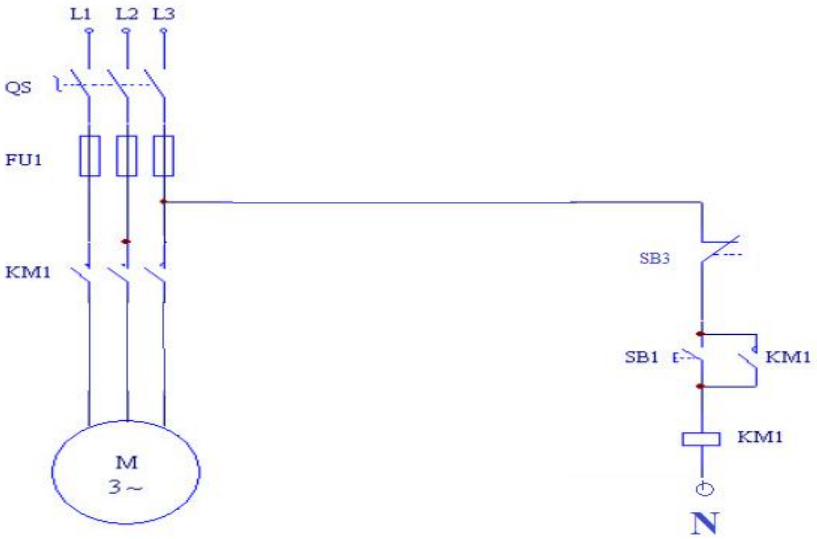


Fig. 1.1.2

1.4 Experiment steps:

1) Recognize structure, graphic symbols and wiring methods of each electrical appliance.

2) Connect three-phase AC motor to a star or a triangle first, and then connect according to Figure 1.1.2

3) After the wiring is completed, it can be energized after being inspected by the instructor and allowed.

4) Observe experimental phenomenon.

1.5 Experiment phenomenon

1) Press the SB1 switch, the AC contactor turned on, the motor rotates, and when the SB1 switch is turned on, the AC contactor will not open and the motor will not stop.

2) Press the SB3 switch, the AC contactor is disconnected, and the motor stops

rotating.

Experiment 3: Three-phase alternator drive

1.1 Experiment purpose:

1) Master the working principle of three-phase generators.

2) Master the star and angle wiring of the three-phase generator.

1.2 Experimental tools

1) Three-phase AC380V power supply

2) Three-phase alternator

3) Three-phase AC motor

4) Power circuit breaker

5) Several security cables

6) DC control module

7) Digital Multimeter

1.3 Experiment content

1) The wiring diagram of the three-phase alternator drive circuit is shown in Figure 1.1.7(a).

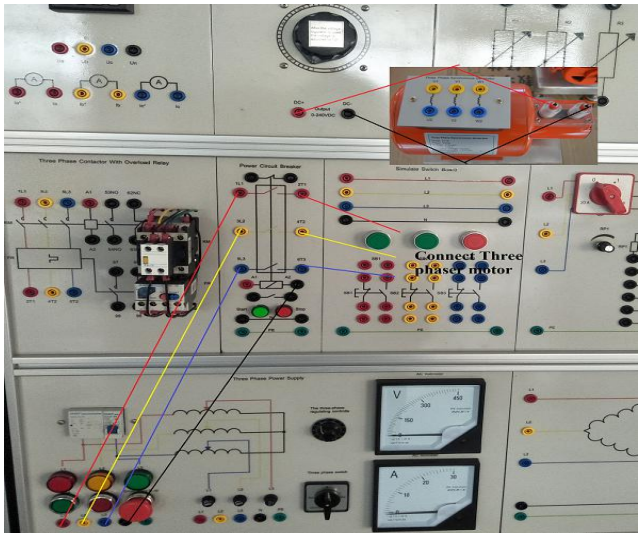


Fig.1.1.7(a)

2) Set up the generator test platform as shown in Figure 1.1.7(b)

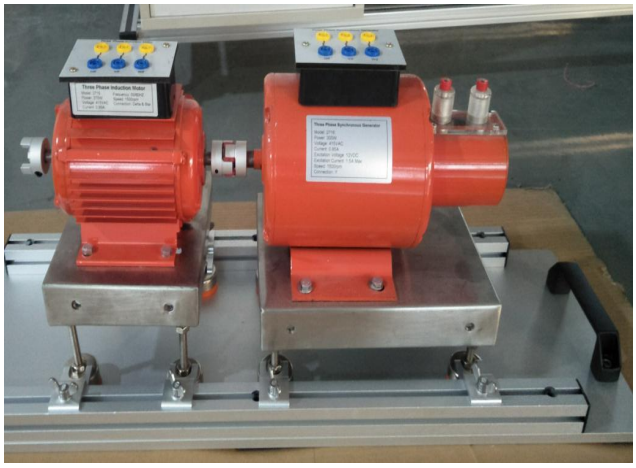


Fig.1.1.7(b)

3) Three-phase AC motor wiring is shown in Figure 1.1.7 (c)

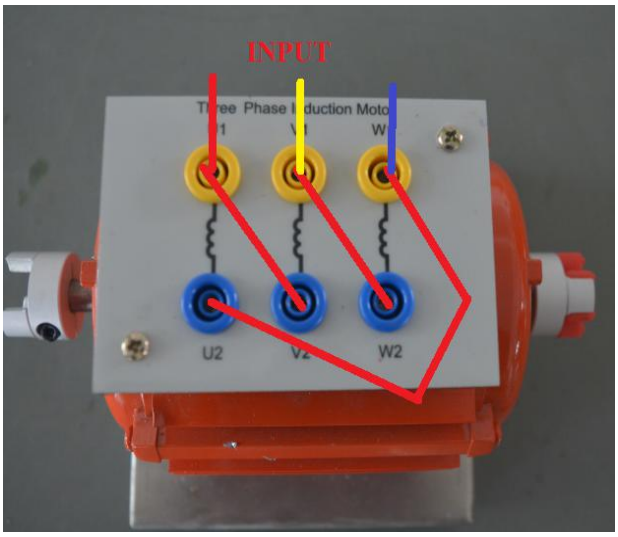


Fig.1.1.7(c)

4) The three-phase generator star connection is shown in Figure 1.1.7(d)

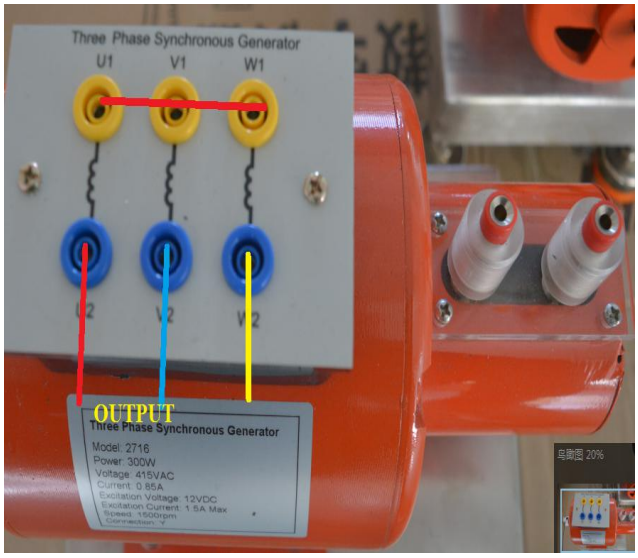


Fig. 1.1.7(d)

1.4 Experiment steps:

1) Recognize the structure, graphic symbols and wiring methods of each electrical appliance.

2) According to Figure 1.1.7 (a) - Figure 1.1.7 (d) wiring experiment circuit

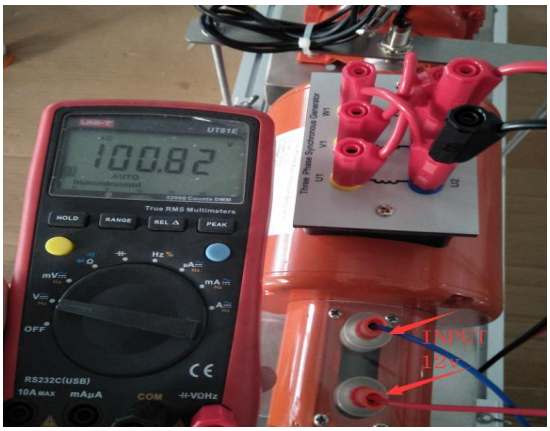
3) After the wiring is completed, it can be energized after being inspected by the instructor and allowed.

4) Observe the experimental phenomenon.

1.5 Experiment phenomenon

1) When the DC excitation voltage is not added, press the START button to start the motor, and use a multimeter to measure the output voltage of the three-phase motor.

2)When adding 12V DC excitation voltage, press the START button to start the motor. Use a multimeter to measure the AC voltage output of the three-phase motor output as shown below.



Experiment 4: Use inverter to drive the three-phase AC motor

1.1 Experiment purpose:

1) Understand the operating steps of the inverter.

2) Master the principle of the inverter driving three-phase asynchronous motor.

1.2 Experiment tools:

1) Three-phase AC380V power supply

2) Three-phase AC motor

3) Inverter module

4) Several security cables

1.3 Experiment content

1) The wiring diagram of the inverter's circuit for controlling the three-phase AC motor is shown in Figure 1.1.8(a). R, S,T are connected to three-phase voltage, U, V, W are connected to three-phase motor, LI1 on the inverter are respectively pass SB1 switch and connected to +24V.

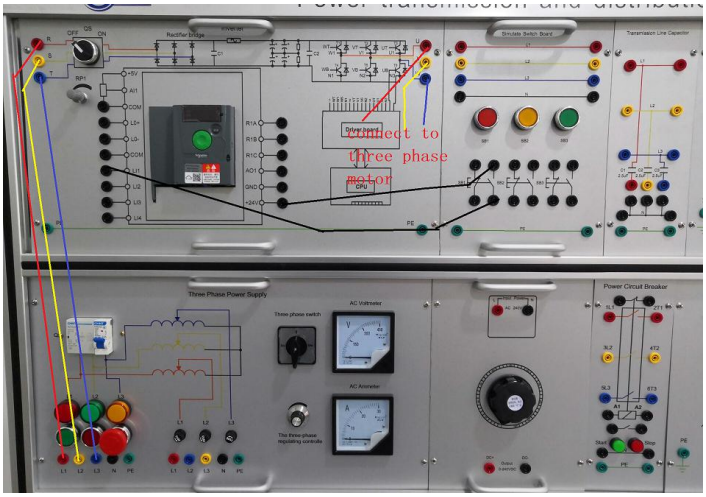


Fig. 1.1.8(a)

2)Connect the three-phase AC motor according to Figure 1.1.8(b)

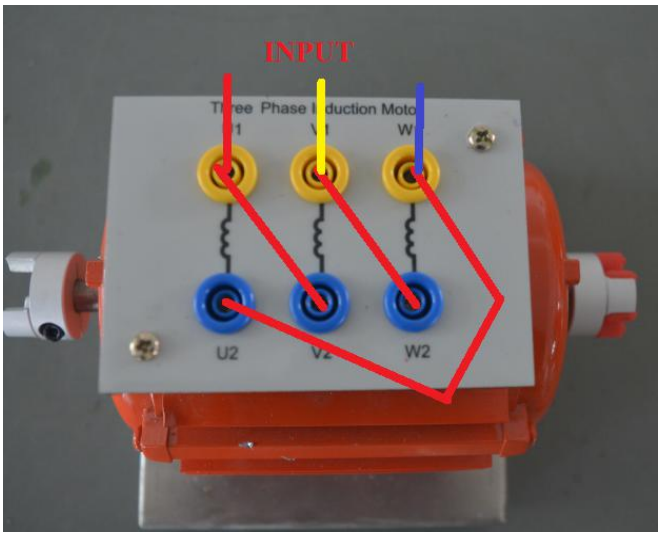


Fig. 1.1.8(b)

1.4 Experiment steps

1) Recognize the structure, graphic symbols and wiring methods of each electrical appliance.

2) Connect the experimental circuit diagram according to Figure 1.1.8(a) - Figure 1.1.8(b)

3) After the wiring is completed, it can be energized after being inspected by the instructor and allowed.

4) Observe the experimental phenomenon.

1.5. Experimental phenomenon

Press SB1 and the three-phase AC motor will rotate.

Experiment 5: Three-phase electric power measurement

1.1 Experiment purpose:

1) Master the measurement method of three-phase electric power.

2) Master the wiring method of the three-phase power meter

1.2 Experiment tools

1) Three-phase AC380V power supply

2) Three-phase AC motor

3) Electrical meter

4) Several security cables

5) Power circuit breaker

1.3 Experiment content

1) The wiring diagram of the three-phase electric power measurement circuit is shown in Figure 1.1.9(a).

Ua, Ub, Uc, Ia*, Ib*, Ic* of the meter are connected to the three-phase power, Un is connected to the neutral line, Ia, Ib, and Ic are respectively connected to the 1L1, 3L2, 5L3 of the power circuit breaker module, and A2 Into the zero line, 2T1, 4T2, 5T3 connected to the three-phase AC motor.

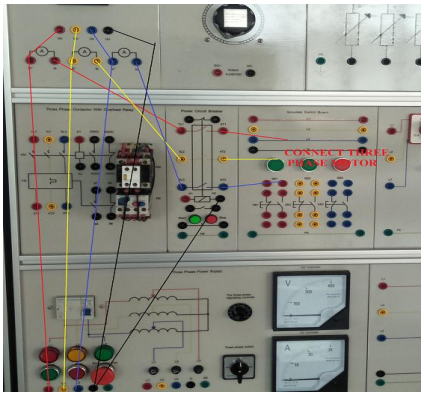


Fig.1.1.9(a)

2)Connect the three-phase AC motor according to Figure 1.1.9(b)

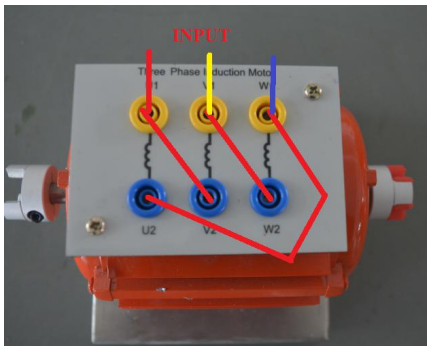


Fig. 1.1.9(b)

1.4 Experiment steps

1) Recognize the structure, graphic symbols and wiring methods of each electrical appliance.

2) Connect the experimental circuit according to Figure 1.1.9(a) - Figure 1.1.9(b)

3) After the wiring is completed, it can be energized after being inspected by the instructor and allowed.

4) Observe the experimental phenomenon.

1.5 Experiment phenomenon

1) Turn on the main power switch, press the START button to start the motor, and the corresponding measurement parameters will be displayed on the measuring meter.

2)Press the selection button on the measurement meter to display the corresponding measurement parameters.

Experiment 6: Application of RC circuit in transmission line

1.1 Experiment purpose:

1) Learn how RC circuits work in transmission lines..

2) Master the application of RC circuits in transmission lines.

1.2 Experiment tools

1) Three-phase AC380V power supply

2) Three-phase transformer module

3) Load resistance module

4) Several security cables

5) Transmission line capacitor module

6) AC measurement module

1.3 Experiment content

1) The wiring diagram of the RC circuit in the transmission line is shown in Figure 1.2.0(a). U, V, W are inputs, U*, V*, W* are outputs.

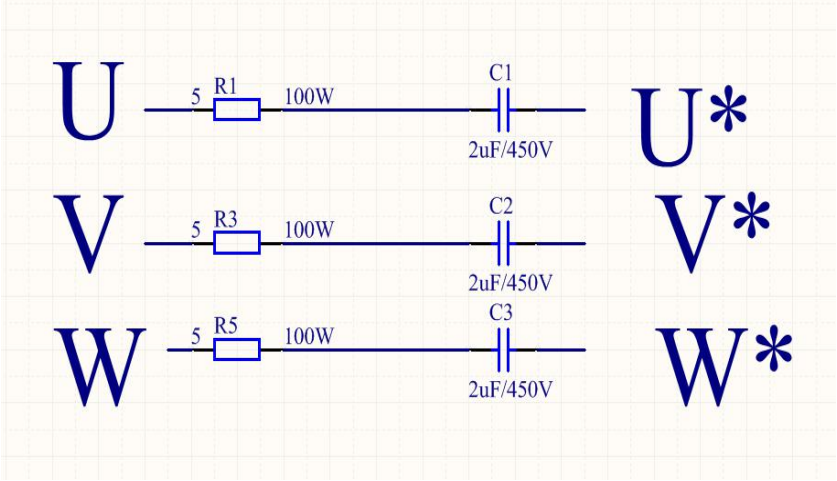


Fig. 1.2.0(a)

2) The wiring diagram of the three-phase transformer is shown in Figure 1.2.0(b). Use a jumper to select a set of voltages to be connected to the output. In the figure, the three-phase output power is selected as 361V.

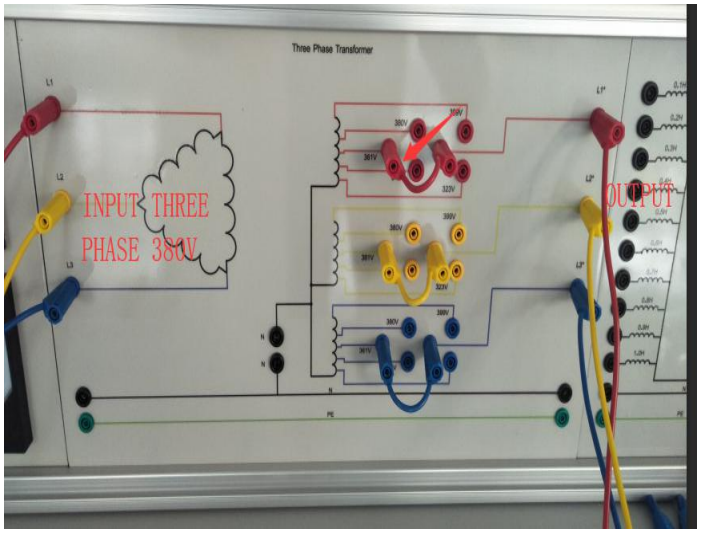


Fig. 1.2.0(b)

The block diagram of the system wiring is shown in Figure 1.2.0(c).

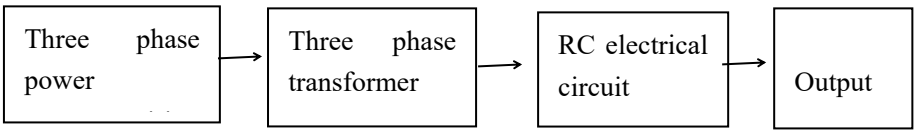


Fig.1.2.0(c)

1.4 Experiment steps

1) Recognize the structure, graphic symbols and wiring methods of each electrical appliance.

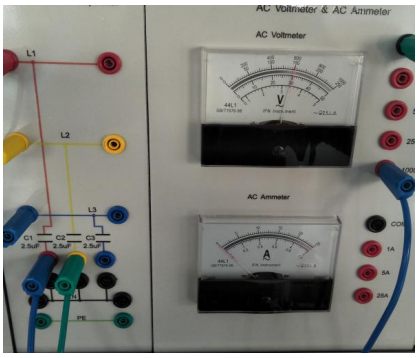
2) Connect the experimental circuit according to Figure 1.2.0(a) - Figure 1.2.0(c).

3) After the wiring is completed, it can be energized after being inspected by the instructor and allowed to be allowed.

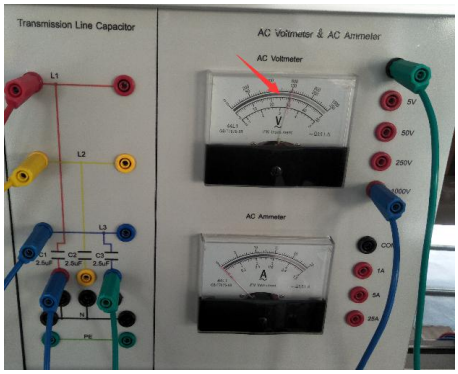
4) Observe the experimental phenomenon.

1.5 Experiment phenomenon

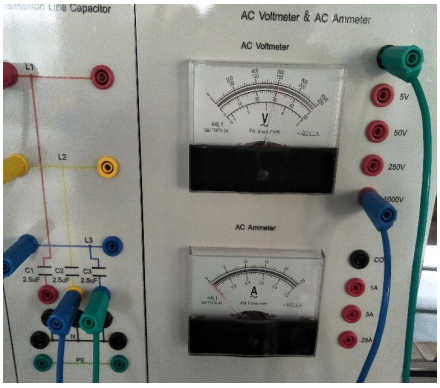
1) After power-on, use the AC measurement module to measure the output voltage between L1 and L2 as shown below.



2) Measure the output voltage between L1 and L3, as is shown in the figure below.



3)Measure the output voltage between L2 and L3, as is shown in the figure below



Experiment 7: Application of RL circuit in transmission line

1.1 Experiment purpose:

1) Understand how the RL circuit works in the transmission line.

2) Master the application of the RL circuit in the transmission line.

1.2 Experiment tools

1) Three-phase AC380V power supply

2) Three-phase transformer module

3) Load resistance module

4) Several security cables

5) Load inductor module

6) Digital Multimeter

1.3 Experiment content

1) The wiring diagram of the RL circuit in the transmission line is shown in Figure 1.2.1(a). U, V, W are inputs, U*, V*, W* are outputs.

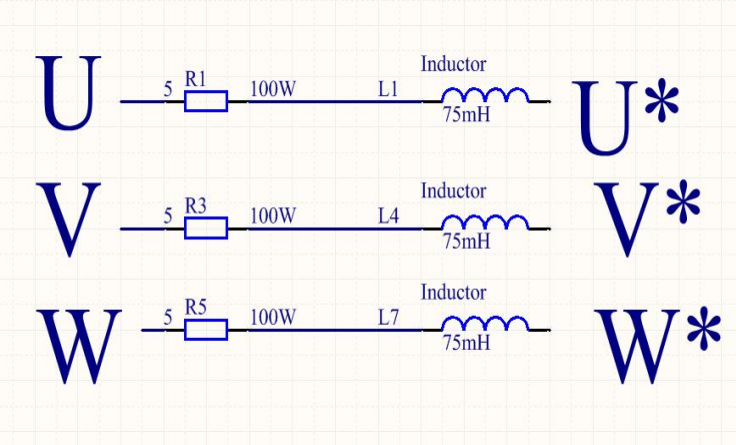


Fig.1.2.1(a)

The wiring diagram of the three-phase transformer is shown in Figure 1.2.1(b). Use a jumper to select a set of voltages to be connected to the output. In the figure, the three-phase output power is selected as 361V.

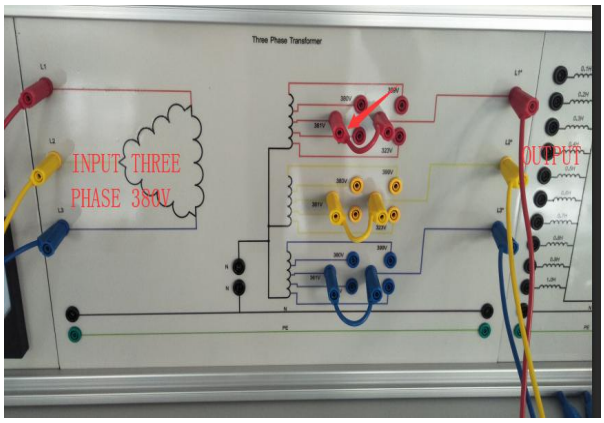


Figure 1.2.1(b)

The block diagram of the system wiring is shown in Figure 1.2.1(c).

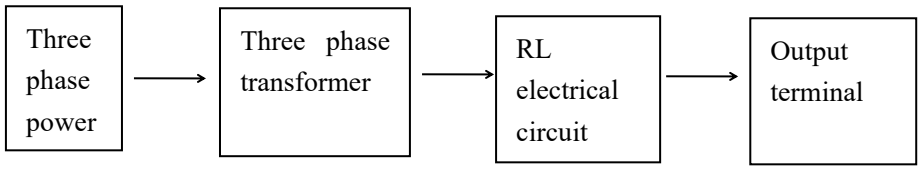


Fig. 1.2.1(c)

1.4 Experiment steps

1) Recognize the structure, graphic symbols and wiring methods of each electrical appliance.

2) Connect the experimental circuit according to Figure 1.2.1(a) - Figure 1.2.1(c),

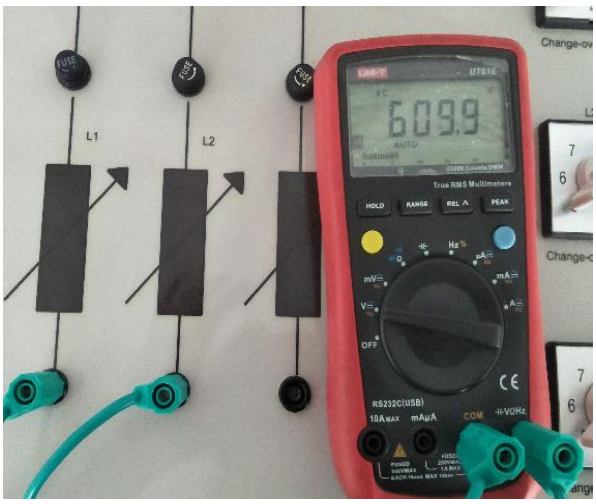
3) After the wiring is completed, it can be energized after being inspected by the instructor

and allowed.

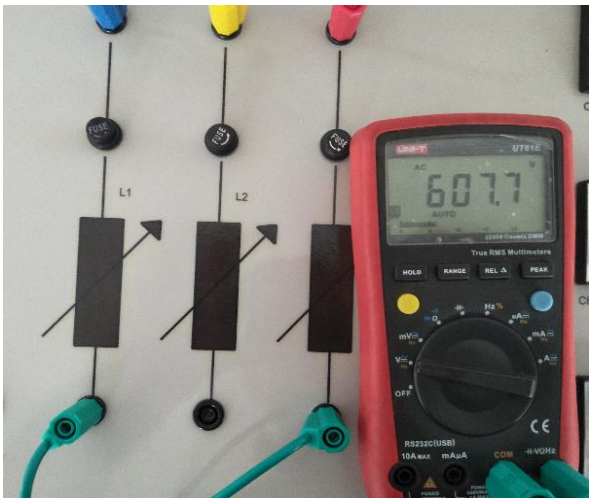
4) Observe the experimental phenomenon.

1.5 Experiment phenomenon

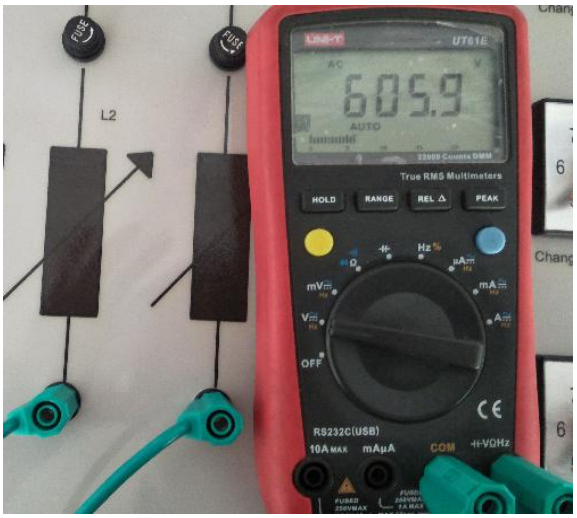
1) After power-on, use a digital multimeter to measure the output voltage between L1 and L2 as shown below.



2) Measure the output voltage value obtained between L1 and L3 as shown below



3) Measure the output voltage value obtained between L2 and L3 as shown below



Experiment 8: Application of RLC circuit in transmission line

1.1 Experiment purpose:

1) Understand how the RLC circuit works in the transmission line.

2) Master the application of the RLC circuit in the transmission line.

1.2 Experiment tools

1) Three-phase AC380V power supply

2) Three-phase transformer module

3) Transmission line module

4) Several security cables

5) Digital Multimeter

1.3 Experiment content

1) The wiring diagram of the transmission line module is shown in Figure 1.3.1(a). U, V, W are inputs, U*, V*, W* are outputs. (Note: You can choose one of the RLC circuit analog transmission lines, here select the line as shown in the figure as the transmission line)

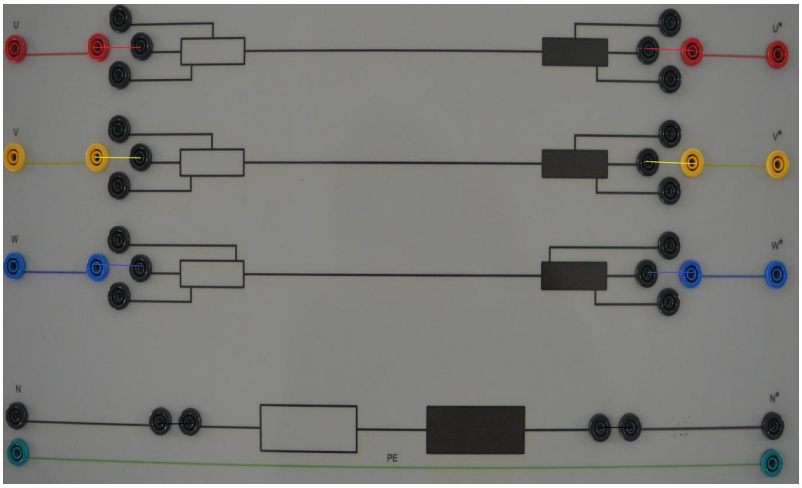


Fig.1.3.1(a)

3) The wiring diagram of the three-phase transformer is shown in Figure 1.3.1(b). Use a jumper to select a set of voltages to be connected to the output. In the figure, the three-phase output power is selected as 361V.

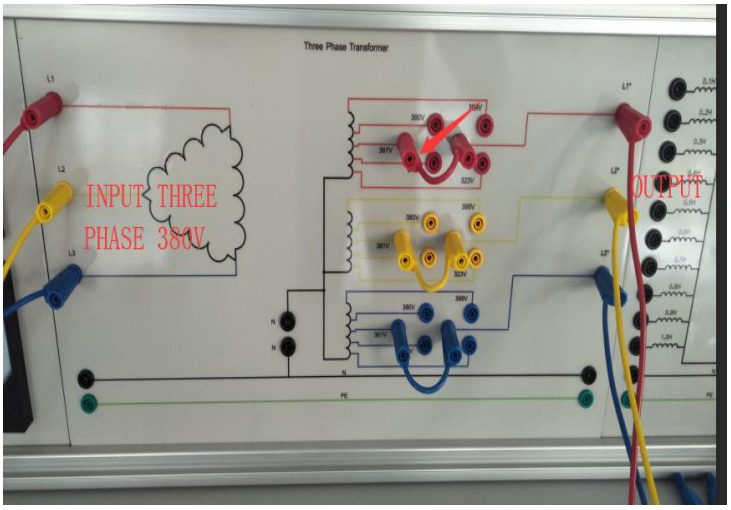


Fig 1.3.1(b)

4) The block diagram of the system wiring is shown in Figure 1.2.1(c).

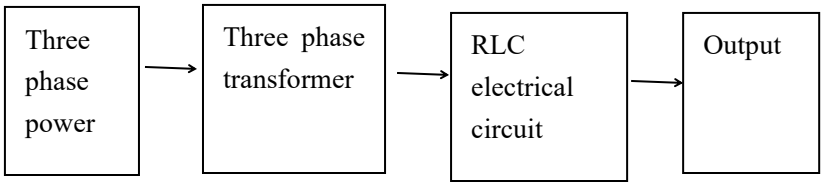


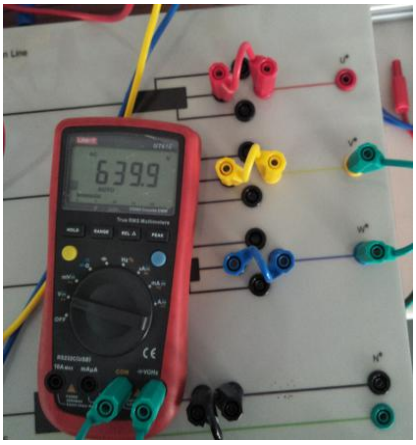
Fig.1.3.1（c）

1.4 Experiment steps

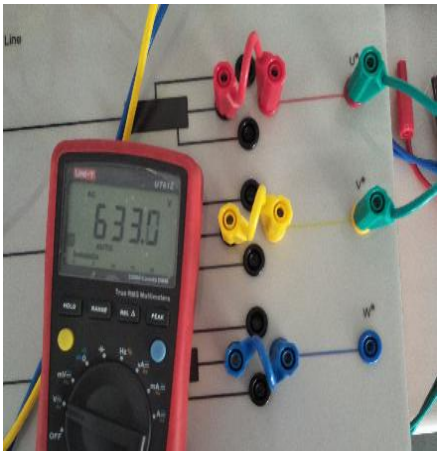
1) Recognize the structure, graphic symbols and wiring methods of each electrical appliance.
2) Connect the experimental circuit according to Figure 1.3.1(a) - Figure 1.3.1(c),
3) After the wiring is completed, it can be energized after being inspected by the instructor and allowed to be allowed.
4) Observe the experimental phenomenon.

1.5 Experiment phenomenon

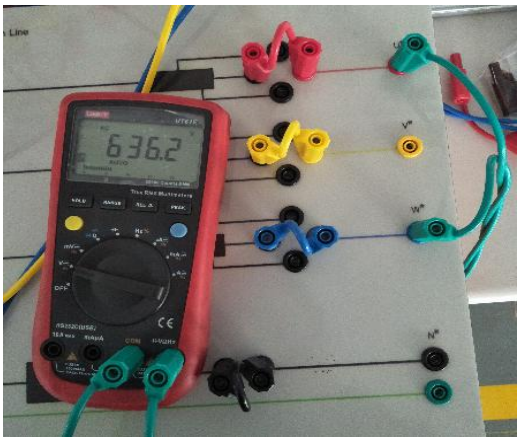
1) After power-on, use a digital multimeter to measure the output voltage between V* and W* as shown below.



2) Measure the output voltage between U* and V*,as is shown in the figure below.



3) Measure the output voltage between U* and V*,as is shown in the figure below.



Experiment 9: Single phase synchronous generator drive

1.1 Experiment purpose:

Master the working principle of single phase synchronous generator.

1.2 Experimental tools

1) Three-phase AC380V power supply

2) Single phase synchronous generator

3) Three-phase AC motor

4) Power circuit breaker

5) Several security cables

6) DC control module

7) Digital Multimeter

1.3 Experiment content

1) The wiring diagram of the three-phase alternator drive circuit is shown in Figure 1.4.1(a).

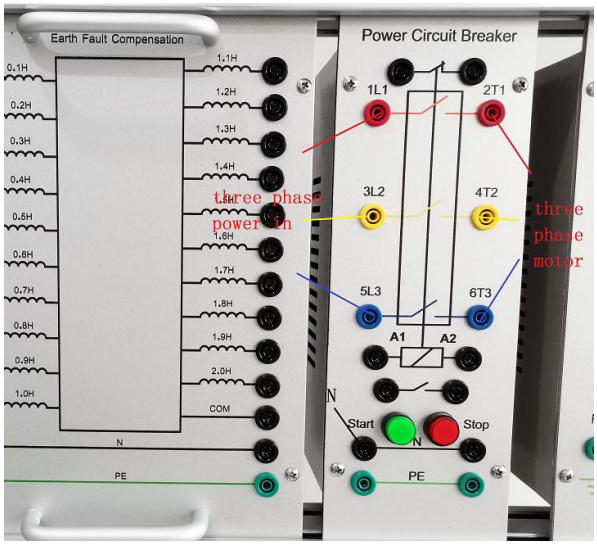


Fig.1.4.1(a)

2)Set up the generator test platform as shown in Figure 1.4.2(b)

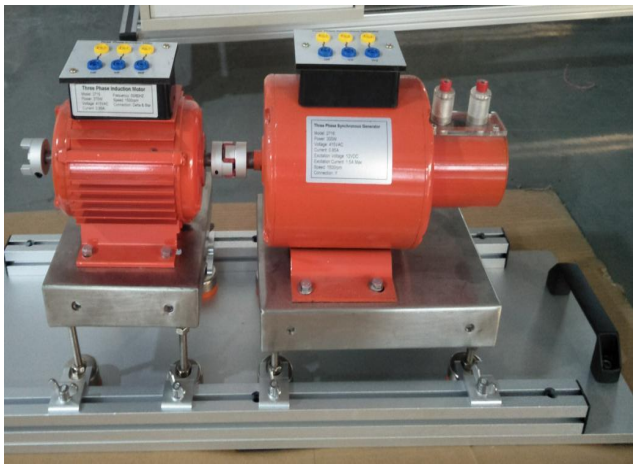


Fig.1.4.2(b)

5) Three-phase AC motor wiring is shown in Figure 1.4.3 (c)

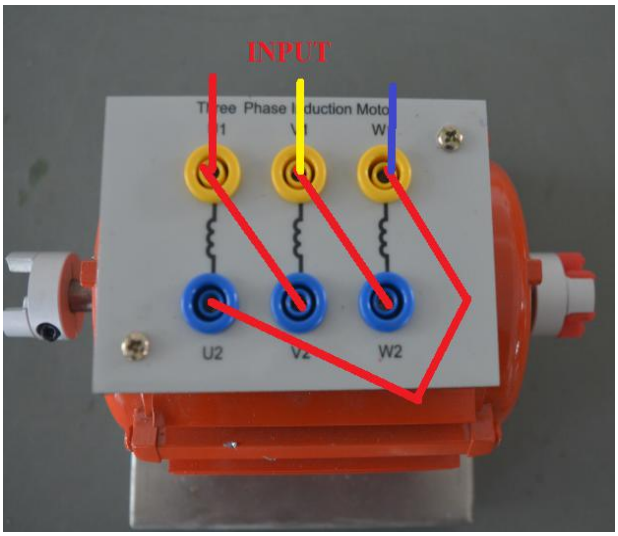


Fig.1.4.3(c)

6) Single phase generator connection is shown in Figure 1.4.4(d)

Fig. 1.4.4(d)

1.4 Experiment steps:

1) Recognize the structure, graphic symbols and wiring methods of each electrical

appliance.

2) According to Figure 1.4.1 (a) - Figure 1.4.4 (d) wiring experiment circuit

3) After the wiring is completed, it can be energized after being inspected by the instructor and allowed.

4) Observe the experimental phenomenon.

1.5 Experiment phenomenon

1) When the DC excitation voltage is not added, press the START button to start the motor, and use a multimeter to measure the output voltage of the single phase generator.

2)When adding 12V DC excitation voltage, press the START button to start the motor. Use a multimeter to measure the AC voltage output of the single phase generator.