Model : KTE-7000GH

GEOTHERMAL HEAT PUMP EXPERIMENTAL EQUIPMENT GUIDEBOOK Ver.1.1.0

KTENG
CORPORATION

Korea Technology Institute of Energy Convergence
Korea Technology Engineering Co.,Ltd.

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5. Failure and Correction

6. The Equipment Usage Notification

7. Patent and Authentication

1. Geothermal Heat Pump Experimental Equipment

1-1. Summary

Geothermal heat pump system is a device that collects and pump heat from or to the ground. Underground temperatures are more stable than air temperatures through the year. The heat from underground is used to evaporate and condense a refrigerant that circulates in a system such as in refrigeration system.

The geothermal heat pump experimental equipment consist of steam pressure mode standard freezing cycle, and lets the tester experience the performance of convertible action of warming and cooling through the operation of 4-way valve as well as the experiment and practice of auto control drive of each basic refrigerator and the configuration practices of the freezing system.

Especially, the expander attaches and controls manual expansion valve and can arbitrarily change the evaporation pressure randomly while you drive. Therefore, on the basis of theoretic freeze cycle which concentrates on textbook(theoretic education), we let you verify, compare and analyze the performance to the actual standard freeze cycle while driving with various variables such as condense temperature variable (condense pressure variable), evaporate temperature variable (evaporation pressure variable), overheat compression, moist compression, dry saturation compression and supercooling, etc.

We can also draw P-h line using the program and hands about various changes (variables) while we drive the standard freeze cycle. The performance of standard freeze cycle change all the time according to the quantity of the coolant, open air temperature, driving time, evaporation pressure and condense pressure, and the evaporate pressure change might affect much to the performance variable with the control of opening of the manual expansion valve.

Auto control device lets us experience the needed business in performance and control task of the basic practice of each controlling task that we must learn at the science and engineering field with the heat and freezing system. Also, we let you prepare business ability and understand the auto control circuit of the heat and freezing system, which is complicated, by experiencing the forming and driving experiment and practice of the basic circuit composition and applied circuit needed at the standard freezing cycle driving, using each control device with the banana jack directly and quickly.

Moreover, it is a device that simulates an adapting power for geothermal heat pump to help students to understand the operation principles of geothermal heat pump through driving and performance measurement with the equipment in laboratory scale with the geothermal system which is recognized as one of important energy source.

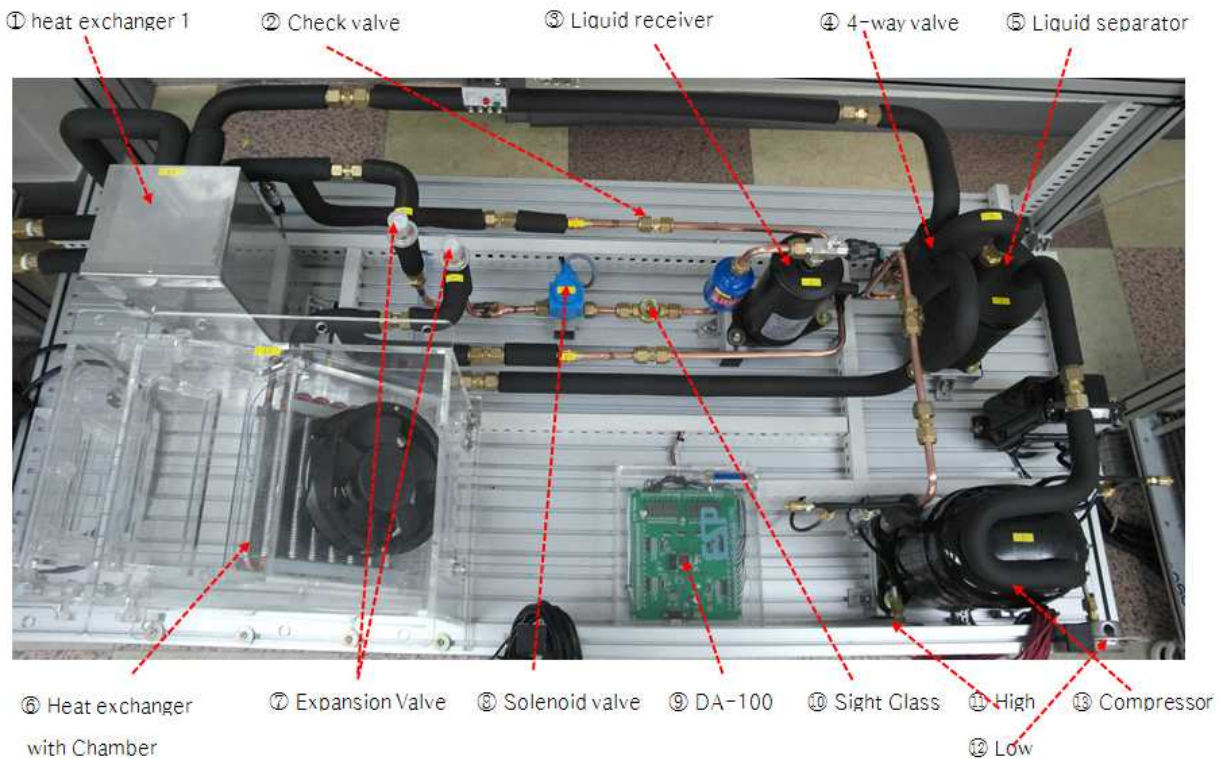# 1-2. Composition of geothermal heat pump experimental equipment
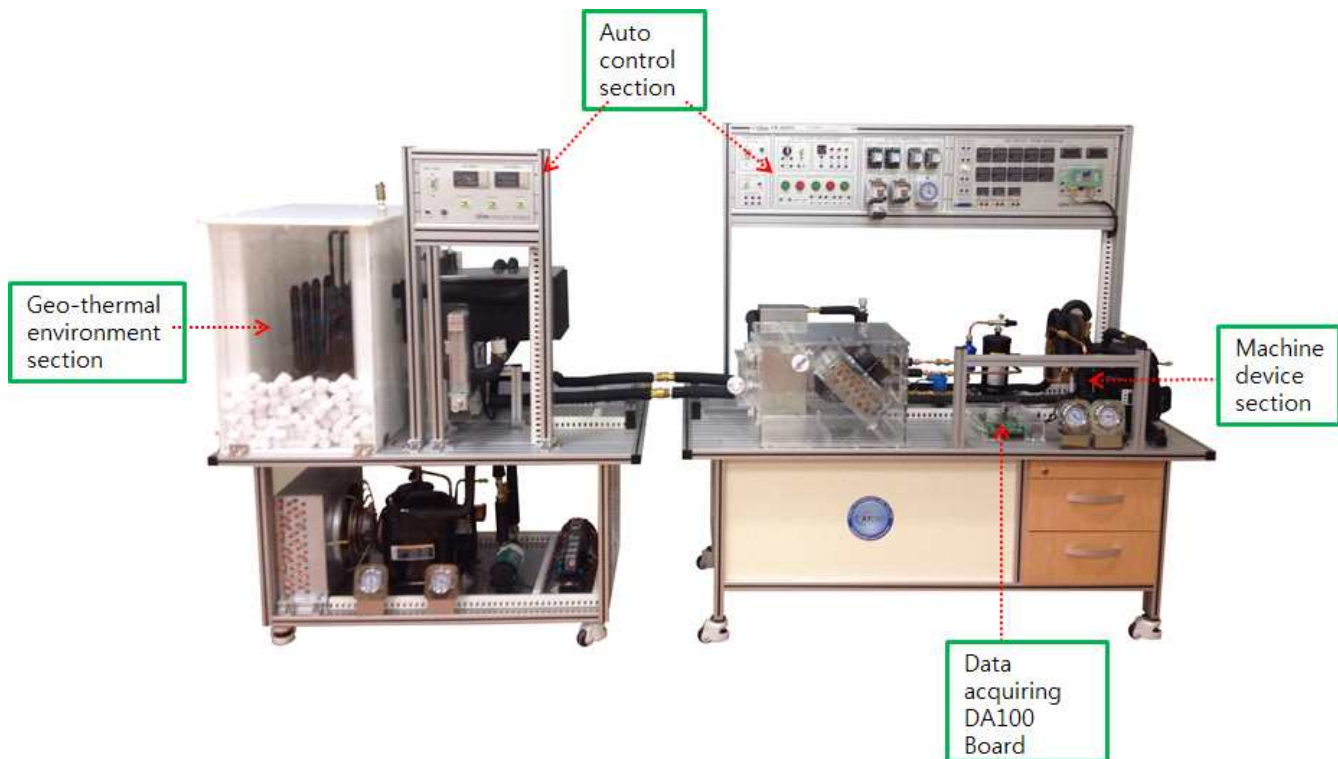
Geothermal heat pump experimental equipment

(1) Automatic control: Timer, Relay, NFB, toggle switch, ampere-voltage meter, buzzer, lamp 9red, green, orange), high pressure switch, low pressure switch, Magnetic Contactor (MC), power input, thermal switch, push button and so on. It controls the operation of heat pump mechanism.

(2) Machine parts: Compressor, plate heat exchanger, receiver, filter dryer, sight glass, solenoid valve, expansion valve, evaporator with fan, high pressure gauge, low pressure gauge, electric immerse heater and so on. They will be run according circuit configuration on the control panel.

(3) Geothermal section: geothermal environment chamber, water tank consisting of chiller and electric immerse heater, vertical and horizontal circular pipe, water flowmeter, solenoid valve, pump, temperature controller to maintain temperature inside geothermal chamber and so on.

(4) Software: KTE-DA100 records each part's temperature, pressure, enthalpy, heat amount, COP of the cycle every unit time and save the data in excel file. Thus can be analyze with graphics.

(5) Hardware: KTE-DA100 composed of SMPS, T type thermocouple, pressure sensor and computer interface (minimum specification pentium 4, windows 98, memory 256 MB, hardisk space 100MB).

2. Detail Equipment Components

2-1. Heat pump machinery device section

Machine parts of geothermal heat pump experimental equipment

① Plate heat exchanger

② Check valve

③ Liquid receiver

④ 4-way valve

⑤ Liquid separator

⑥ Heat exchanger with Chamber

⑦ Solenoid valve

⑧ Expansion valve

⑨ KTE-DA100

⑩ Sight glass

⑪ Low pressure gauge

⑫ High pressure gauge

⑬ Compressor

2-2. Geothermal environment section

① Geothermal Environment ② Horizontal Pipe ③ Vertical Pipe ④ Control Panel ⑤ Flow Meter

⑥ Refrigeration Part
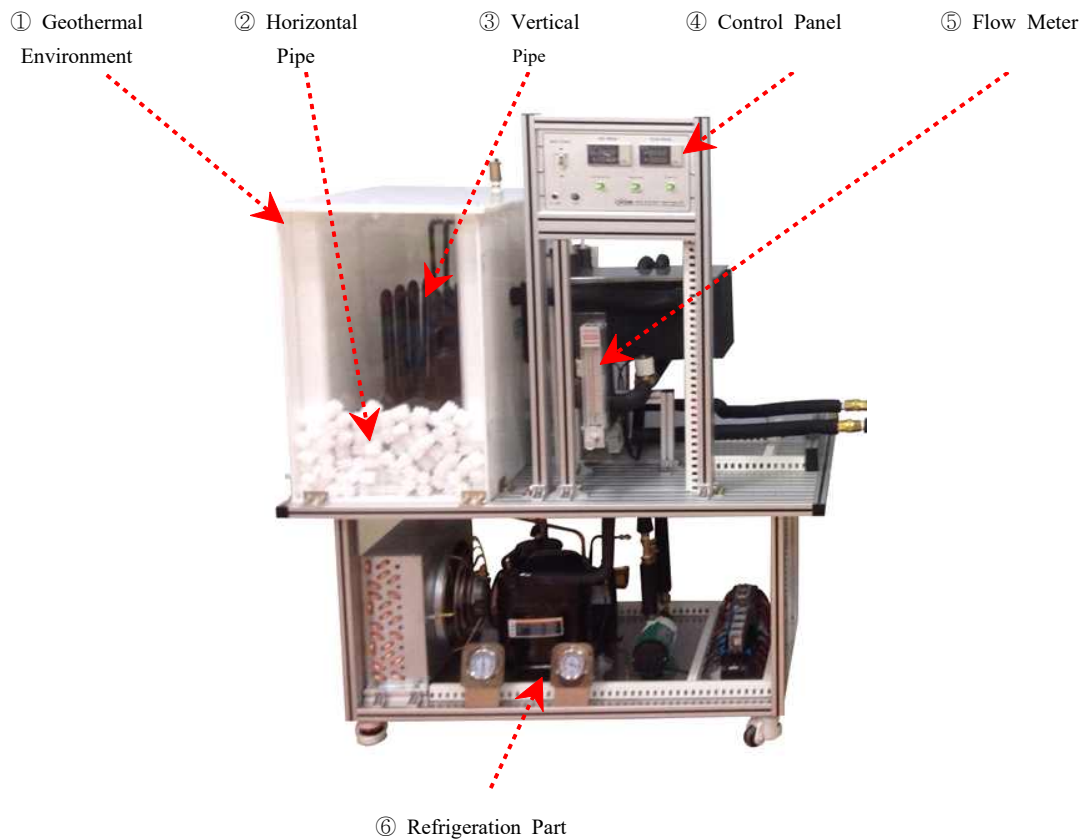
Geothermal environment of geothermal heat pump experimental equipment

① Geothermal Environment Chamber   ④ Control Panel
② Horizontal Pipe   ⑤ Flow meter
③ Vertical Pipe   ⑥ Refrigeration & Heating Part

2-3. Heat pump parts description

(1) Compressor

Compressor

※ Specification
- Model : P-12TN(ACC)
- 1/2 HP
- Application scope: medium and high temperature
- Range of evaporating   temperature: -25℃~10℃
- Motor Type: CSR
- Cooling quantity: 1,588kcal/h
- Refrigerant: R-22
- Single-phase 220V
- Controller included

This Compressor (gas compressor) is mechanical device common use in a standard refrigeration system. It is designed to operate, and be cooled by, the refrigerant being compressed. the compressor increases the pressure and temperature on a refrigerant (in gas state) and transport the refrigerant through a pipe in refrigeration cycle.

In other words, it plays role of sending a heat from evaporator (lower heat source) to condenser in form of high pressure and temperature gas and it circulates refrigerant in the system.

(2) Fill nipple

Fill Nipple

Fill nipple is a necessary device used with manifold gauge when transferring a refrigerant, testing the air-tightness, testing under vacuum status, refrigerant charging of the standard refrigeration device by attaching it to the compressor discharge and suction side.

(3) Heat exchanger

Condenser is a device that condenses a high pressure and temperature refrigerant discharged from compressor into liquid by extracting heat of the refrigerant to outside air or cooling fluid e.g. cold water. The reason we make it into liquid phase is to utilize the potential heat when the phase changes. In order to absorb the heat from evaporator, the best performance comes out when using potential heat, that is, when it changes from liquid phase to gas phase.

Heat exchanger 1

(4) Liquid receiver

Liquid receiver is the vessel which stored temporarily a condensed refrigerant from condenser before deliver it to the expansion valve. The quantity of the condensed refrigerant of the receiver vary the amount of refrigerant in the evaporator, remaining in the liquid state of refrigerant in the receiver and able to smooth the drive of the device. Also, it plays a role in the pump down operation when the equipment will be stop in a long time and need repairing.

Liquid receiver

(5) Filter drier

Filter drier is used to remove moisture acid and other contaminant, to providing reliable, long-lasting system protection. So in order to this, we install it in the liquid duct between the expansion valve and the liquid receiver.

Filter Drier

(6) Solenoid valve

The solenoid valve has two main parts: the solenoid and the valve. The solenoid converts electrical energy into mechanical energy which, in turn, opens or closes the valve mechanically. So it controls the flow of the coolant. When driving the pump-down, it is connected in series with the temperature switch and the solenoid valve for main piping is opened and closed according to the closure and opening of the contact point of the temperature switch, letting pump-down process operate.

Solenoid valve

(7) Expansion valve

Expansion valve

Manual expansion valve is used for reducing pressure and temperature of liquid refrigerant from condenser. The liquid state of the refrigerant will be changed to a liquid-gas state, as the liquid refrigerant after through the expansion valve. In addition, it controls proper amount of heat absorb from the evaporator.

(8) Plate-type heat rxchanger

Plate-type Heat Exchanger

Heat exchanger is used in a heat transfer process from one media to another. Plate-type heat exchanger uses plate type wall as separator between cold and hot fluid so that they will never mix. It is designed for the heat of the hot media to be transmitted to the cold media by passing a hot media at one side and cold media at the other side between the adjacent plates.

(9) 4-Way valve
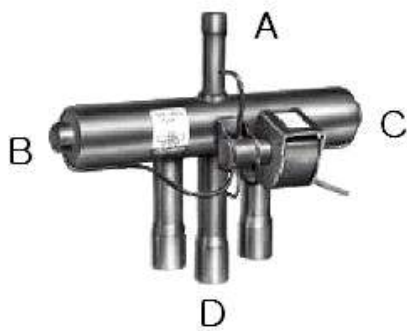
4-Way valve

4 way valve basically doesn't operate at a status where high and low pressure is not authorized. Of course, the solenoid valve that controls the direction operates according to the sign, but there is no direction change inside the actual 4 way valve. In other words, it is designed to be operated only under the condition high and low pressure is authorized. Figure 1.1.12 shows thin pipe is connected to A, B, C and D part at the 4 way valve solenoid valve. Inside the body of 4 way valve, there is a cap of size that can connect only 1 cap at the right and left lines on the basis of D lines, and they are designed to move from left to right and vice versa.

From the 4 way valve picture, A is always high pressure and D is low compressure. Under the status where cycle operates, when the thin pipe A&B and C&D are connected by solenoid V/V, B area of the inside of the 4way valve body is authorized by high pressure and the C area by low pressure, so the cap aforementioned is adhered to C area by pressure gap. At this time, the water way within the 4way valve becomes A-B and C-D. On the contrary, if the thin pipe A&C and B&D are connected, water way becomes A-C, B-D, and they change the direction inside the cycle.
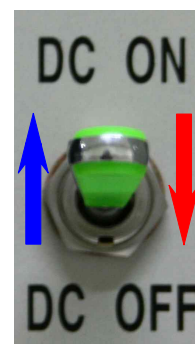
2-4. Heat pump control panel
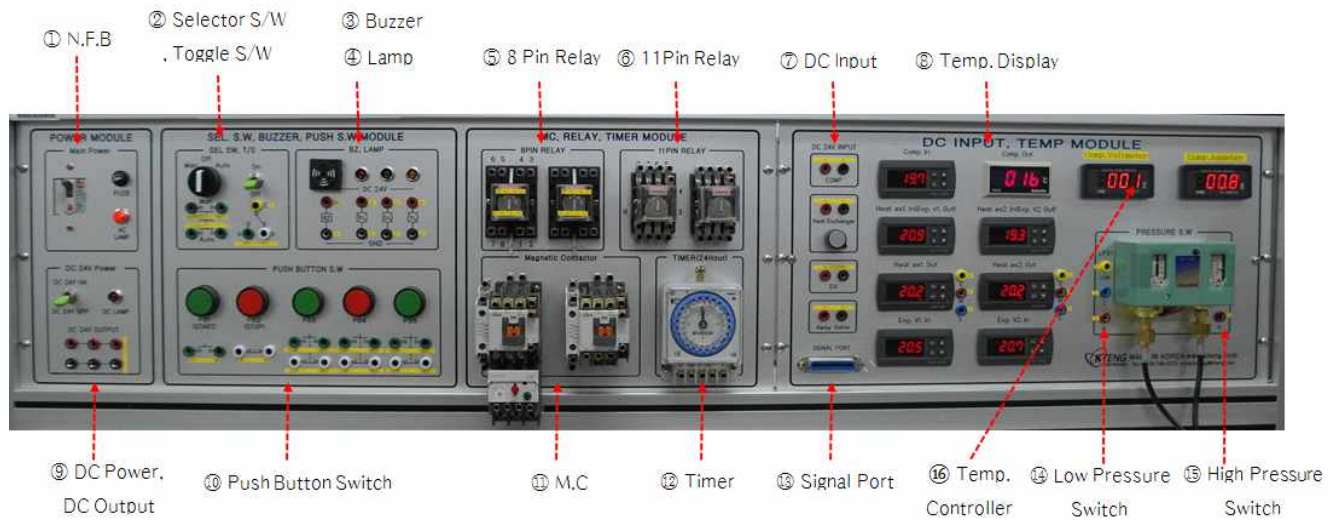
Control panel of heat pump department

① N.F.B	⑨ DC Power, DC Output
② Selector S/W, Toggle S/W	⑩ Push Button Switch
③ Buzzer	⑪ M.C
④ Lamp	⑫ Timer
⑤ 8 Pin Relay	⑬ Signal Port
⑥ 11Pin Relay	⑭ Low Pressure Switch
⑦ DC Input	⑮ High Pressure Switch
⑧ Temp. Display	⑯ Temp. Controller

(1) Main power
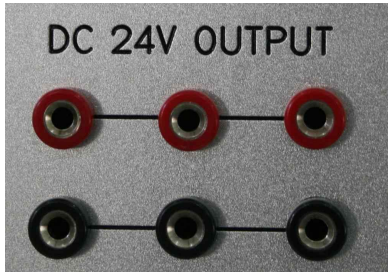

Main power section

TOGGLE Switch

Main power section is a part of control panel which has purpose alternating current (AC) electrical power supply. AC LAMP is a lamp to indicate the electricity current is flowing to the system. As you turn ON the toggle switch, direct current (DC) 24V is authorized to the system of the experimental equipment.
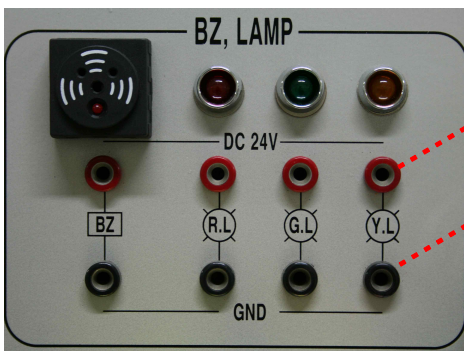
(2) Voltage and Electric current measurement

The DC 24V output section is the section for measuring voltage and electric current that use at the equipment, and it is the first section of wiring process as you star to plug **red jack wire (+)** and **black jack wire (-)**.
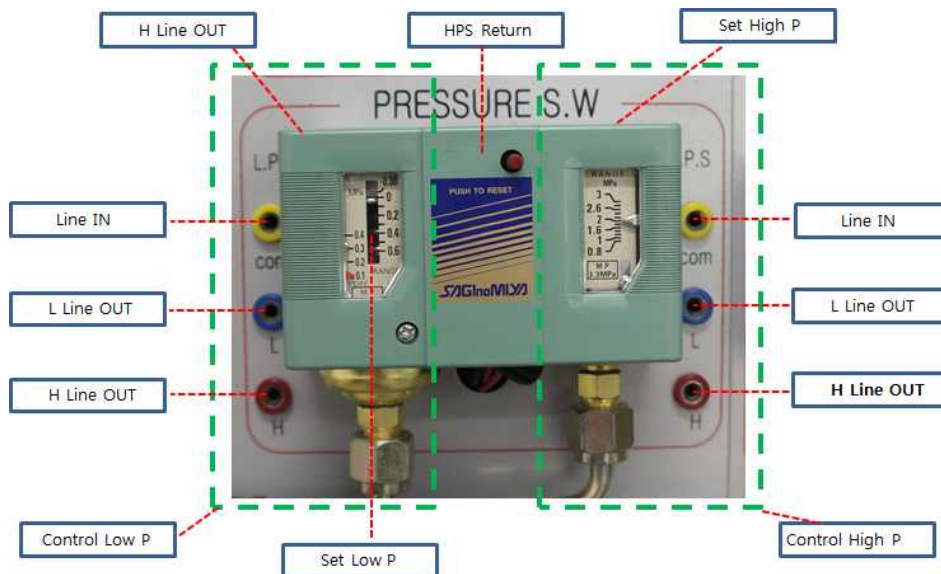
DC 24V Output

(3) Buzzer, Lamp

anode (-), red

cathode (+), black

It is the device installed to indicate whether the equipment is operating or if there is trouble. Plug the **red jack wire (+)** and **black jack wire (-)**.

Buzzer, Lamp

(4) Pressure switch

Pressure switch

It is a form of switch that makes electrical contact when a certain set pressure has been reached on its input. In this equipment, it controls the pressure in the compressor.

At the low pressure control (LPS) side there are RANGE and DIFF meter. RANGE is a middle value of pressure and DIFF is a deviation value of pressure to establish the minimum and maximum value of the pressure

Ⓐ To control the RANGE and DIFF values we need a screw driver (+) to rotate a screw at the upper side of the device.

Ⓑ We plug the anode power in the com port and plug the banana jack cable in the blue (L) and/or red (H)

ports according to the method of wanted control. The pressure switch is used to control the compressor.

(5) Magnetic Contactor (M/C)
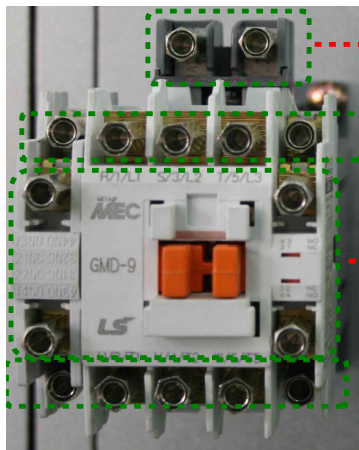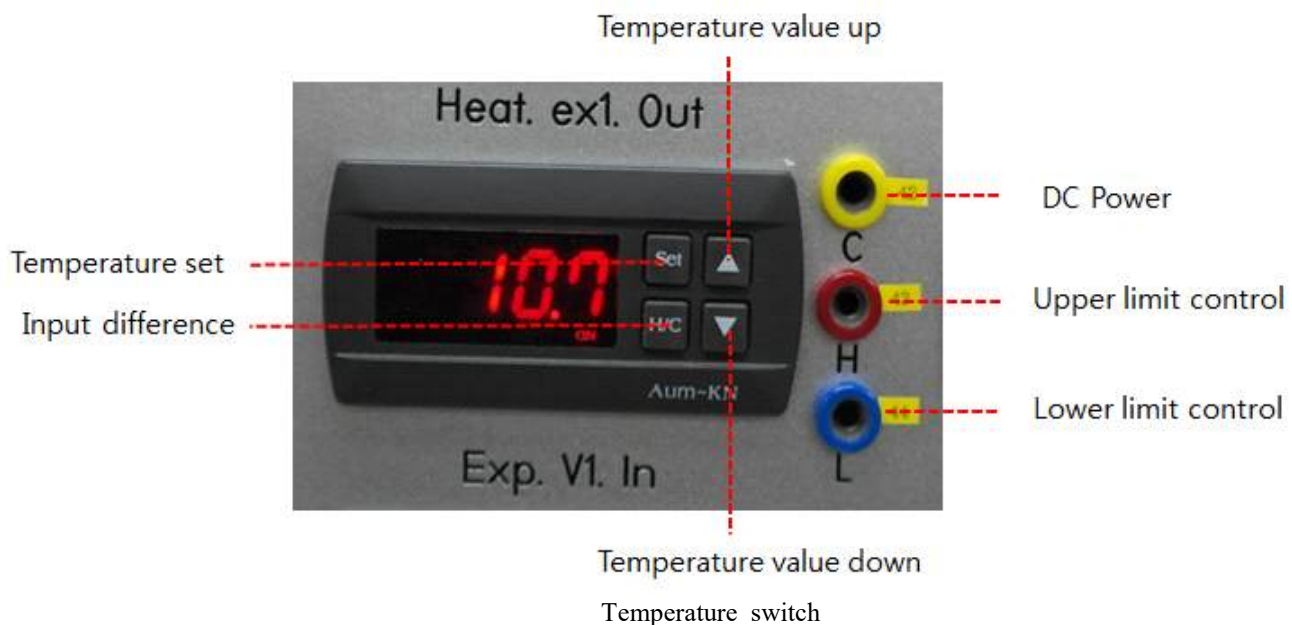

DC Power input (+,-)

a-contact point

b-contact point

a-contact point

Magnetic Contactor(M/C)

It is the part that is used to switch a power circuit ON and OFF of the equipment

Ⓐ The input in the DC power input section red port is for (+) positive and black port is for negative (-).

Ⓑ A contact or normal open contact point is the contacts are separated and the switch is nonconducting, and B contact or normal open is the contacts are touching and electricity cal flow between them.

(6) Temperature switch (OLD VERSION)

Temperature value up

Heat. ex1. Out

Temperature set

Input difference

DC Power

Upper limit control

Lower limit control

Temperature value down

Exp. V1. In

Temperature switch

It is the part that is used to control a circuit turn ON and OFF by setting the temperature of the equipment.

① Push the "set" button to the temperature main value section.

② Push the up or down arrows to set the value of main temperature.

③ Push the "H/C" button to set temperature deviation and push the up or down arows to set the deviation value.

④ The red / positive (+) cable is connected to com

⑤ Connect equipment anode to H or L according to the equipment that you are to control

(7) RELAY

Output section

input section
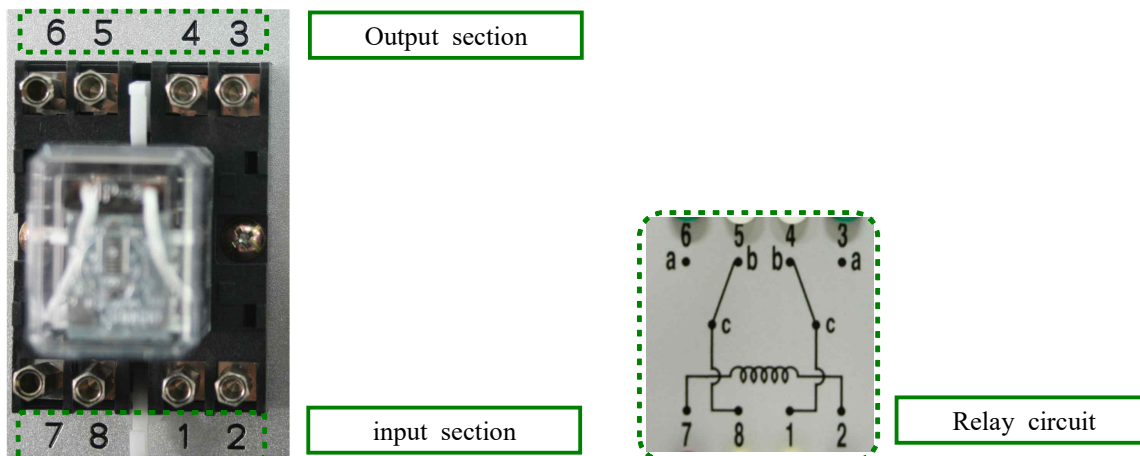
Relay circuit

RELAY

Relay is a part that is used to control the circuit by switching ON and OFF with low power signal.

Ⓐ Connect the positive (+) port with the red jack cable and negative (-) port with the black jack cable of the power input section.

Ⓑ Connect the input and output ports with the red jack cables depend on the contact type we are using to control the circuit.

(8) Button, Toggle Switch

Toggle switch

It is a switch that break an electrical circuit or diverting the current from one conductor to another by flip the buttons.

① As for the toggle switch, input + power to C and turn on or stop through a or b choice.
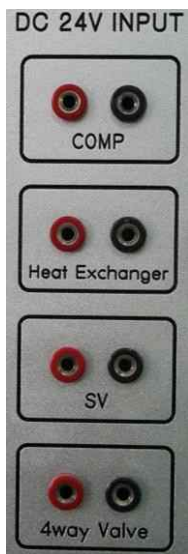
(9) Other temperature displays

Temperature display

Device that display temperature at each location.

(10) Equipment power input section

Parts that inputs power to each part of equipment (Connect anode (+) to red jack cable and cathode (-) to black jack cable)

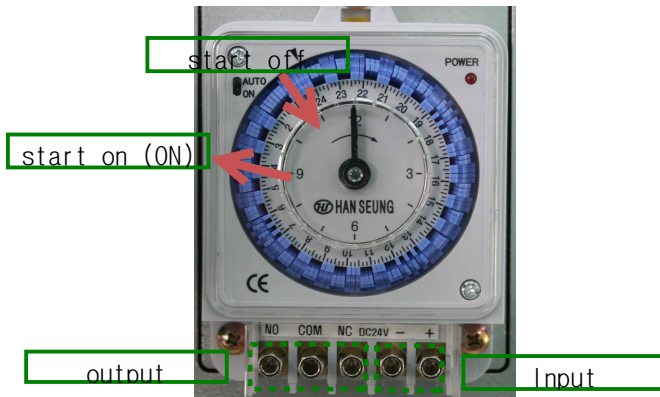Equipment power input section

(11) Push button switch
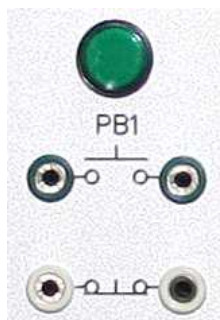
Push button with A (normal open) and B (normal close) contacts, it switches on or off of a circuit configuration mechanism.

There is no different polarity of input and output in the system.
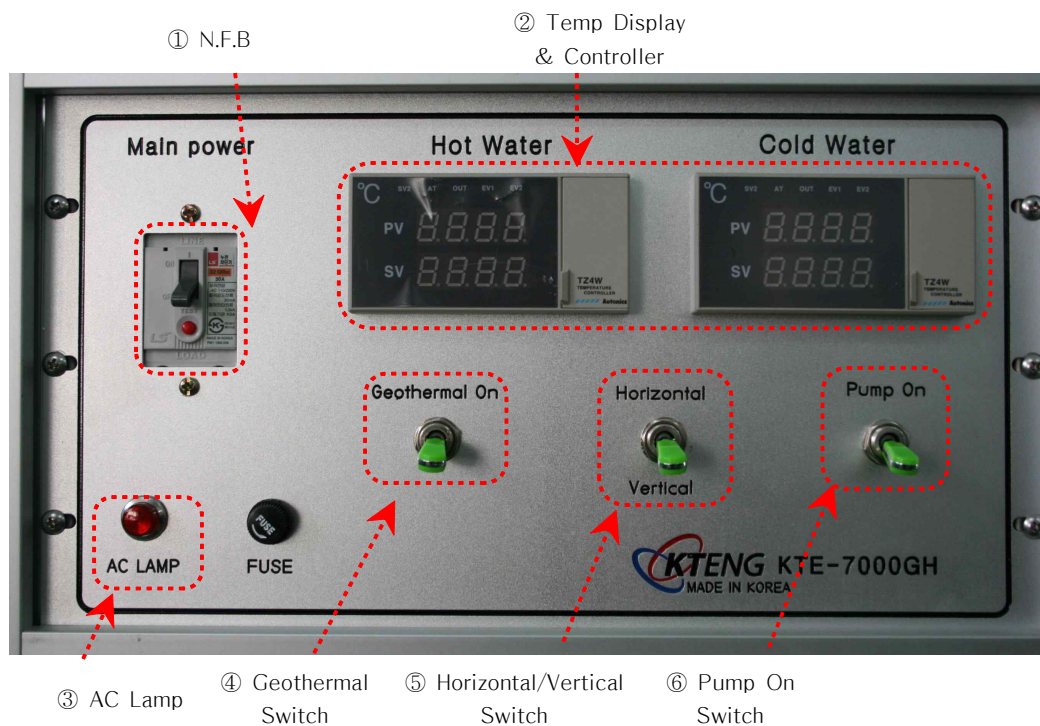
Push button switch

(12) Timer

start off

start on (ON)

output

Input

POWER

NO COM NC DC24V − +

Timer

Connect DC curent to the positive (+) and negative (-) ports

AUTO: Panel adjustment to the ON and OFF position

ON: the contacts are always connect

the minimum timing range is 10 minutes and full timing range is 24 hours

2-5. Control panel of geothermal division

① N.F.B

② Temp Display & Controller

Main power

Hot Water

Cold Water

Geothermal On

Horizontal

Pump On

Vertical

AC LAMP

FUSE

KTENG KTE-7000GH
MADE IN KOREA

③ AC Lamp   ④ Geothermal Switch   ⑤ Horizontal/Vertical Switch   ⑥ Pump On Switch

Control panel of geothermal department

(1) Main power (N.F.B)

Main power section is a part of control panel which has purpose alternating current (AC) electrical power supply. AC LAMP is a lamp to indicate the electricity current is flowing to the geothermal division system. As you turn ON the toggle switch, direct current (DC) 24V is authorized to the system of the experimental equipment.

(2) AC LAMP

When you turn on the N.F.B power, power is authorized and light is on the AC LAMP.

(3) Geo-thermal environment ON/OFF switch

When you turn ON the Geothermal switch, it operates cooling/heating mode according to the setting of temperature value.

(4) Horizontal/Vertical Convertible Switch

When we activate the switch toward horizontal, the horizontal ground heat exchanger is operating, and when we ativate the switch toward vertival, the vertical ground heat exchanger is operating.

(5) Circulation pump ON/OFF switch

the water in the ground heat exchanger will be pumped to the plate heat exchanger in the heat pump division when we switch up to the pump on.

3. Data Acquisition device between PC and machine

3-1. Data Acquisition and System Monitoring Program

3-1-1. Function

(1) Monitoring the measured data of temperature and pressure in real time.

(2) Monitoring the measured data of enthalpy on a diagram of Standard refrigeration system in real time.

(3) Monitoring factors like as refrigeration effect, compressor work, condensing heat in condenser, evaporating latent heat, coefficient of performance in the abstract with temperature and pressure data which are measure in real time

(4) Being saved data all of temperature, pressure and enthalpy on every second as excel

(5) Experiment for variety of condensation temperature(Subcool) on second cycle as change of evaporation temperature on first cycle.

(5-1) Experiment for variety of condensation pressure on second cycle as change of evaporation temperature on first cycle.

(6) Experiment for variety of evaporation temperature(Superheat) on first cycle as change of evaporation temperature on first cycle.

(6-1) Experiment for variety of evaporation pressure on first cycle ass change of evaporation temperature on first cycle.

(7) Check the COP as change of evaporation temperature on first cycle.

3-1-2. Composition
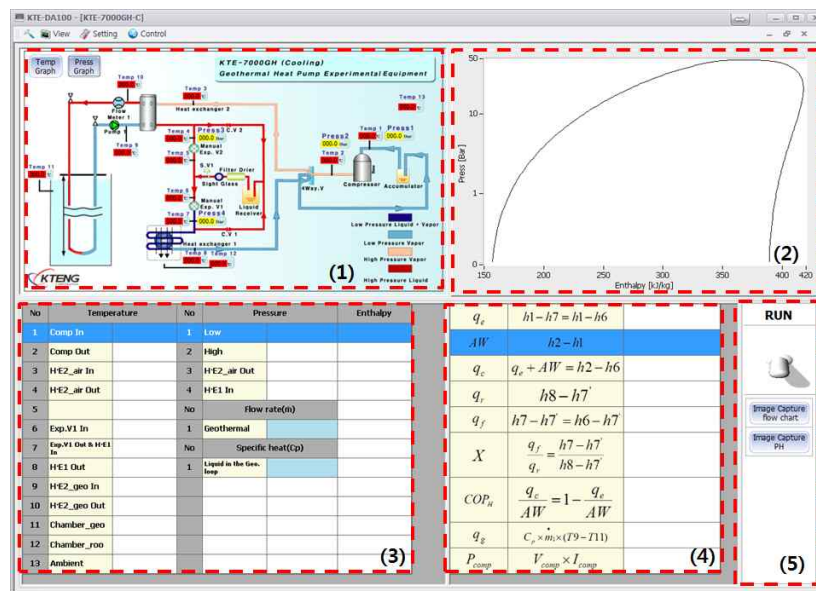
(1) Schematic diagram of equipment.

(2) p-h diagram.

(3) Data table for temperature, pressure and enthalpy.

(4) Sort of Calculation value like as COP, cooling capacity and heating capacity.

(5) Start switch and capture button

3-1-3. Being registered with KoreaSoftwareCopyrightCommittee.

3-2. Install and how to use KTE-DA100

3-2-1. INSTALL USB TO SERIAL

- Communication method is using computer and RS232 protocol for communication.
- If you got a desktop which is connected with Serial Port back. you don't have to install USB To Serial.
- If you got a desktop which doesn't have notebook or Serial Port, you need to install progress for collecting data using USB Port.

1. Run Windows 7
2. Connect USB MultiPort to your PC's USB port.
3. Inset media CD(provided with MultiPort) into the CD drive.
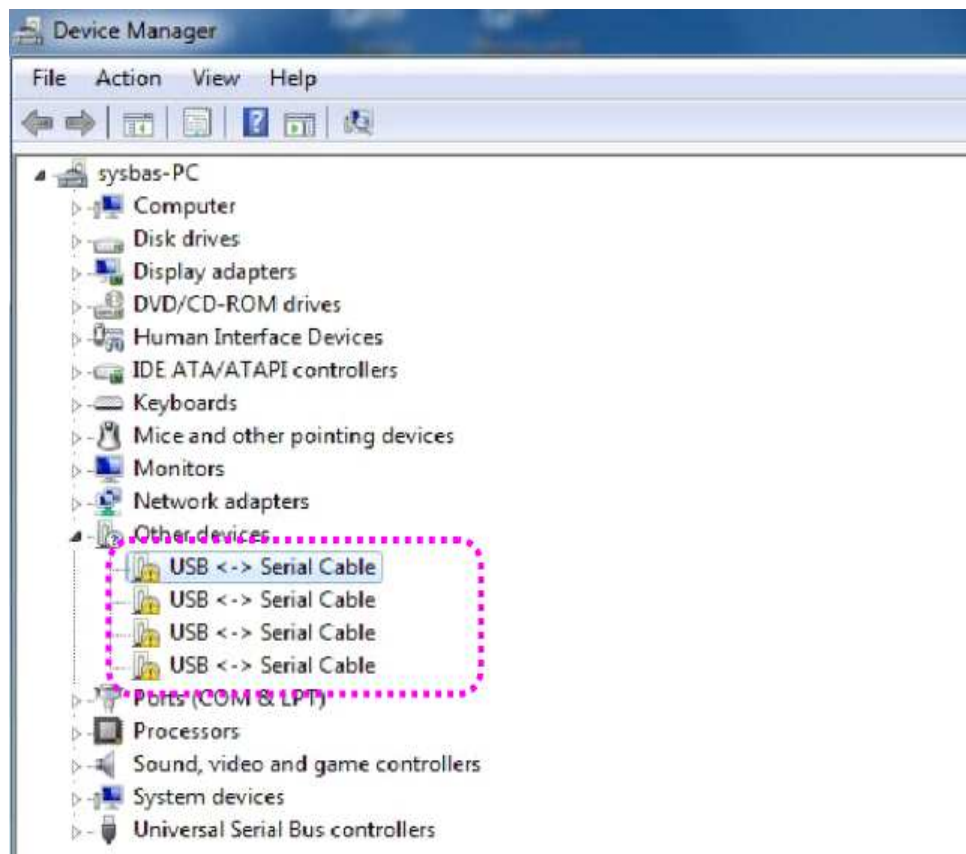4. Click "Hardware and Sound" in "Control Panel"
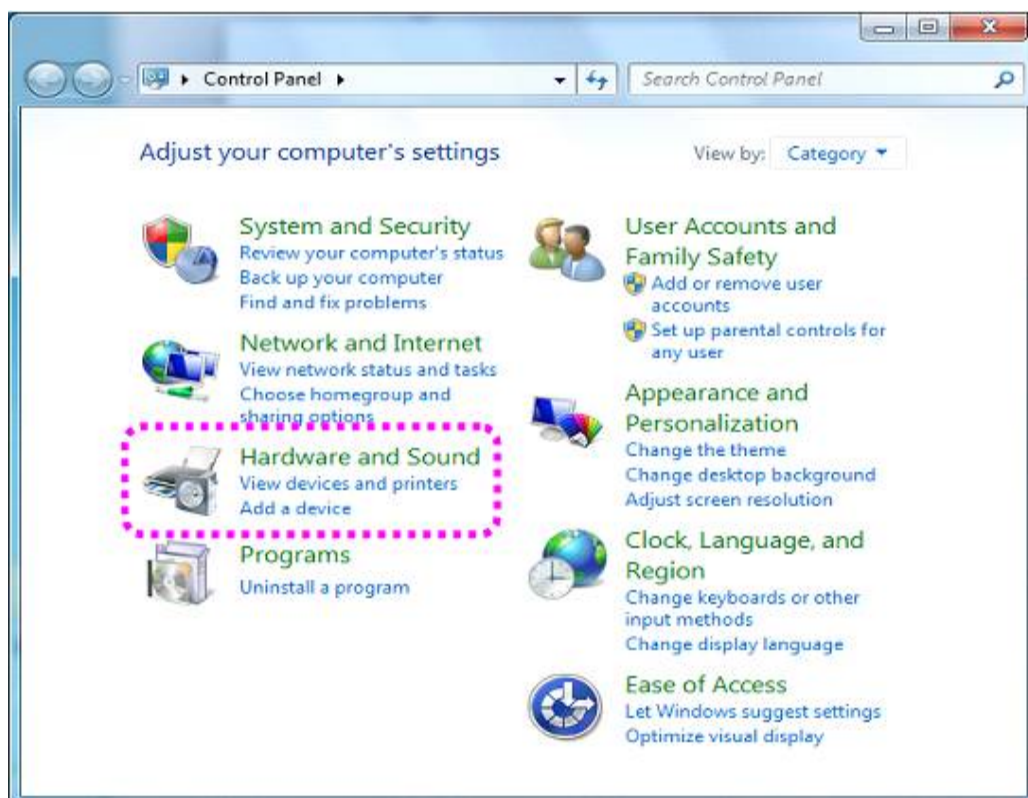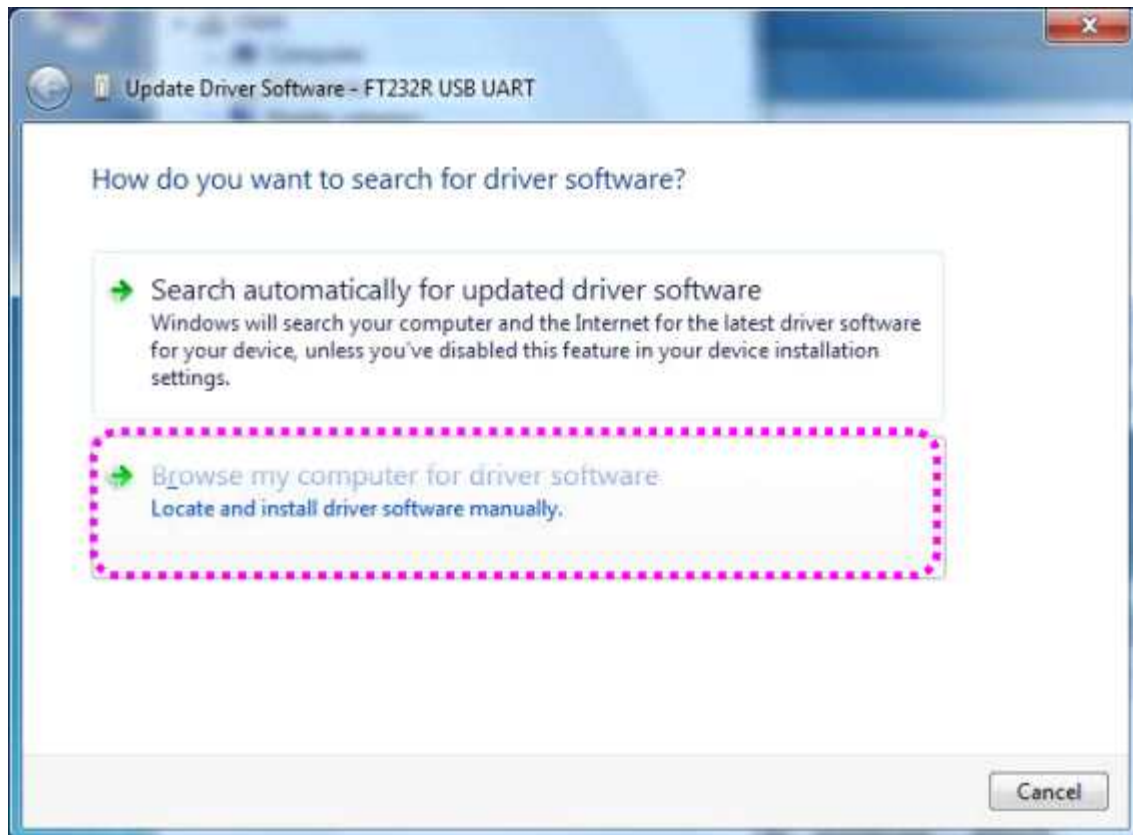
5. Following picture depicts Device Manager after carrying out step 4. Click "Device Manager".
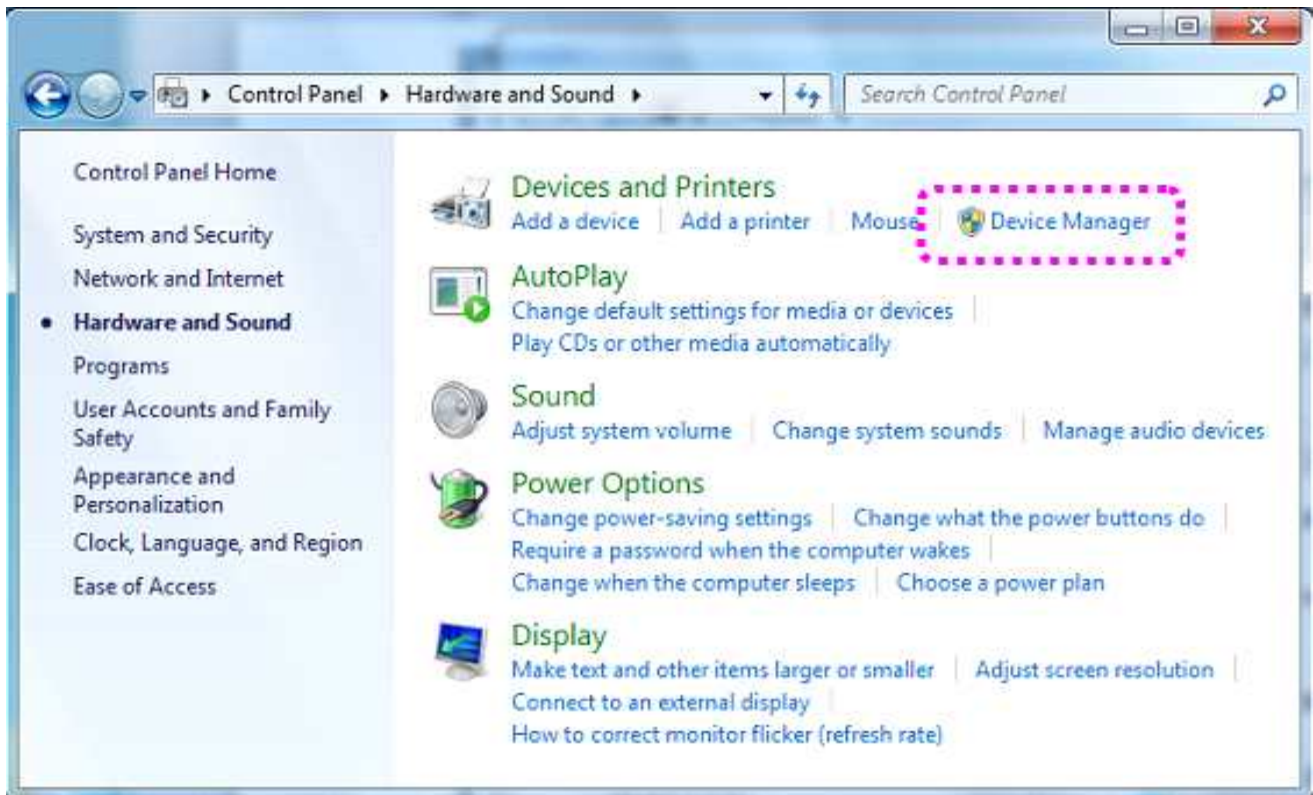
6. Right click "USB <-> Serial Cable" in "Device Manager". Then choose "Update Driver Software".

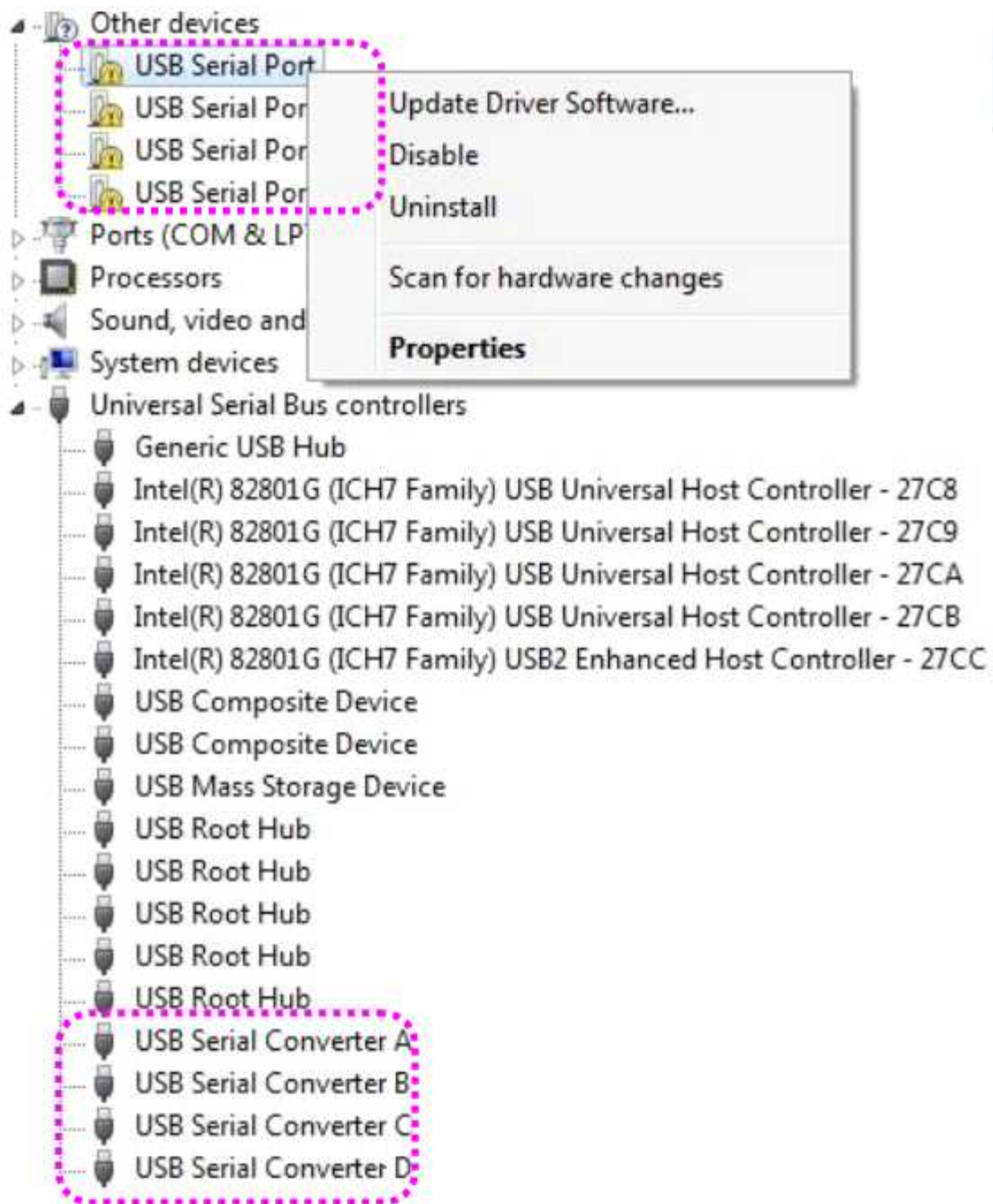7. Click "Browse my computer for driver software"in order to install driver manually.

8. Click "Browse"and set driver software's location to
   [CD]:\Driver\USB\Win2000\,XP,2003,Vista,2008,7".

9. Confirm that "USB Serial Converter" is installed normally. Then, right click "USB Serial Port"and follow the same process from number 6 again.

Other devices
  USB Serial Port
  USB Serial Por | Update Driver Software...
  USB Serial Por | Disable
  USB Serial Por | Uninstall
Ports (COM & LP | Scan for hardware changes
Processors
Sound, video and | **Properties**
System devices
Universal Serial Bus controllers
  Generic USB Hub
  Intel(R) 82801G (ICH7 Family) USB Universal Host Controller - 27C8
  Intel(R) 82801G (ICH7 Family) USB Universal Host Controller - 27C9
  Intel(R) 82801G (ICH7 Family) USB Universal Host Controller - 27CA
  Intel(R) 82801G (ICH7 Family) USB Universal Host Controller - 27CB
  Intel(R) 82801G (ICH7 Family) USB2 Enhanced Host Controller - 27CC
  USB Composite Device
  USB Composite Device
  USB Mass Storage Device
  USB Root Hub
  USB Root Hub
  USB Root Hub
  USB Root Hub
  USB Root Hub
  USB Serial Converter A
  USB Serial Converter B
  USB Serial Converter C
  USB Serial Converter D

10. Following picture depicts "Device Manager"after carrying out all steps. As can be seen, all "USB Serial Converters" and"USB Serial Ports" are successfully installed.

KTENG CORPORATION 20
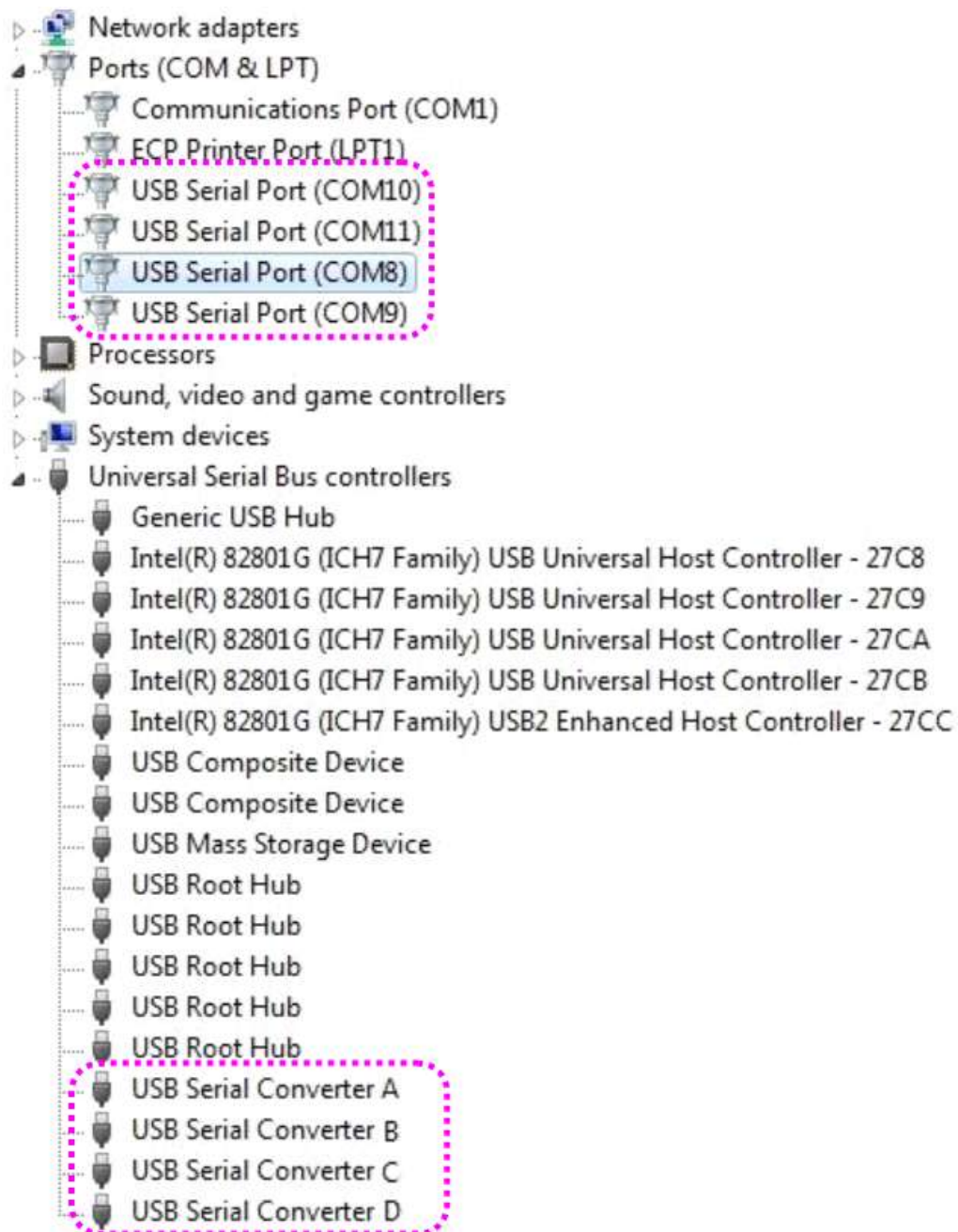
11. "USB Multiport"installation on Window 7 is now finished.

3-2-2. KTE-DA100 Installation and Operating

① KTE-DA100 Installation
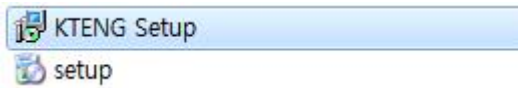
1) You can see a installation files that in CD or USB for installation then double click 'KTENG Setup' file to start installation. If the program cannot be installed using 'KTENG Setup', try to 'setup'file.
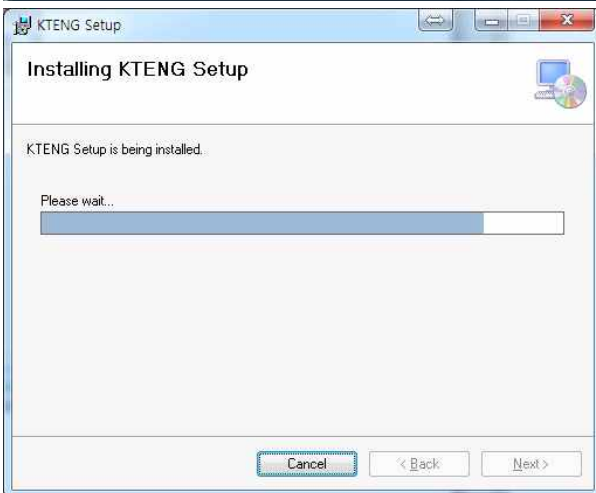

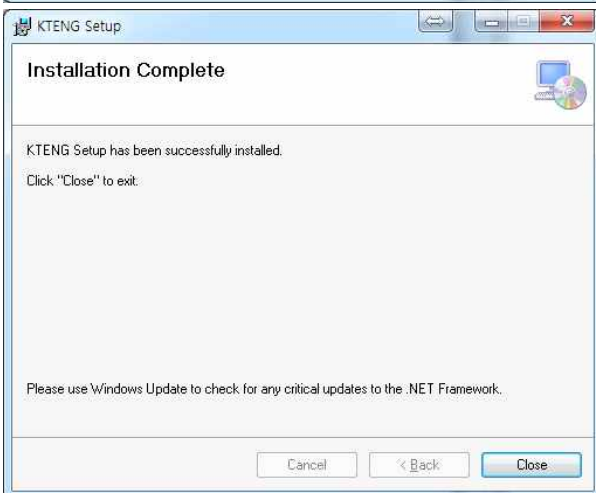2) If you can see a 'Setup Wizard' screen, click the 'Next>'.

3) You can change a installation route. If you want to change a installation route, click the 'Browse..' and find a new route then click the 'Next>'.
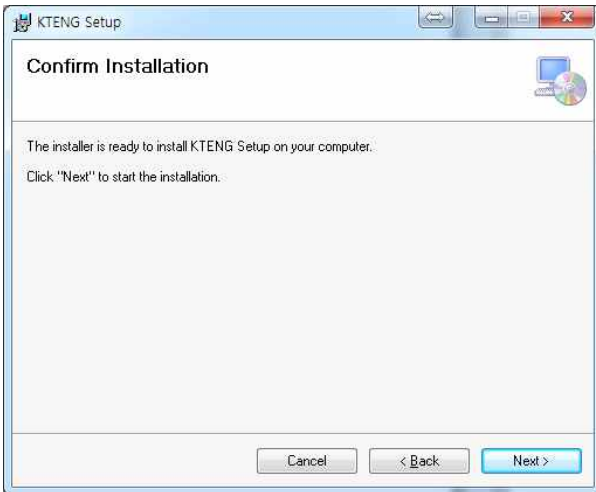
4) It require to confirm installation intention. Please click the 'Next>'.

5) Installing a program.

6) Please click the 'Close' and complete a installation.

5) Start program by using icon in wallpaper or routing folder then the main page of program come up.


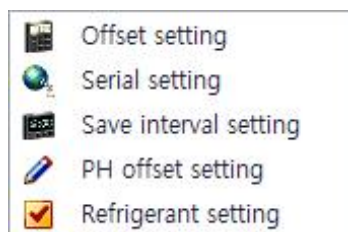| KTE-1000BA	Standard Refrigeration Experimental Equipment	KTE-7000SR	Solar Radiation Energy Experimental Equipment
KTE-2000EP	Evaporation Pressure Parallel Control Experimental Equipment	KTE-7000SB	Solar Heating Hot Water Boiler Experimental Equipment
KTE-2000EV	Refrigerant Parallel Expansion Valve Experimental Equipment	KTE-7000PVT	PVT Performance Measuring Equipment
KTE-3000HD-H	4-Way Reverse Valve Control Heat Pump Experimental Equipment (Heating Mode)	KTE-7000GH-H	Geothermal Heat Pump Experimenatl Equipment (Heating Mode)
KTE-3000HD-C	4-Way Reverse Valve Control Heat Pump Experimental Equipment (Cooling Mode)	KTE-7000GH-C	Geothermal Heat Pump Experimenatl Equipment (Cooling Mode)
KTE-5000LT	Binary Refrigeration Experimental Equipment	KTE-HB520	Hybrid Power Conversion Experimental Equipment
KTE-6000BR	Brine Refrigeration Experimental Equipment	KTE-7000SG	Solar Power Generation Experimental Equipment
KTE-9000AU	Car Air-Conditioner Experimental Equipment	KTE-7000WG	Wind Power Generation Experimental Equipment
KTE-1000AHU	Air-Conditioning Unit Automatic Control Equipment	KTE-7000SH	Solar-hydrogen Fuel Cell Experimental Equipment
KTE-2000AHU	Air Handing Unit Lab-view Programing Equipment		

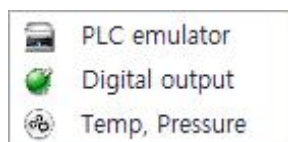② Main Menu Composition

1) View
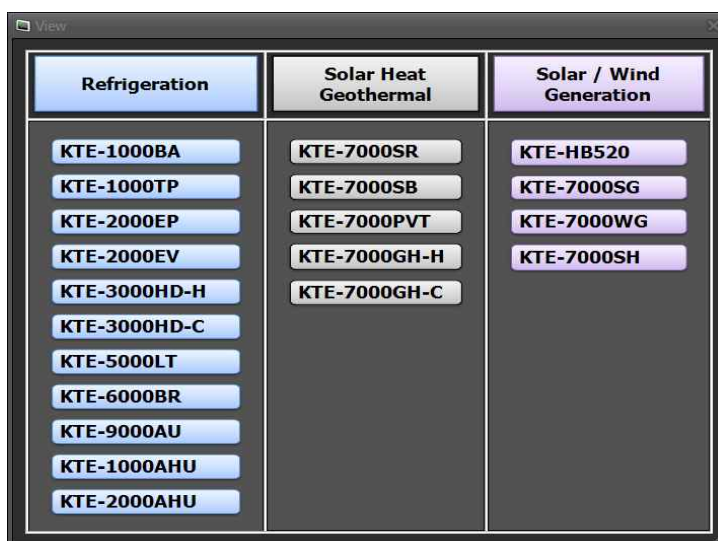
(Refrigeration 11 species, Solar-Geothermal 5 species,
Solar-Wind energy 4 species)

2) Setting

- Offset setting
- Serial setting
- Save interval setting
- PH offset setting
- Refrigerant setting

3) Control

- PLC emulator
- Digital output
- Temp, Pressure

(2) Setting

Menu	Explain
Offset Setting	Setting initial pressure, temperature
Serial Setting	Communicating port setting
Save Interval Setting	Setting data acquisition time interval
PH Offset Setting	Setting range of axis at p-h chart
Refrigerant Setting	Select refrigerants

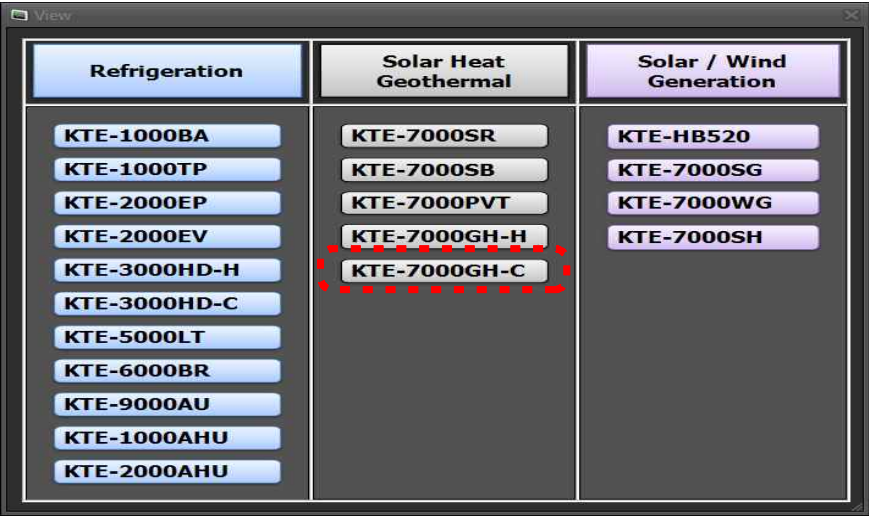※ Please refer to page 69 for more detail information.

(3) Control

Menu	Explain
PLC emulator	Using PLC control
Digital output	Control a Hardware
Temp, pressure	Control a temperature, pressure

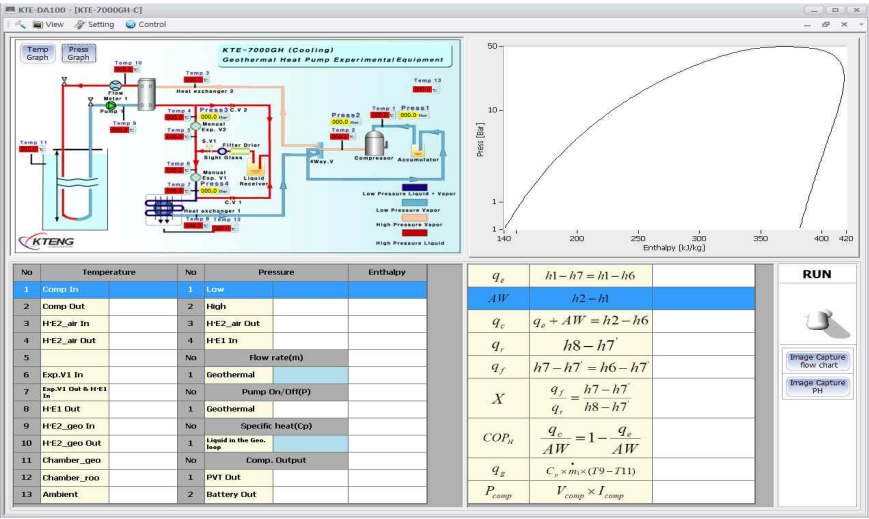※ Please refer to page 76 for more detail information.

(3) Application of data acquisition equipment(Model : KTE-DA100)
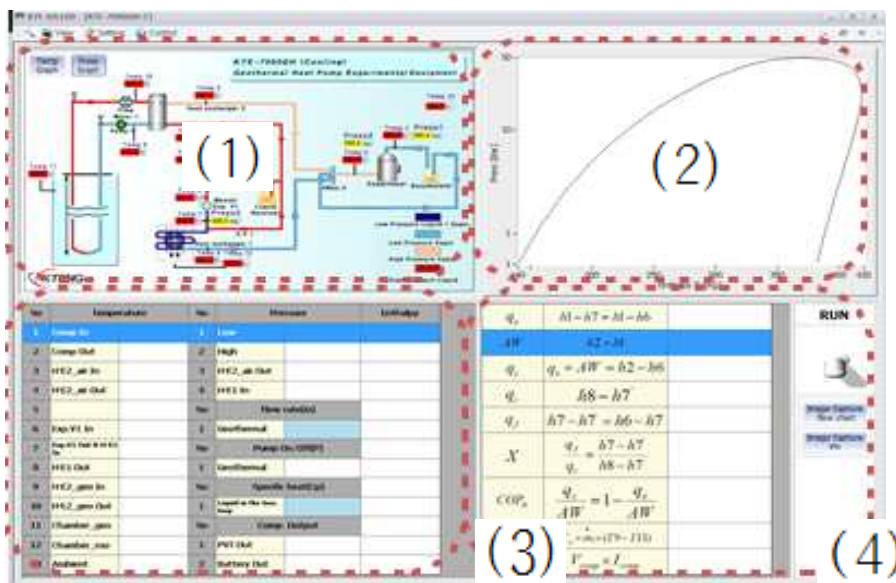
① Selection of Model

(1) When program started, 'View'screen is activated.

(2) Select a model what you want. (Click the KTE-7000GH-C)
※ GH-C : Cooling
   GH-H : Heating
   mode

(3) Main user interface of KTE-7000GH-C(Geo-Thermal Heatpump Experimental Equipment) is activated.

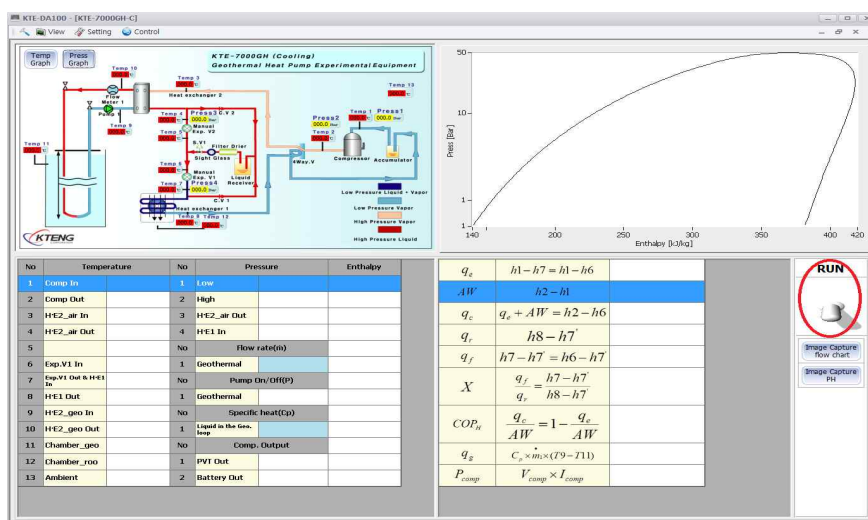## ⅰ) Composition of main user interface

(1) Schematic diagram of system show temp, press. in realtime
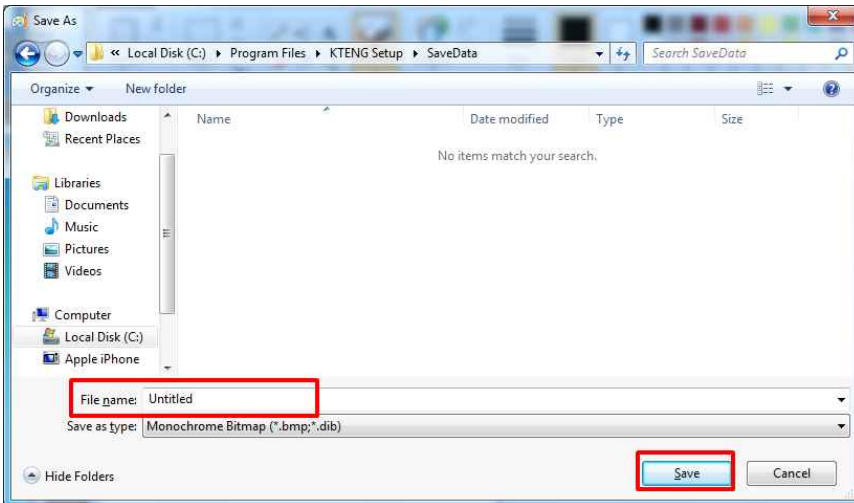
(2) p-h chart.

(3) Data table of temp, press, and enthalphy

(4) Calculation value of COP, cooling capacity, heat capacity in HX.
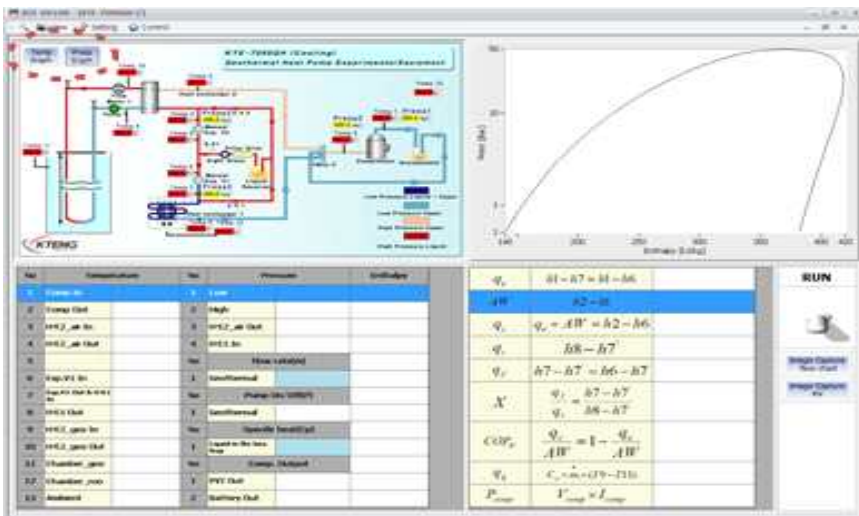
ⅱ) Operating and saving data
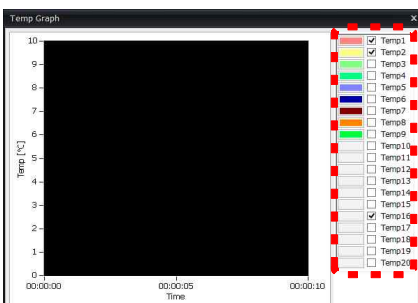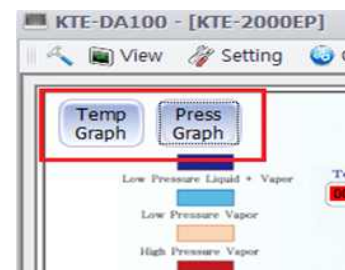

(1) Click a toggle switch to run program to save data.

(2) Write a title and save a file by excel.

※ The reason of writing title first is that can save data even though unavoidable situation happened.

iii) Find a graph

(1) If you want to see a temp., and press, graphically, please click a icon in red box below.
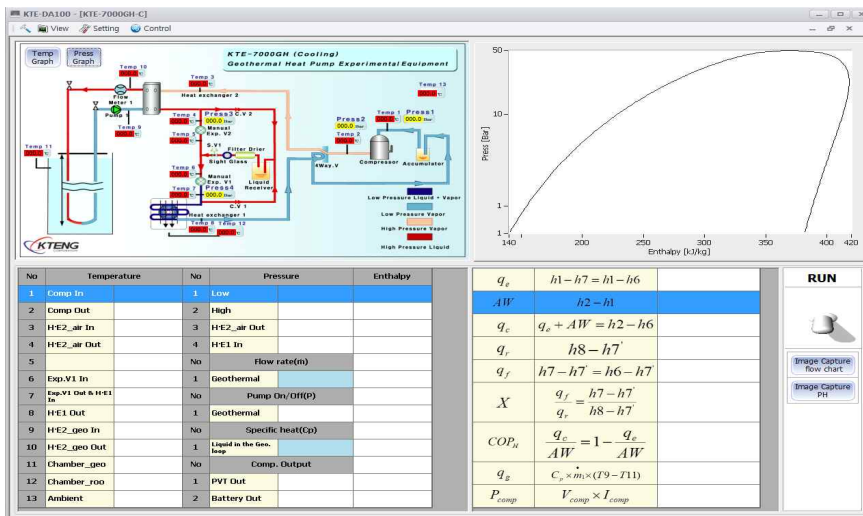

Temperature Realtime Graph   Pressure Realtime Graph
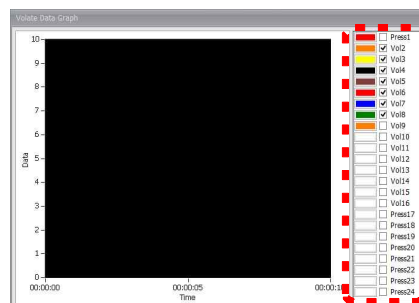
(2) You can always see the graph for location and figure through checking temperature, pressure

(3)Seeing the graph for individual temperature and pressure is that double click display of monitor then indicate the graph window as below

(4)You can always check the temperature

iv) Function for capture
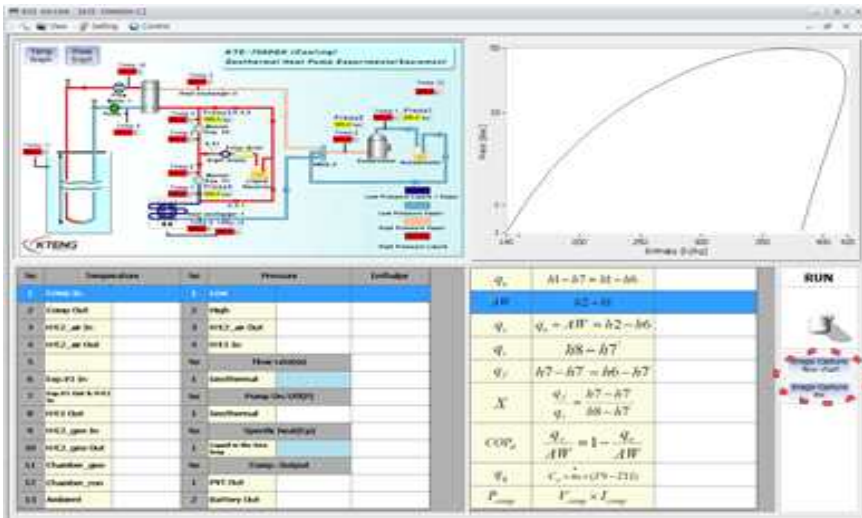
(1)
The bottom of the right side, click Image Capture flow chart and Image Capture PH then it is saved to JPG files
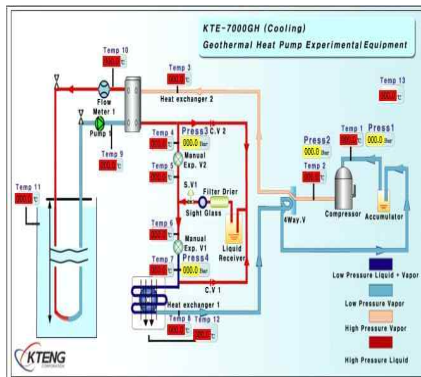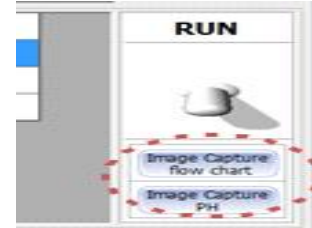
Diagram capture(Flow Chart)
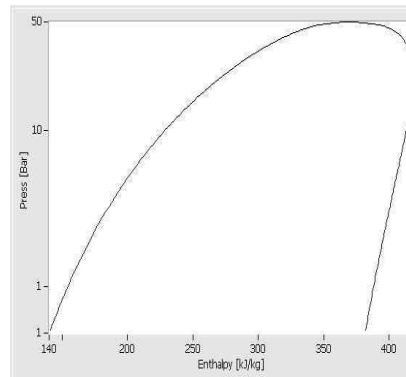
PH line capture

(2) Monitor when choosing
- Diagram(Flow Chart) capture
- PH line capture

② Function for collecting data tools
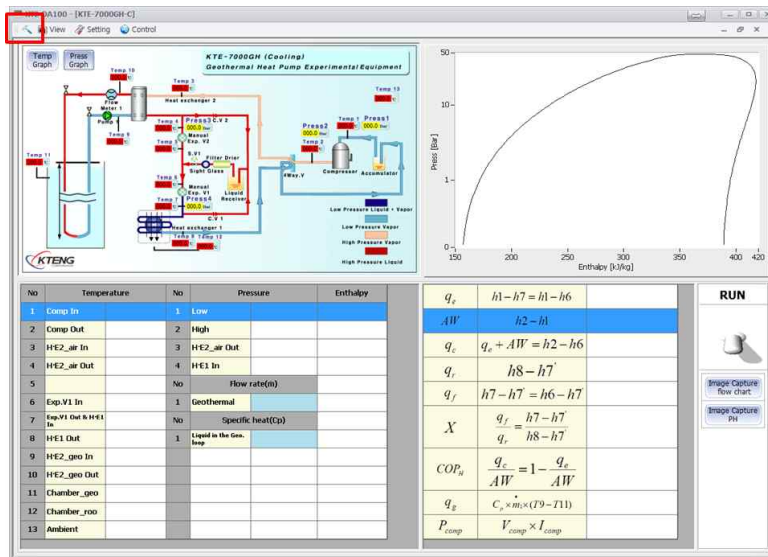
(1) Click in Tools
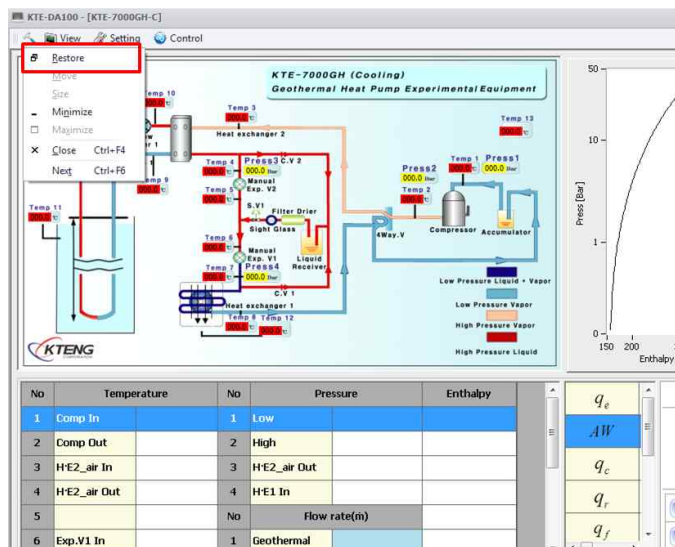
(2)When you click (R) for before size, the window is activated for moving
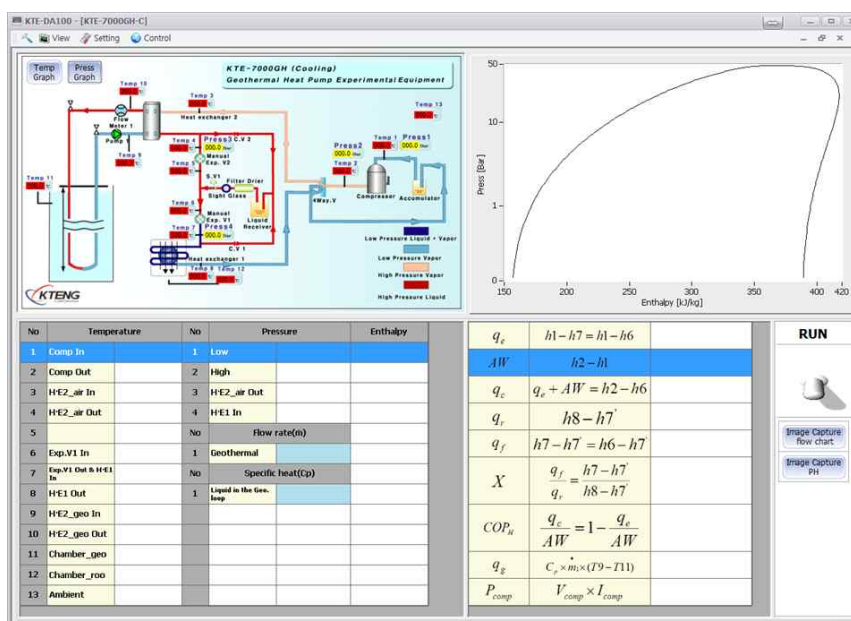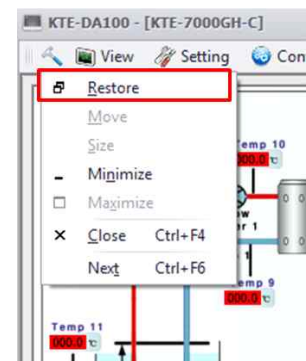
(3) Click that button, the window is bigger.

i)Tools
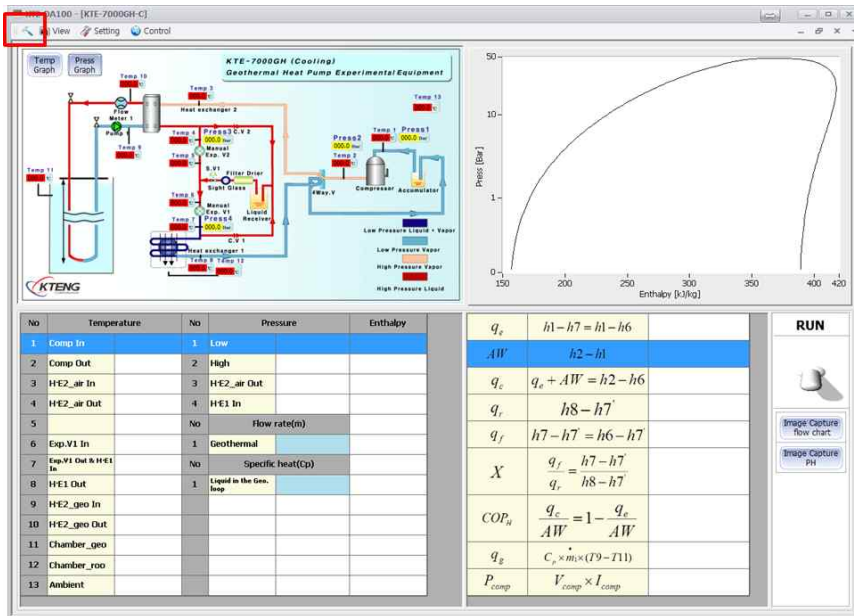
(4) Click
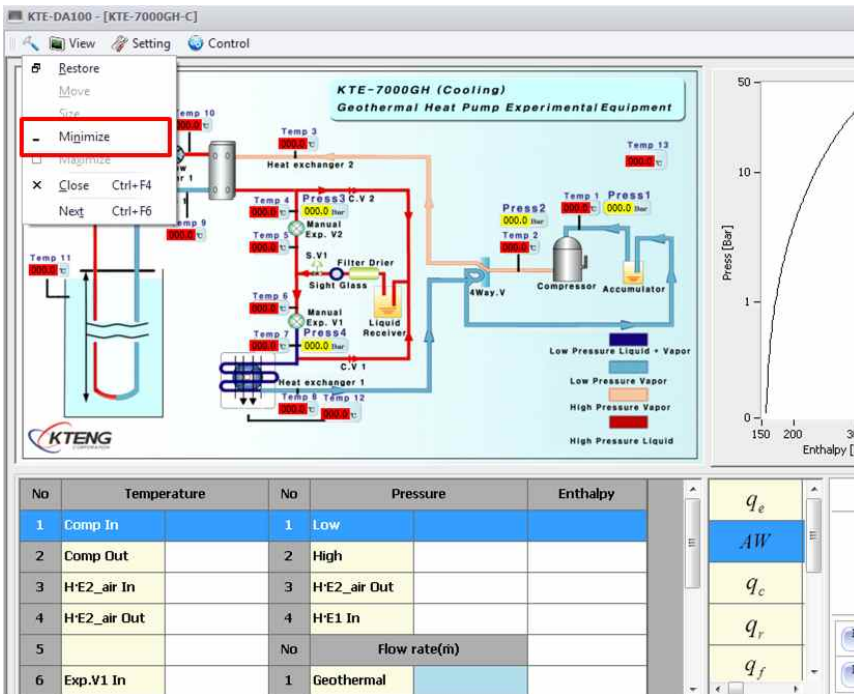
(5) When click the minimum(N), indicate bottom of the left side.
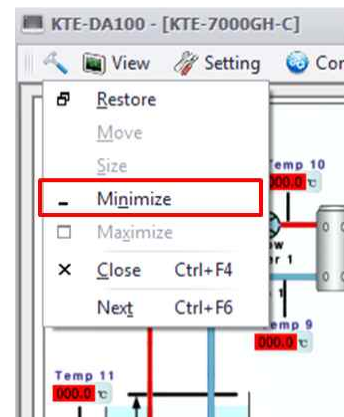
(6
When click whole monitor, it is returned.

ⅱ) View
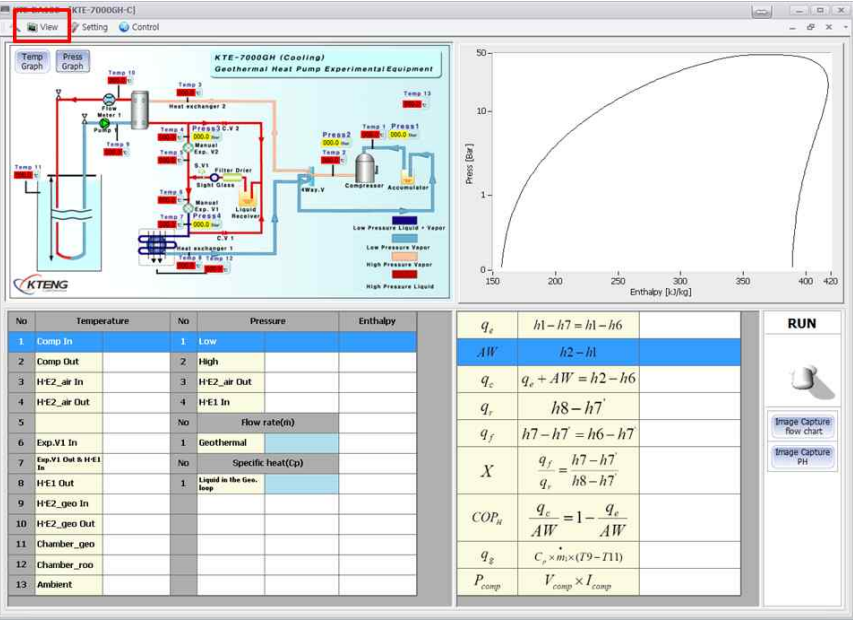
(1) Click the view in Tools
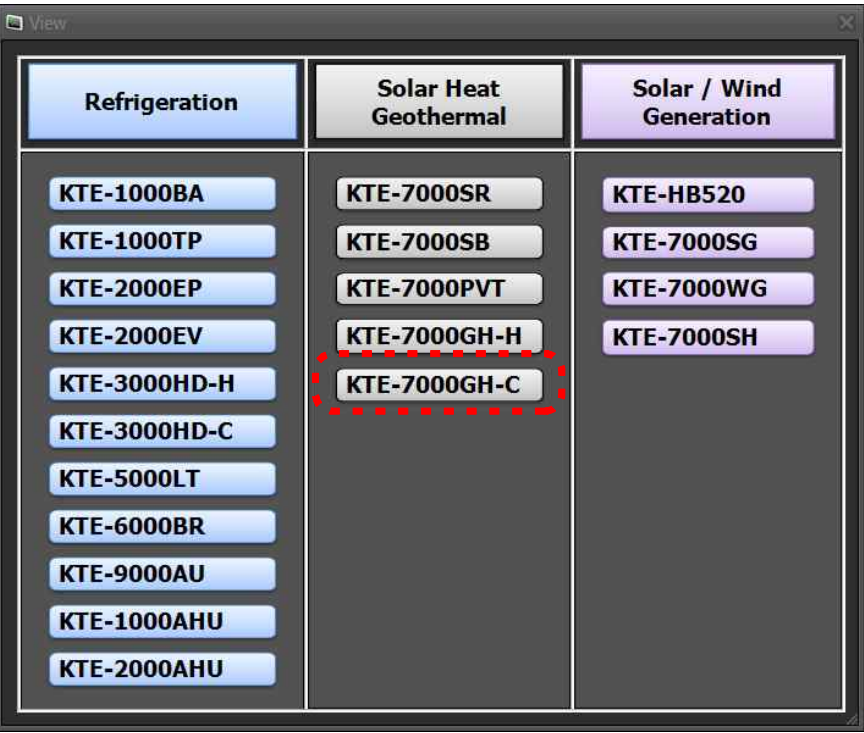
(2)

When you click the view and click Model name then it goes to main sreen and it indicates program screen which is connected with real equipments

iii) Setting

a) Serial setting
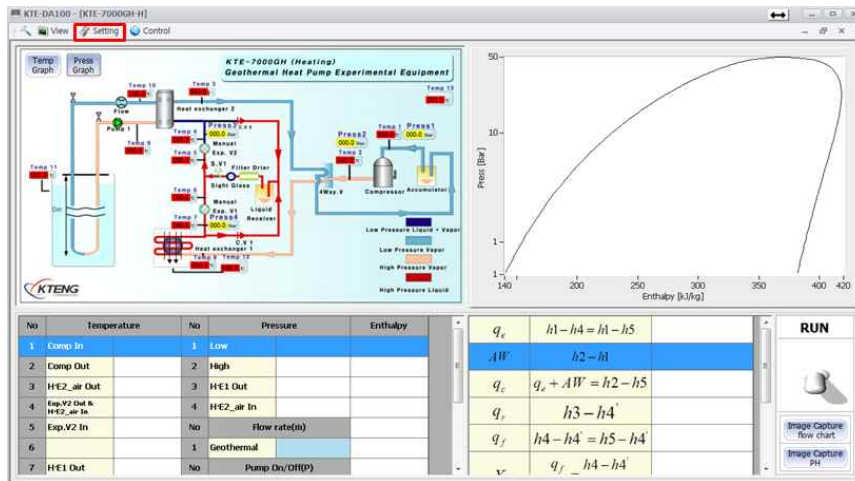
(1) Click Setting
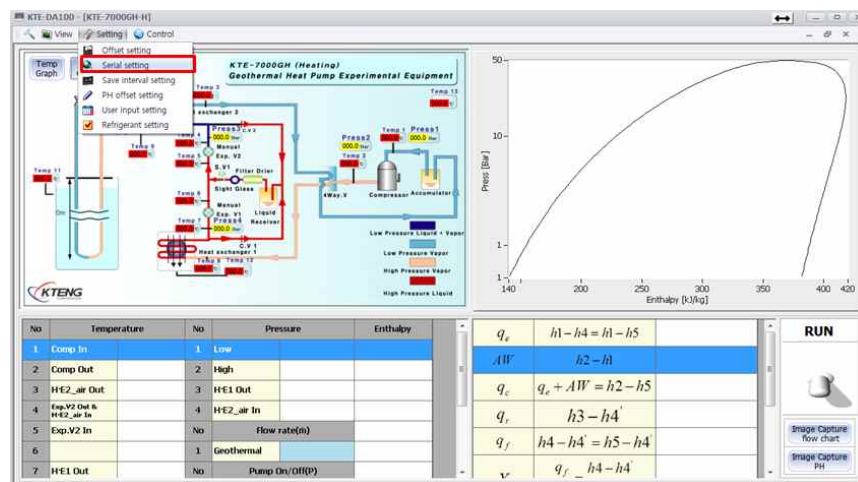
(2) Click Serial setting
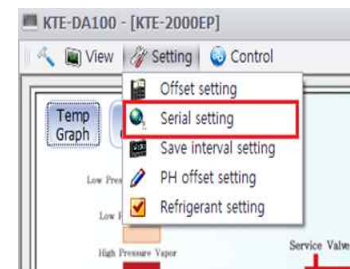
(3)
COM No is changed depend on port location. choose COM No and Click OK

※Chcking port No is on Page_1-1 use to serial installation

b) Offset setting
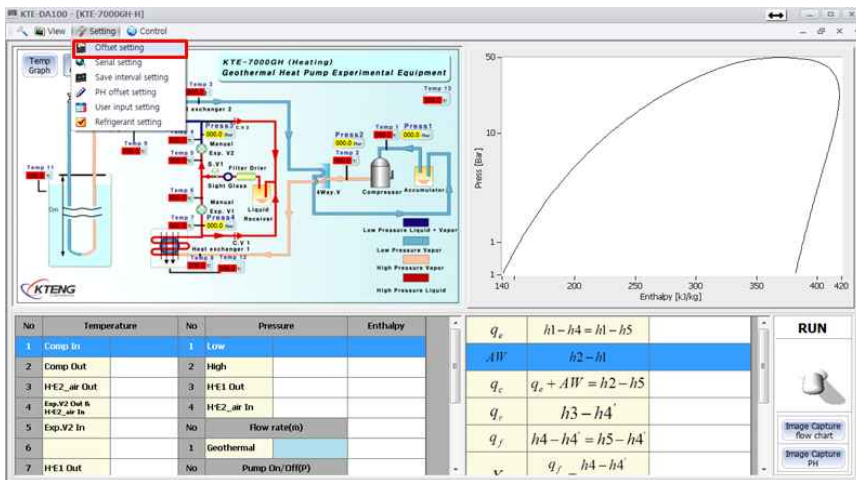
(1) Click Setting in Tools
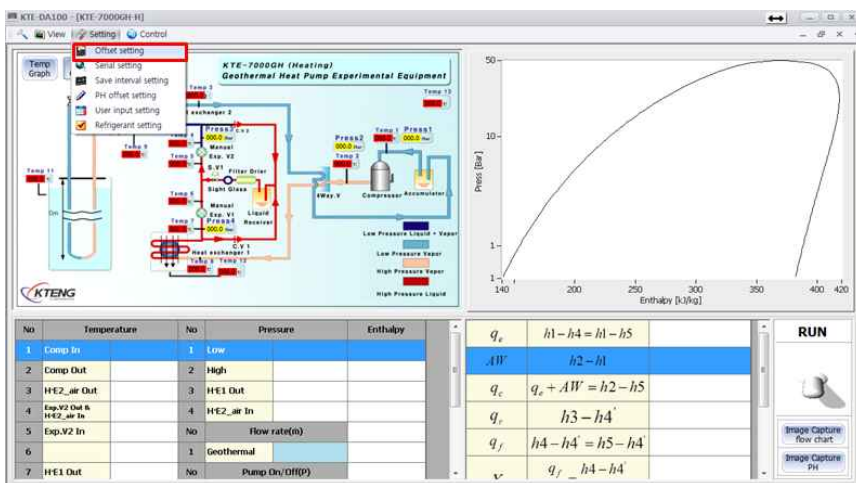
(2) When you click Offset setting, below screen is indicated
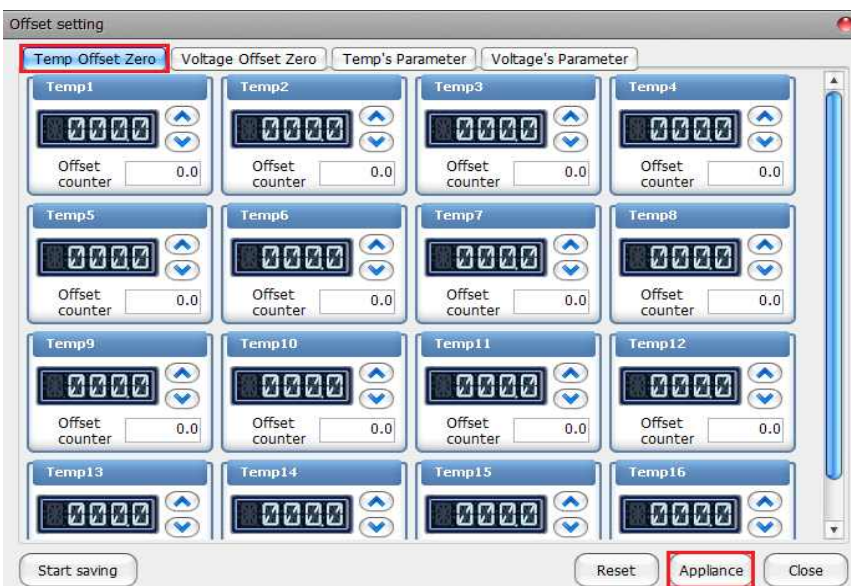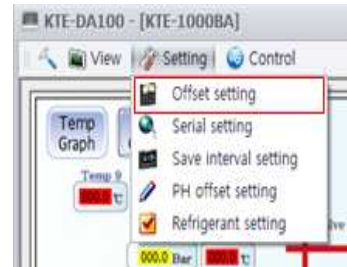
(3) Temp Offset Zero is that can control temperature

⌃
⌄ : You can control using direction key

Offset counter 0.0 : It is indication for temperature figure

Click the application then click the Close for applying the figure

*Refer : Temp No has twenty section which is separated as a sensor
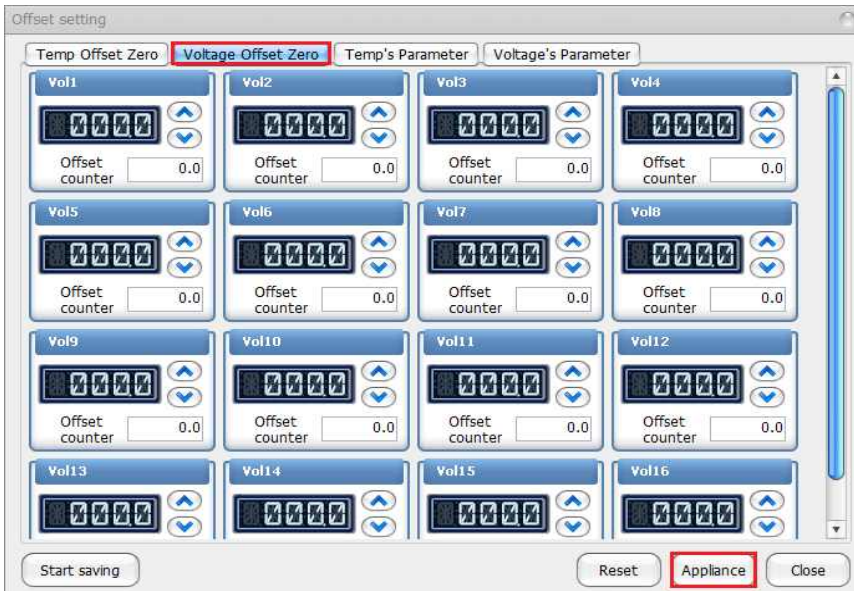
(4) Voltage Offset Zero is a part of can control voltage

 : You can control using direction key

 : It is indication for voltage figure

Click the application then click the Close for applying the figure
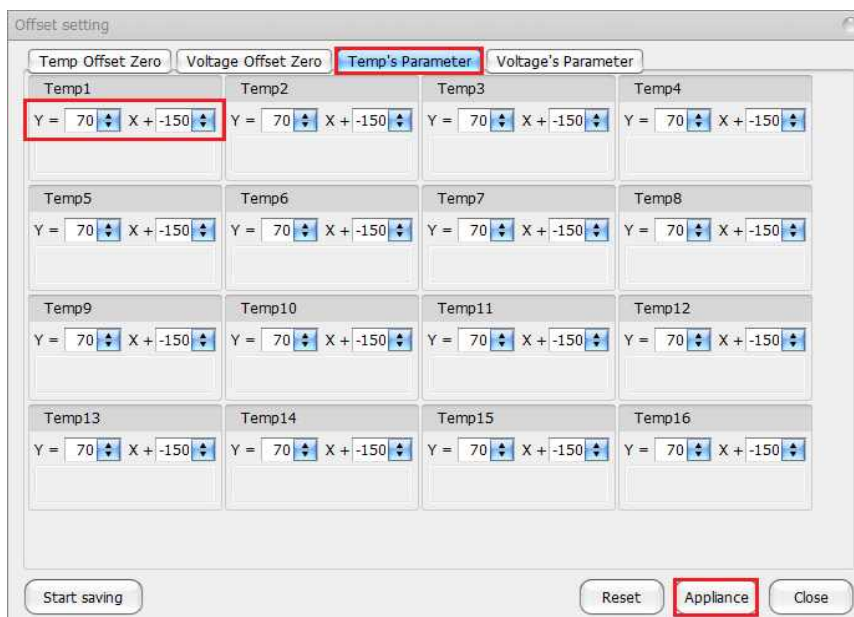
(5)Temp's Parameter must enter a value of Y = 70X-150 on all of the items is a place to enter a formula that converts the output signal of the thermometer with temperature. click the "Application" and click "Close" for Application
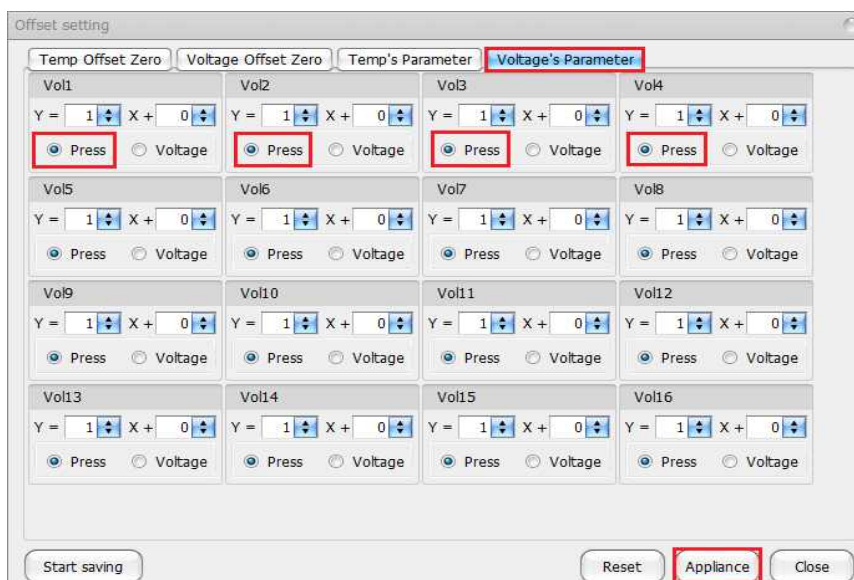
(6) Voltage`s Parameter has a function which can input the figure for changing input figure, You can set as choosing Pressure, Voltage. Click"Application" and click "Close" for Application.

(8) Start saving set figure and Click "Close" on the left screen

c) Save interval setting
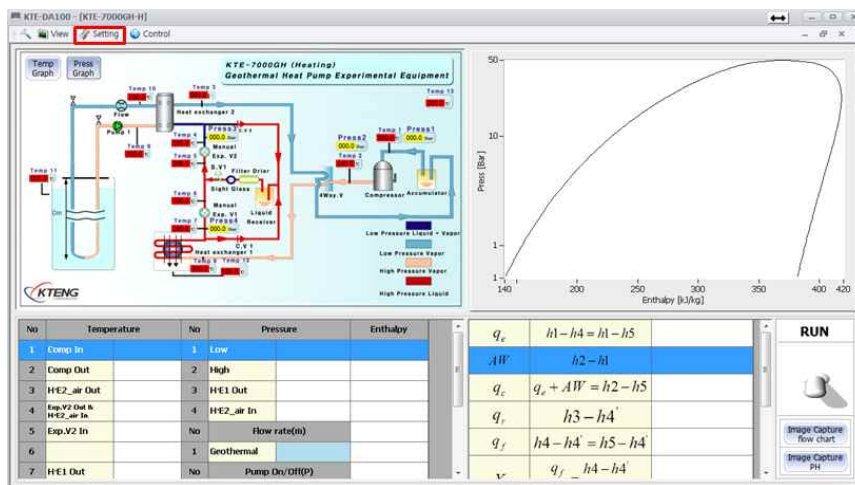
(1)Click Setting
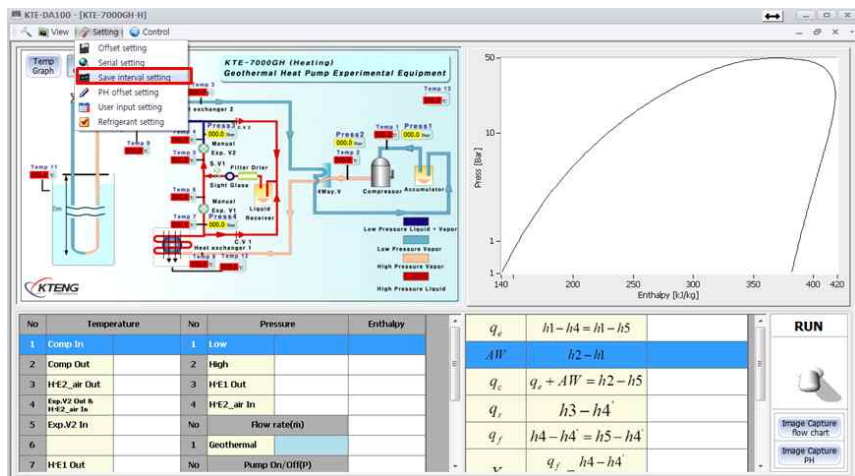
(2) Click Save interval setting

Save interval setting
A function for setting a data storage time interval The time interval as an Excel file Can be stored in line.(However, the number of seconds (Sec) because When set to one minute is Set to 60Sec)
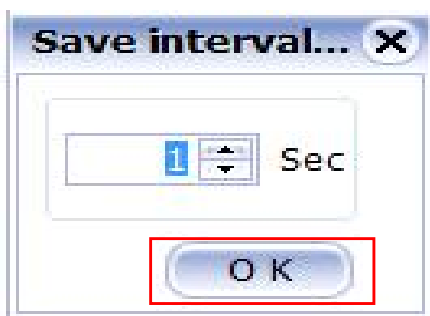
d) PH offset setting
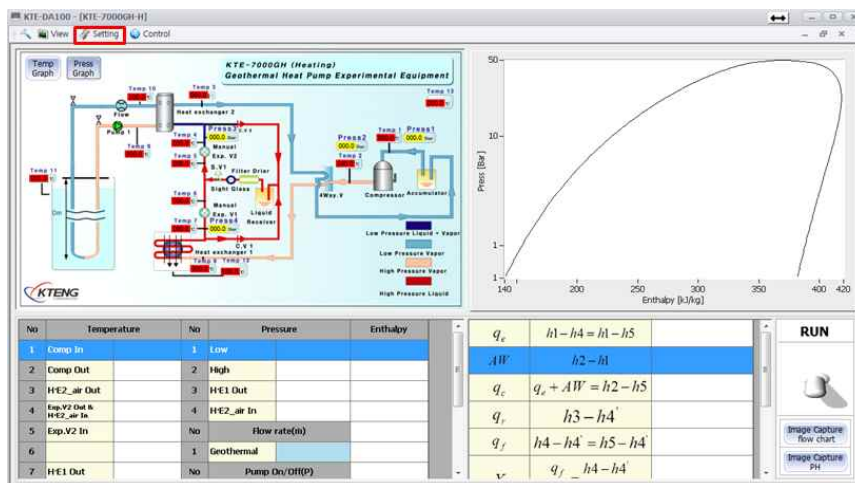
(1)Click Setting

(2) Click PH offset setting
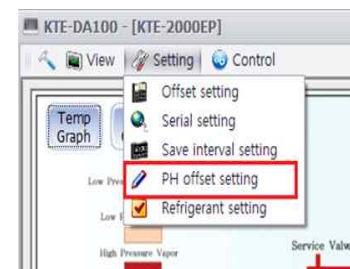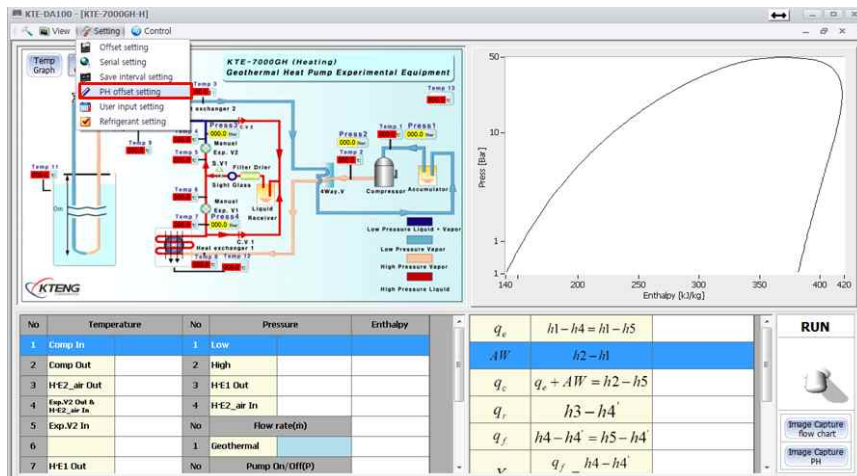
(3)On the main screen
 The PH seondopyo Press,
 The axis values of the Enthalpy
 Adjustment function

e) User Input setting
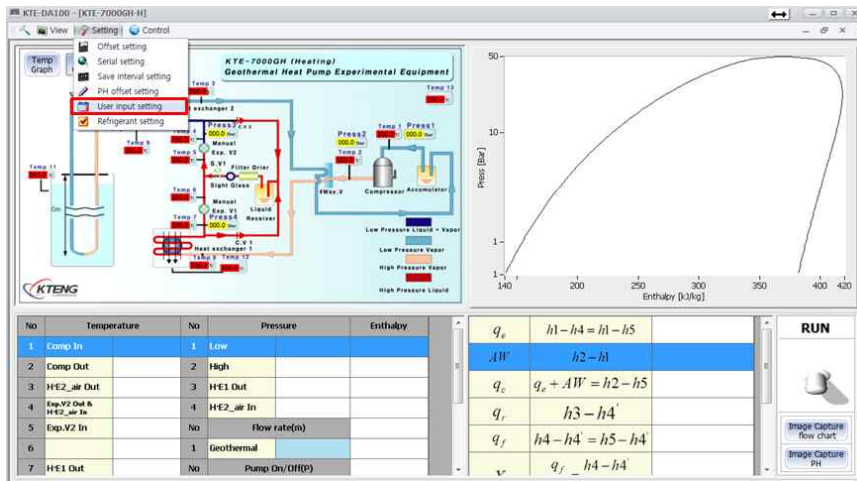
(1) User Input Setting click

(2) Check No.1 (Geotheraml) and No.2 (Liquid In ther Geo.loop) then the parameter input windows in data table are activated.

(3) Parameter input window in data table.

>Unit: Geothermal(g/s), Specific capacity (J/K·℃)

>Value
Geothermal: refer to flow meter
Cp: 4.2 J/K·℃ (atmosphere)

f) Refrigerant setting
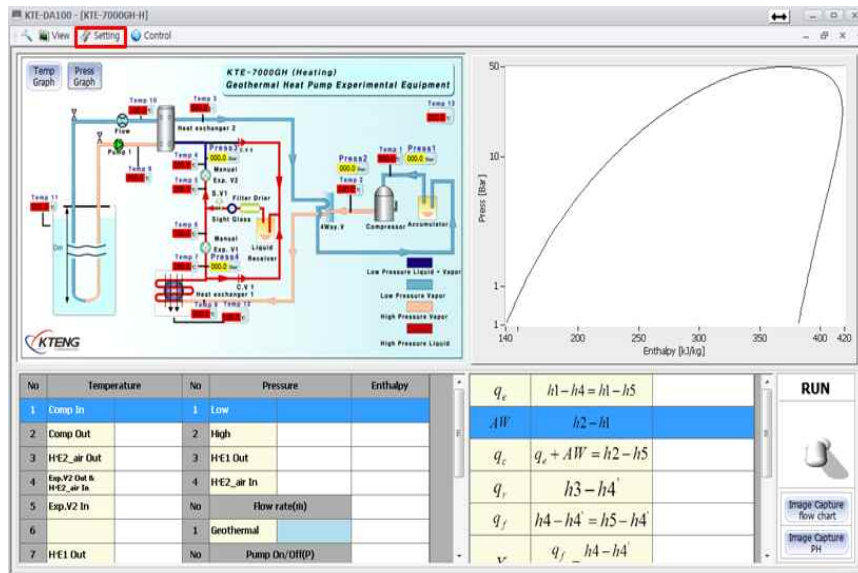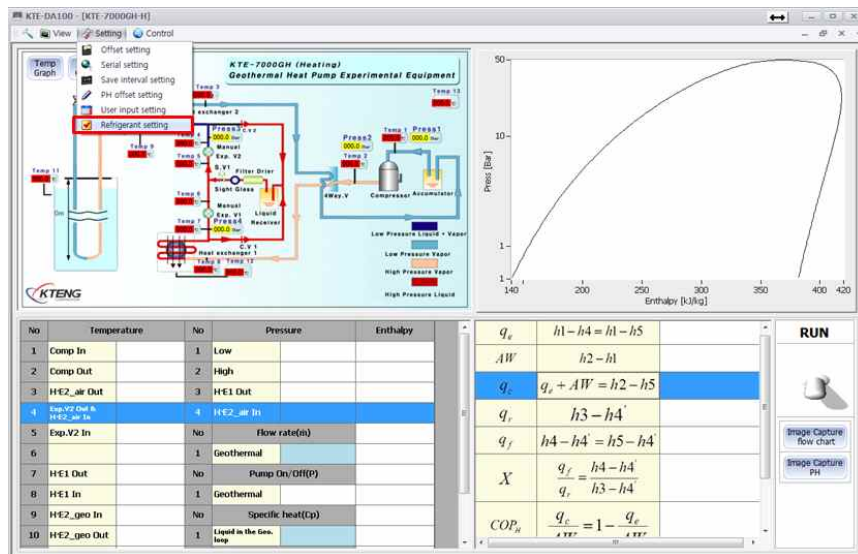
(1)Click Setting

(2) Click Refrigerant setting
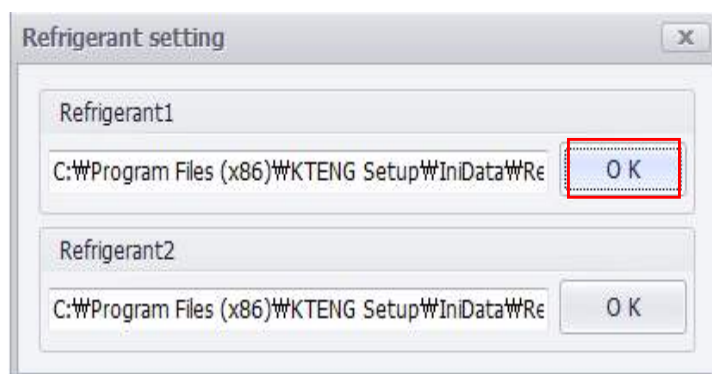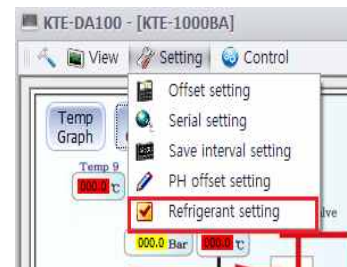
(3) Refrigerant setting
 Isafunctionfor selectingthe refrigerant-1won refrigeration cycle Refrigerant thousand -2won refrigeration cycle is selected for the selection of the Refrigerant 2Refrigerant1 and canbe appliedto the program. Click " OK "
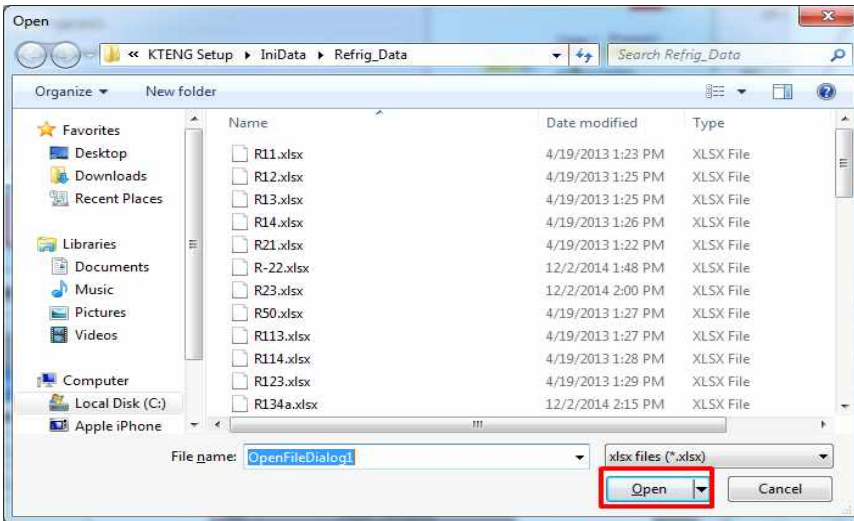
(4) Then refrigerant lists come up and choose refrigerant that is matched with system. And click the 'open' button then refrigeration properties apply to program.

iv) Control

a) PLC emulator
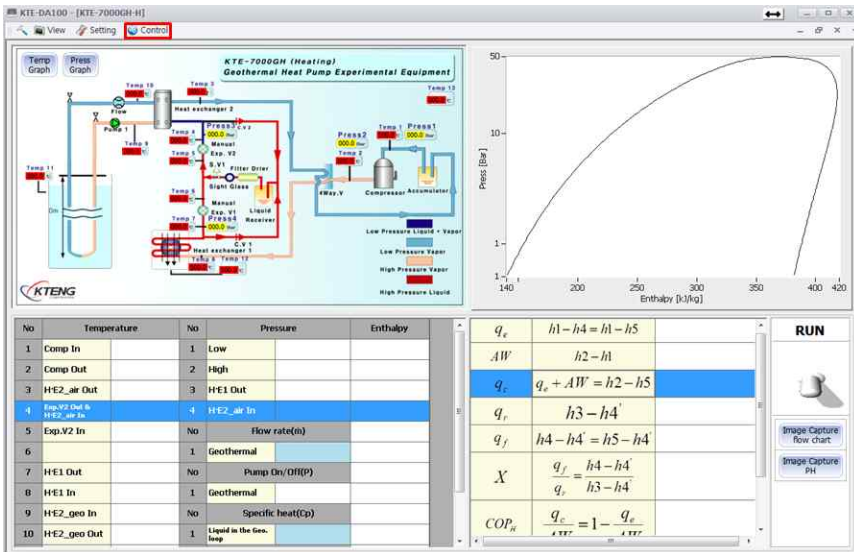
(1) Clock
Control in Tools
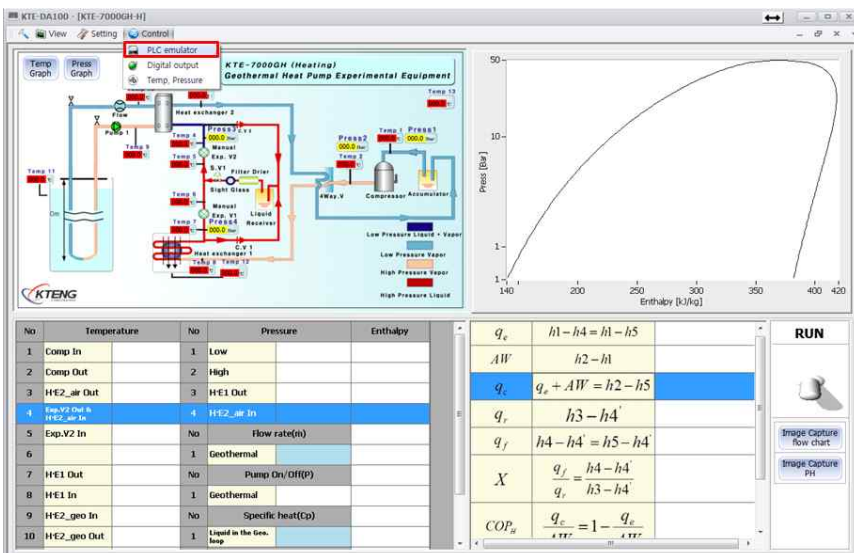
(2) Using PLC, The function for ON/OFF and control timer about all equipments.
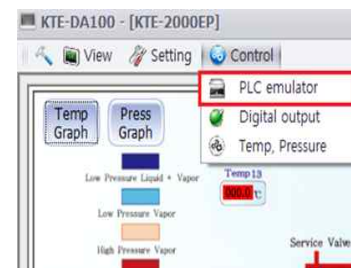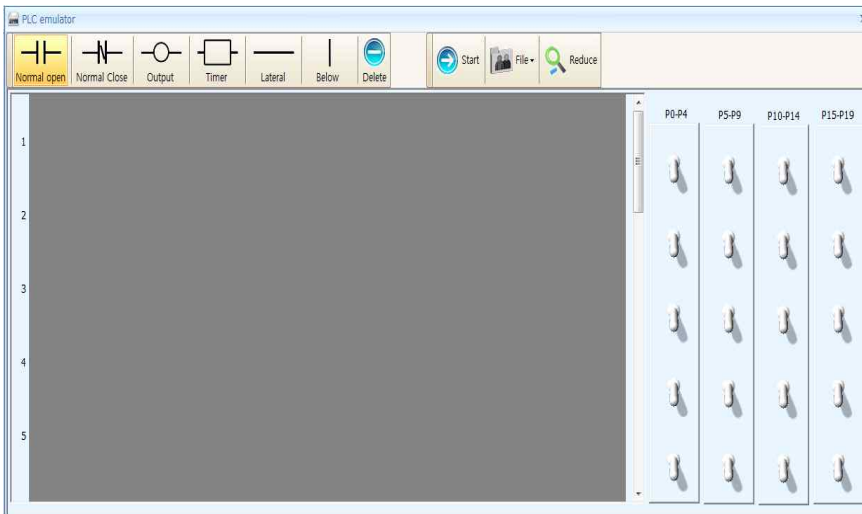
(3)When Click"PLC emulator"
Indicate the window such as left screen
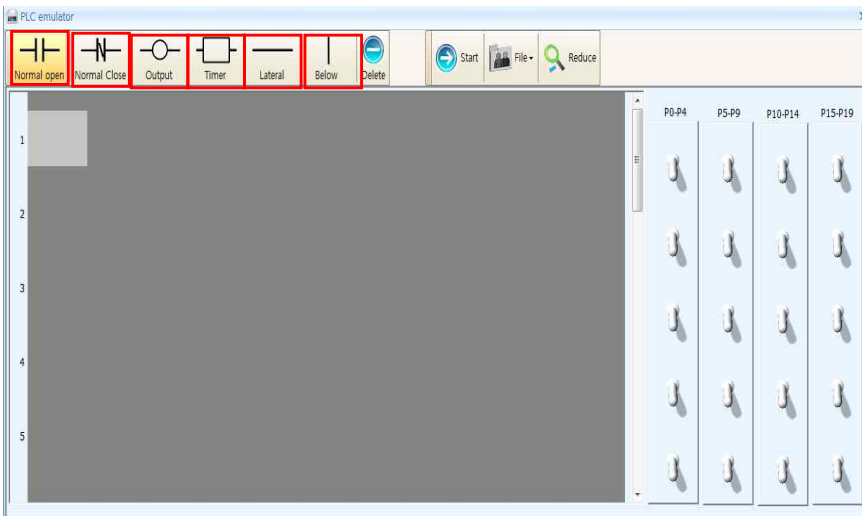
(4)Using method is that after selecting the zone first, programming with inputting command

Command	Explain
Normal open	Normal Open
Normal Close	Normal Close
Output	Coil(Load)
Timer	Timer
Lateral	Horizontal Extending Line
Below	Vertical Extending Line
Delete	Delete
Start	Start
File	Open Recent File
Reduce	Reduce Screen
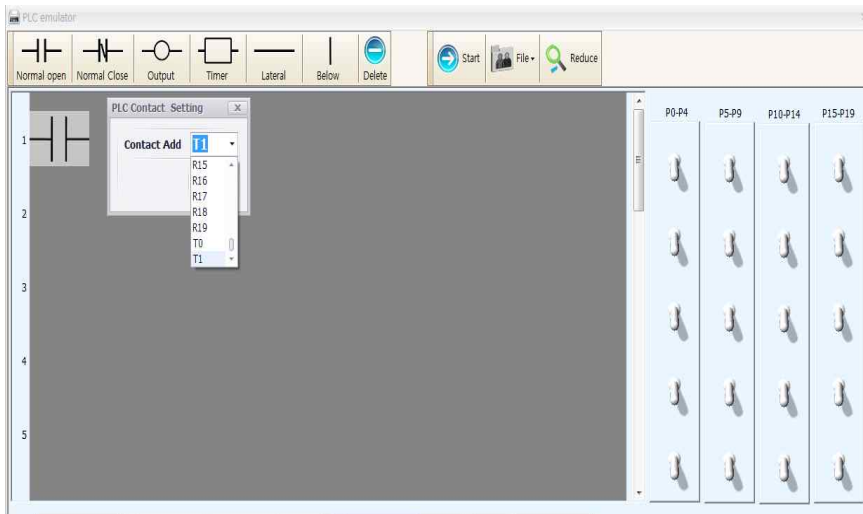
(5) Double click the marker then set P,R,T

P : Push

R : Relay

T : Timer
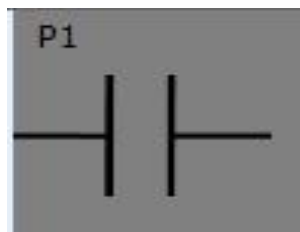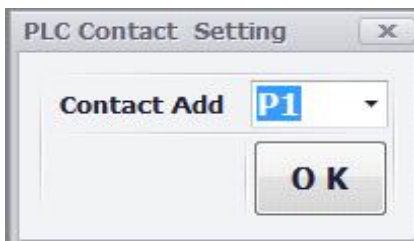
- Set P1 then Click"OK"

- Indicate P1 the top of the left side
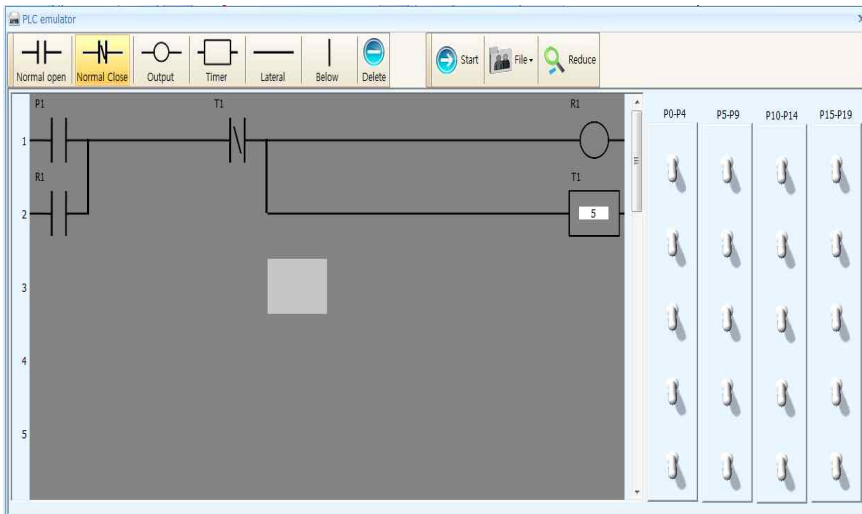
(6)It is example using command
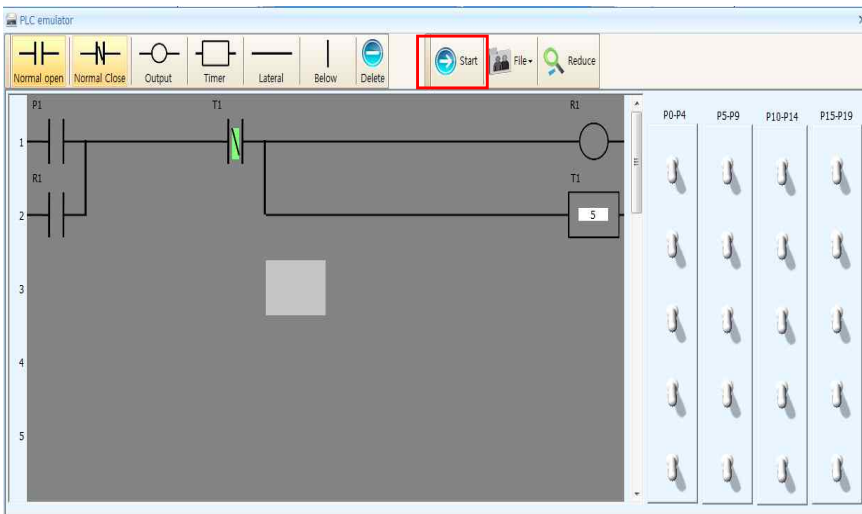
(7)Click Start then indicate mark which is T1-B
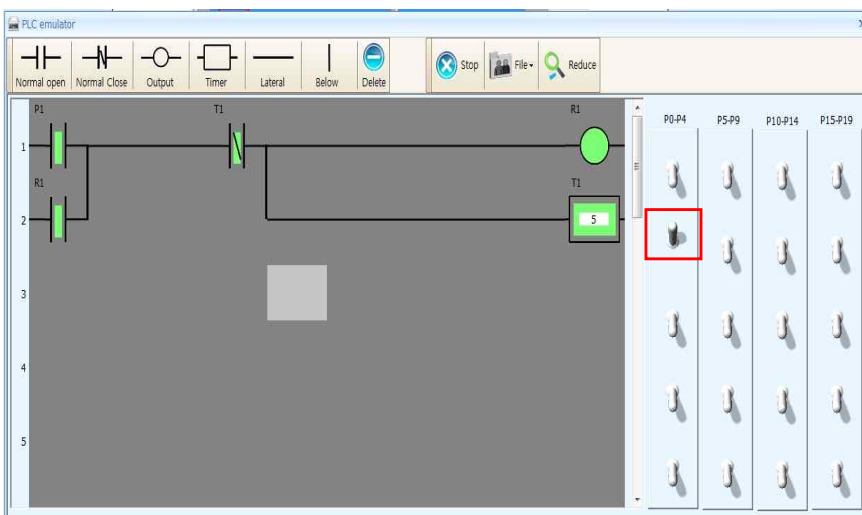
(8)Detach, press the P1.If R1 is a woman become a contact is closed, andt he self-maintenanceof R1 at the same time as the set time T1 is also a woman(Sec) after the b contact of T1Opensbeing supplied to R1

As Dunn power is cut off.Being returned to its original position
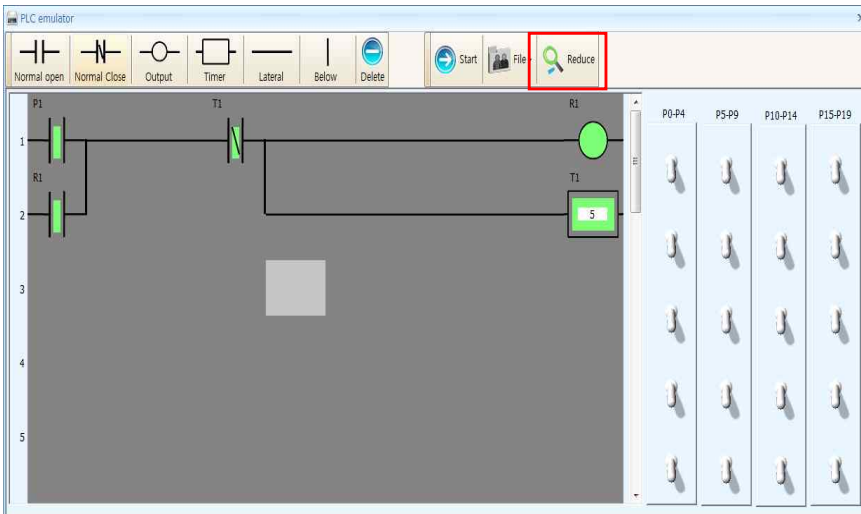
(9)Click Reduce

(10)When you click "Reduce", left screen is indicated.

Click view of PLC, it is returned

b) Digital output
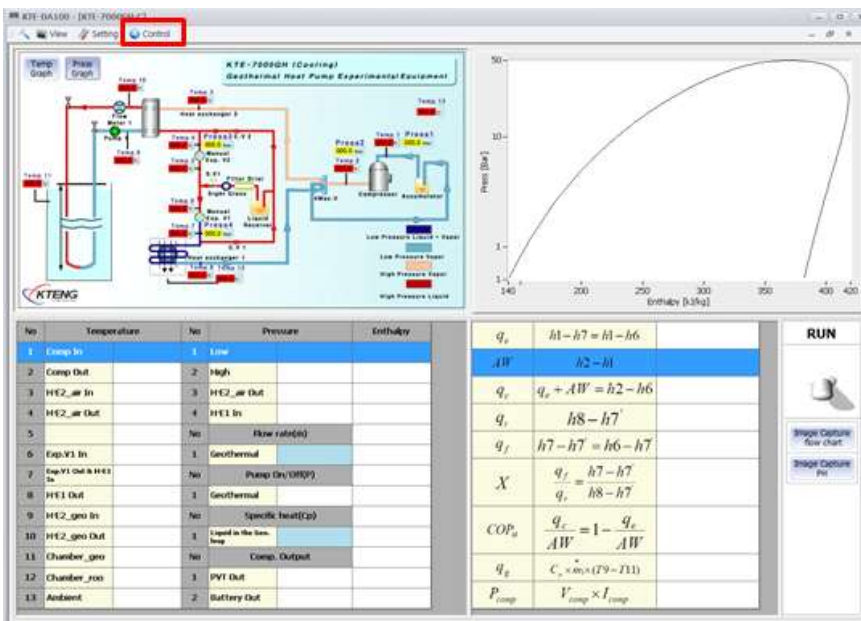
(1) Click

" Control " in Tools
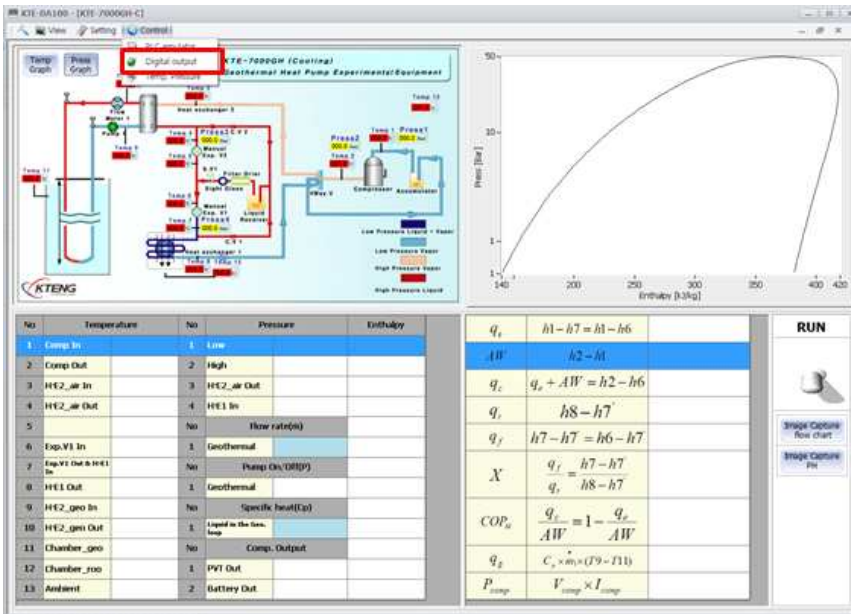
(2)Click"Digital output"
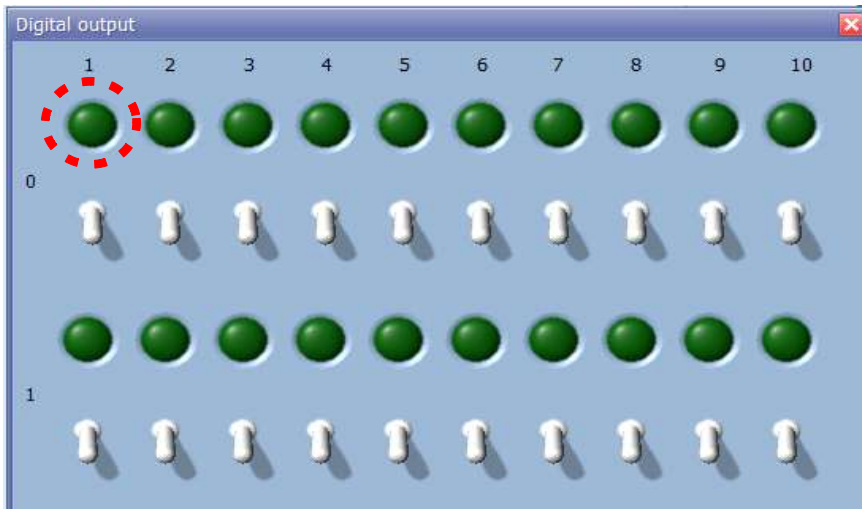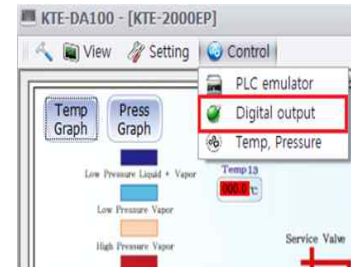
(3)Digital output is the second comp by number And to the switch ON / OFF When you work with equipment to operating the stand relay and the operation or without through the lamp Function to determine

(4) Green circle (comp) top numbers are located on the control panel comp 1 from above

c) Temp, Pressure
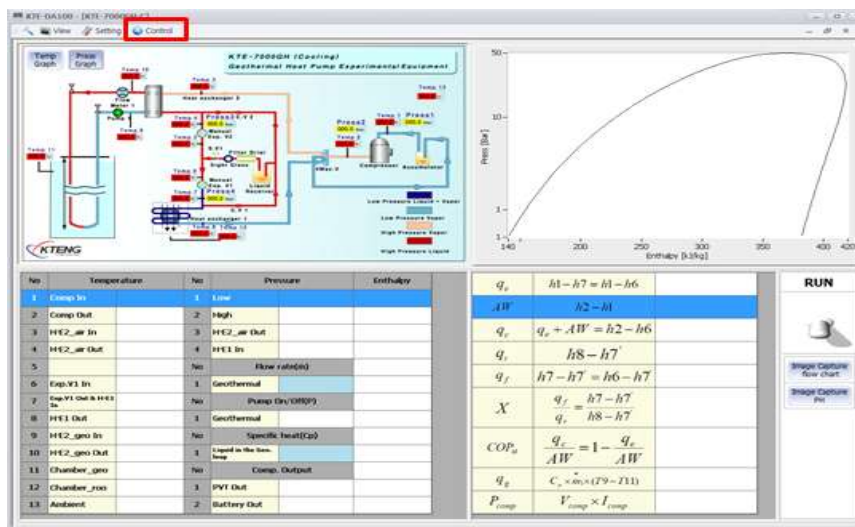
(1)Click "Control"
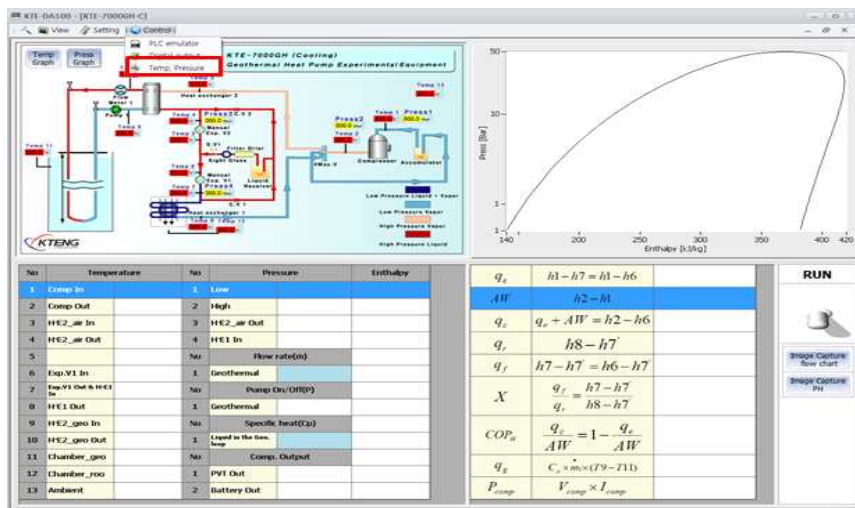
(2) Temp, Pressure has a function which is interlocked with temperature and pressure

When click"Temp, Pressure", indicate the window as below
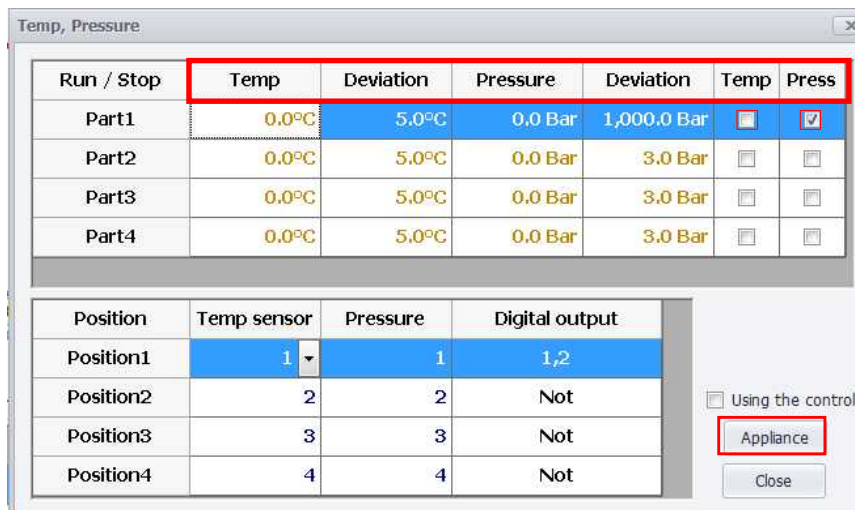
(3) Temp(settemperature), Deviation, Pressure(set pressure)

Deviation is indicated deviation and it can be saving the figure you want and it can choose both Temp and Pressure
Temp sensor : Selection for pressure sensor location
Digital output : Selection output port what you want to control
After setting, Click "Appliance" and "Close"

※ When ON condition, Step (3→4→5→1→2)
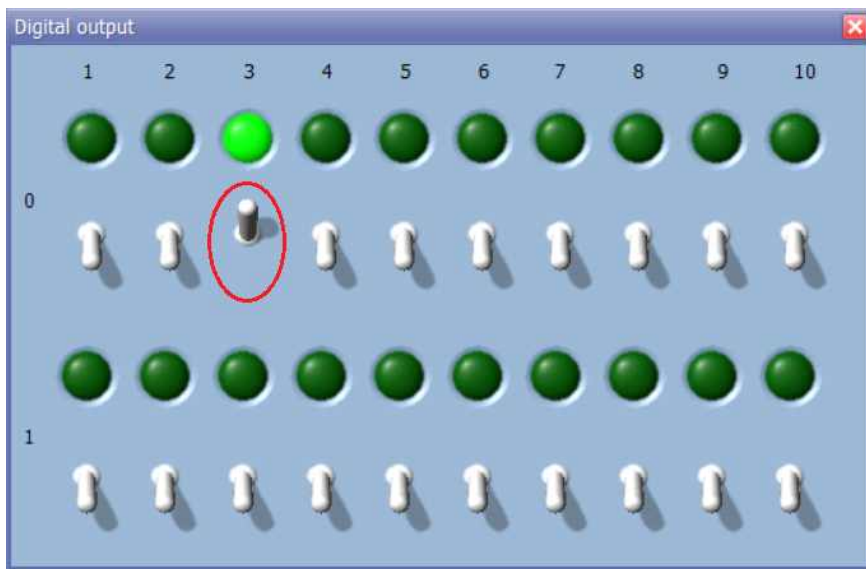
(7) Like left picture, Set 3(CFM) is On, Next operate 4(EFM), Next operate 5(SV), Next operate 1(COMP)
(The reason operating compressor lastly is when operating on no load conditon, there are effection which is big load in compressor)
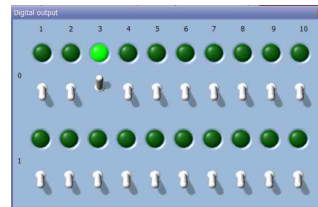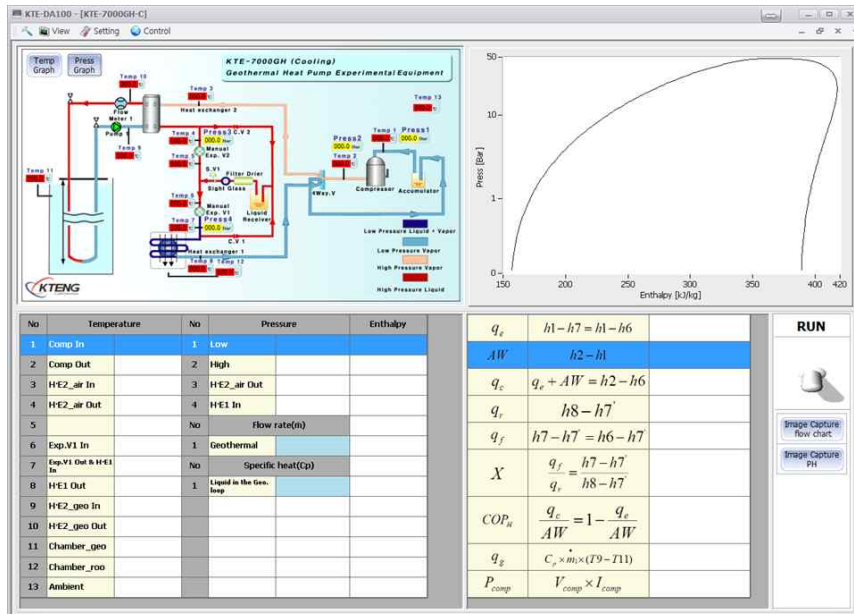
① Compressor ON
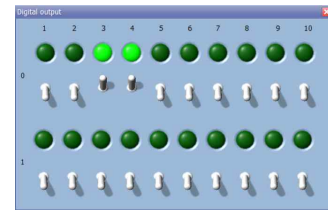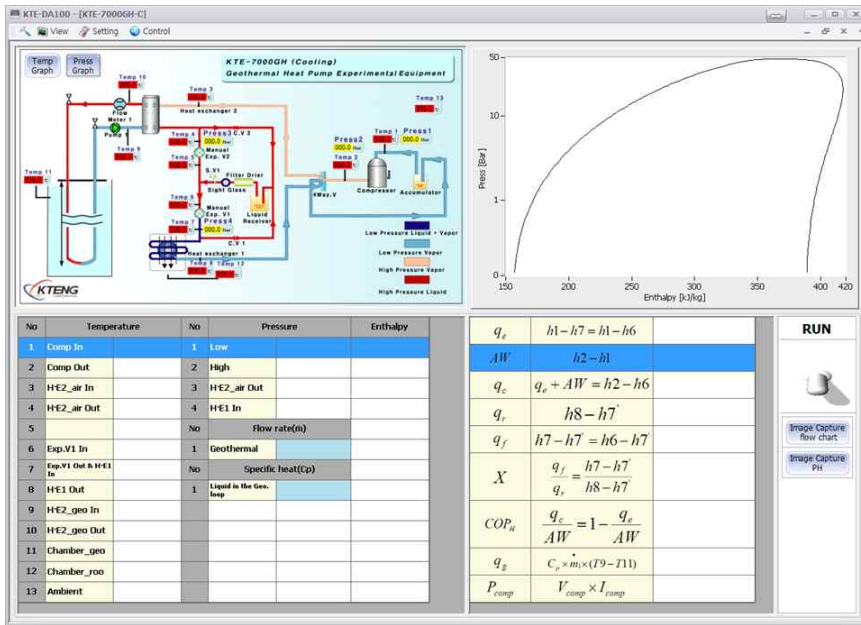
① Compressor ON
② Evaporator ON
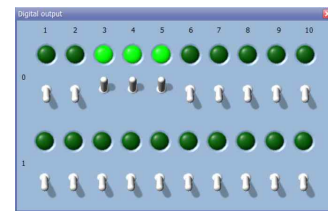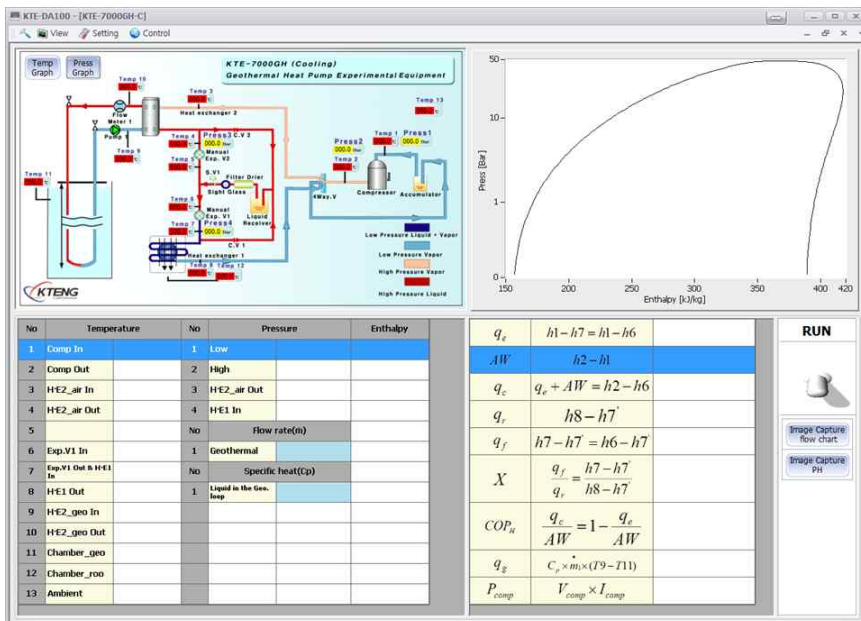
① Compressor ON
② Evaporator ON
③ S.V ON

4. Circuit Configuration on Geothermal Heat Pump Experimental Equipment

Experiment Description	Practice 1. Circuit configuration of reverse refrigeration flow direction in "Geothermal heat pump refrigeration system".	Class time (hr)
		8

Experiment Objectives	① To understand the principal of reverse refrigeration flow direction using 4-way valve. ② To know how to build the basic circuit configuration of the system ③ To understand the principal of cooling and heating operation of the system.

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire stripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage   SV : Solenoid valve

N.F.B : Nofuse circuit breaker   4way valve : Reversing valve

HE1 : 1 Heat Exchanger Fan Motor   TS : Toggle witch

COMP : Compressor

1. Configure circuit

 (1) Geothermal environmental chamber temperature set up.

 (2) Configure circuit using banana jacks

 (3) When N.F.B is on, Toggle switch is OFF(Toggle switch ON is Heating)

 (4) Pump On of control panel of Geothermal environmental chamber

Schematic diagram of heat pump system cycle
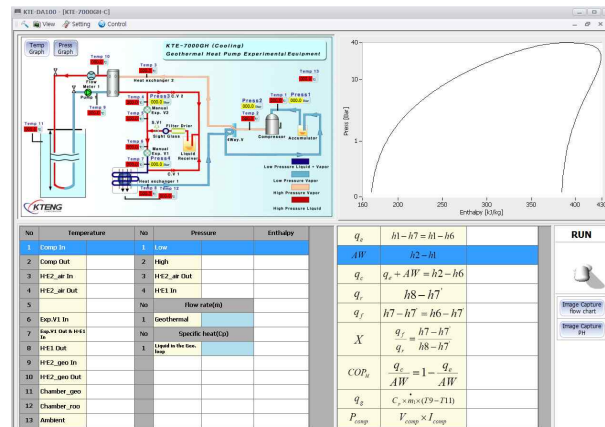
Cooling mode cycle
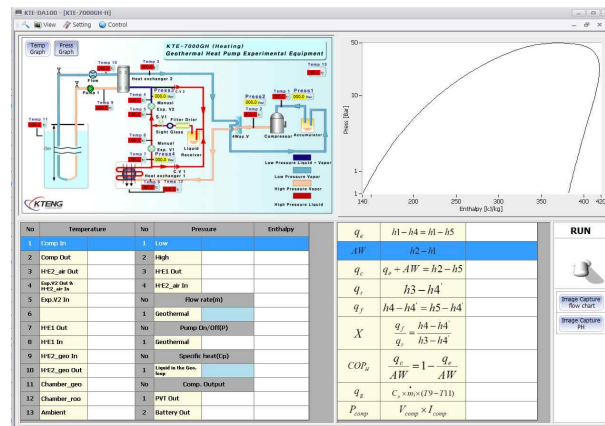
Heating mode cycle

COMP : Compressure

HE1 : Heat Exchanger1 (Fan type 1)

HE2 : Heat Exchanger2 (Plate type 2)

S.V : Solenoid Valve

4-Way.V : 4-Way Reversing Valve
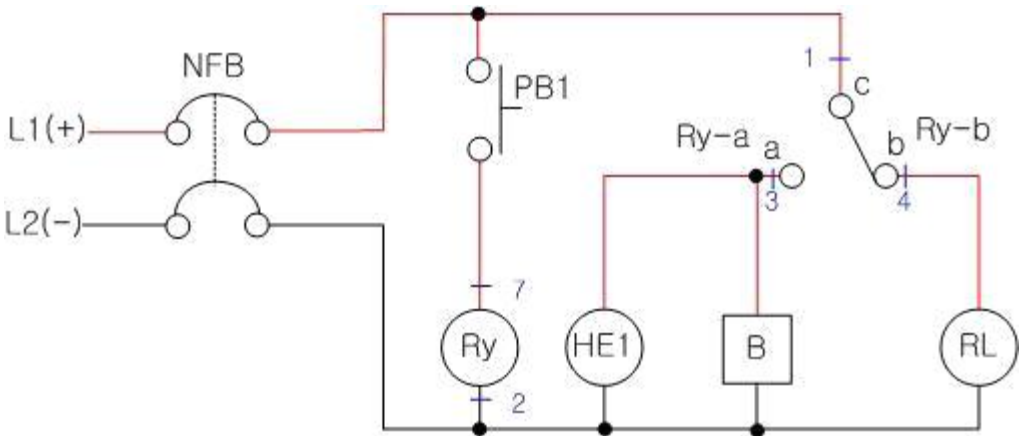
Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment and check electric state and refrigerant charging state.

2. Understand the function of operating circuit.

  (1) Able to explain the progress that refrigerator starts when NFB is on.

  (2) Able to explain the principal of heating cycle comparing with cooling cycle when TS (Toggle switch) reverses.

3. Understand the function of 4-way reverse valve.

4. Able to construct the circuit configuration using banana jack cables on the experiment equipments

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	**I Experiment (50 Points)**	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes Points ( )			**I**	**II**	**III**	**Total**

Experiment Description	Practice 2. Circuit configuration using contact point "c" of toggle switch and Ry device.	Class time (hr)
		8

Experiment Objectives	① To know how to construct circuit by using relay and toggle switch ② To understand the working principal of relay and toggle switch ③ To descript about configuration circuit using contact point "c" of Ry

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire stripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage   PB : Push button

N.F.B : No fuse circuit breaker   B : Buzzer

HE1 : Heat Exchanger 1 Fan Motor   Ry : Relay

RL : Red Lamp

1. Configure circuit

(1) N.F.B switch power on

(2) Configure circuit using banana jacks

(3) When N.F.B is on, HC2 and RL are ON because contactor RY-b is closed, and for contactor RY-a is open, HE1 and Buzzer are OFF. (Under PB1 is open)

(4) When PB1 is pushed, current flows on Relay coil at the same time contactor RY-a is closed, so HE1 and Buzzer are ON, RL is OFF

Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Configure circuit using banana jack cables and operating.

3. Understand the composition and theory of operation of Relay.

   (1) Contactor "a" means working contact (normal open connection), initial a from "arbeit" contact

   (2) Contactor "b" means breaking contact (normal closed connection), initial b from "breaking" contact.

4. Understanding the function of operating circuit.

   (1) Able to explain the running process when PB is pushed.

   (2) Able to explain the running process when PB is released.

5. Describing contact "c" of refrigeration circuit.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	**I Experiment (50 Points)**	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes			**I**	**II**	**III**	**Total**
		Points ( )						

Experiment Description	Practice 3. Circuit configuration by applying a and b contacts of magnetic contactor(MC).	Class time (hr)
		8

Experiment Objectives	① To know how to buid circuit configuration using magnetic contactor (MC) ② To understand the working principal of MC ③ Able to descript about circuit configuration using a and b contact of MC

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire stripper · Hook meter	· #2×6×175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage
N.F.B : No fuse circuit breaker
HE1 : 1 Heat Exchanger Fan Motor
B : Buzzer
MC-a : MC (normal open) "a" contact

MC-b : MC (normal closed) "b"contact
PB : Push button
RL : Red Lamp
MC : Magnet contactor coil

1. Configure circuit
   (1) When N.F.B is on, HC2 and R.L are ON because contactor MC-b is closed, and for contactor MC-a is open, HC1 and Buzzer are OFF. (Under PB1 is open)
   (2) When PB1 is pushed, current flows on magnetic coil at the same time contactor MC-a is closed.
   (3) Contactor "a" means working contact, initial a from "arbeit" contact
   (4) Contactor "b" means breaking contact, initial b from "breaking" contact.

Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2 Practicing for more than 2 times with banana jacks cable using equipment, tools and materials.

3. Understanding construct and principal of MC.

4. Understanding the function of operating circuit.

  (1) Able to explain the running process when PB is pushed.

  (2) Able to explain the running process when PB is released.

5. Describing contact "a" and contact "b" of refrigeration circuit

6. Configure circuit using banana jack cable and operating.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	I Experiment (50 Points)	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes Points ( )			I	II	III	Total

Experiment Description	Practice 4. Circuit configuration by applying time switch	Class Time (hr)
		8

Experiment Objectives	① To understand the working principle of timer in the equipment ② To know how to construct a circuit configuration using contact point "c" of timer

Experiment equipments	Tool and material	Spec. of tool	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire stripper · Hook meter	· #2×6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage   T_b : Timer "b"contact

NFB : No Fuse circuit breaker   TS : Toggle S/W

24h : Timer   SV : Solenoid valve

COMP : Compressor Motor   4way valve : Reversing valve

HE1 : 1 Heat Exchanger Fan Motor

1. Circuit configuration

   (1) When NFB is on, DC 24V Power, and timer is set ON, T_b is closed, COMP, HE1 and SV is operated, TS is OFF(Cooling), TS is ON(Heating)

   (2) When timer is set OFF, T_b is opened, COMP, HE1 and SV is stopped.

   (3) "NO"means is Normal Open, it is same"a"contact.

   (4) "NC"means is Normal Close, it is same"b"contact.
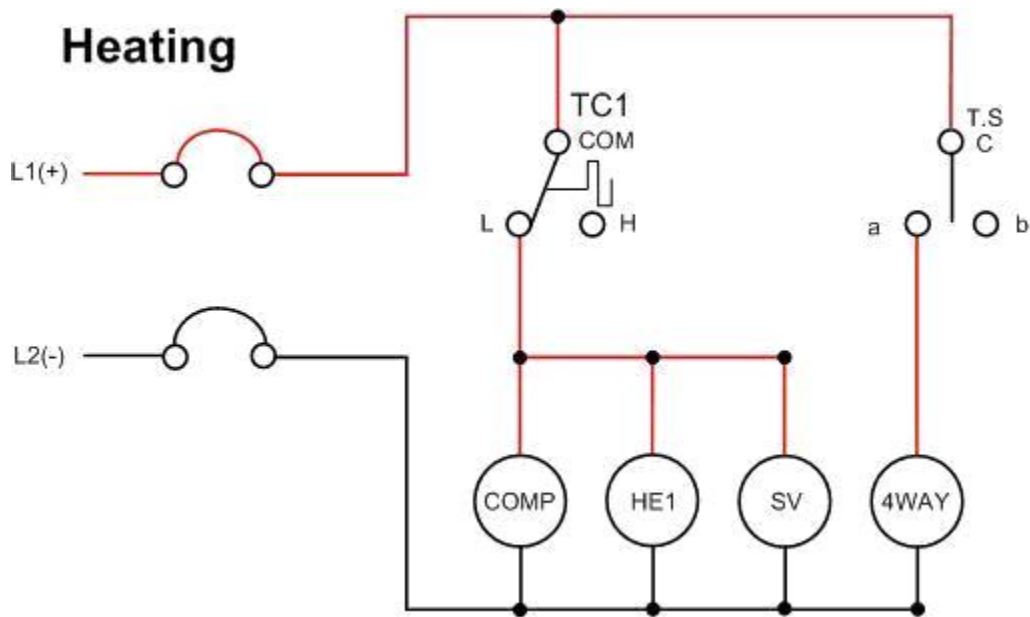
Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Build circuit configuration more than 2 times using banana jack cables and operating.

3. Understand the composition and theory of operation of Timer

4. Understand the function of operating circuit.

  (1) Able to explain the running process when timer is set to operate.

  (2) Able to explain the running process when timer is set stopping.

5. Describing "NC" contact and "NO" contact of refrigeration circuit.

6. Configure circuit using banana jacks and operating.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	I Experiment (50 Points)	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes Points ( )			I	II	III	Total

Experiment Description	Practice 5. Circuit configuration with temperature automatic control	Class time(hr)
		8

Experiment Objectives	① To know how to make circuit configuration by using temperature control switch on cooling and heating heat pump refrigeration system. ② To understand the use of temperature control switch and how to adjust it. ③ To understand the application of the circuit configuration with temperature control switch

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire Stripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage   HE1 : Heat Exchanger 1 fan type

NFB : No fuse circuit breaker   TS : Toggle switch

TC1 : Temperature automatic controller   SV : Solenoid valve

COMP : Compressor Motor   4WAY : 4 way valve

Cooling

1. Circuit configuration
  (1) NFB switch power on
  (2) Configure circuit using banana jacks
  (3) Temperature set up using the △, ▽ button of Temperature automatic controller
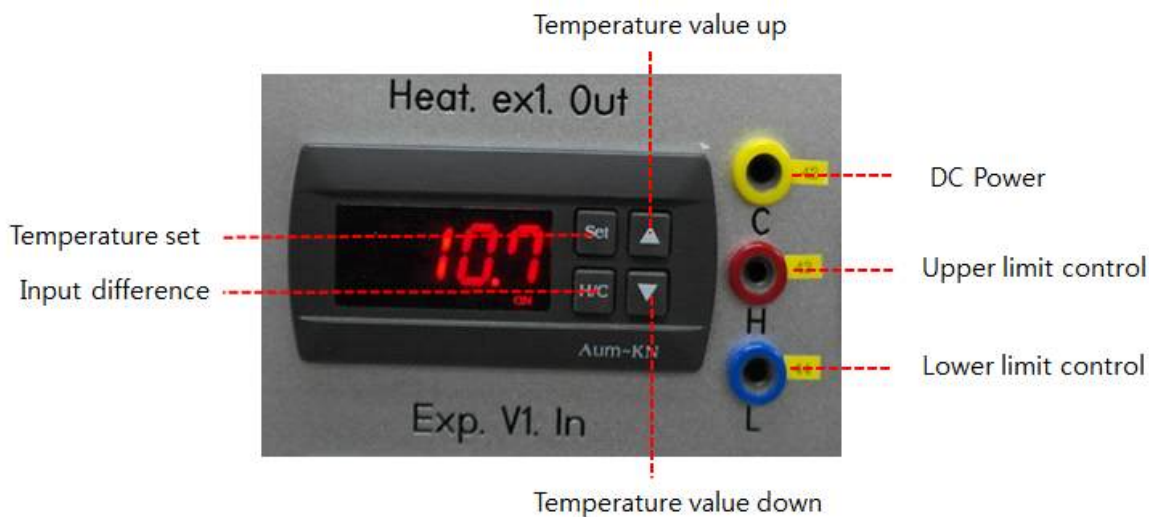
  (4) When temperature set up with toggle switch ON ("a" contact, heating), OFF ("b" contact, cooling), pump on of Geothermal environmental chamber.
  (5) When temperature is higher then setting temperature in Cooling mode: COMP, HE1 and SV are operating, When temperature is lower then setting temperature in Heating mode: COMP, HE1 and SV are operating.

Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Build circuit configuration using banana jacks and operate.

3. Understand the composition and operation of circuit configuration with temperature automatic controller.

  (1) Able to explain the running process with setting temperature when Temperature automatic controller is operating.

  (2) Able to explain the process when TS is switched to heating operation during the system running.

  (3) Able to explain the process when TS is switched to cooling operation during the system running.

4. Able to construct the circuit configuration using banana jacks in other equipment.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	I Experiment (50 Points)	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes			I	II	III	Total
		Points ( )						

Experiment Description	Practice 6. Circuit configuration by applying low pressure control switch (LPS).	Class time(hr)
		8

Experiment Objectives	① To understand function and how to use low pressure control switch (LPS) ② To understand the construction of circuit configuration with LPS and toggle switch and its application in geothermal heat pump experiment equipment (KTE-7000GH)

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire stripper · Hook meter	· #2× 6 × 175mm · 150mm · 0.5~6mm^2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage

N.F.B : No fuse circuit breaker

LPS : Low pressure S/W

COMP : Compressor motor

HE1 : Heat Exchanger 1 fan tyoe

TS : Toggle switch

SV : Solenoid valve

1. Circuit configuration

　(1) NFB switch power on

　(2) Construct the configuration circuit using banana jack cables

　(3) Set the pressure by turning the Low-pressure adjustment screw and set the pressure deviation.
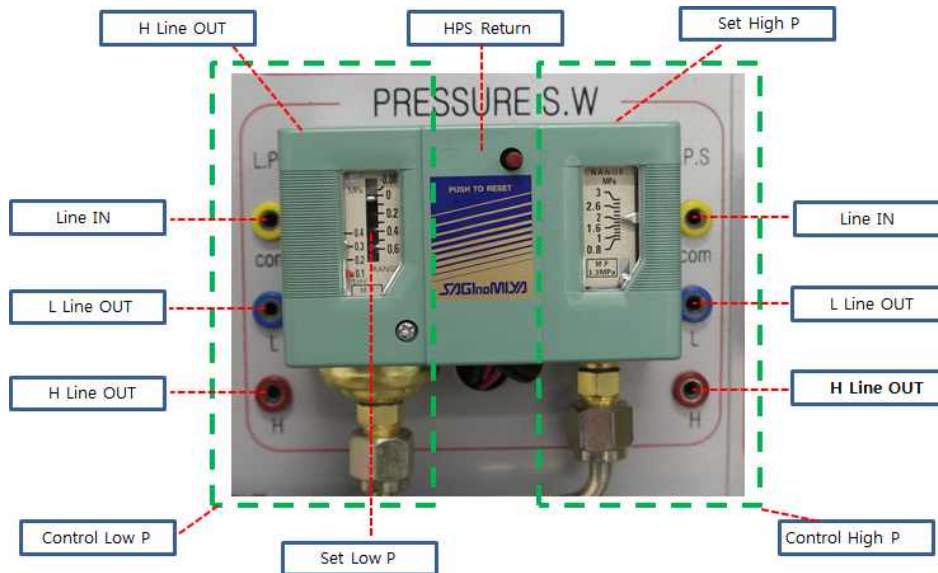
　(4) Set toggle switch ON("a" contact, heating) or OFF("b" contact, cooling), then pump on of geothermal environmental chamber.

　(5) When the input pressure of the compressor is lower than the setting of low-pressure, heat pump is stop working, When the input pressure of the compressor is higher than the setting low-pressure, COMP, HE1 and SV is operated.

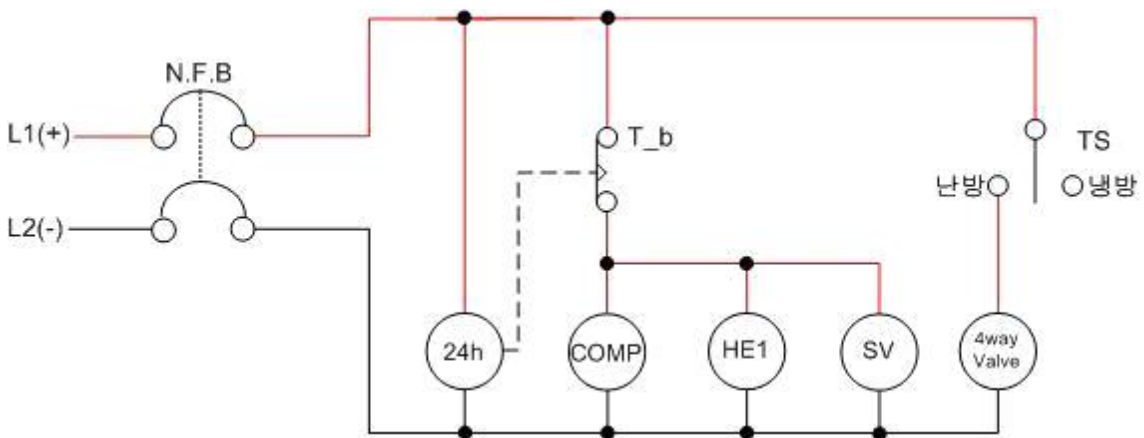　(6) The change of inlet pressure of compressor is visible when adjusting the load of HE1

Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Build circuit configuration using banana jacks and operate it.

3. Understand the circuit configuration process by applying LPS

   (1) Able to explain how to set the pressure and deviation of the low-pressure switch

   (2) Able to explain the running process with heating cycle when TS (Toggle Switch) reverses.

   (3) Able to explain the running process with cooling cycle when TS(Toggle Switch) reverses.

   (4) Able to explain the running process with load of HE1.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	**I** **Experiment** **(50 Points)**	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II **Analysis** **(30 Points)**	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III **Presentation** **(20 points)**	Time ( ) minutes Points ( )			**I**	**II**	**III**	**Total**

Experiment Description	Practice 7. Self-holding STOP priority circuit configuration for 4-way valve heat pump experimental equipment	Class Time (hr)
		8

Experiment Objectives	① To be able to construct and operate a self-holding circuit configuration on geothermal heat pump cooling and heating refrigeration experimental equipment ② To understand the working principle of self-holding circuit and it application in 4-way reverse heat pump experimental equipment.

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire Stripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

<div align="center">Control Circuit</div>

L1, L2 : Voltage line   PB : Push button

NFB : No fuse circuit breaker   COMP : Compressor motor

MC : Magnet contactor   HE1 : Heat Exchanger 1 fan type

MC-a : MC "a" contact (normal open)   4Way : 4 way V/V

TS : Toggle switch

1. Circuit configuration

(1) NFB switch power on

(2) Construct the circuit configuration using banana jack cable.

(3) Refrigerator and heater of geothermal environmental chamber is operating when the main power of geothermal control panel is turned on. When circulation pump is on whether using horizontal or vertical heat exchanger oscillation pipe, flowmeter shows the flow rate of working water.

Control panel of geothermal department

(4) Set the heating mode or cooling mode using the toggle switch ON ("a" contact, heating), OFF ("b" contact, cooling)

(5) Power lamp is indicating when the power is on.

(6) When we push the PB1 button of control panel, MC is magnetized, MC_a contact is closed and the system is operating.

※ Caution

There is a danger of damage, when reverse the toggle switch (change the cooling or heating mode) during operating equipment. After stopping the operating of refrigerator reverse the toggle switch.

Geothermal heat pump experimental equipment
(KTE-7000GH)

1) Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Build the circuit configuration using banana jack cables.

3. Able to describe the behavior of the circuit configuration

   (1) Able to describe the process when NFB is switched on

   (2) Able to describe the process behavior when PB1 is pushed

   (3) Able to describe the process behavior when PB2 is pushed

   (4) Able to understand the priciple of first stop self holding circuit configuration

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	**I Experiment (50 Points)**	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes Points ( )			**I**	**II**	**III**	**Total**

Experiment Description	Practice 8. Manual control circuit configuration on "cooling and heating system"	Class time(hr)
		8

Experiment Objectives	① To understand the 4 way reversing valve motion of manual operation of circuit configuration for "cooling and heating heat pump refrigeration system". ② To build self holding circuit configuration on "cooling and heating heat pump refrigeration system using 4-ways reversing valve.

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire Stripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage

N.F.B : No fuse circuit breaker

MC-a : MC "a" contact

HE1 : Heat Exchanger 1 fan type

COMP : Compressor Motor

SV : Solenoid valve

YL : Yellow Lamp

Ry-a : Relay"a"contact

Ry-b : Relay"b"contact

Ry : Relay Coil

PB : Push button switch

TS : Toggle switch

4way valve : reversing valve

MC : Magnetic Contactor

1. Circuit configuration

(1) NFB switch power on

(2) Construct the circuit configuration using banana jack cable.

(3) Refrigerator and heater of geothermal environmental chamber is operating when the main power of geothermal control panel is turned on. When circulation pump is on whether using horizontal or vertical heat exchanger oscillation pipe, flowmeter shows the flow rate of working water.

Control panel of geothermal department

(4) Set the heating mode or cooling mode using the toggle switch ON ("a" contact, heating), OFF ("b" contact, cooling)

(5) When the main power is turned on, Yellow lamp is on.

(6) When PB1 is pushed, refrigeration system is working and Yellow lamp will be off.

(7) When PB2 is pushed, refrigeration system is not working and Yellow lamp will be on.

※ Caution

There is a danger of damage, when reverse the toggle switch(change the cooling or heating mode) during operating equipment. After stopping the operating of refrigerator reverse the toggle switch.
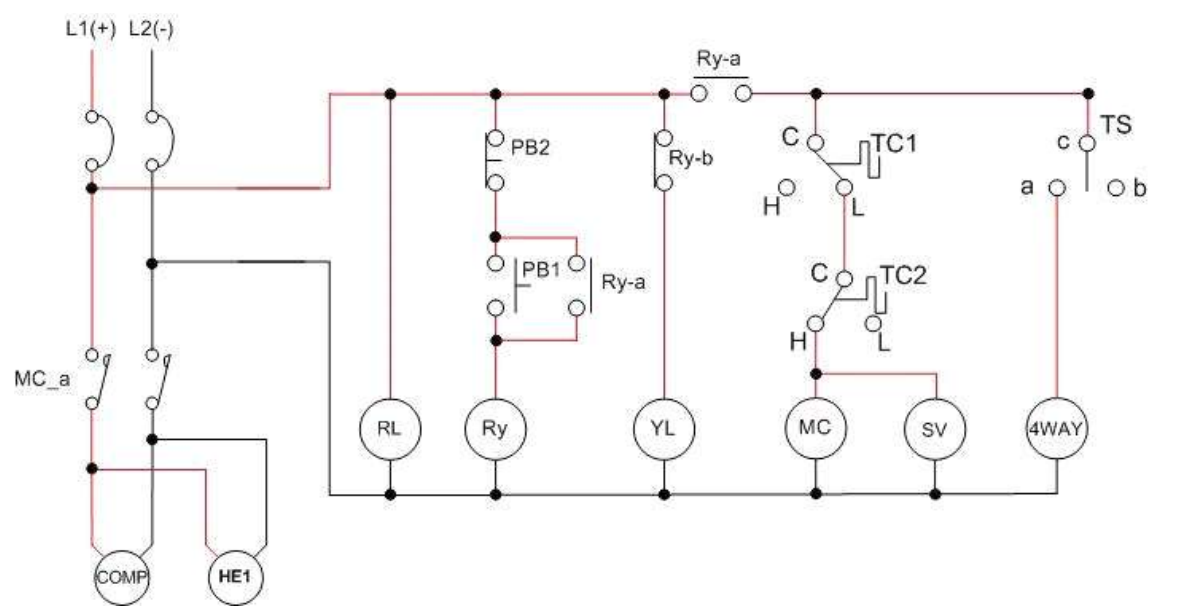
Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Build the circuit configuration using banana jacks and operate it.

3. Able to understand the function of operating circuit.

  (1) Able to explain the process when PB1 is pushed.

  (2) Able to explain the process of cooling mode when reversing the TS

  (3) Able to explain the process of heating mode when reversing the TS

  (4) Able to explain the process when PB2 is pushed.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	**I Experiment (50 Points)**	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes			**I**	**II**	**III**	**Total**
		Points ( )						

Experiment Description	Practice 9. Circuit configuration with temperature automatic control on "cooling and heating heat pump refrigeration system"	Class time(hr)
		8

Experiment Objectives	① To understand the role of temperature automatic control circuit on "cooling and heating heat pump refrigeration system". ② To know how to build temperature automatic control circuit configuration for heating and cooling on heat pump refrigeration system using 4-ways reversing valve".

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire stripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage
N.F.B : No fuse circuit breaker
MC-a : MC "a" contact (normal open)
Ry-a : Relay"a"contact (normal open)
Ry-b : Relay"b"contact (normal closed)
HE1 : Heat Exchanger 1 fan type

PB : Push Button
TC : Temperature switch
RL : Red Lamp
SV : Solenoid valve
Ry : Relay

YL : Yellow Lamp
TS : Toggle switch
4way valve : reversing valve
COMP : Compressor Motor
MC : Magnetic Contactor

1. Circuit configuration

(1) NFB switch power on

(2) Construct the circuit configuration using banana jack cable.

(3) Refrigerator and heater of geothermal environmental chamber is operating when the main power of geothermal control panel is turned on. When circulation pump is on whether using horizontal or vertical heat exchanger oscillation pipe, flowmeter shows the flow rate of working water.

Control panel of geothermal department

(4) Set the heating mode or cooling mode using the toggle switch ON("a" contact, heating), OFF("b" contact, cooling)

(5) When the main power is turned on, yellow and red lamps are on.

(6) Set the temperature of TC1 and TC2

(7) When the PB1 is pushed, refrigeration system is working while yellow lamp will be off.

(8) When the PB2 is pushed, refrigeration system is stop working and the yellow lamp will be on.

※ Caution

There is a danger of damage, when reverse the toggle switch (change the cooling or heating mode) during operating equipment. After stopping the operating of refrigerator reverse the toggle switch.
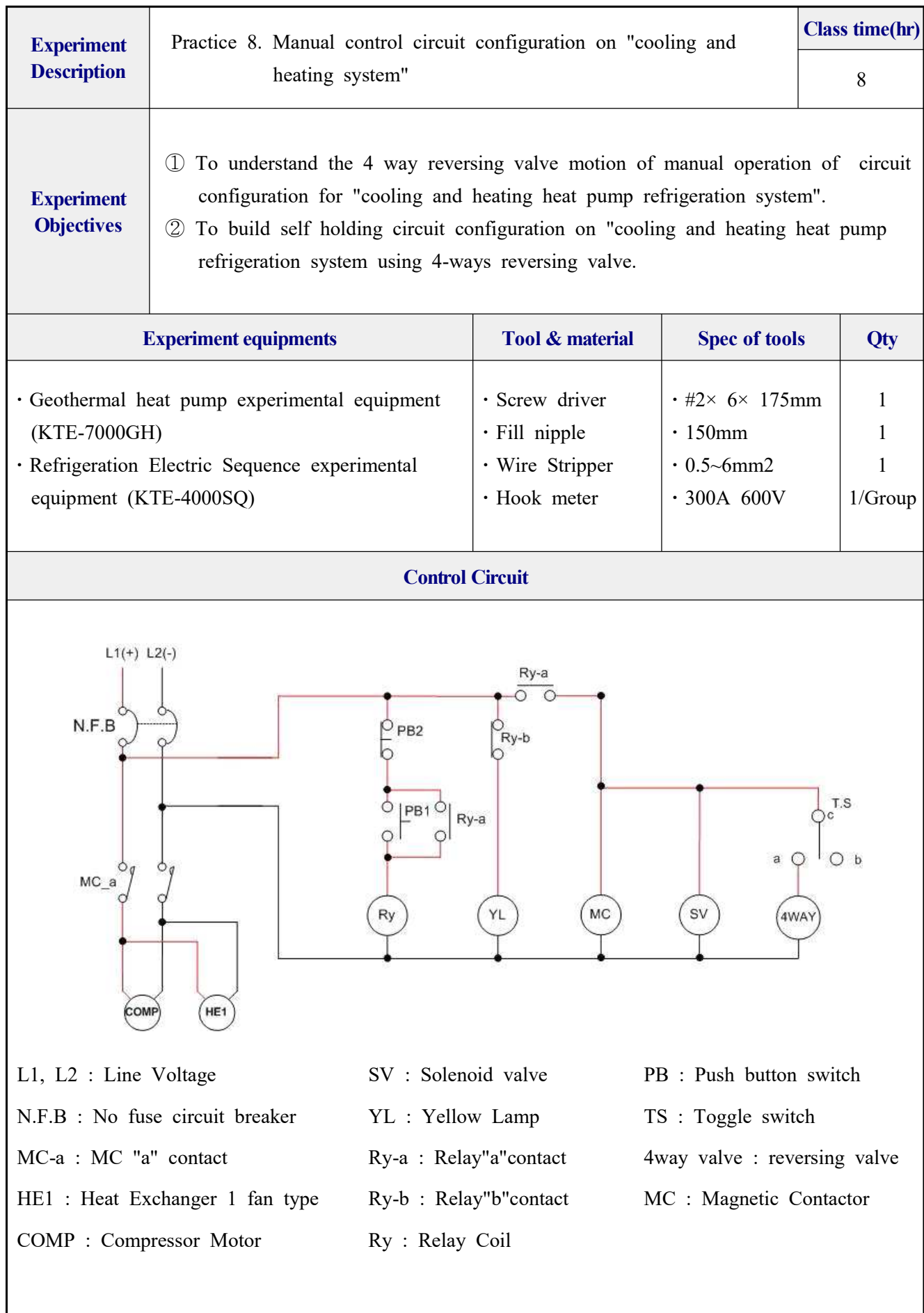
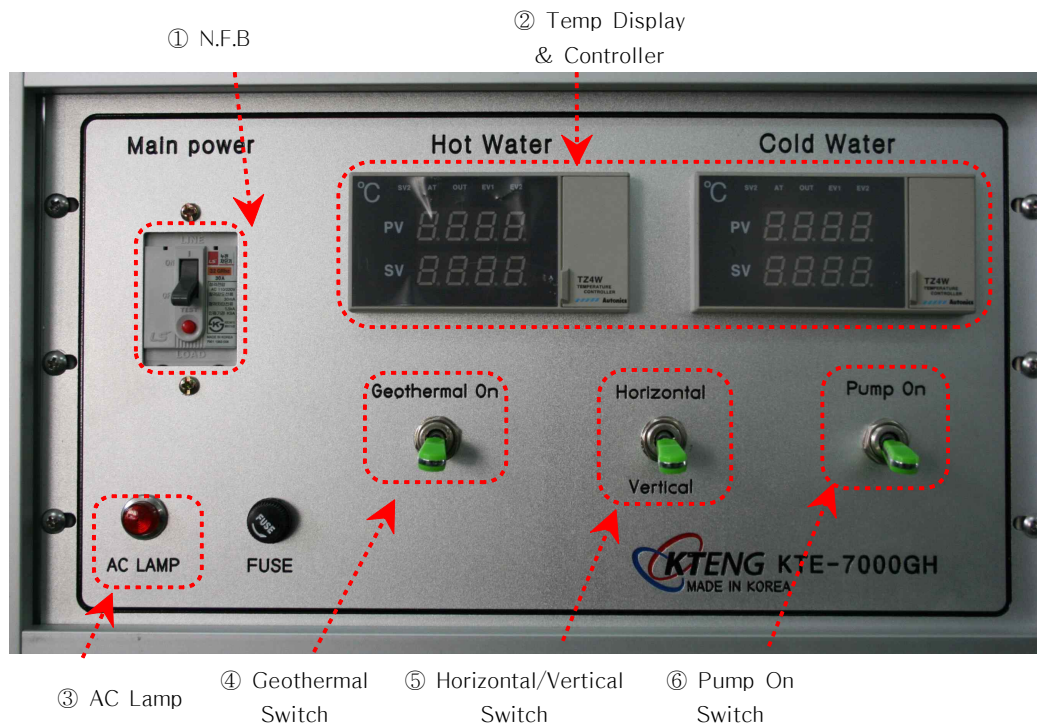Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Construct the circuit configuration using banana jack cables and operate it.

3. Understand the function of operating circuit.

  (1) Able to explain the process when PB1 is pushed.

  (2) Operating the system with setting temperature of TC1, TC2

  (3) Able to explain the process when temperature automatic controller is working in cooling mode.

  (4) Able to explain the process when temperature automatic controller is working in heating mode.

  (5) Able to explain the process when PB2 is pushed.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	**I Experiment (50 Points)**	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes			**I**	**II**	**III**	**Total**
		Points ( )						

Experiment Description	Practice 10. Circuit configuration with temperature and pressure automatic control on "cooling and heating heat pump refrigeration system"	Class time (hr)	
		8	

Experiment Objectives	① To understand the role principle of temperature and pressure automatic control circuit for "cooling and heating heat pump refrigeration system". ② To know how to build a temperature and pressure automatic control circuit on cooling and heating heat pump refrigeration system using 4-ways reversing valve".

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire Stripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage   PB : Push Button   COMP : Compressor

NFB : No fuse circuit breaker   YL : Yellow lamp   TS : Toggle switch

MC-a : MC "a" contact (normal open) LPS : Low Pressure switch   RL : Red Lamp

Ry-a : Relay"a"contact (normal open) 4way valve : reversing valve   SV : Solenoid valve

Ry-b : Relay"b"contact (normal closed TC : Temperature control switch Ry : Relay Coil

HE1 : Heat Exchanger 1 fan type   MC : Magnetic Contactor Coil

1. Circuit configuration

(1) NFB switch power on

(2) Construct the circuit configuration using banana jack cable.

(3) Refrigerator and heater of geothermal environmental chamber is operating when the main power of geothermal control panel is turned on. When circulation pump is "on" whether using horizontal or vertical heat exchanger oscillation pipe, flowmeter shows the flow rate of working water.

Control panel of geothermal department

(4) Set the heating mode or cooling mode using the toggle switch ON ("a" contact, heating), OFF ("b" contact, cooling) of control panel of mechanical part.

(5) When the main power is turned on, yellow and red lamps are on.

(6) Set the temperature of TC on the control panel of the heat pump division.

(7) Set the pressure and deviation of LPS of control panel of heat pump division

(8) When the PB1 is pushed, refrigeration system is working with self holding circuit and yellow lamp will be off.

(9) When the PB2 is puushed, refrigeration system is not working and yellow lamp will be on.

※ Caution

There is a danger of damage, when reverse the toggle switch(change the cooling or heating mode) during operating equipment. After stopping the operating of refrigerator reverse the toggle switch.기계장치부 제어판의 DC 24V Power ON시 RL

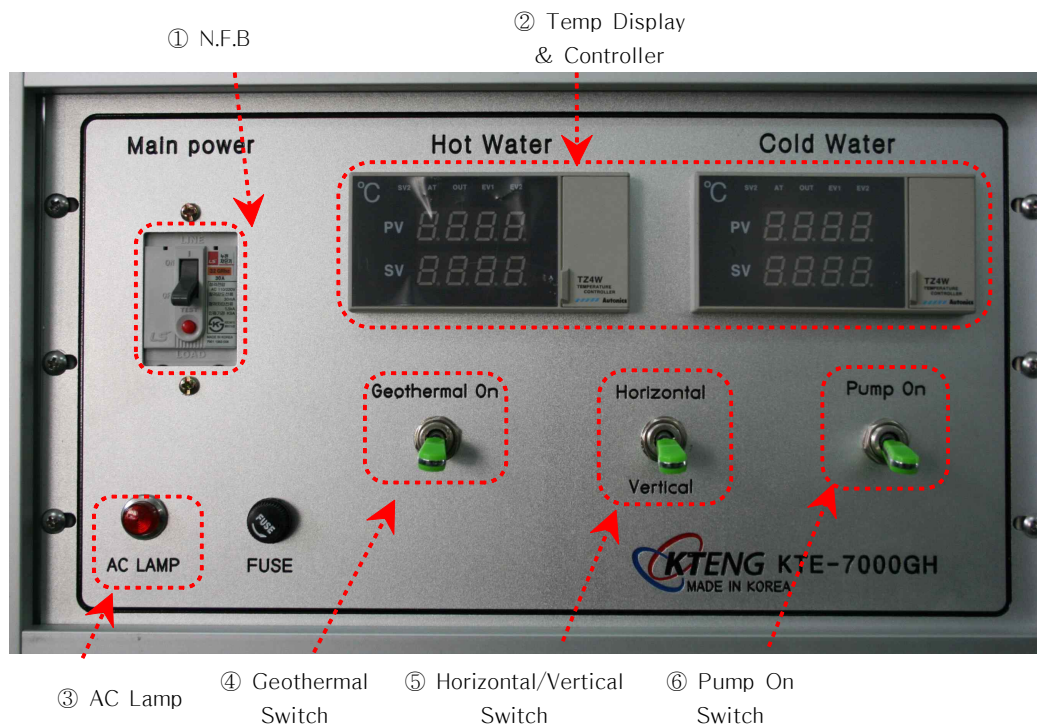Geothermal heat pump experimental equipment
(KTE-7000GH)

Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Construct the circuit configuration using banana jack cables and operate it.

3. Understanding the function of operating circuit.

  (1) Able to explian the process when PB1 is pushed.

  (2) Able to explain the process in cooling mode when TC and LPS are opened.

  (3) Able to explain the process in cooling mode when TC and LPS are closed.

  (4) Able to explain the process in heating mode when TC and LPS are opened.

  (5) ABle to explain the process in heating mode when TC and LPS are closed.

  (6) Able to explain the process when PB2 is pushed.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	I Experiment (50 Points)	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II Analysis (30 Points)	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III Presentation (20 points)	Time ( ) minutes			I	II	III	Total
		Points ( )						

Experiment Description	Practice 11. Pressure automatic control circuit configuration on geothermal cooling and heating experimental experiment	Class time (hr)
		8

Experiment Objectives	① To understand the principle of pressure automatic control operation on 4 way reversing valve cooling and heating experimental equipment. ② To understand how to build a pressure automatic control circuit configuration

Experiment equipments	Tool & material	Spec of tools	Qty
· Geothermal heat pump experimental equipment (KTE-7000GH) · Refrigeration Electric Sequence experimental equipment (KTE-4000SQ)	· Screw driver · Fill nipple · Wire tripper · Hook meter	· #2× 6× 175mm · 150mm · 0.5~6mm2 · 300A 600V	1 1 1 1/Group

Control Circuit

L1, L2 : Line Voltage

NFB : No fuse circuit breaker

MC-a : MC "a" contact (normal open)

Ry-a : Relay"a"contact (normal open)

Ry-b : Relay"b"contact (normal closed

SV : Solenoid valve

PB : Push Button

YL : Yellow lamp

RL : Red Lamp

COMP : Compressor

Ry : Relay Coil

TS : Toggle switch

LPS : Low Pressure switch

MC : Magnetic Contactor Coil

4way valve : reversing valve

HE1 : Heat Exchanger 1 fan type

TC : Temperature control switch

1. Circuit configuration

 (1) NFB switch power on

 (2) Construct the configuration circuit using banana jack cables

 (3) Set the pressure by turning the Low-pressure adjustment screw and set the pressure deviation.

Pressure switch

 (4) Set toggle switch ON ("a" contact, heating) or OFF ("b" contact, cooling), then pump of geothermal environmental chamber.

 (5) When the main power is turned on, yellow and red lamps are on.

 (6) Set the pressure and deviation of LPS and HPS of control panel of heat pump division

 (7) When the PB1 is pushed, refrigeration system is working with self holding circuit and yellow lamp will be off.

 (8) When the PB2 is puushed, refrigeration system is not working and yellow lamp will be on.

※ Caution

 When the input pressure of the compressor is lower than the setting of low-pressure, heat pump is stop working, When the input pressure of the compressor is higher than the setting low-pressure, COMP, HE1 and SV is operated.
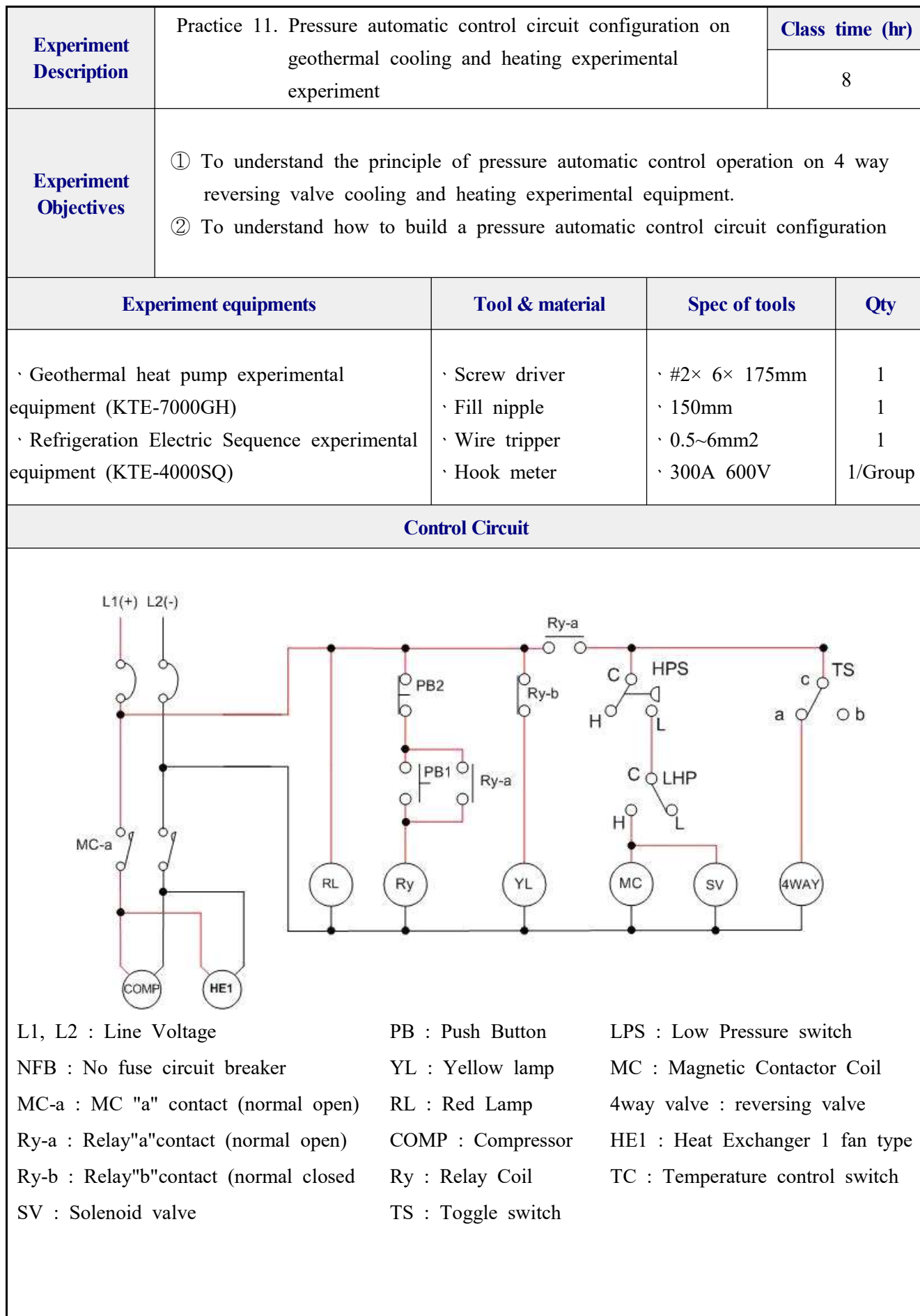
Geothermal heat pump experimental equipment
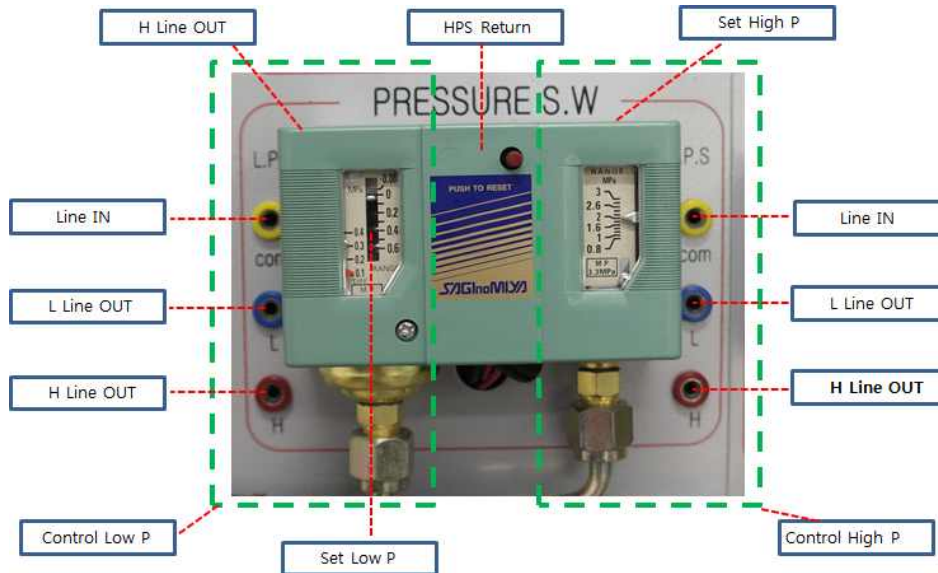(KTE-7000GH)

2) Requirement points

1. Preparation the experimental equipment, tools and material and checking of electric state and refrigerant charging state.

2. Construct the circuit configuration using banana jack cables and operate it.

3. Understanding the function of operating circuit.

(1) Able to explain the process when PB1 is pushed.

(2) Able to explain the process in cooling mode when LPS is opened.

(3) Able to explain the process in cooling mode when LPS is closed.

(4) Able to explain the process in heating mode when LPS is opened.

(5) ABle to explain the process in heating mode when LPS is closed.

(6) Able to explain the process when PB2 is pushed.

		Evaluation Items	Max. points	Score	Remarks			
Evaluation	**I** **Experiment** **(50 Points)**	Check the status of preparation and safety testing	10					
		Circuit configuration and operation	10					
		The understanding of experiment method	10					
		Report of experimental data and graph construction	20					
	II **Analysis** **(30 Points)**	The accuracy graph construction due to analysis	10					
		Discussion and conclusion of the experiment	20					
	III **Presentation** **(20 points)**	Time ( ) minutes			**I**	**II**	**III**	**Total**
		Points ( )						

5. Failure and Correction

5-1. When power is not connected

If there is no power even if NFB is switched on, we can check on the back side to make sure that power cable is connected as shown in the figure below,
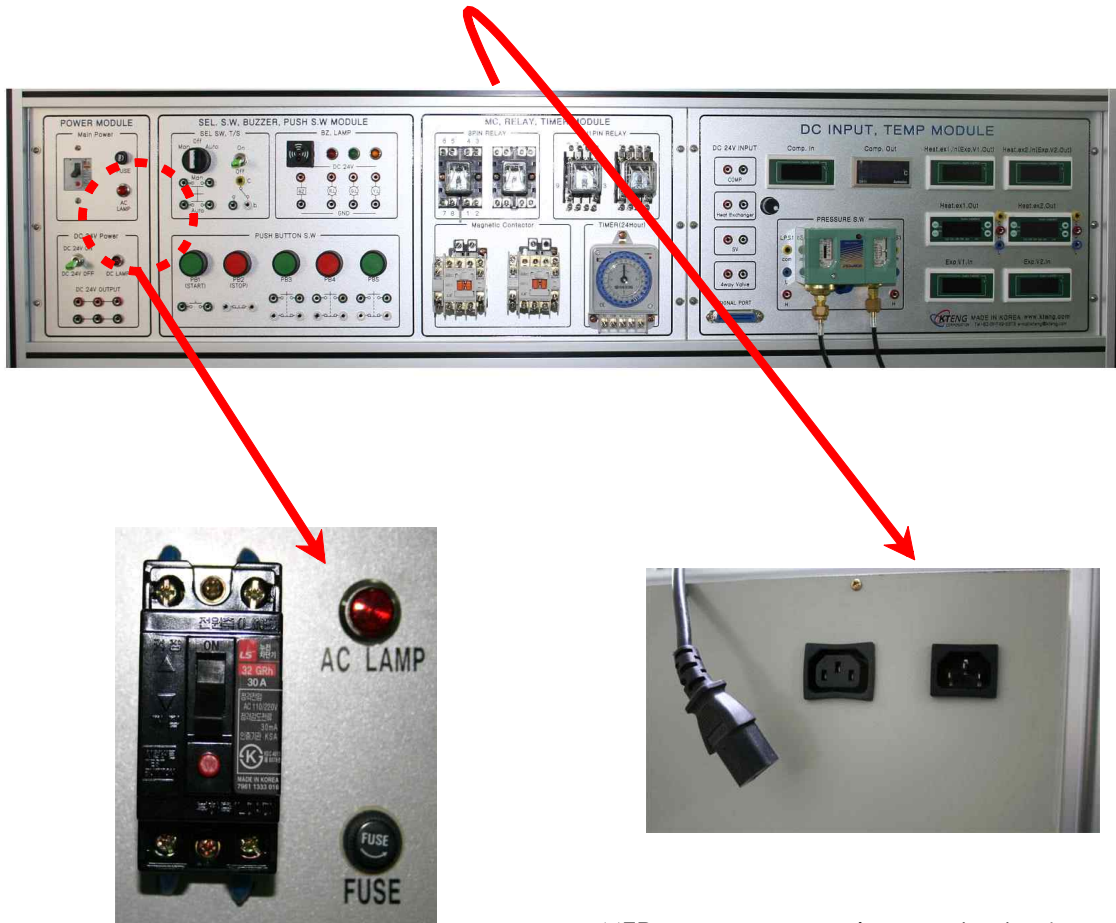
NFB power connection on the back panel

AC LAMP indicates power connection

① Make sure that power cord is plugged in already
② Power Cord is connected to power output

5-2. When temperature displays are off

※Temperature displays in OFF condition

Check the power cord installed on the back panel

Back panel of temperature displays

① Make sure that the power cord is plugged in.
② Power cord extension can be use to connect 2 panel

5-3. DA-100 access error

1) Error window

Access error may happen when follow p.41 to set a "User Input Setting".
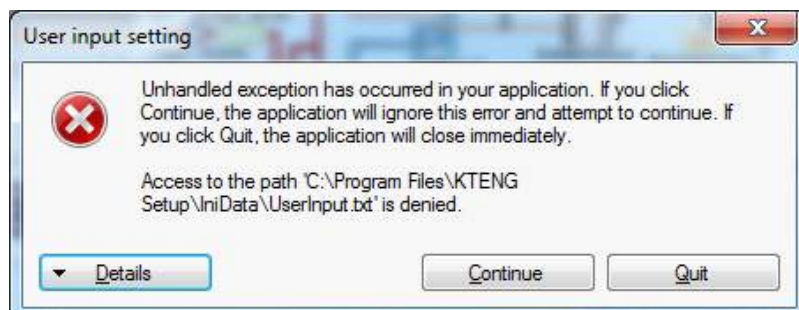
2) Solution

2-1) Open folder: Local Disk(C:)\Program files\KTENG Setup\IniData.

Right click the "UserInput" and click the "property"
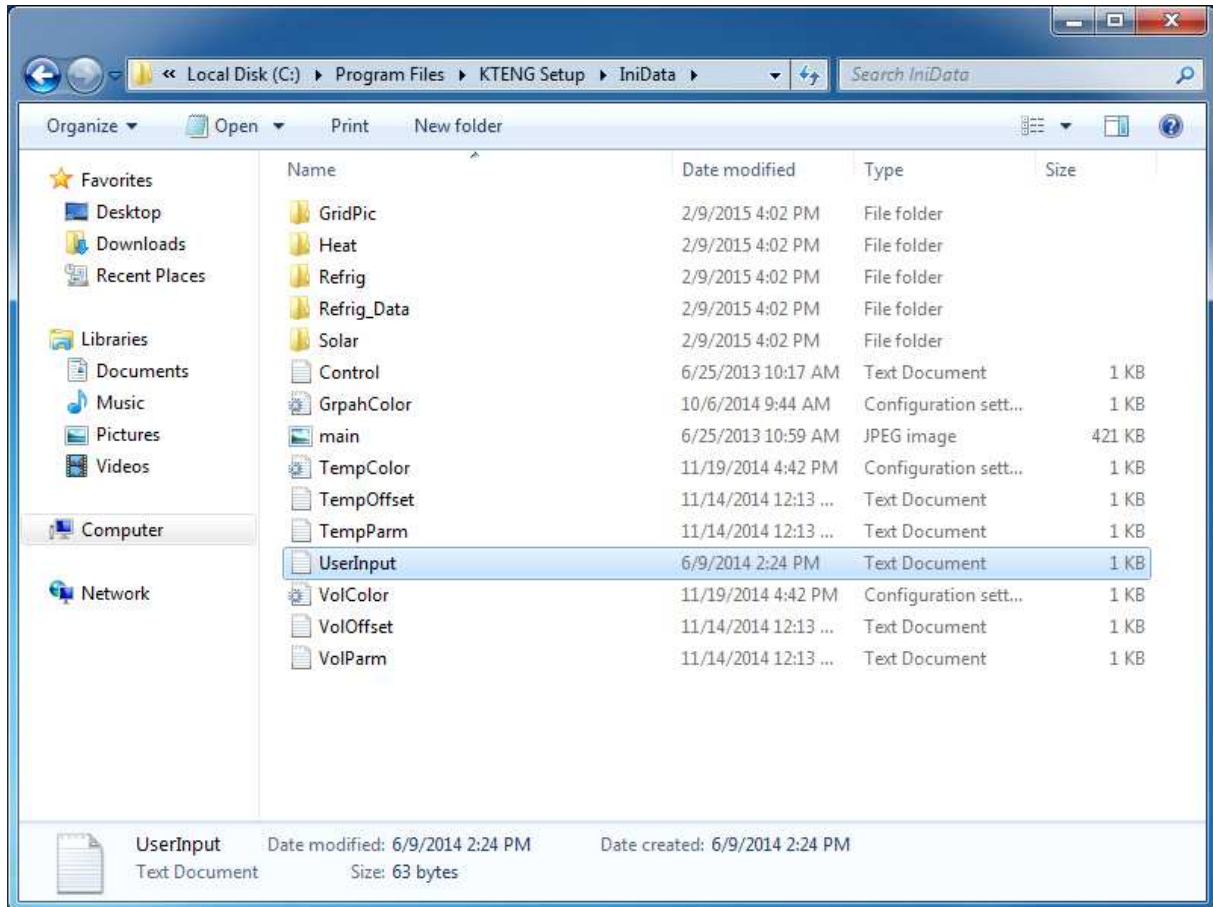
2-2) Click the "Security" and click the "Edit"
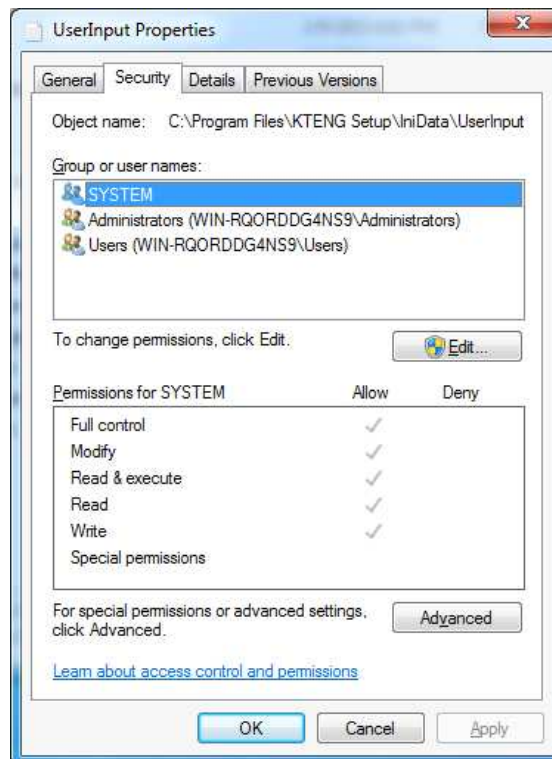
2-3) Click the "Users" in Group or users names. Click the "Full control" in Permissions for Users.

Click the "Apply" and "OK".
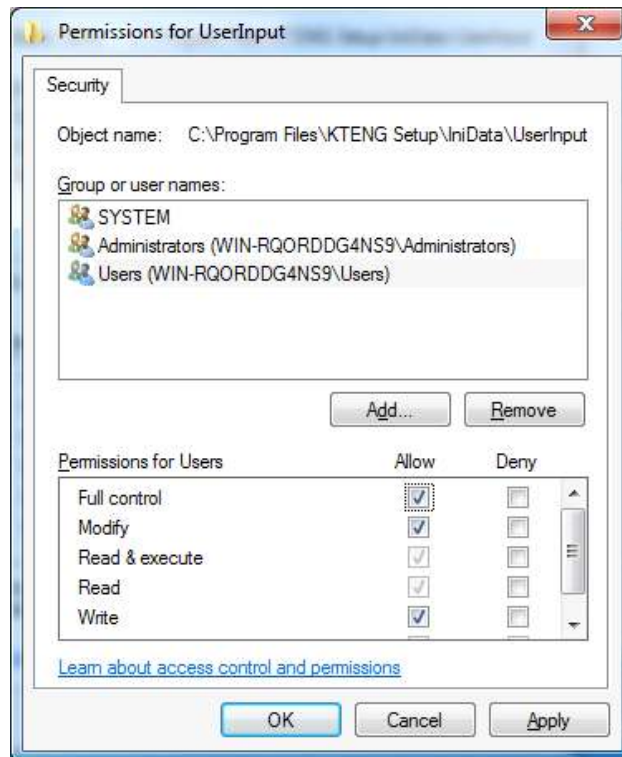
5-4. For complex failure

If there are other complex failures our after sales (A/S) service will help and processed quickly.

6. The Equipment Usage Notification

6-1. Power supply

(1) The experimental equipment uses main power of single phase and AC 220V

(2) Process sequence in the use of the equipment is plug in the power cord, construct circuit configuration with banana jack cables, switch ON the NFB and also DC 24 toggle switch.

(3) The control panel is designed for save utilization as it is in DC circuit, but please take attention with positive (+) and negative (-) currents to avoid short-circuit.

(4) Base of the control panel is made by aluminum therefore user need to avoid the banana jack tip from touching the base when its one end is connected to the positive (+) port and the NFB and DC toggle are switched ON.

6-2. Machine devices

(1) Refrigerant charging at low and high pressure side, it has to be careful to make perfectly installation of fill nipple and make sure that there is no leak.

(2) In case of manual expansion valve, we should understand how to operate it correctly

(3) Initial setting value of super heat and sub cooling 5±2℃

(4) Heat exchanger 1 is made form transparent acrylic, therefore it's need to be careful by avoiding it from such big impact.

(5) All parts are connected by welding, please do not disassemble them by your self to avoid the declining of equipment performance, please contact us if you find any problem as we our best on after sales service.

6-3. Data acquisition device and software

Data acquisition device can be used after the following process
(1) Construction circuit configuration
(2) Toggle switch is at ON position
(3) USB To Serial gender of PC or Laptop is connected already to the Data acquisition device.
(4) Click "RUN" button on the program installed in PC or Laptop

6-4. General information

(1) In order to use this equipment, it is better if we should follow the manual book
(2) Within the period of after sales service (1 year after inspection) if there is disassembly by user due to repairing of the equipment and it is still found problem then if user call us for repairing it will be charge.
(3) If there is failure operation of the equipment, please contact us for consultation.

7. Patent and Authentication

CERTIFICATE OF PATENT

PATENT NUMBER	10-0432527	APPLICATION NUMBER	2002-0002662
		FILING DATE	Jan. 17 2002
		REGISTRATION DATE	May. 11. 2004

TITLE OF THE INVENTION   Stop valve, sold valve, 4way valve controls type heatpump system

PATENTEE   KTENG Co. Ltd., (141111-0******)
601 Postechno B/D 234-1 Sangdaewon-dong Jungwon-gu Seongnam-si Gyeonggi-do Korea

INVENTOR   Kim, Chul Su
122-701 Jangan town Kunyoung Apt., Bundang-dong Bundang-gu Seongnam-si Gyeonggi-do Korea

THIS IS TO CERTIFY THAT THE PATENT IS REGISTERED ON THE REGISTER OF THE KOREAN INTELLECTUAL PROPERTY OFFICE

Oct. 30. 2009

COMMISSIONER,
THE KOREAN INTELLECTUAL PROPERTY OFFICE

PROGRAM REGISTRATION

No. 119813

PROGRAM REGISTRATION NO.	2006 - 01 - 134 - 004226
PROGRAM TITLE	Data acquisition & Monitoring program
CREATIVE DATE	Mar. 18. 2006
REGISTRATION DATE	Aug. 16. 2006
PROGRAM COPYRIGHT REGISTER&NATIONATY	Republic of Korea KTENG Co. Ltd.,
SOCIAL NO. CORPORATION NO.	141111-0******

THIS HAS BEEN REGISTERED WITH RECORDING AS ARTICLE 23-1 AND 16 OF THE COMPUTER PROGRAM PROTECTION LAW.

Aug. 16. 2006

PROGRAM DELIBERATION MEDIATION COMMITTEE

COPYRIGHT REGISTRATION

NO. C-2008-009452

1.Work Title	Air conditioning & Refrigeration Electric control simulation for national skill certification and craft competitions
2. Work Type	Literature
3. Register name	KTENG Co.,Ltd.
4. Corporate company registration No.	141111-0019270
5. Copyright owner	
6. Corporate company No.	
7. Creative date	Sept. 16. 2008
8. Announce date	
9. Reference	Owner : KTENG Co.,Ltd. Creative Sept. 16. 2008
10. Registration date	Sept. 29. 2008

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Sept. 29. 2008

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NO. C-2007-011707

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2. Work Type	Literature
3. Register name	KTENG Co.,Ltd.
4. Corporate company registration No.	141111-0019270
5. Copyright owner	KTENG Co.,Ltd. & 1person
6. Corporate company No.	
7. Creative date	July.11. 2007
8. Announce date	
9. Reference	Owner : KTENG Co.,Ltd. & 1 person (Co-Register) Creative : July. 11. 2007
10. Registration date	July. 26. 2007

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July. 26. 2007

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Regrigeration & Air conditioning, Renewable energy training equipment

※ For more information, please mark the list below with the required contents and send it to overseas@kteng.com or by fax: +82-31-749-5376

Model	Specification	Manual	Education Data (PPT·Book)	Model	Specification	Manual	Education Data (PPT·Book)
KTE−1000BA				KTE−7000HS			
KTE−1000RA				KTE−7000ISG			
KTE−1000BO				KTE−7000SG			
KTE−1000MO				KTE−7000SH			
KTE−2000EV				KTE−7000WG			
KTE−2000EP				KTE−7100ASG			
KTE−3000HD				KTE−7100AWG			
KTE−5000LT				KTE−DA100M			
KTE−6000BR				KTE−HB520N			
KTE−9000AU				KTE−7000GH			
KTE−1000AHU				KTE−7000PVT			
KTE−2000AHU				KTE−7000SB			
KTE−4000PL				KTE−7000SR			
KTE−4000SQ				KTE−7000SW			
KTE−DA100				KTE−7000SQ			
				KTE−7000PL			

Educational lab equipment training programs

KTE-101 : Standard Refrigeration System Experiment Practical Course
KTE-102 : Refrigerant Parallel Valve Automatic Control Experiment Practical Course
KTE-103 : E.P.R(Evaporation Pressure Parallel Control) Refrigeration Experiment Practical Course
KTE-104 : Heat Pump System Performance Experiment Practical Course
KTE-105 : Cryogenic Cold & Heat(Dual Refrigeration) System Performance Experiment Practical Course
KTE-106 : Brine Refrigeration(Ice-storage Refrigeration) System Performance Experiment Practical Course
KTE-107 : Vehicular Heating and Cooling Performance Experiment Practical Course
KTE-108 : Air-conditioning System Performance Experiment Practical Course
KTE-109 : Chiller Method Air-conditioning System Performance Experiment Practical Course
KTE-201 : Solar·Wind Power Control Basic Circuit Configuration Practice
KTE-202 : Solar Generation Test Practice
KTE-203 : Solar System Equipment Configuration Practice
KTE-204 : Wind Power Generation Test Practice
KTE-205 : Solar·Wind Power Hybrid Generation Practice
KTE-206 : Hydrogen Fuel Cell Generation Practice
KTE-301 : Solar Radiant Energy Measurement Practical Experiment
KTE-302 : Solar Hot water boiler Performance Practical Experiment
KTE-303 : Geothermal Heat Pump Cooling & Heating Practical Experiment
KTE-304 : Solar-Thermal Combined Geothermal System Practical Experiment
KTE-401 : LED Basic Theory & Performance Assessment Practice
KTE-402 : LED Application System Configuration Practice
KTE-403 : LED Lighting Equipment Practice
KTE-404 : LED Media Facade Lighting Practice
KTE-405 : LED Luminescent property analysis Experiment
KTE-406 : OLED Unit Element Characteristic Evaluation Experiment
KTE-501 : PLC Automation Control Practice Basic
KTE-502 : PLC Automation Control Practice Intermediate
KTE-503 : PLC Automation Control Basic Advanced
KTE-601 : Sequence Control Practical Basic Course
KTE-602 : Sequence Control Practical Intermediate Course
KTE-603 : Sequence Control Practical Advanced Course
KTE-701 : Power Equipment Basic Course
KTE-702 : Power Equipment Intensive Course
KTE-901 : Water-based Fire Extinguishing Equipment
KTE-902 : Gas Fire Extinguishing Equipment
KTE-903 : Alarm Equipment
KTE-904 : Fire Extinguisher
KTE-905 : Evacuation Equipment
KTE-1101 : Robot Control Practical Basic Course
KTE-1102 : Robot Control Practical Intermediate Course
KTE-1103 : Robot Control Practical Advanced Course
KTE-1201 : Welding Machine Practical Basic Course
KTE-1202 : Welding Machine Practical Intermediate Course
KTE-1203 : Welding Machine Practical Advanced Course
KTE-1301 : Basic Pneumatic Practice
KTE-1302 : Electro-pneumatic Basic Practice
KTE-1303 : Electro-pneumatic Intermediate Practice
KTE-1401 : Automatic Control Mechatronics Basic Practice
KTE-1402 : Automatic Control Mechatronics Intermediate Practice
KTE-1403 : Automatic Control Mechatronics Advanced Practice

※ **Please contact us for educational training program registration**

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Automation controls(PLC) / Robot controls / Electric & Electronics(LED lighting)
Firefighting & safety / Big data & ICT / Automobile & ship / Nano chemical

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