

Code : KTE7000SG-AE100

SOLAR POWER GENERATION EXPERIMENTAL EQUIPMENT

Ver.1.0.0



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Chapter 1. Solar power generation experiment equipment

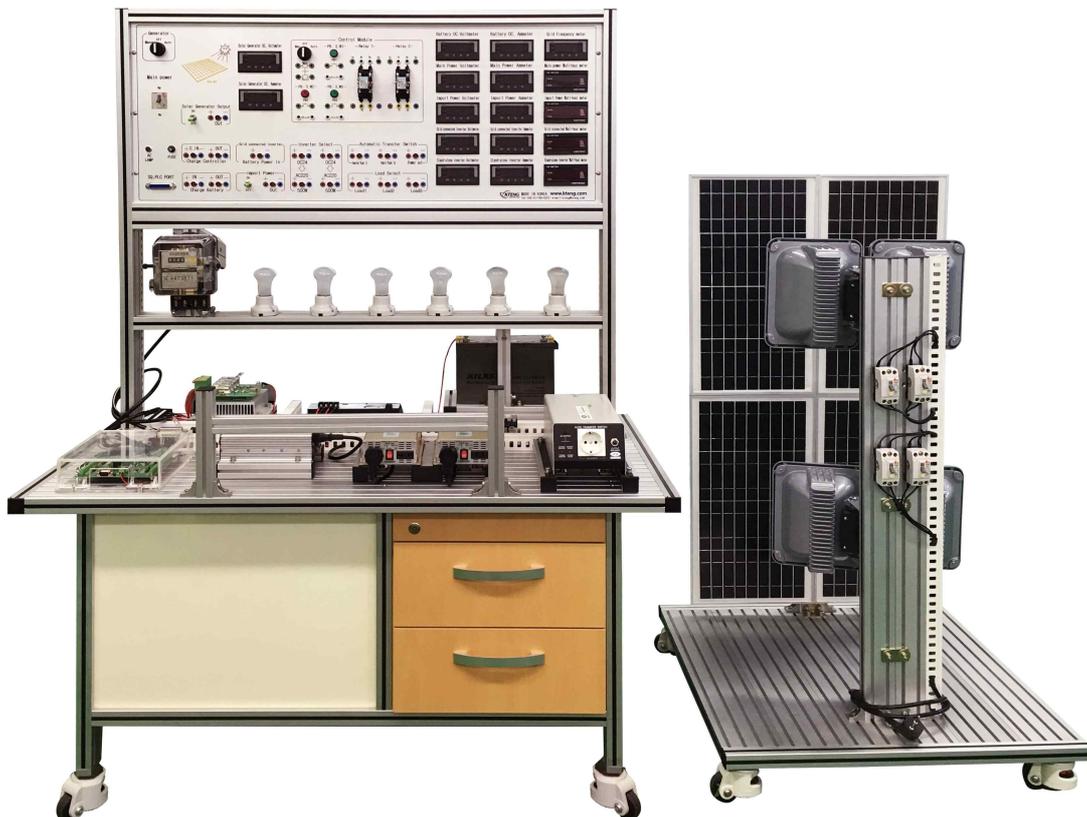
1. Solar Power generating test system

(1) Summary

Solar generating test system, KTE-7000SG, consists of solar generating system and solar power convert test system. Power used in test is produced from fixed pole solar generating system, and power convert test system converts the electric energy to usable power for normal load operation throughout power convert from ac to dc or dc to ac. Also, power convert test system creates the basic sequence controlling circuit throughout automatic control part for control tests for each capacity of solar generating system.

(2) Configuration of the experimental device

- 1) Solar Power conversion experiment equipment
- 2) Fixed-axis photovoltaic devices
- 3) Artificial sun experiment equipment



2. Characteristics of solar generating test system

(1) Solar generating system

Solar fixed pole generating system is equipped with 80w module.

- 1) Solar module : It consists of solar battery cell which is minimum unit of solar battery that converts energy of solar light to electric energy. Because solar module is made in series or parallel, so it can produce the electricity.
- 2) Fixed pole of solar module : It is made with 30° which is fixed pole solar battery installation angle of Korea, and 80w modules can be installed.

(2) Characteristics of solar power convert experimental device

- 1) This device is the educational energy collect test device, registered as a design of practical utility (no. 20-2009-894).
- 2) Power convert test can be conducted to use the renewable energy generated from solar generator to load.
- 3) Using electric element, basic sequence circuit related to solar generating can be created and tested.
- 4) By connecting to thread wiring test system (SQ) and (PLC) controlling test system, experiments about series/ parallel controlling circuit formation, load power supply circuit, automatic convert circuit formation in case of discharge or black out, and independent inverter system circuit formation, can be conducted.
- 5) Because it is console type, mobile test is easy.
- 6) To save the wiring times, circuit formation part of control panel consists of terminals, such as circular terminal and banana jack, etc.
- 7) Power generated from solar generating system can be stored in battery safely.
- 8) Power generated from solar or commercial power can be converted to 80w class ac throughout independent inverter and grid-connected inverter.
- 9) It can be linked to solar monitoring test system, and by using this, more efficient solar generating test can be conducted.
- 10) Considering that situation which has no solar, test using commercial power can be conducted.
- 11) Controlling system is controlled with 24v, and protection function is applied basically using protection fuse.
- 12) It is designed for easy internal circuit inspection and repair, and to have excellent heat protection.

3. Configuration of solar generating test system

(1) Solar Generator



[Diagram 2-1] Solar Module

※ Specifications

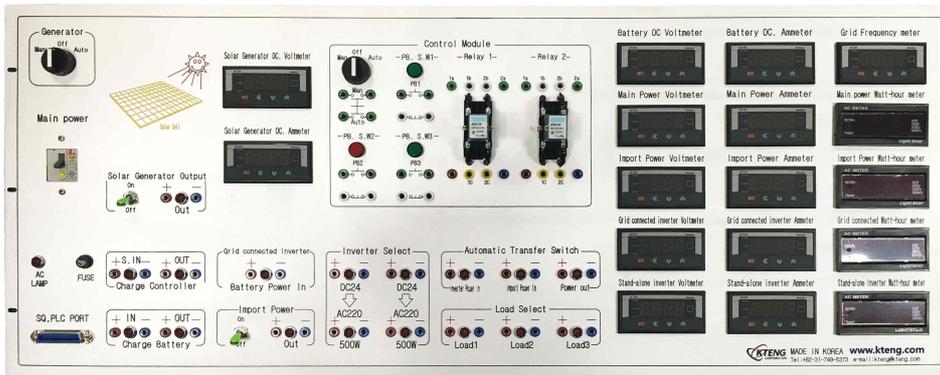
- Max. Power: 20W
- Max. Power Voltage: 19.5V
- Max. Power Current: 1.26A
- Open Circuit Voltage: 23.5V
- Short Circuit Current: 1.34A
- STC: Insolation $1000W/m^2$, atmospheric mass AM1.5, temperature $25^{\circ}C$



The solar module consists of solar cells, the minimum unit of solar cell that converts solar energy to electrical energy. It produces electricity with solar modules in arrays of parallel or series. This module is used for testing solar generation with single crystal silicon and has an efficiency of 13.98%.

(2) Power Conversion System control panel configuration

Power converter consists of generating and controlling parts, and using banana jack to control panel, solar generating system can be created. Also, by using basic sequence emergent, sequence tests related to solar generating can be conducted, and basic information such as ac and dc voltage, current, power, etc during system operation can be obtained. Next image shows each configuration of controlling panel.



1) Power supply, communication ports, manual and automatic control switch

A. Power N.F.B



- * Model 32GRh
- * Operating Voltage Range: 88V~242V
- * breaking current: 30A
- * Current sensitivity: 30mA



- * AC LAMP(1EA):
24V Red Lamp
- * FUSE(1EA) : 250V, 30A

[(N.F.B,GR Type)]

[Fuse & Lamp]

It is the switch that controls the main power of system for preventing overload. If excess currents, such as leakage current flowing when leakage and short circuit or excessive current generated due to overuse of device or machine, over the rated current, breaker will be turned off. Internationally used english name is molded case circuit breaker(mccb), and no fuse breaker(N.F.B) is mostly used in north america. Generally, name of breaker that has leakage break function is called as earth leakage circuit breaker(ELCB). If turn on the breaker, ac lamp will be on, and in case of breakdown of breaker, power is supplied throughout fuse.

B. SQ & PLC Communication Port



[Centronic Connector]

- * Centronic Connector 1EA
- * Pin : 36pin
- * female.

Remote control test of wired control method can be conducted by connecting 7000SQ and 7000PL throughout centronic connector(male) to sq and plc ports. SQ and plc connected to power convert test system with centronic connector is supplied from this cable without additional power supply, and it is used when educating basic sequence and plc.

C. Select switch



[Select switch]

Select switch located on power breaker switch is made that manual or automatic controls are available for generating method of power convert test system.

2) Show Info

A. PV voltage and current display



[Digital Display]

It displays the voltage and current values produced from solar fixed pole generator.

B. Display generated electricity



[Digital Display]

- ① Battery Voltmeter
- ② Battery Ammeter
- ③ Grid Frequency meter
- ④ Main Power Voltmeter

- ⑤ Main Power Ammeter
- ⑥ Main Power Watt-Hour meter
- ⑦ Import Power Voltmeter
- ⑧ Import Power Ammeter
- ⑨ Import Power Ammeter
- ⑩ Grid Connected Inverter Voltmeter
- ⑪ Grid Connected Inverter Ammeter
- ⑫ Grid Connected Inverter Watt-Hour meter
- ⑬ Stand-alone Inverter Voltmeter
- ⑭ Stand-alone Inverter Ammeter
- ⑮ Stand-alone Inverter Watt-Hour meter

3) PV system configuration Part

A. Solar Generator Output



[PV output]

- * Toggle Switch 1EA
- * (+), (-)Each output 1EA
- * Blue LED Blower 1EA
- * LED LAMP
- * Solar Generator DC. Voltmeter
- * Solar Generator DC. Ammeter

In solar generator output, toggle switch is used when on/off the both poles trace device and generating system. 24v electric signal that can consist the solar generating system when toggle switch is 'on', and lamp will be on. Connect the banana jack from output terminal of solar generator output to s. In of charge controller to create a circuit.

B. Charge controller



[Input and output terminals of Charge controller]

- * [+]Terminal 2EA
- * [-]Terminal 2EA
- * Lamp terminal 2EA

If jack is connected, power of solar generator is supplied to charge controller. Supplied power is converted to constant 24v.

C. Charge Battery



- * [+]Terminal 2EA
- * [-]Terminal 2EA
- * Lamp terminal 1EA

[Input and output terminals Charge Battery]

If banana jack is connected from output terminal of charge controller to charge battery input terminal, solar power generated as 24v constantly is stored in battery. Charge battery output terminal connects the banana jack to inverter input terminal.

D. Import power



- * Toggle Switch 1EA
- * [+]Terminal 1EA
- * [-]Terminal 1EA
- * Lamp terminal 1EA

[Import power supply switch and output jack]

Commercial power can be used in case of bad weather or night when solar generating is hard. Connect the banana jack from output terminal of import power to import input terminal of ats, and after creating load device, turn on the switch and then load test using commercial power can be conducted.

E. Grid connected inverter



- * [+]Terminal 1EA
- * [-]Terminal 1EA
- * Lamp terminal 1EA

[Grid connected inverter configuration terminal]

It is the terminal that can grid-connected by connecting battery power and commercial power, so throughout this terminal configuration, generated power can be supplied to kopec.

F. Inverter (DC to AC)



- * DC [+]Terminal 2EA
- * DC [-]Terminal 2EA
- * AC [+]Terminal 2EA
- * AC [-]Terminal 2EA
- * Lamp terminal 4EA

[Inverter Select Lamp terminal (500W)]

Connect the banana jack from output terminal of charge battery to inverter input terminal, and then 24v dc can be converted to 220v ac. Ac220v output terminal is connected and created with inverter input terminal of ATS.

G. Automatic Transfer Switch



- * [+]Terminal 3EA
- * [-]Terminal 3EA
- * Lamp terminal 3EA

[Inverter & Import power input terminals and output terminals]

When creating the independent solar generating system, connect the banana jack from inverter output terminal to inverter power input terminal of ats, and then create and use the load from output terminal of ats. When test is conducted using commercial power, connect the banana jack from import output terminal to import power input terminal of ats to create the load from output terminal of ats. If inverter system is created, load will operate immediately, but in case of generating system using commercial power, load will operate after 30 seconds of delay time. In other words, load created throughout import power input terminal of ats, will operate after 30 seconds.

H. Load select

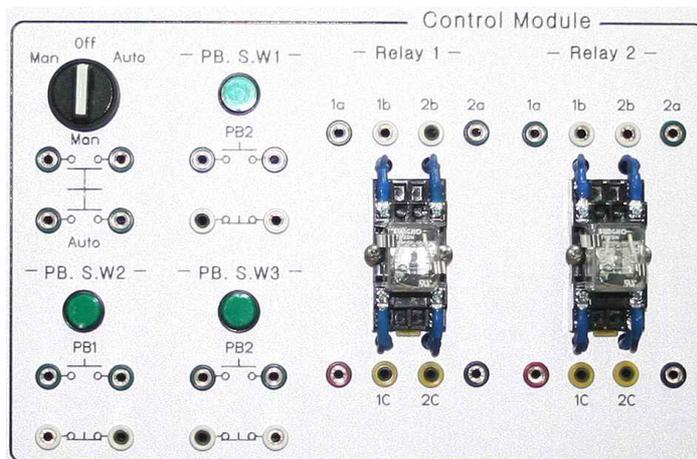


- * [+]Terminal 3EA
- * [-]Terminal 3EA
- * Lamp terminal 3EA

[Select the load terminals]

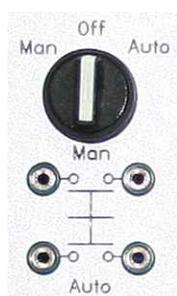
Connect the banana jack to 50w load terminals of output terminal of inverter, output terminal of import and output terminal of ats, and operate system, and then connected lamp will work. Because connecting configuration is ac load, it should be connected in parallel.

4) Based sequence circuit part



To create a basic sequence controlling circuit, it consists of one select switch, three a/b contact point switches and 2 8pin relays.

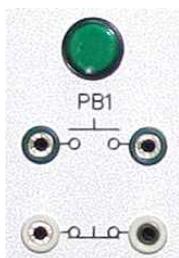
A. Select switch



- * Select switch 1EA
- * Input Terminal 2EA
- * Output Terminal 2EA

Automatic or manual controls can be selected in select switch. Neutral position of center is off. Terminal configuration consists of man 2 terminal and auto 2 terminal. Connect one terminal from each man and auto. It is used as common terminal 'c'. Remaining man 1 terminal and auto 1 terminal can be connected to other load.

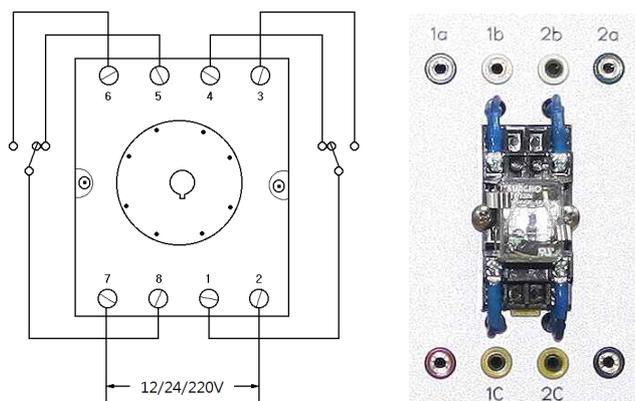
B. Push button switch



- * Push-button switch 3EA
- * Input Terminal 2EA
- * Output Terminal 2EA

Push button switch has function of a contact point and b contact point used in start and stop. It is the components used to on/off control of system, a contact point is connected at the same time that push the switch, and b contract point will be disconnected if put the switch. Terminal of switch is not classified with polarity, but input and output. System is configured with (=) terminal to input and (-) terminal to output. Using this switch, power and reset switch of generating system can be configured.

C. 8pin Relay



- * 8Pin Relay 2EA
- * (+) Terminal 1EA
- * (-) Terminal 1EA
- * Input Terminal 2EA
- * Output Terminal 4EA

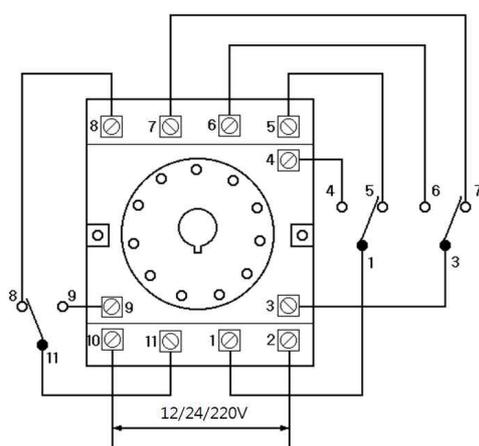
Relay Structure

8pin relay is two power terminal and six terminals consisting a and b contact points, so it has total 8 terminals from no.1 to 8.

- Terminal 2: Power (-), pin 7: Power (+)
- 1, 8 terminals: Common C-point input
- 3, 6 terminal: A contact output terminals
- 4, 5 terminal: B contact output terminals

However, if use no.1 as an input terminal, no. 3 a contact point and no.4 b contact point will be switching element of one group, and if use no. 8 as an input terminal, no. 6 a contact point and no 5 b contact point will be switching element of the other group.

D. 11pin Relay



- * 11Pin Relay 3EA
- * (+) Terminal 3EA
- * (-) Terminal 3EA
- * Input Terminal 9EA
- * Output Terminal 18EA

Relay Structure

11pin relay is the 11 terminals consisting two power terminals and a/b contact points, so it has total 11 terminals no. From 1 to 11.

- Terminal 2 : Power (-), pin 7: Power (+)
- 1, 3, 11 terminals : Common C-point input

- 4, 6, 9 terminals : A contact output terminals
- 5, 7, 8 terminals : B contact output terminals

However, if use no.1 as an input terminal, no. 4 a contact point and no.4 b contact point will be switching element of one group, and if use no. 3 as an input terminal, no. 6 a contact point and no 7 b contact point will be switching element of the other group, and if use no. 11 as an input terminal, no. 9 a contact point and no b b contact point will be switching element of the other group

(3) Part of power conversion device.

1) Joint box



It receives the electricity produced from solar generator (both side tracker).

2) Charge Controller



It converts the unstable voltage of electricity produced from solar generator to 12v constant voltage, and it protects the battery from over charge and over discharge.

3) Battery



It is the device that stores the electricity with 12v dc produced from solar generator. If input voltage is instable, battery life will be shorten, and problem may occur when charging the battery, so charging using charging controller.

5) Stand-alone inverters



It converts 12V DC to 220V AC. It receives 12V DC from the battery, converts it to AC and supply it to the load.

6) Grid-connected inverter inverters



It converts 12V DC to 220V AC. It communicates to the commercial electricity system to supply power to the load and supply the left over electricity to the system.

7) Auto Transfer Switch



ATS, Automatic Transfer Switch, secures double or triple power in order to automatically switch to spare electricity when the main power is cut or the voltage thereof falls below the standard rate, allowing the user to be supplied with a constant power.

8) Load



Lamp (40W, 6EA)

6, 40W incandescent lamps for AC220V are used to use used as loads for load testing with electricity generated.

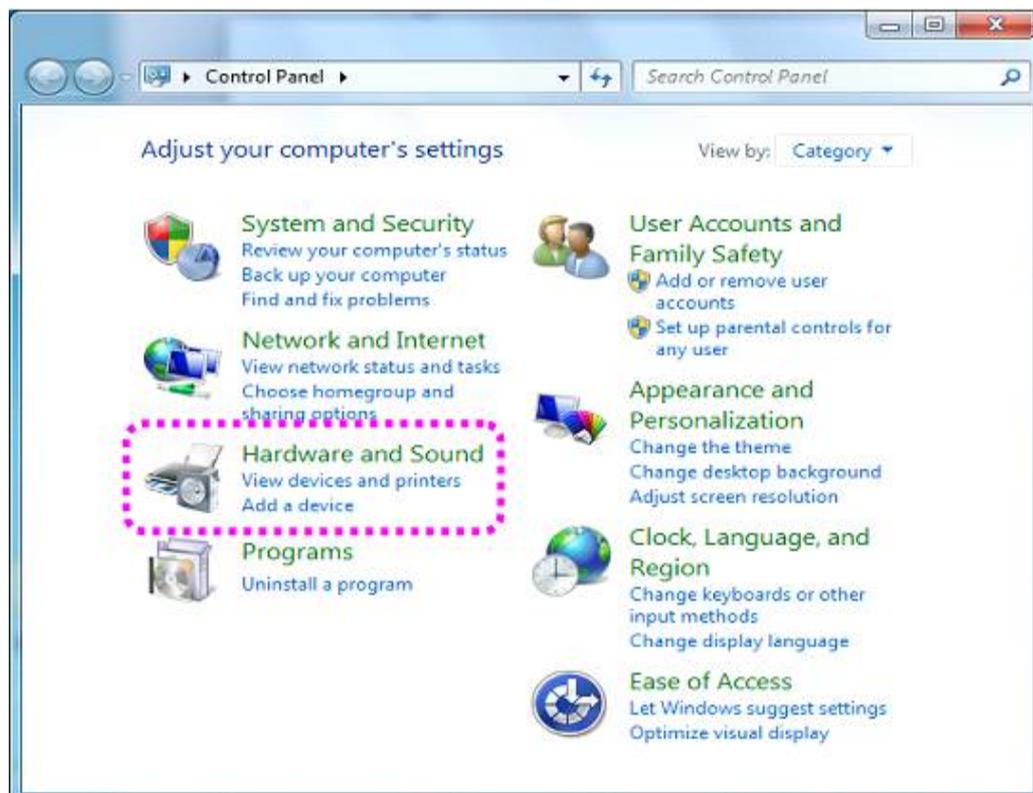
4. Data Acquisition device between PC and machine

4-1. Install and how to use KTE-DA100

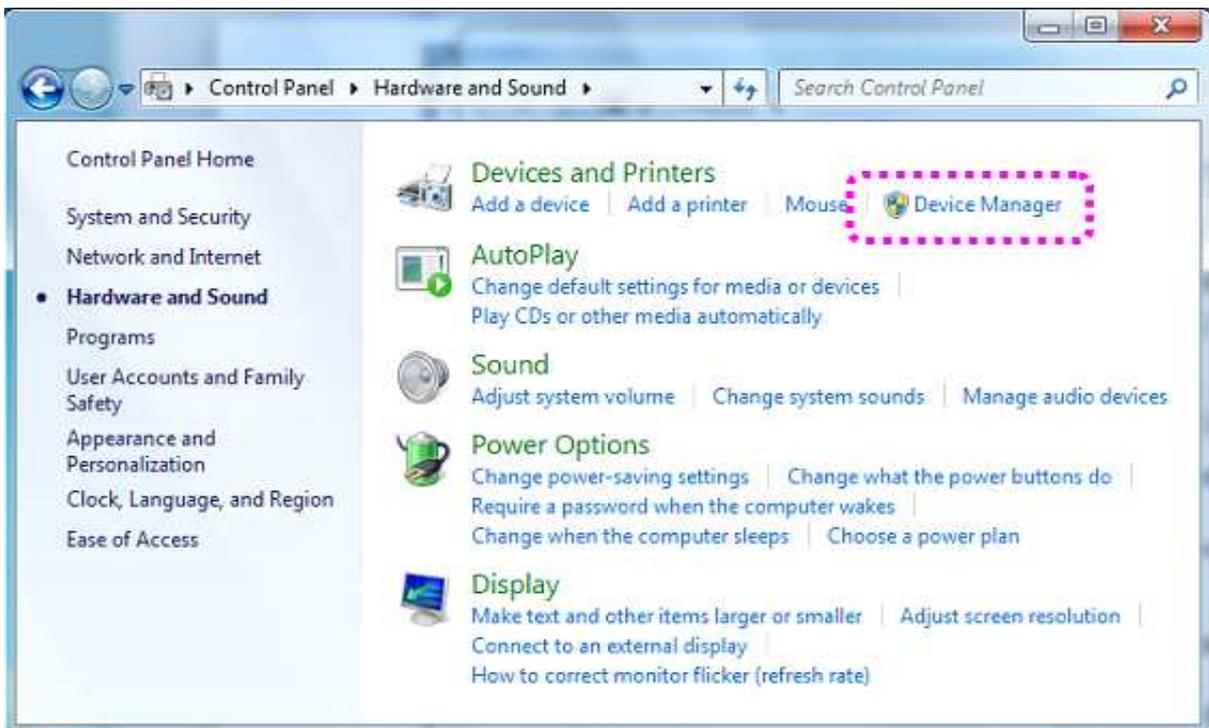
(1) INSTALL USB TO SERIAL

- 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.

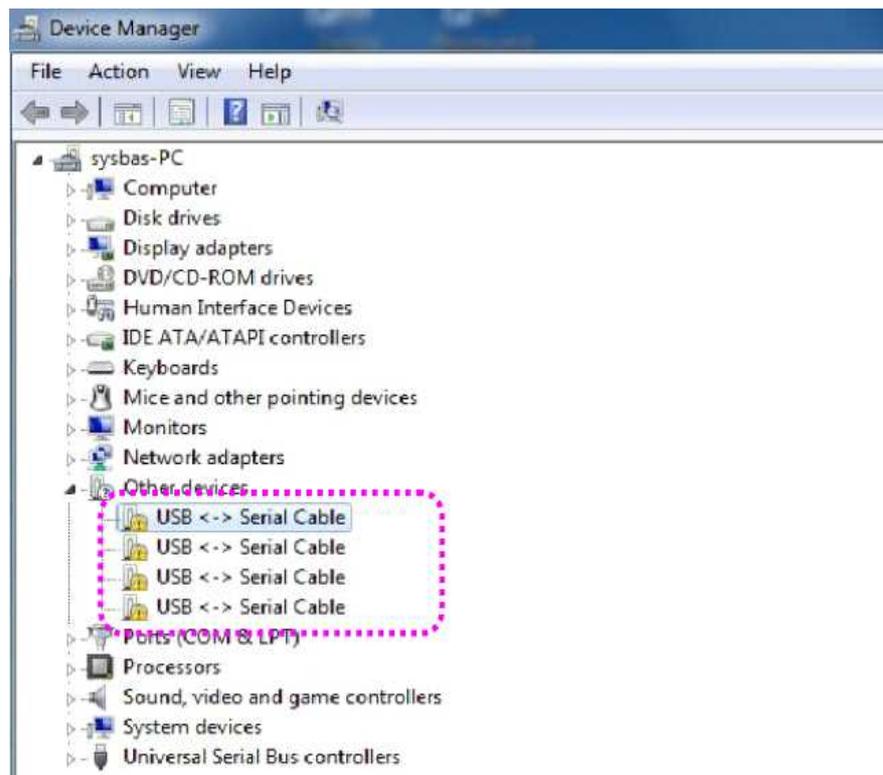
- 1) Run Windows 7
- 2) Connect USB MultiPort to your PC's USB port.
- 3) Inset media CD(provided with MultiPort) into the CD drive.
- 4) Click "Hardware and Sound" in "Control Panel"



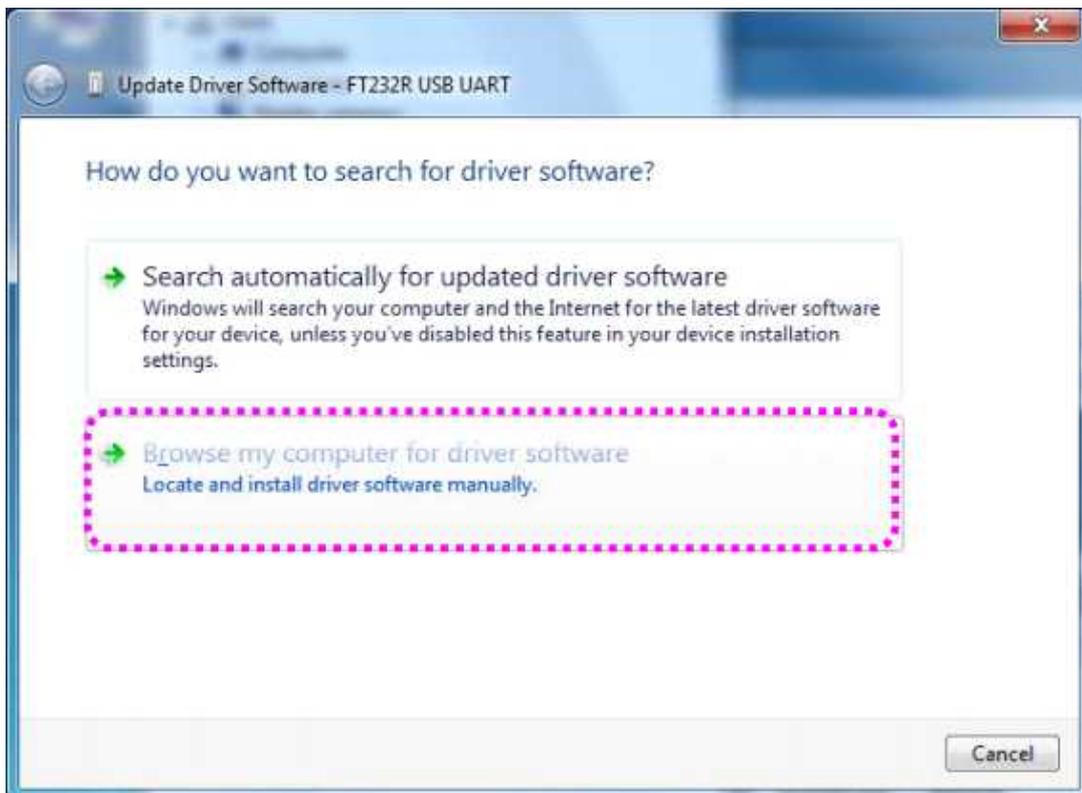
5) Following picture depicts Device Manager after carrying out step 4. Click “Device Manager”.



6) Right click “USB <-> Serial Cable” in “Device Manager”. Then choose “Update Driver Software”.



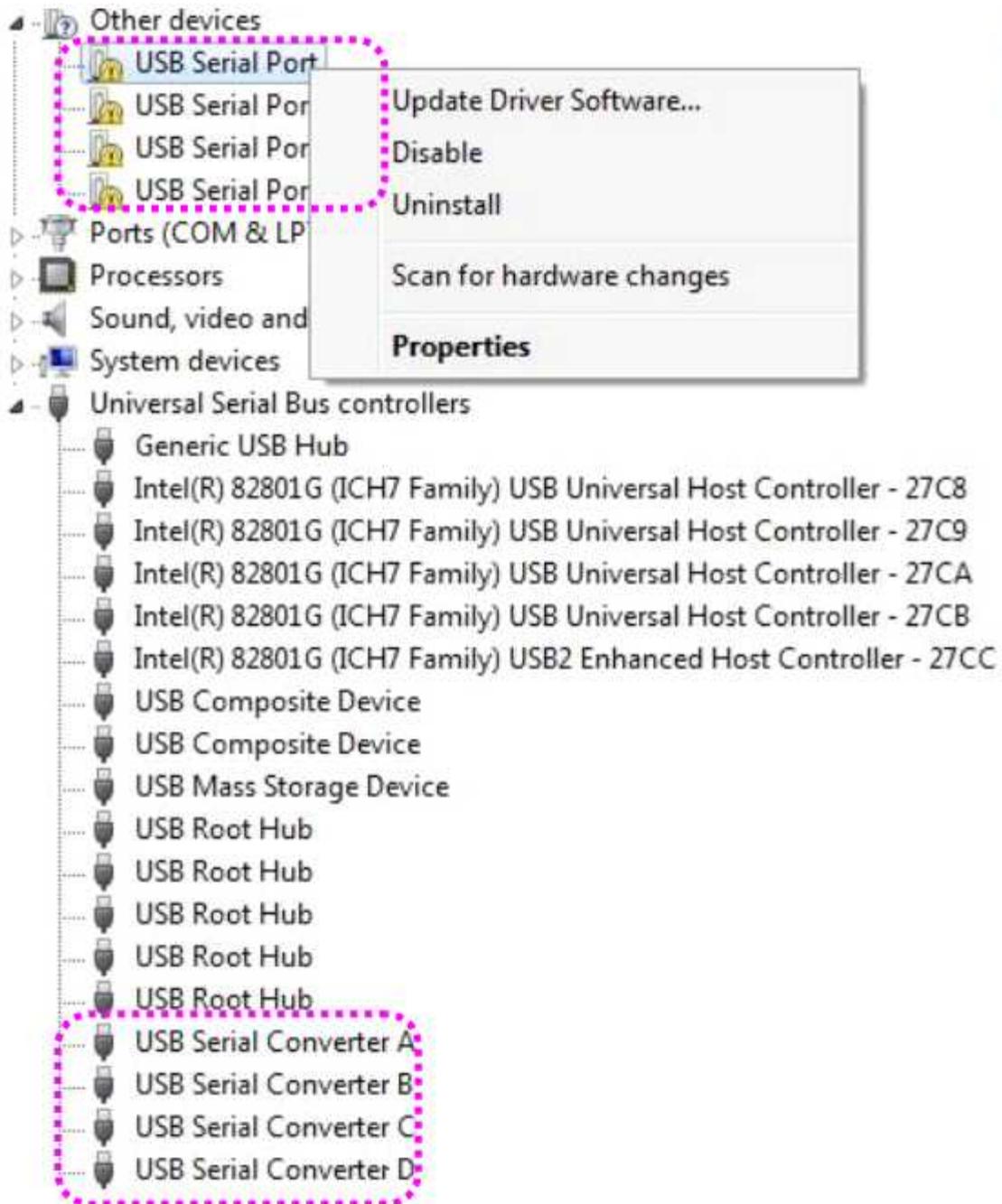
- 7) Click “Browse my computer for driver software” in order to install driver manually.



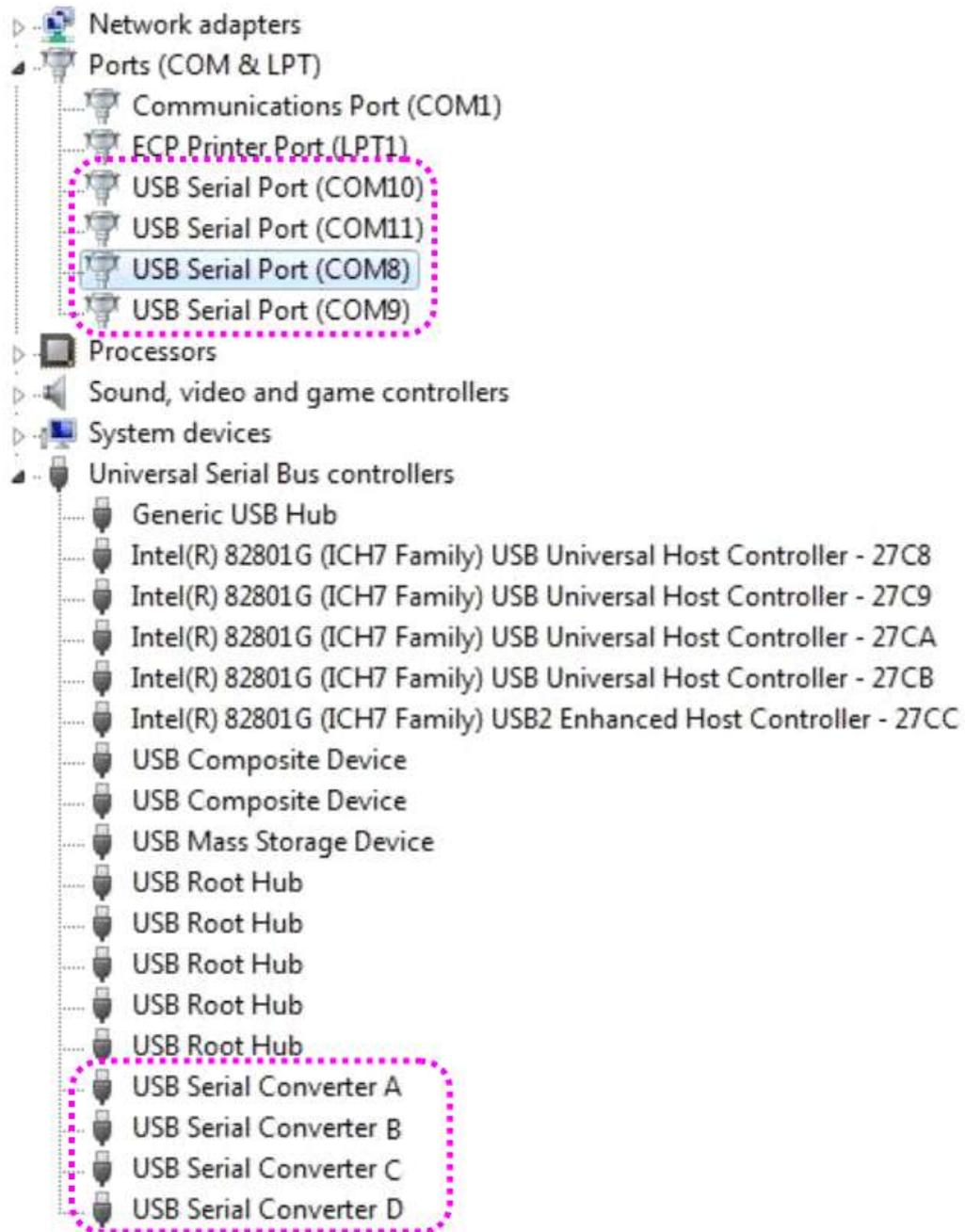
- 8) Click “Browse” and set driver software’s location to [CD]:\Driver\USB\Win2000\,XP,2003,Vista,2008,7”.



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



- 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.



- 11) “USB Multiport” installation on Window 7 is now finished.

(2) KTE-DA100 Installation and Operating

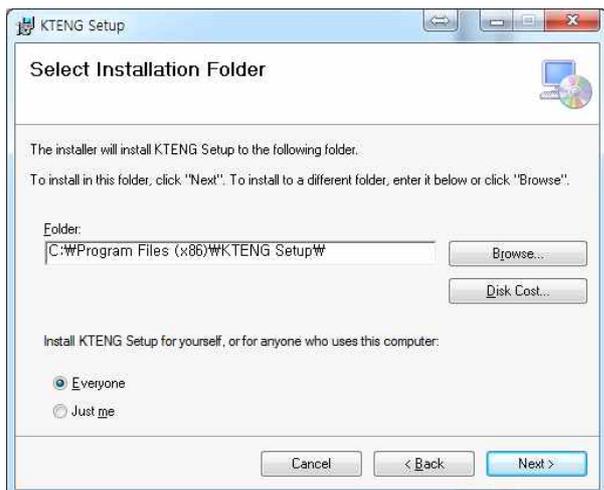
① KTE-DA100 Installation



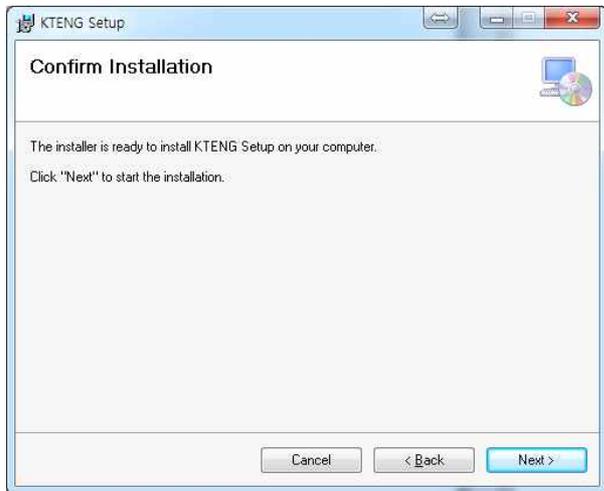
1) You can see a installation files that in CD or USB for installation then double click 'KTENG Setup' file to start installation. If the program cannot be installed using 'KTENG Setup', try to 'setup' file.



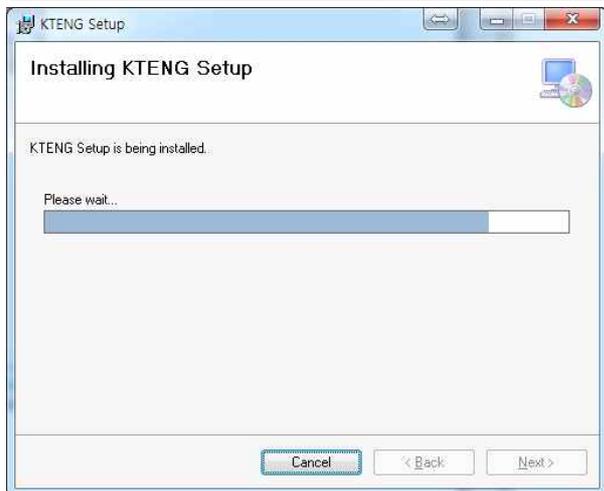
2) If you can see a 'Setup Wizard' screen, click the 'Next>'.



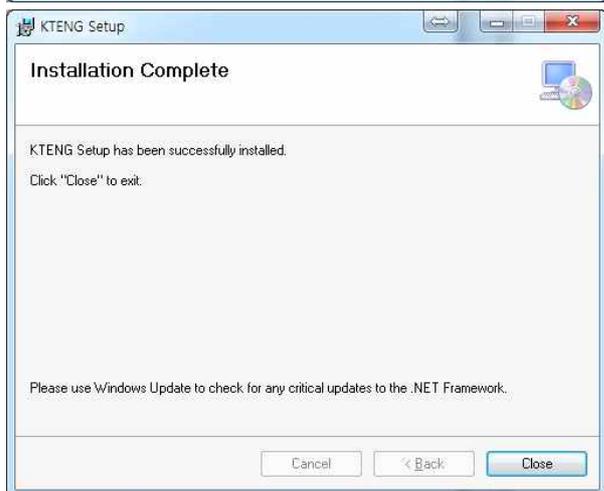
3) You can change a installation route. If you want to change a installation route, click the 'Browse..' and find a new route then click the 'Next>'.



4) It require to confirm installation intention. Please click the 'Next>'.

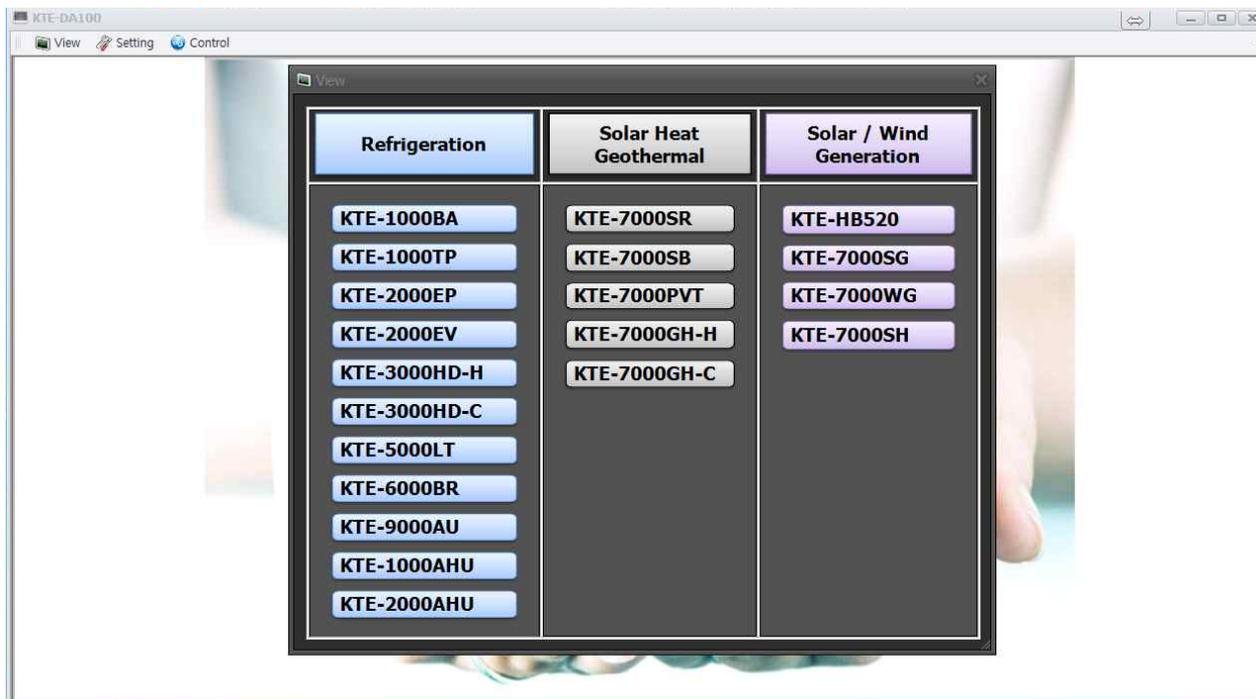


5) Installing a program.



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

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

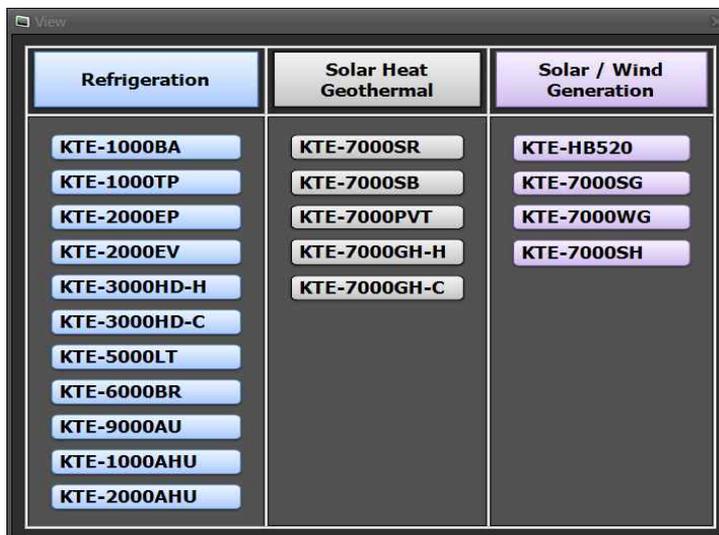


KTE-1000BA	Standard Refrigeration Experimental Equipment	KTE-7000SR	Solar Radiation Energy Experimental Equipment
KTE-2000EP	Evaporation Pressure Parallel Control Experimental Equipment	KTE-7000SB	Solar Heating Hot Water Boiler Experimental Equipment
KTE-2000EV	Refrigerant Parallel Expansion Valve Experimental 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 Experimentatl Equipment (Heating Mode)
KTE-3000HD-C	4-Way Reverse Valve Control Heat Pump Experimental Equipment (Cooling Mode)	KTE-7000GH-C	Geothermal Heat Pump Experimentatl 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

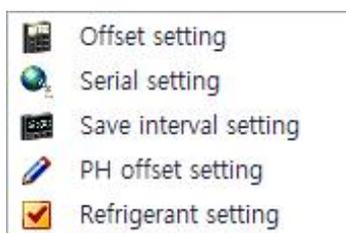


1) View

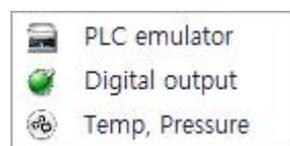


(Refrigeration 11 species, Solar-Geothermal 5 species, Solar-Wind energy 4 species)

2) Setting



3) Control



(3) 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

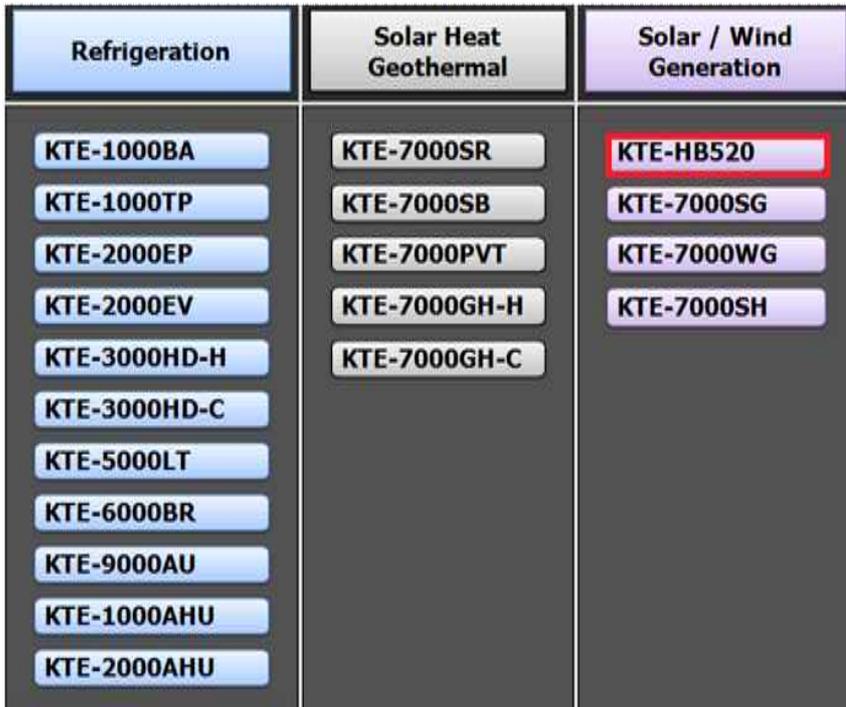
※ Please refer to page 69 for more detail information.

(4) Control

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

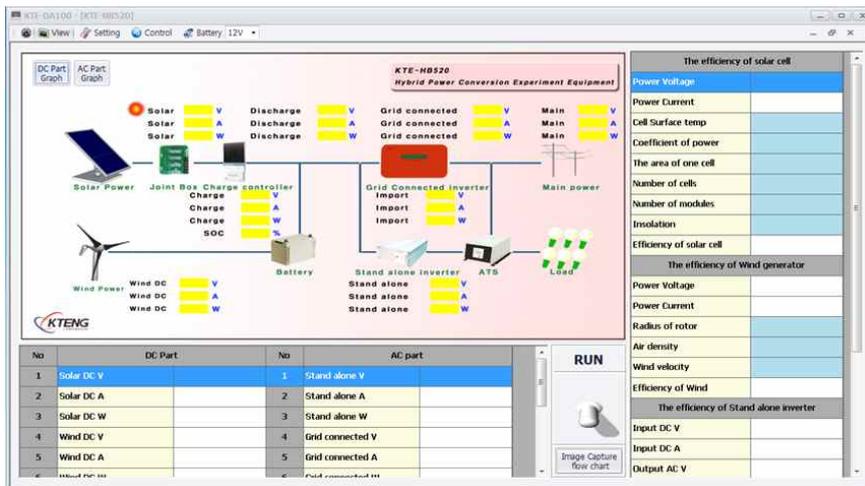
(5) Application of data acquisition equipment(Model : KTE-DA100)

① Selection of Model



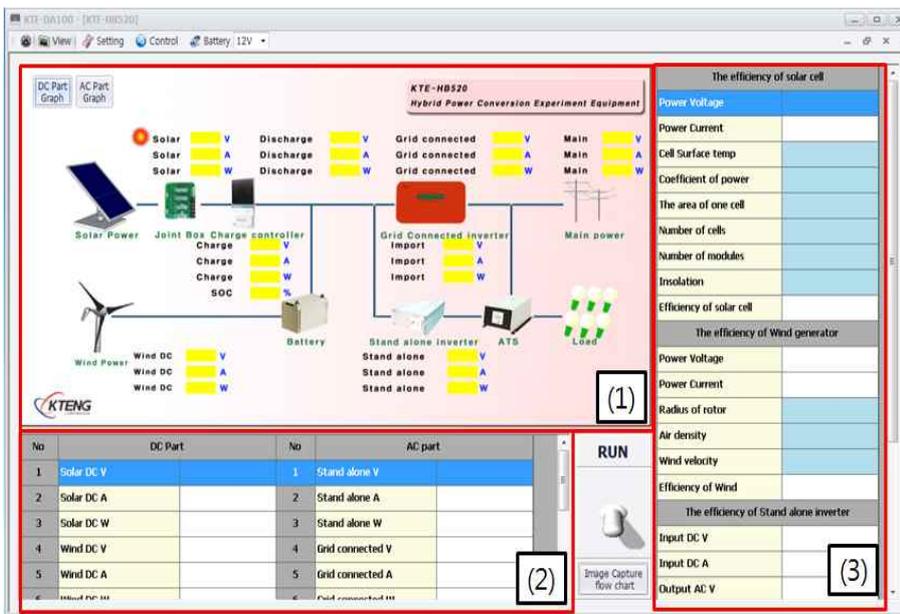
(1) When program started, 'View'screen is activated.

(2) Select a model what you want. (Click the KTE-HB520)



(3) Main user interface of KTE-HB520 is activated.

i) Composition of main user interface

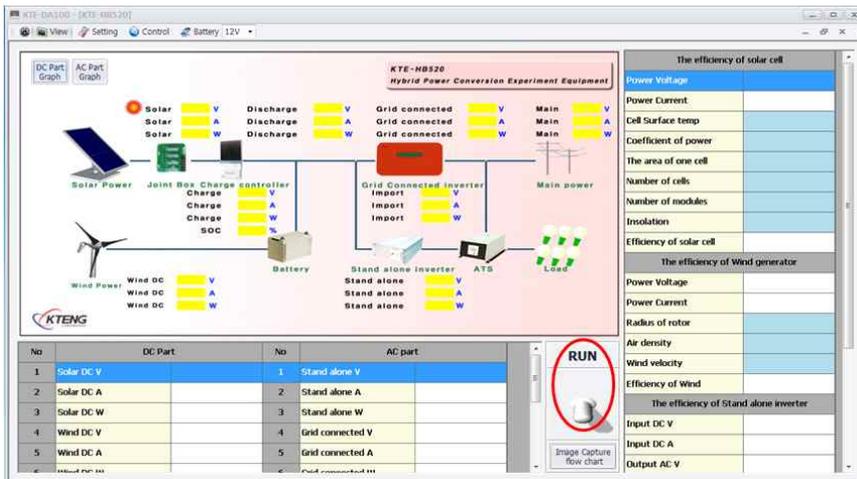


(1) Diagram display area and real-time voltage and current configuration

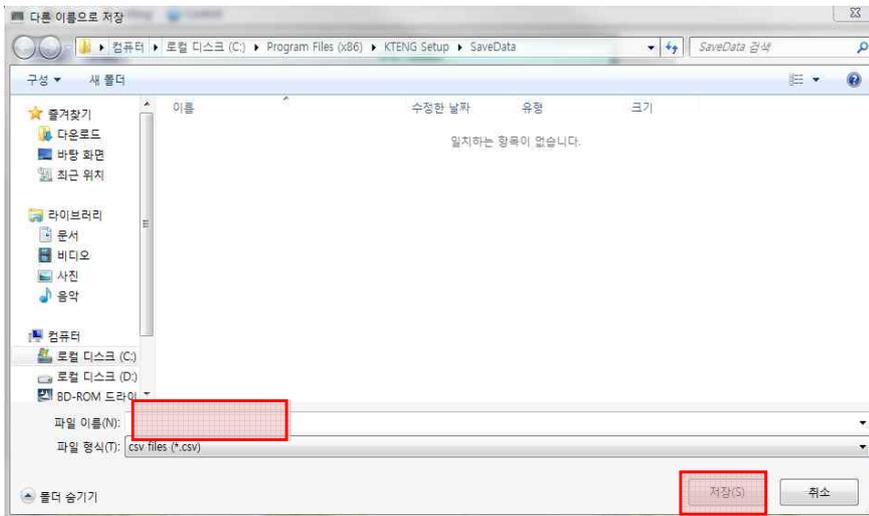
(2) Voltage, current, power chart.

(3) Solar cell efficiency, Wind turbine efficiency, Stand-alone and grid-connected inverter efficiency calculations

ii) Operating and saving data



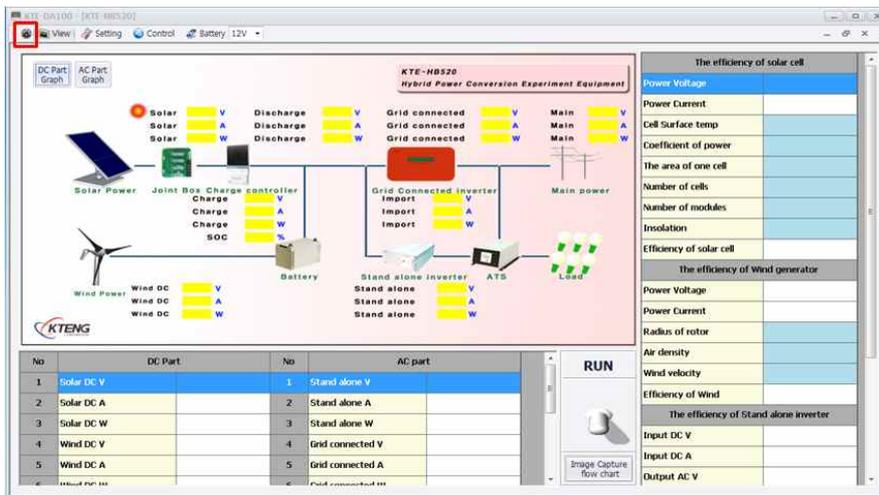
(1) Click a toggle switch to run program to save data.



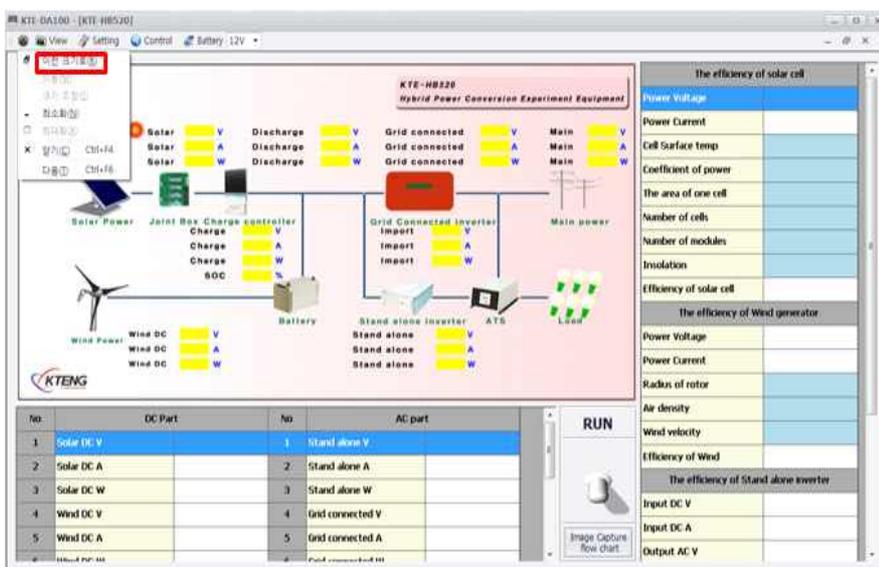
(2) Write a title and save a file by excel.

② Function for collecting data tools

i)Tools

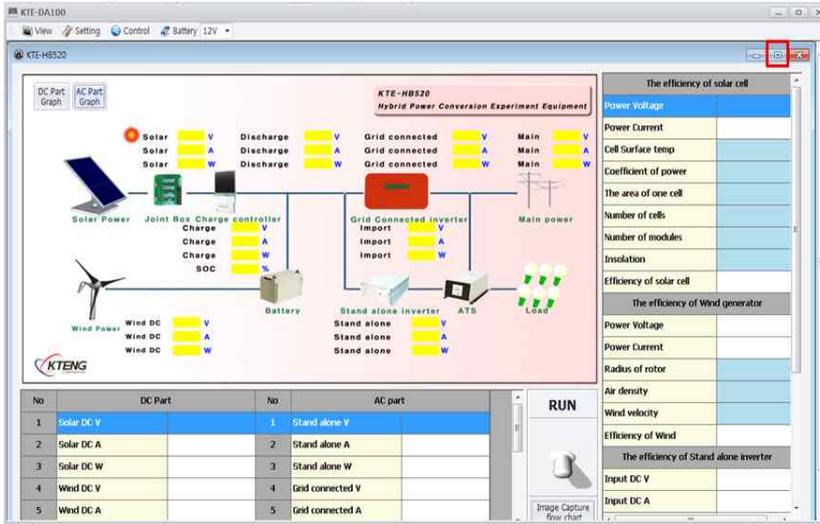


(1) Click  in Tools

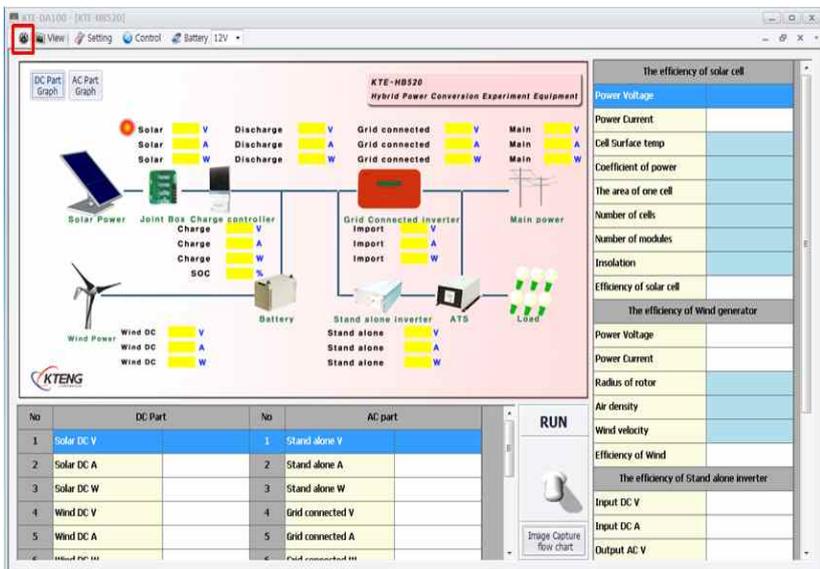
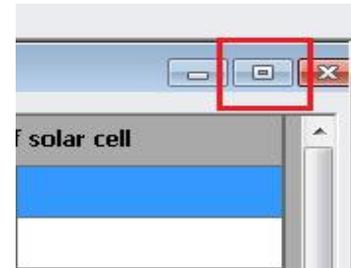


(2) When you click (R) for before size, the window is activated for moving

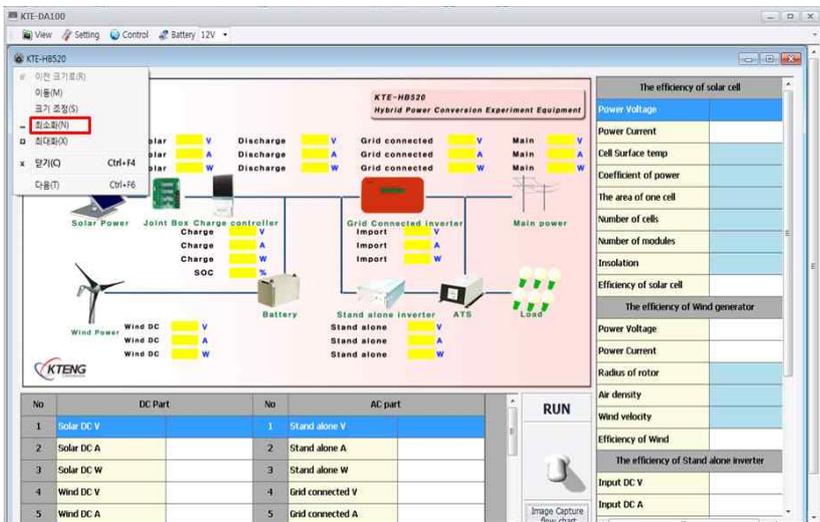




(3) Click that button, the window is bigger.



(4)  Click



(5) When click the minimum(N), indicate bottom of the left side.



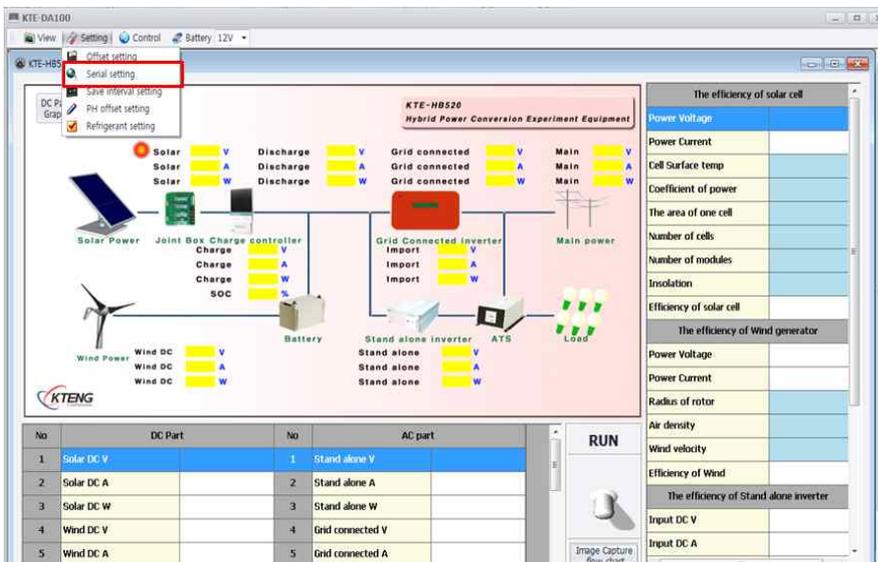
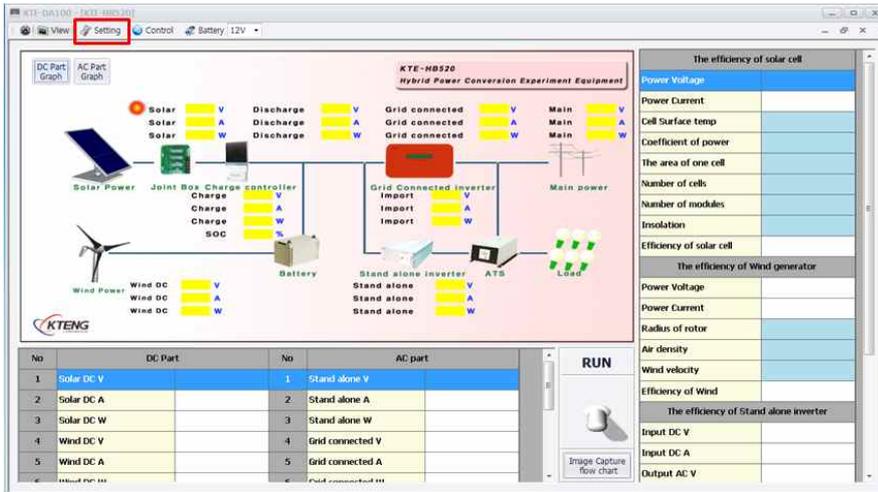


(6) When click whole monitor, it is returned.

iii) Setting

① Serial setting

(1) Click Setting



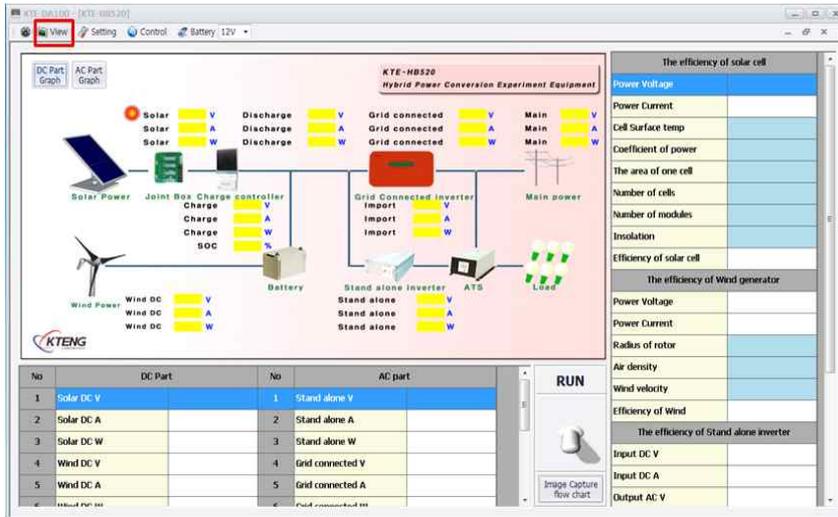
(2) Click Serial setting



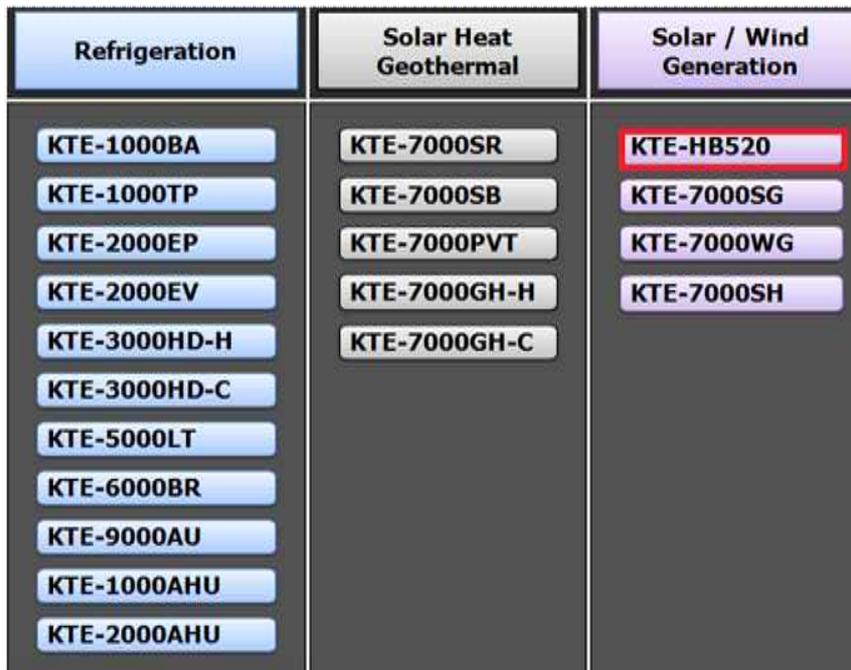
(3)
COM No is changed depend on port location. choose COM No and Click OK

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

ii) View

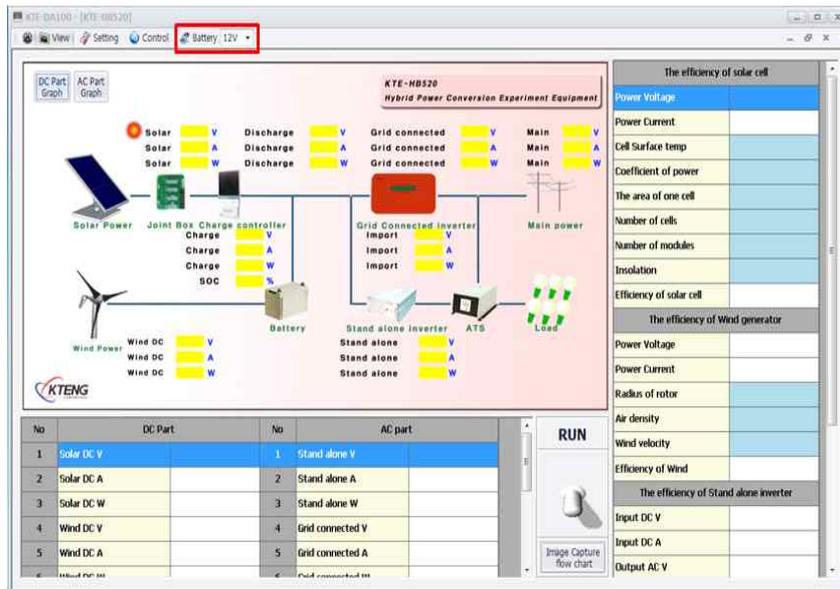


(1) Click the view in Tools

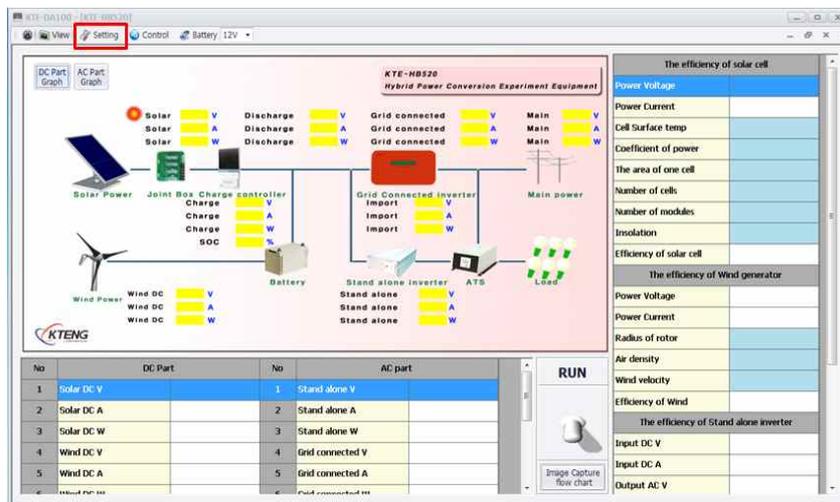
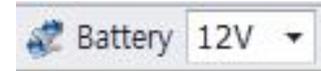


(2) When you click the view and click Model name then it goes to main screen and it indicates program screen which is connected with real equipments

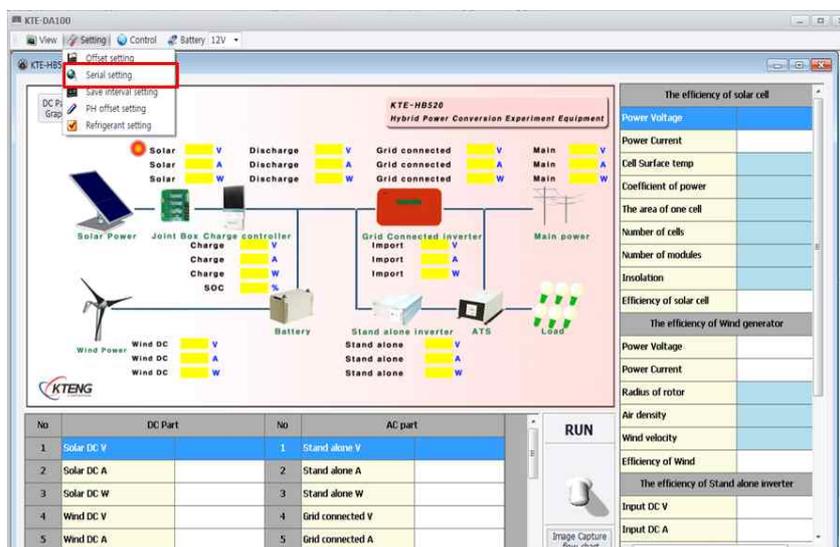
② Offset setting



(1) Click 12V Setting in Tools(Battery)

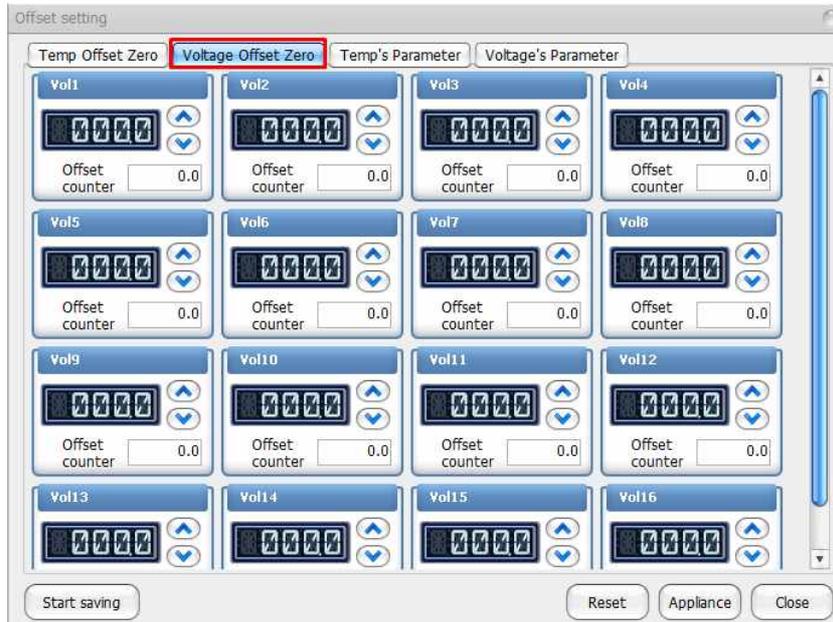


(2) Click Setting in Tools



(3) Click Offset Setting

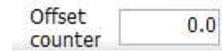




(4) Voltage Offset
Zero is a part of can control voltage

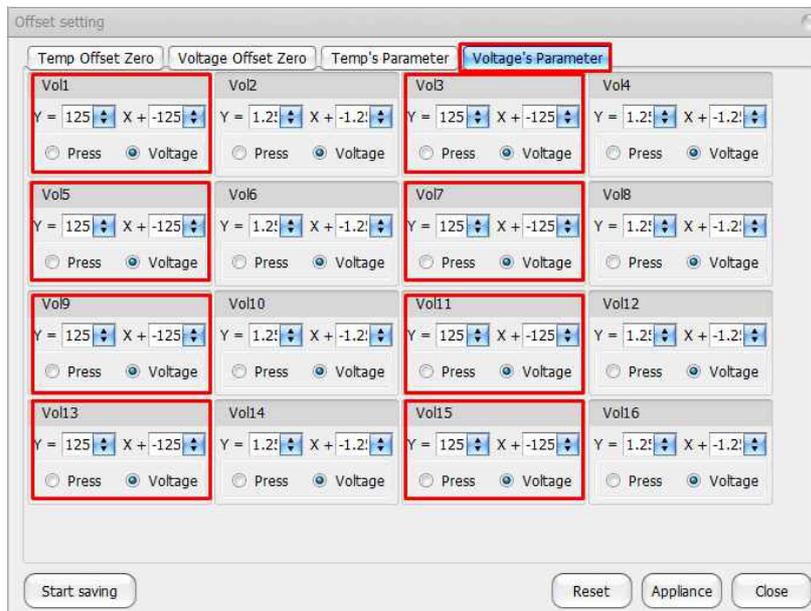


: You can control using direction key



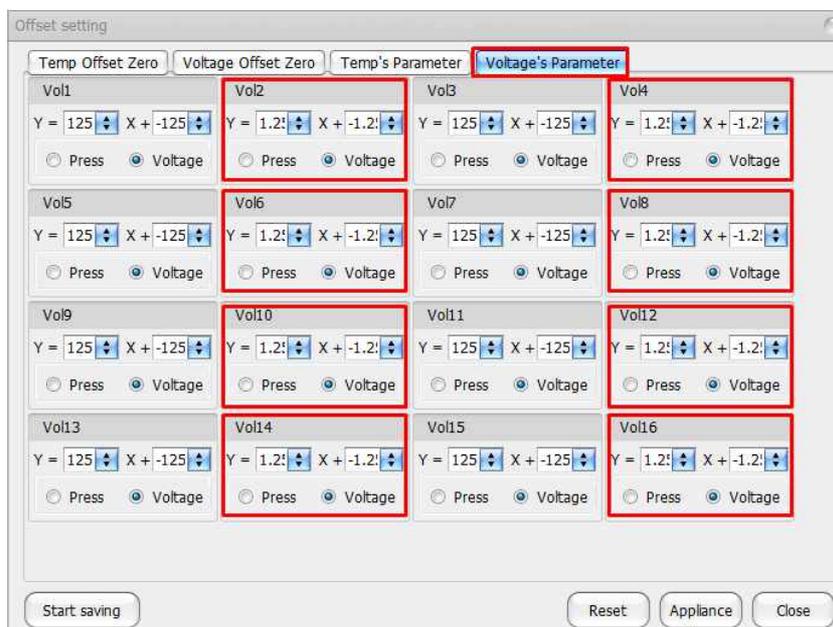
Offset counter 0.0 : It is indication for voltage figure

Click the application then click the Close for applying the figure

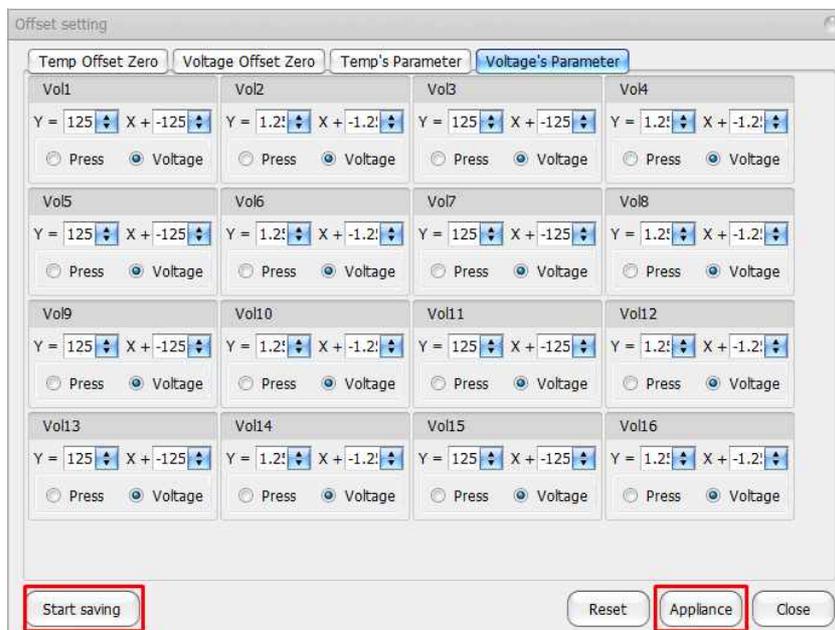


(5) Voltage's Parameter has a function which can input the figure for changing input figure, You can set as choosing Voltage.

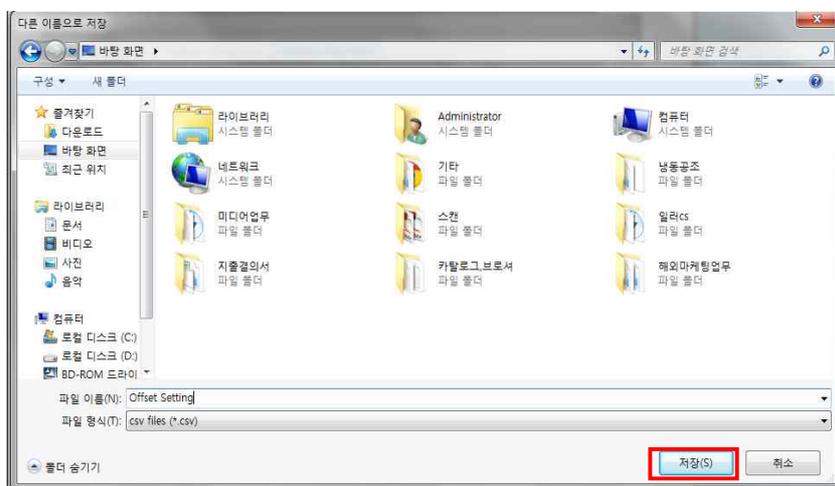
Vol1, Vol3, Vol5, Vol7, Vol9, Vol11, Vol13, Vol15 must enter a value of "Y=125x-125"



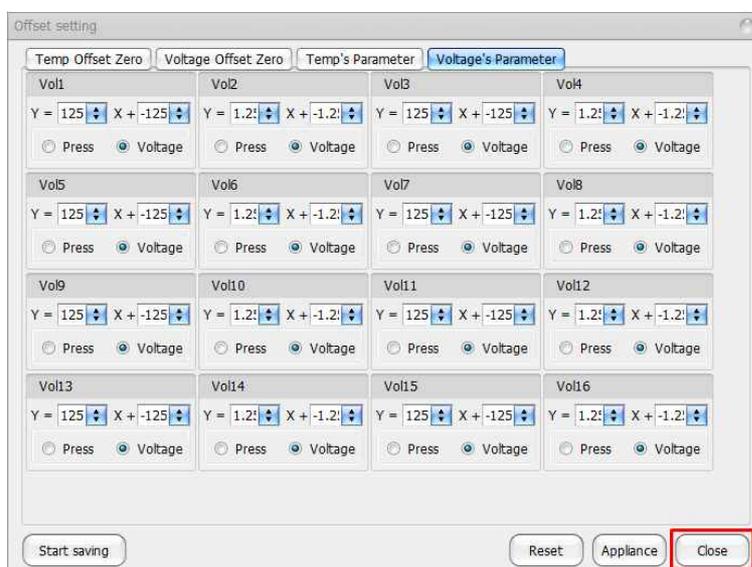
(6) Vol2, Vol4, Vol6, Vol8, Vol10, Vol12, Vol14, Vol16 must enter a value of "Y=1.25x-1.25"



(7) Click "Appliance" and click "Start Saving" for Application.

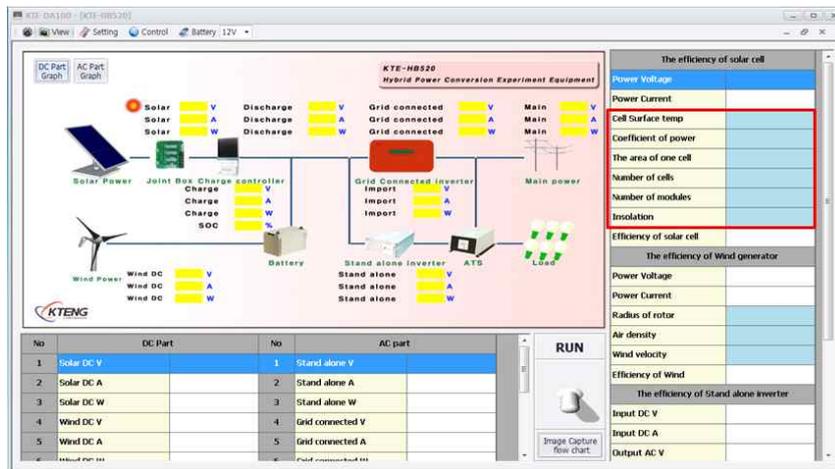


(8) Click Start Saving Save the file name entered in the left side of the screen

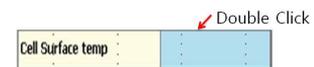


(9) Start saving set figure and Click "Close" on the left screen

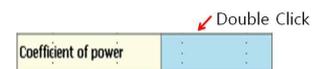
④ Efficiency of solar cell setting



(1) enter of measured temperature(ex:60°C)



(2) enter a value of "0.4°C"



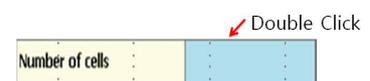
- The temperature coefficient is different according to the type of PV module.

- Crystalline silicon module is "-0.45%"

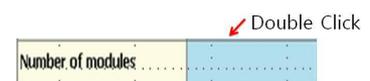
(3) enter a value of "0.1m²"



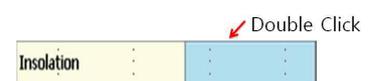
(4) enter a value of "1EA"



(5) enter a value of "4EA"



(6) enter a value of "1000W/m²"



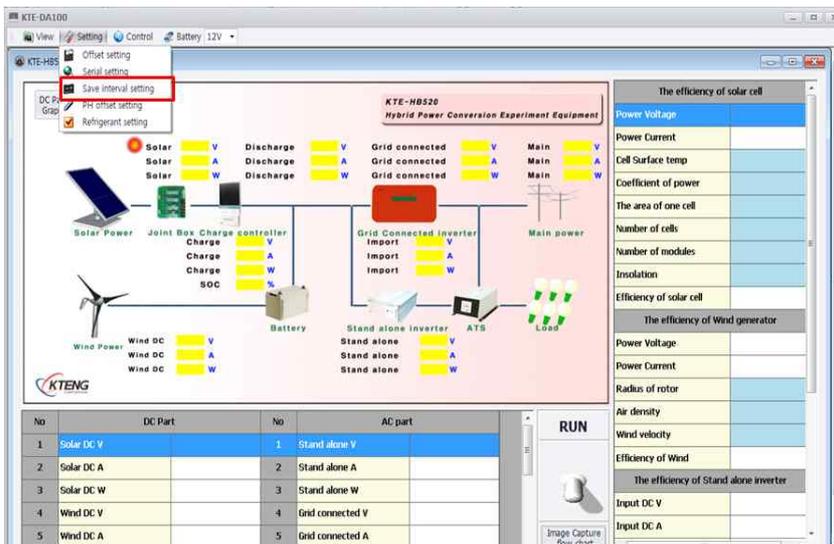
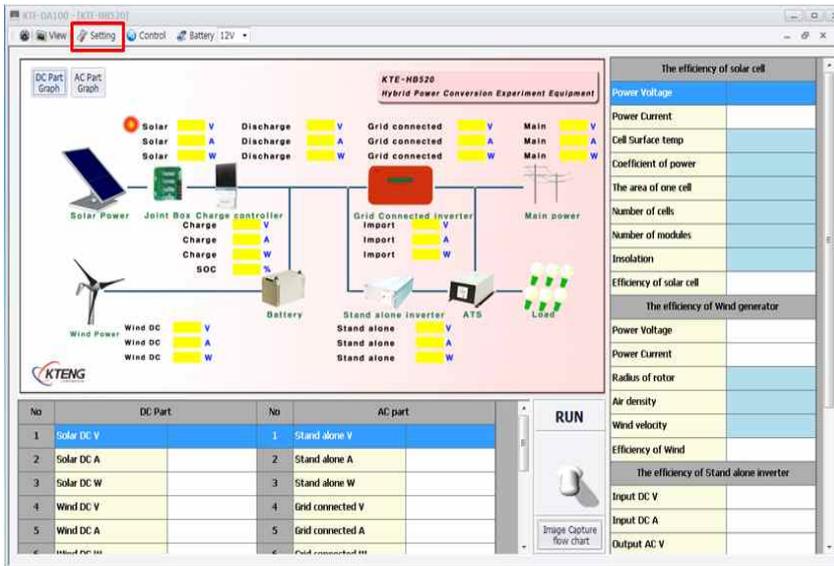
⑥ Calculation

$$\text{Efficiency of Solar Cell} = \frac{(\text{Output Modules "V" x "I"}) + [(\text{Surface Temperature} - 25) \times \text{Output Temperature Coefficient}]}{\text{The area of One Cell(m)} \times \text{Number of Cells(ea)} \times \text{Number of Modules(ea)} \times \text{Insolation}} \times 100\%$$

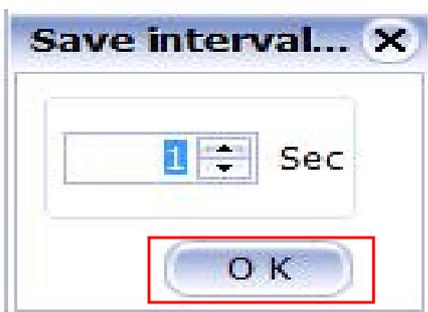
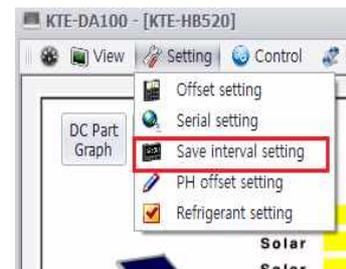
$$\text{Efficiency of Wind Generator} = 2 \times \frac{(\text{Output Wind Power "V" x "I"})}{(\pi \times \text{Radius of Rotor}^2) \times \text{Wind Velocity}^3 \times \text{Air Density}} \times 100\%$$

⑦ Save Interval setting

(1) Click Setting



(2) Click Save interval setting

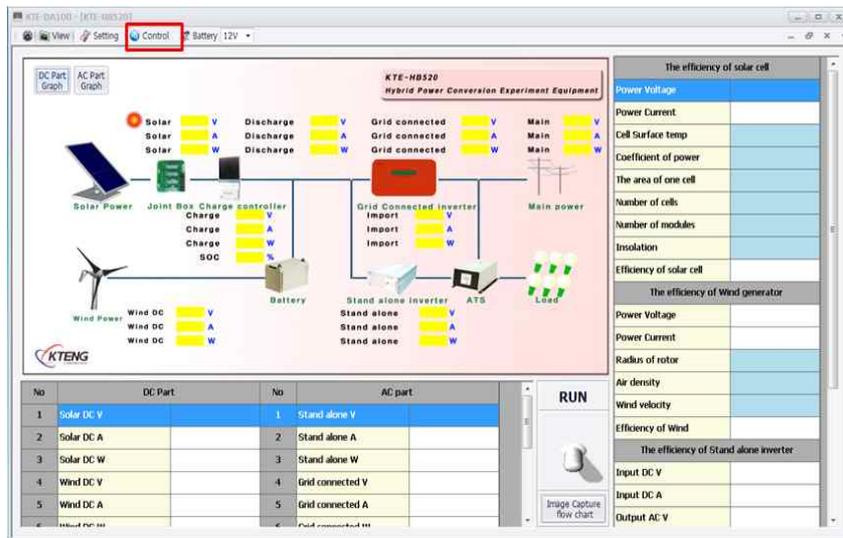


(3) Save interval setting

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)

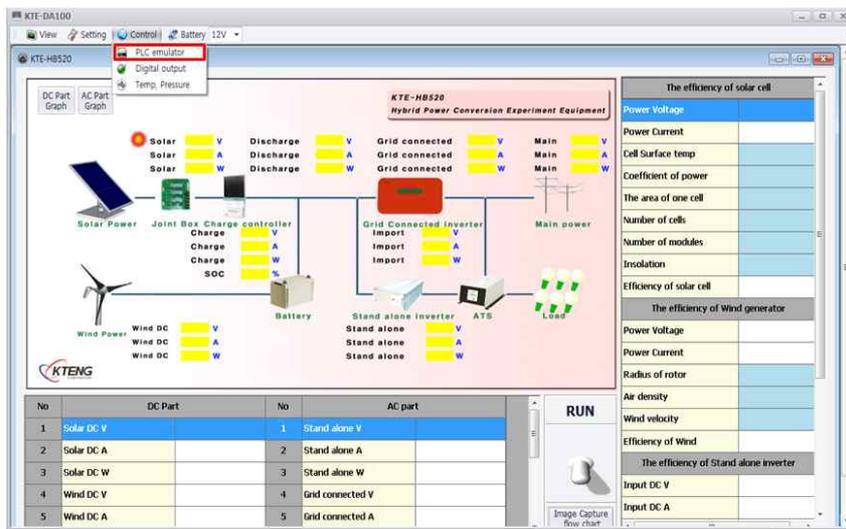
iv) Control

① PLC emulator

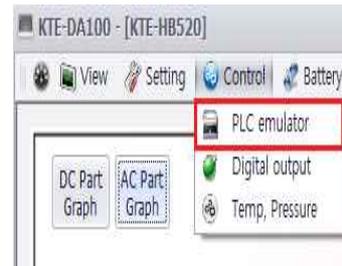


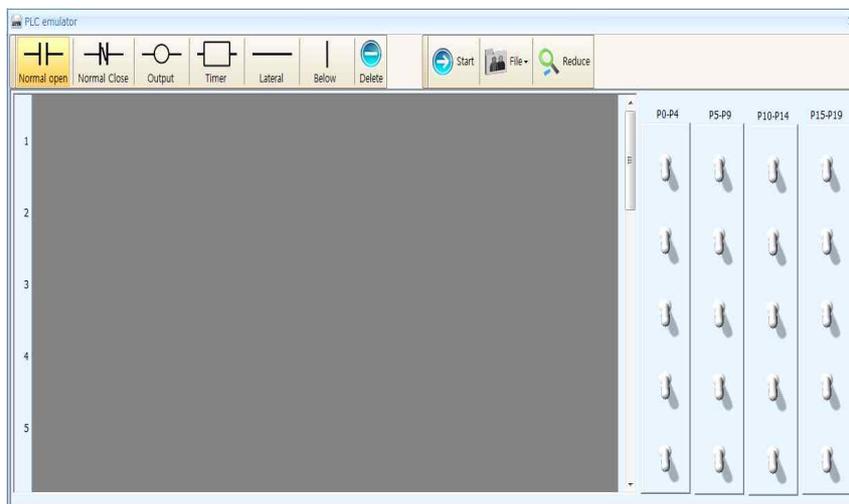
(1) Clock

Control in Tools



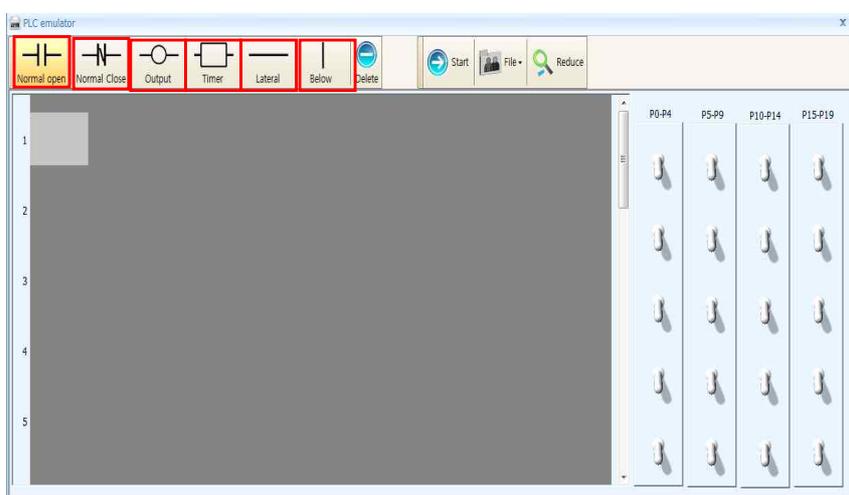
(2) Using PLC, The function for ON/OFF and control timer about all equipments.



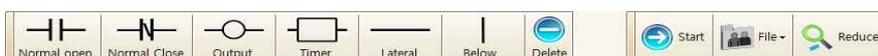


(3)When Click“PLC emulator”

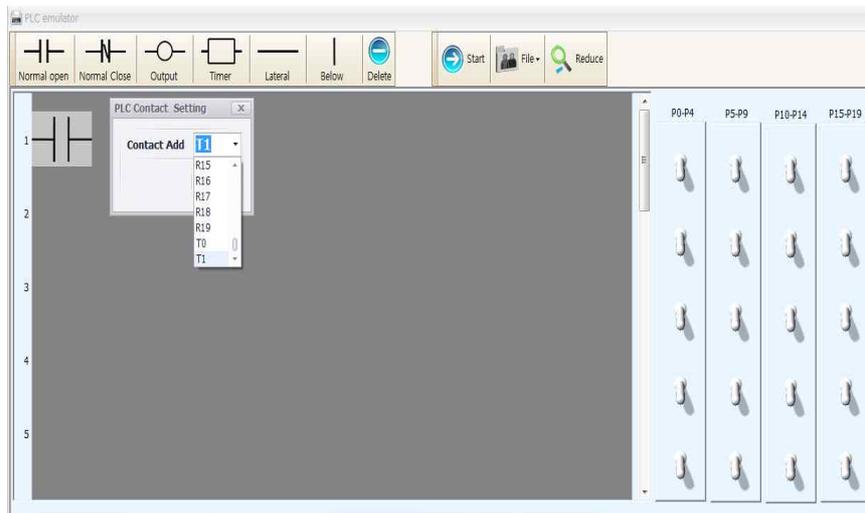
Indicate the window such as left screen



(4)Using method is that after selecting the zone first, programming with inputting command

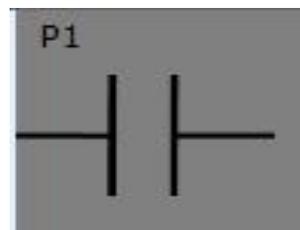
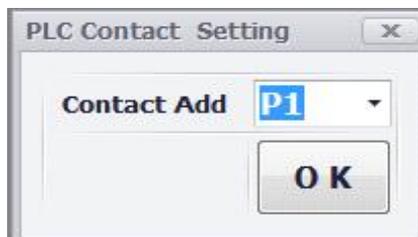


Command	Explain
	Normal Open
	Normal Close
	Coil(Load)
	Timer
	Horizontal Extending Line
	Vertical Extending Line
	Delete
	Start
	Open Recent File
	Reduce Screen



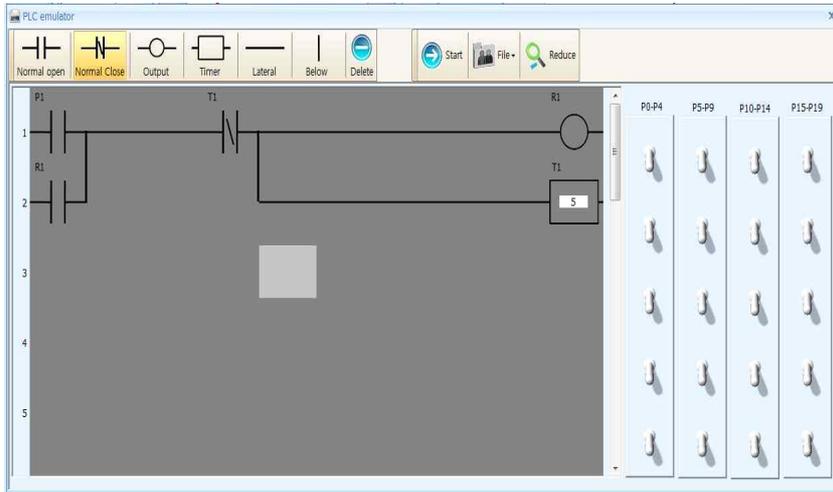
(5) Double click the marker then set P,R,T

- P : Push
- R : Relay
- T : Timer

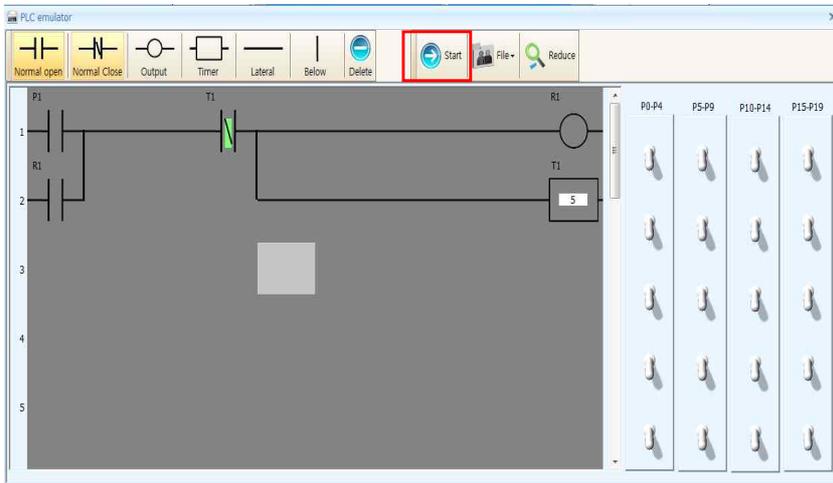


- Set P1 then Click"OK"

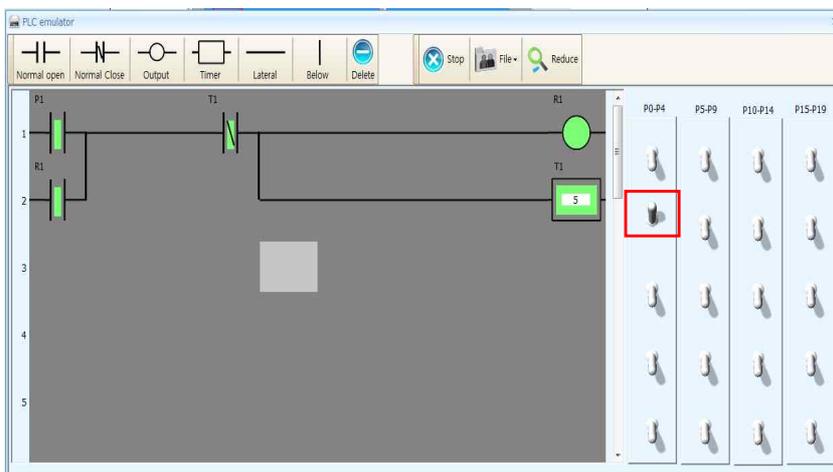
- Indicate P1 the top of the left side



(6) It is example using command

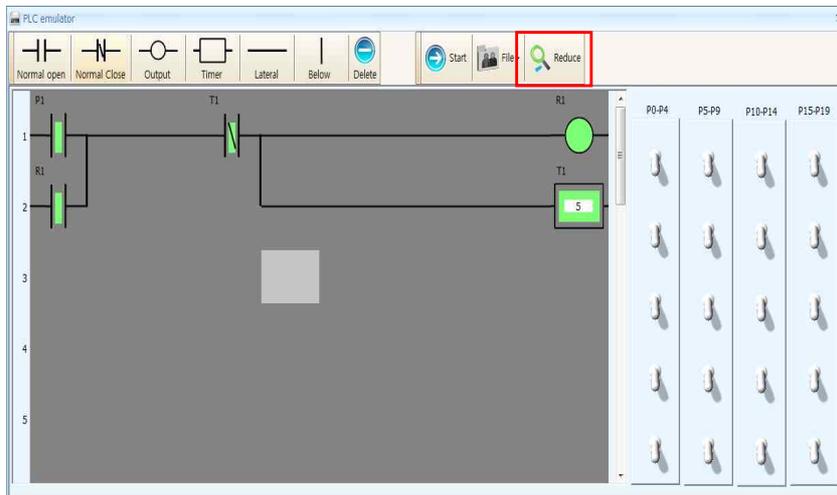


(7) Click Start then indicate mark which is T1-B



(8) Detach, press the P1. If R1 is a woman become a contact is closed, and the self-maintenance of R1 at the same time as the set time T1 is also a woman (Sec) after the b contact of T1 opens being supplied to R1

As Dunn power is cut off. Being returned to its original position



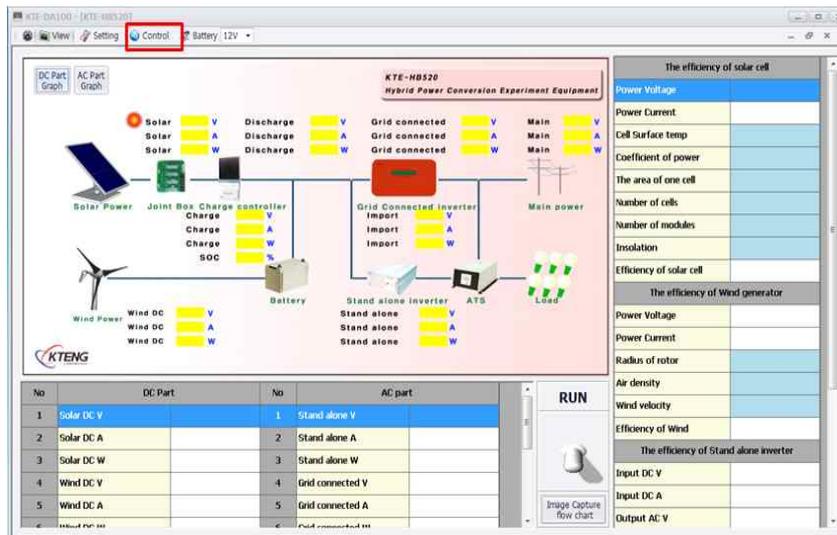
(9)Click Reduce



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

Click view of PLC, it is returned

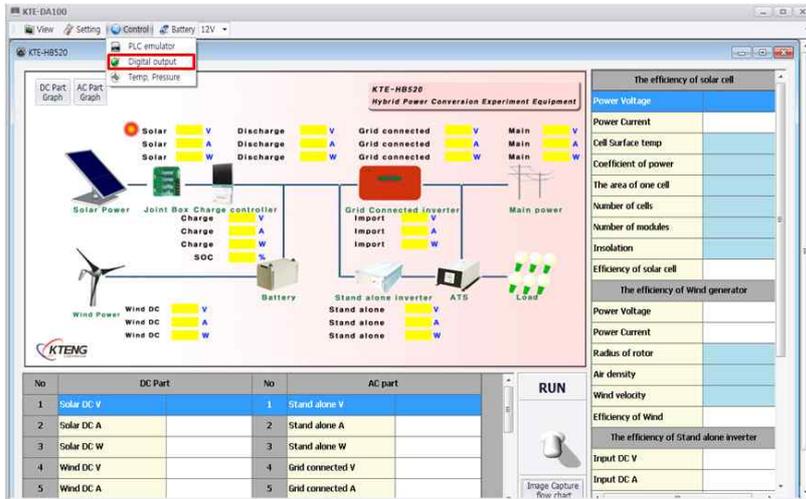
② Digital Output



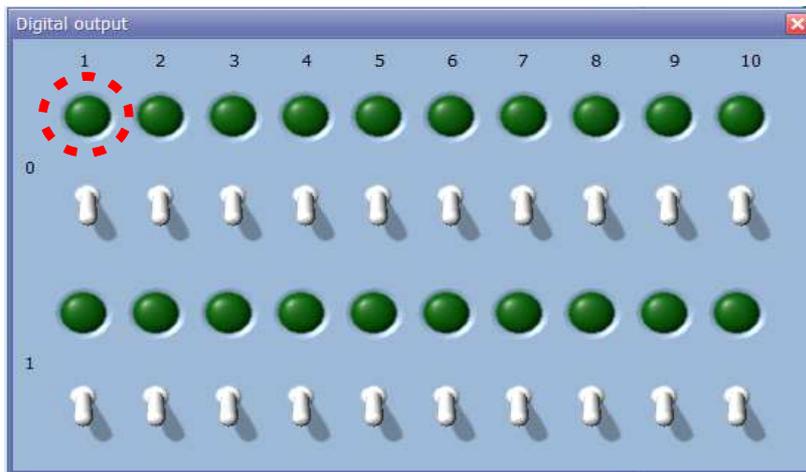
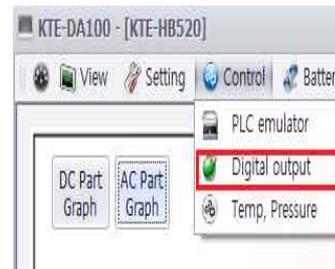
(1) Click

" Control " in Tools





(2)Click"Digital output"

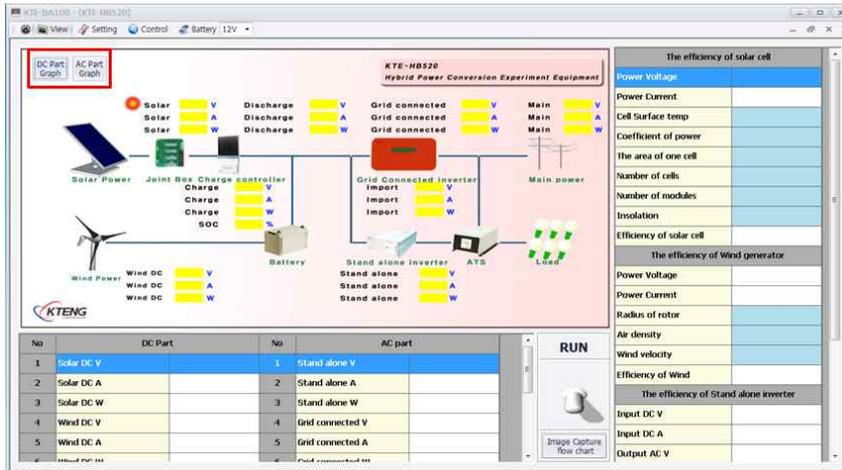


(3)Digital output is the second comp by number And to the switch ON / OFF When you work with equipment to operating the stand relay and the operation or without through the lamp

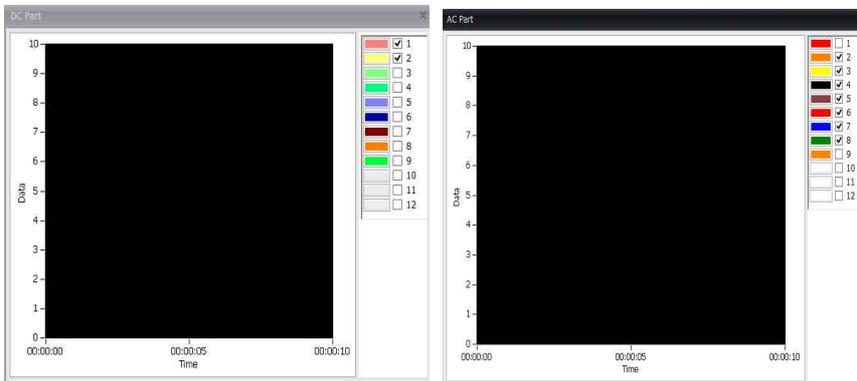
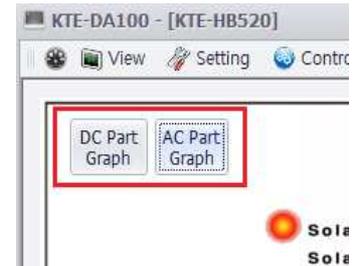
Function to determine

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

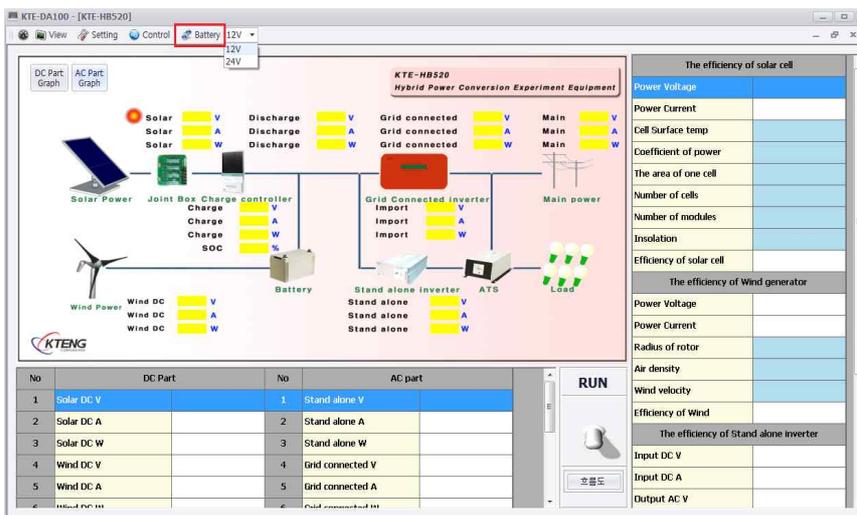
(6) Other Functions



(1) Dc Part, Ac Part Graph DiagramView
Click on the top left of the icon



(2) When selected, can be viewed in real-time to fit the screen by selecting the number



(3) can be selected to 12V, 24V the voltage of the battery



Chapter 2. Practice to configure and operation as circuit

Experiment name	1. The battery power input circuit training			Required time	8
The Object of Experiment	① Wiring can be conducted based on designed circuit diagram. ② It uses the battery direct current voltage and inverter, so the process that convert to alternating power can be understood. ③ Differences between dc and ac can be understood.				
Experiment Equipment	Tool and Material	Spec of Tools	Q`nty		
<ul style="list-style-type: none"> • Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL) 	<ul style="list-style-type: none"> • Screw driver set • Nipper • Wire Stripper • Hook Meter 	<ul style="list-style-type: none"> • #2× 6× 175mm • 150mm • 0.5~6mm² • 300A 600V 	1 1 1 group1		
Control Circuit					
<p>1. Control Circuit</p>					
L1, L2 : Line Voltage N.F.B : No fuse circuit breaker Inver1 : Stand-alone inverters RL, GL, YL : DC Lamp load1 : Load power output signal		Ry: Relay PB1,3 : A contact pushbutton switch PB2,4 : B contact pushbutton switch Bat in : Battery input signal			

2. Battery



Battery converts the chemical energy in the chemical substance inside of it to electric energy by oxidation-reduction reaction, and if all electric energies are consumed, voltage will be getting lower due to discharge. Eventually, it cannot transport the electric charge, and at this time. It is divided into 1st battery and 2nd battery depending on charging possibility. 1st battery is disposable, and 2nd battery can be recycled throughout charging.

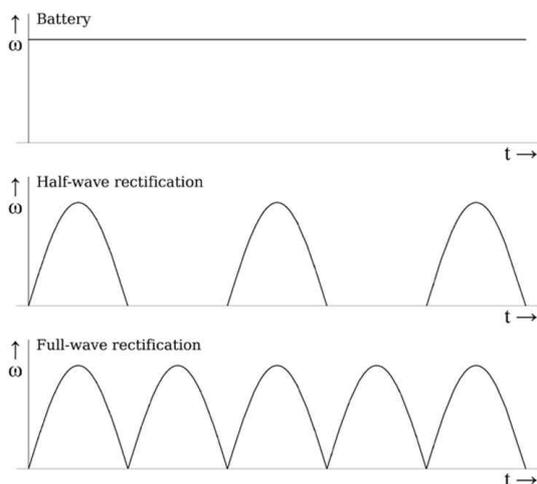
3. Inverter



Generally, inverter is the device that converts dc to ac, and its method and design varies with its use ranges. For example, it varies depending whether it is motor operation, it is ac voltage for house and electricity is exported with kopec, and in this specification, it is the inverter to use the house-purpose ac voltage. From here, it is also divided into modified sin wavelength and sin wavelength.

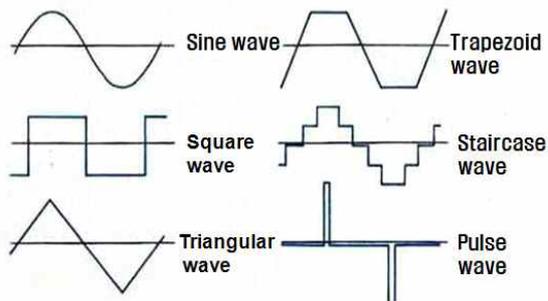
4. DC and AC voltages

* DC



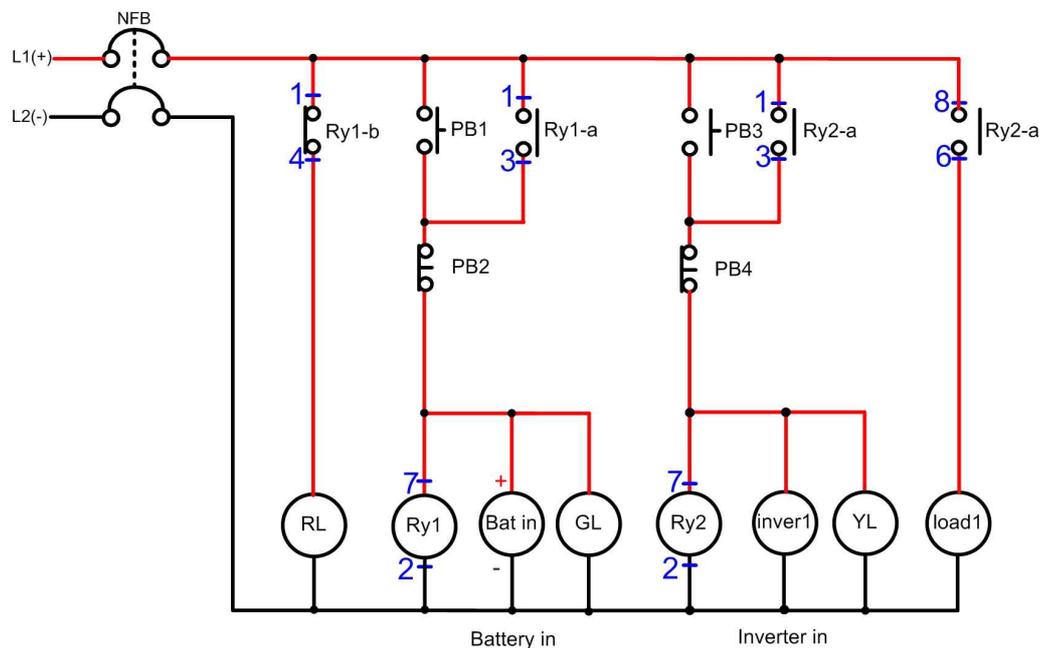
Current that flows to constant direction like current in battery is indicated as dc if + and - pole is not changed. The next shows the wavelength alternating of direct current.

* AC



Because it is current that changes its size and direction periodically, it is indicated as ac if there is + and -. The next shows the wavelength pattern of alternating current.

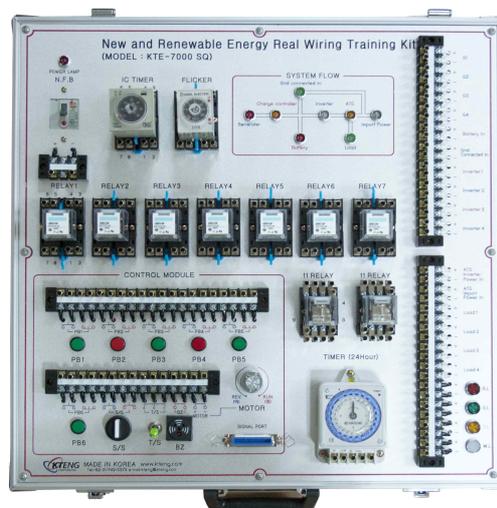
5. Explanation



- (1) Turn on the nfb breaker, then red lamp will be on.
- (2) Push pb1, and then green lamp will be on while red lamp will be off. Also, relay one will be excited, and due to a contact point of relay one, it does self-maintain, and battery in mc will be also excited, so charging controller and battery is connected.
- (3) Push pb3, and then yellow lamp will be on, and relay two will be excited, so due to a contact point of relay two, it does self-maintain, and mc of inverter one will be excited, so charging controller and battery is connected. In same times, mc of load one will be excited, so load will be connected to each other.
- (4) Push pb4, and then relay two, inverter one and yellow lamp will be off, so connections between battery and inverter will be disconnected, and in same times, inverter and load connection will be blocked.
- (5) Push pb2, relay one, battery one and green lamp will be off, and red lamp will be on. Thus, connections between charging controller and battery will be blocked.
- (6) If turn off nfb breaker, red lamp will be off.



Solar Power Generation Experiment Equipment (KTE-7000SG)



New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

• Requirement

1. Prepare and check the test devices, tools and materials.
2. Purpose and effect of battery connection can be explained.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Explain the processes operated when pb2 is pushed.
 - (3) Explain the differences between ac and dc.
5. Roles of inverter can be understood and explained.
6. Use the test devices, tools, and materials, conduct thread wiring and operate.

		Evaluation Item	Allot	Obtain	Remarks			
Valuation Basis	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
		Usage and arrangement of tool	5					
Time point (20)	Subtract () point in every () minute excess				Item	Work	Time	Total

<p>Experiment name</p>	<p>2. Using ATS automatic switch circuit for uninterruptible</p>		<p>Required time</p>
<p>The Object of Experiment</p>	<p>① Wiring can be conducted based on designed circuit diagram. ② Instruction of battery power and commercial power can be understood, and wiring can be conducted. ③ Function of ATS can be understood and explained.</p>		
<p>Experiment Equipment</p> <ul style="list-style-type: none"> • Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL) 	<p>Tool and Material</p> <ul style="list-style-type: none"> • Screw driver set • Nipper • Wire Stripper • Hook Meter 	<p>Spec of Tools</p> <ul style="list-style-type: none"> • #2× 6× 175mm • 150mm • 0.5~6mm² • 300A 600V 	<p>Q`nty</p> <p>1 1 1 group1</p>
<p>Control Circuit</p>			
<p>1. Control Circuit</p> <p>L1, L2 : Line Voltage N.F.B : No fuse circuit breaker Inver : Stand-alone inverters RL : Lamp ATS in1 : ATS inverter input ATS in2 : ATS import input</p> <p>Ry : Relay PB1 : A contact pushbutton switch PB2 : B contact pushbutton switch Bat in : Battery input signal Load : Load power output signal</p>			

2. ATS(Automatic transfer switch)

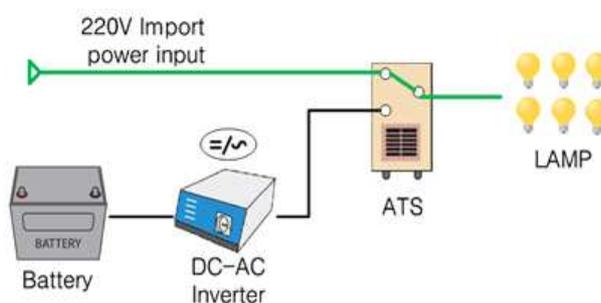


Automatic transfer switch secures the double or triple power, so when main power blackout or voltage is dropped less than standard value, it is converted to backup power automatically, so it is the device that makes customer receive constant power. Due to blackout of main power input, auxiliary power input is automatically converted, so it always supplies the uninterruptible power. Maintain the power supply by auxiliary power, and then if main power input is supplied again, it is converted automatically to main power.

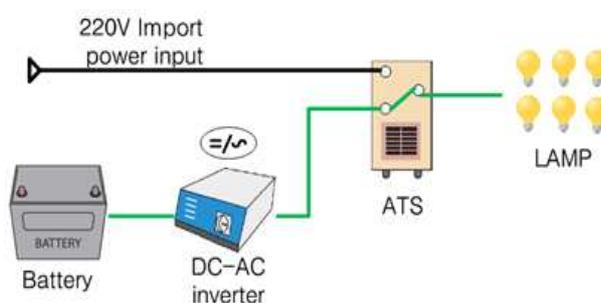
(1) Scope of various using purpose

Emergency generator, substitute for ups, place where power failure frequently, grid-connected solar street lamp, emergency power converter , and other place where stable electricity supply is required.

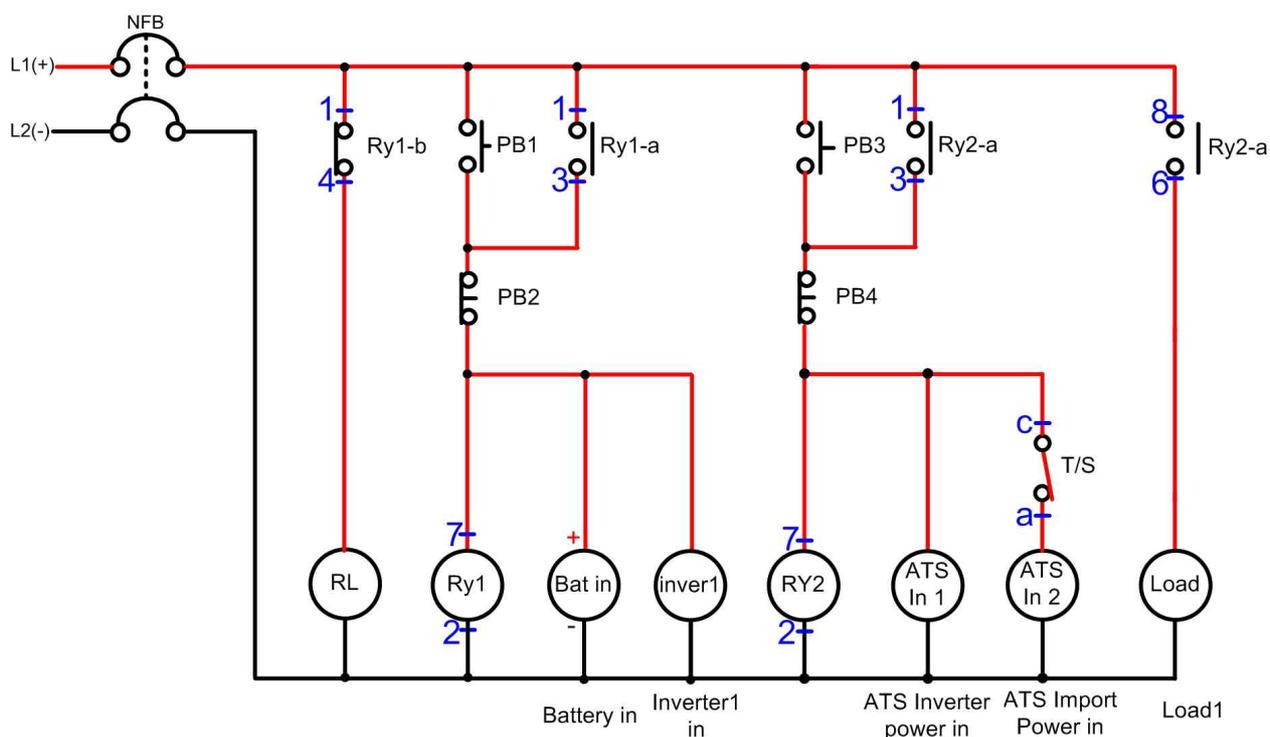
(2) Import power operation status



(3) Import power is interrupted status



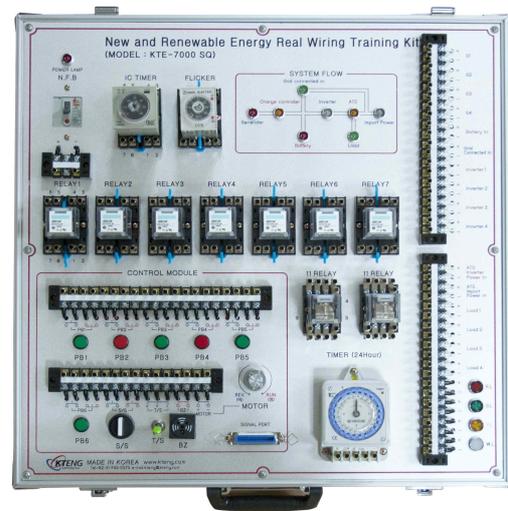
4. Explanation



- (1) Turn on NFB breaker, and then red lamp will be on.
- (2) Push PB1, and then red lamp will be off. Also, relay one will be excited, and due to a contact point of relay one, it does self-maintain, and battery in mc and inverter one mc will be also excited, so charging controller and battery is connected, and in same time, dc is supplied from battery to inverter.
- (3) Push PB3, and then relay two will be excited, and due to a contact point of relay one, it does self-maintain, and ats in one mc and ats in two mc will be excited, as ac output of inverter and commercial power is supplied to ats in same time. Because relay two a contact point is closed in same time, mc of load one will be excited, so power is supplied to load.
- (4) When toggle switch is closed, power is supplied to load with commercial power.
- (5) Open toggle switch, and then mc of ats in tow will be demagnetized, so connections between commercial power and ats import power in will be blocked, and this will make virtual blackout state, so by ats, ups will supply the power to load with output power of inverter simultaneously.
- (6) Push PB4, and then relay twom ats in one, and ats in two mc will be excited, so inverter output and ats inverter power in connections will be blocked, and as same, commercial power and ats import power in connections will be blocked. In same times, load mc will be excited, so load connection will be blocked.
- (7) Turn off nfb breaker, and then red lamp will be off.



Solar Power Generation Experiment Equipment (KTE-7000SG)



New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

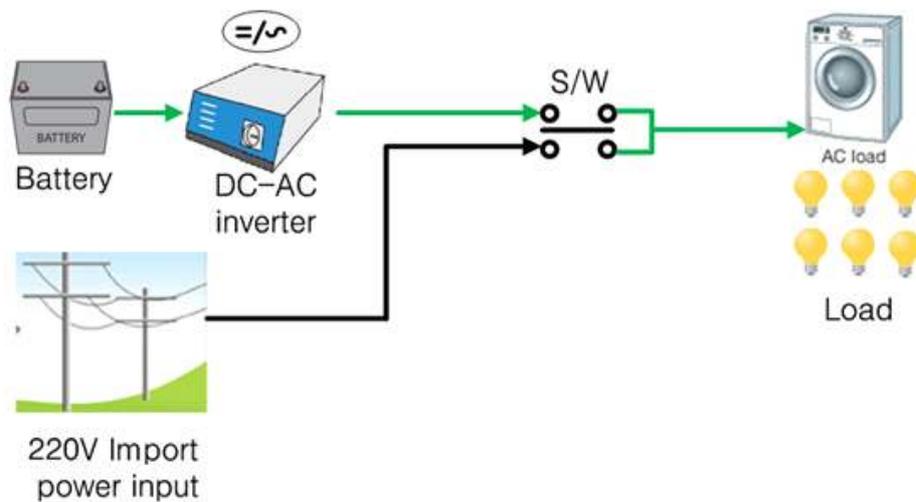
• Requirement

1. Prepare and check the test devices, tools and materials.
2. Using purpose and effect of ats can be explain.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Motion processes depending on changes of ats contact point can be explained.
 - (3) Explain the processes operated when pb2 is pushed.
5. Use the test devices, tools, and materials, conduct thread wiring and operate.

		Evaluation Item	Allot	Obtain	Remarks			
Valuation Basis	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
		Usage and arrangement of tool	5					
Time point (20)	Subtract () point in every () minute excess				Item	Work	Time	Total

<p>Experiment name</p>	<p>3. Practice to configure of commercial electric or battery power selection circuit</p>	<p>Required time</p>		
<p>The Object of Experiment</p> <p>① Wiring can be conducted based on designed circuit diagram. ② Instruction of selector switch can be understood and wiring can be conducted. ③ Using selector switch, deploy circuit of commercial power and battery power can be understood, and wiring can be conducted.</p>		<p>8</p>		
<p>Experiment Equipment</p>		<p>Tool and Material</p>	<p>Spec of Tools</p>	<p>Q`nty</p>
<ul style="list-style-type: none"> • Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL) 		<ul style="list-style-type: none"> • Screw driver set • Nipper • Wire Stripper • Hook Meter 	<ul style="list-style-type: none"> • #2× 6× 175mm • 150mm • 0.5~6mm² • 300A 600V 	<p>1 1 1 group1</p>
<p style="text-align: center;">Control Circuit</p>				
<p>1. Control Circuit</p> <p>L1, L2 : Line Voltage N.F.B : No fuse circuit breaker inver : Stand-alone inverters RL, GL, YL : DC Lamp ATS in2 : ATS Import power in T/S : Toggle Switch</p> <p>Ry : Relay PB1 : A contact pushbutton switch PB2 : B contact pushbutton switch Bat in : Battery input signal Load : Load power output signal</p>				

2. Blocks of the system



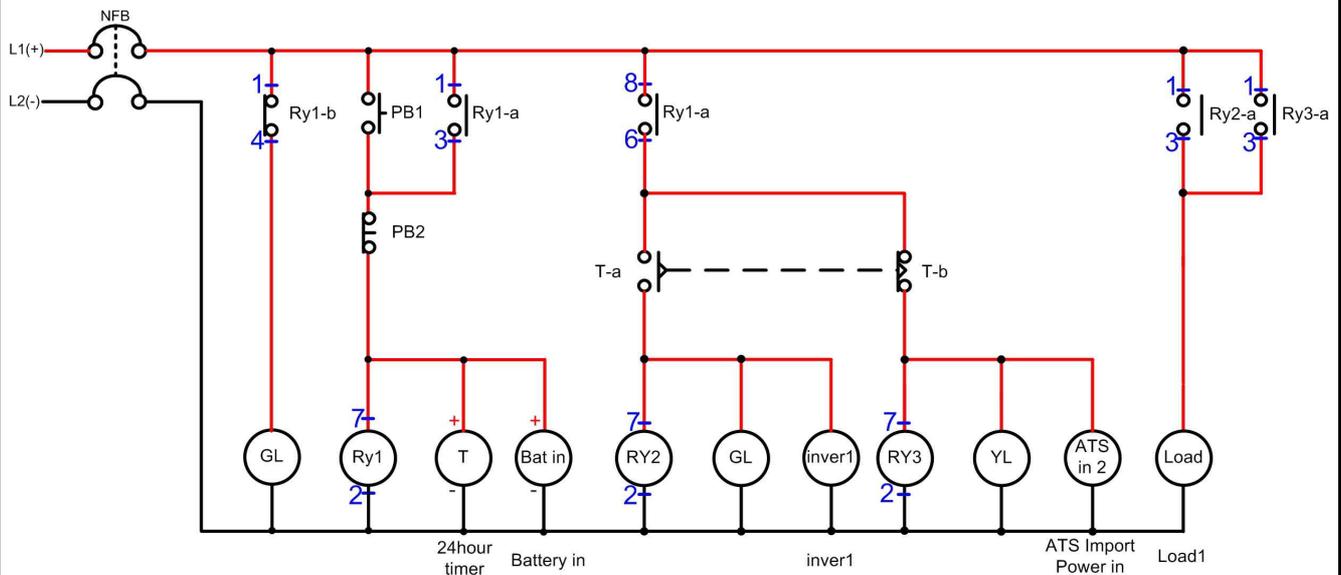
- (1) While charging the electricity generated from new renewable energy, such as solar and wind power, and if battery charging is completed, power supply using battery power is conducted. Using selector switch, if battery is discharged, commercial power line can be used, and when battery is charged completely, use the load using battery power again.
- (2) What is the commercial power? It is the power used in all the times, it is the main power supplied from electric power company.

3. 24 hours time

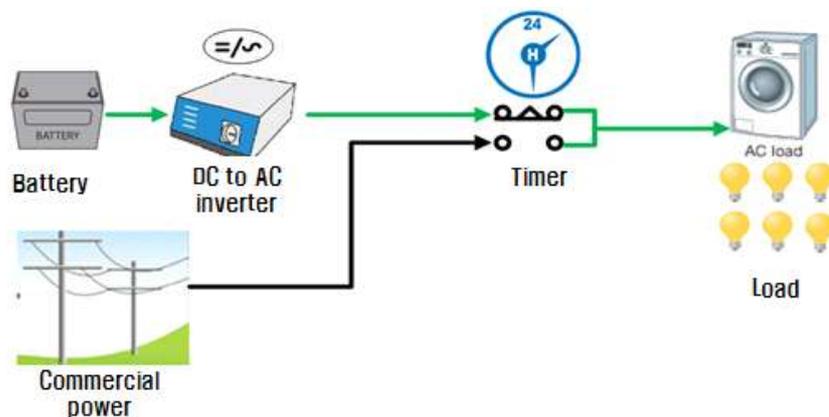


24 hours timer: that contact point is closed or opened during fixed time.

4. Application Circuit



5. Blocks of the system

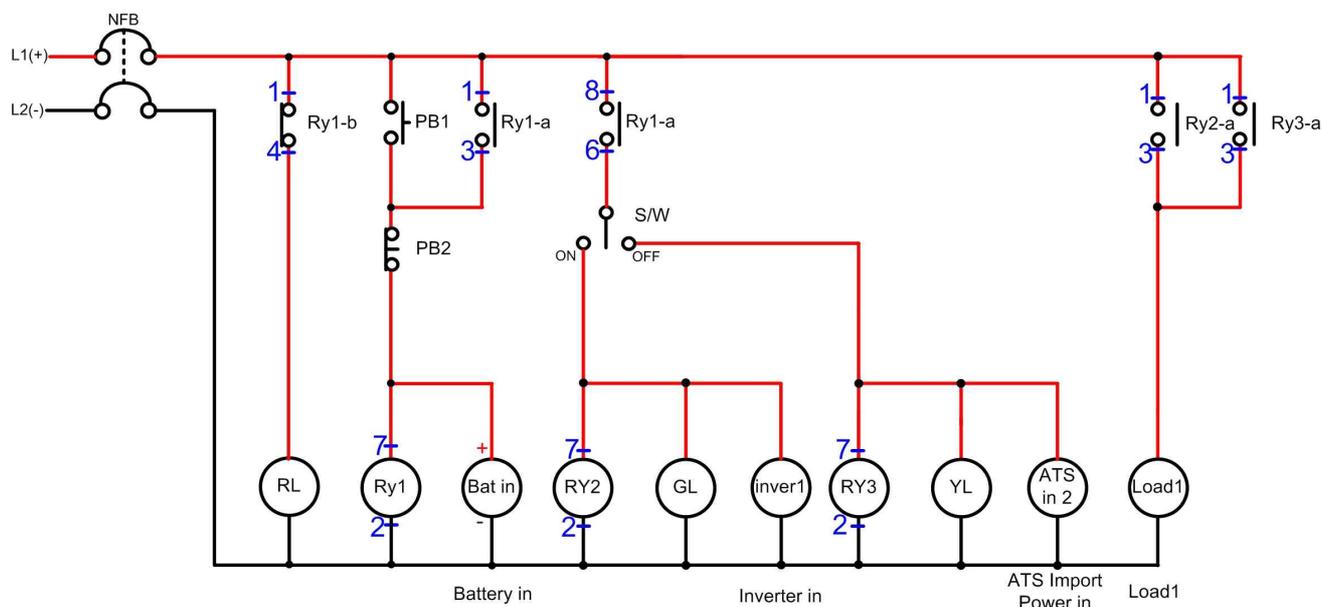


(1) Use the timer instead of selector switch, so commercial power is used in night time that electric cost is not expensive, and during daylight that electric cost is expensive, battery power can be used. Replace the selector switch with 24 hours timer, smart grid can be realized by setting up that power line is selective depending on times.

(2) Smart Grid

- Smart grid is based on combination of information technology (it) to existing power grid, and it is the next generation power grid that exchanges the information between supplier and customer in real time to optimize the energy efficiency.
- ex) Washing machine in home will be operated in the time that electric cost is most inexpensive, and charge the electric mobile in the night, even it is parked during day.

3. Explanation



- (1) Turn on the NFB breaker, then red lamp will be on.
- (2) Push PB1, and then green lamp will be on while red lamp will be off. Also, relay one will be excitation, and due to a contact point of relay one, it does self-maintain, and battery in mc will be also excitation, so charging controller and battery is connected.
- (3) Turn on the selector switch, and then relay two and green lamp will be on, and mc of inverter one will be excited, so battery and inverter is connected. In same times, because relay two a contact point is closed, mc of load one will be excited, so power is supplied from output power to load.
- (4) Put selector switch to middle, and then relay two and mc of inverter one will be excited, so battery and inverter connection will be blocked, and green lamp will be on. Because relay two a contact points are open in same times, mc of load one will be excited, so power supply of load will be blocked.
- (5) Turn off the selector switch, and then relay three and mc of ats in two will be excited, so commercial will be approved, and yellow lamp will be on. Because relay three a contact point is closed in same time, mc of load one will be excited, so power is supplied to load with commercial power.
- (6) Put selector switch to middle, and then relay three and mc of ats in will be excited, so battery and inverter connection will be blocked, and green lamp will be on. Because relay two a contact point is opened in same times, mc of load one will be demagnetized, so power supply to load will be blocked.
- (7) Push PB2, and then relay one and battery one will be excited, and green lamp and yellow lamp will be on. Also, relay two, inverter one, relay threem ats in two, and load one will be demagnetized, so all connection will be blocked.
- (8) Turn off the NFB breaker, and then red lamp will be off.



Solar Power Generation Experiment Equipment (KTE-7000SG)

New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

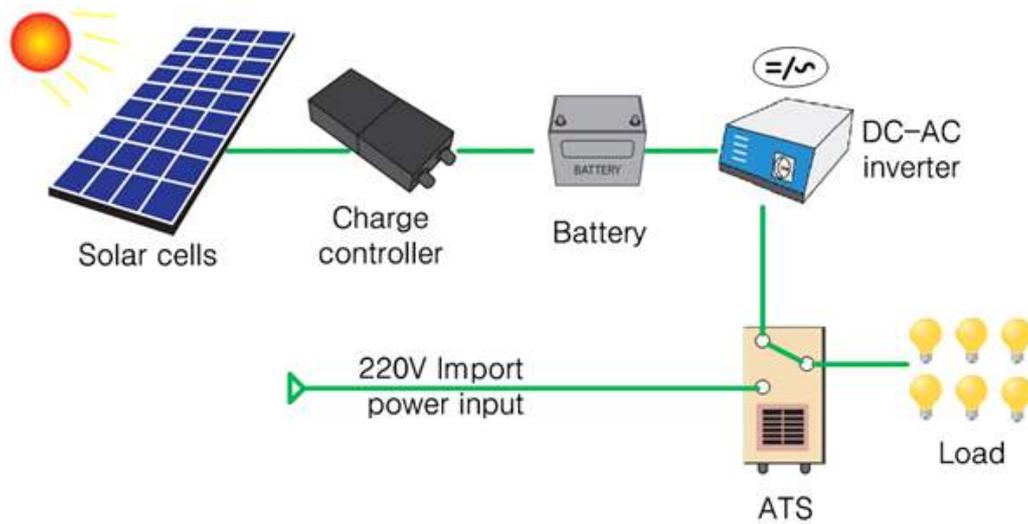
• Requirement

1. Prepare and check the test devices, tools and materials.
2. The purpose of the selector switch, and may explain the effect.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) The advance of the operation of the selector switch contacts to explain the process.
 - (3) Explain the processes operated when pb2 is pushed.
5. Use the test devices, tools, and materials, conduct thread wiring and operate.

		Evaluation Item	Allot	Obtain	Remarks			
Valuation Basis	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
		Usage and arrangement of tool	5					
Time point (20)	Subtract () point in every () minute excess				Item	Work	Time	Total

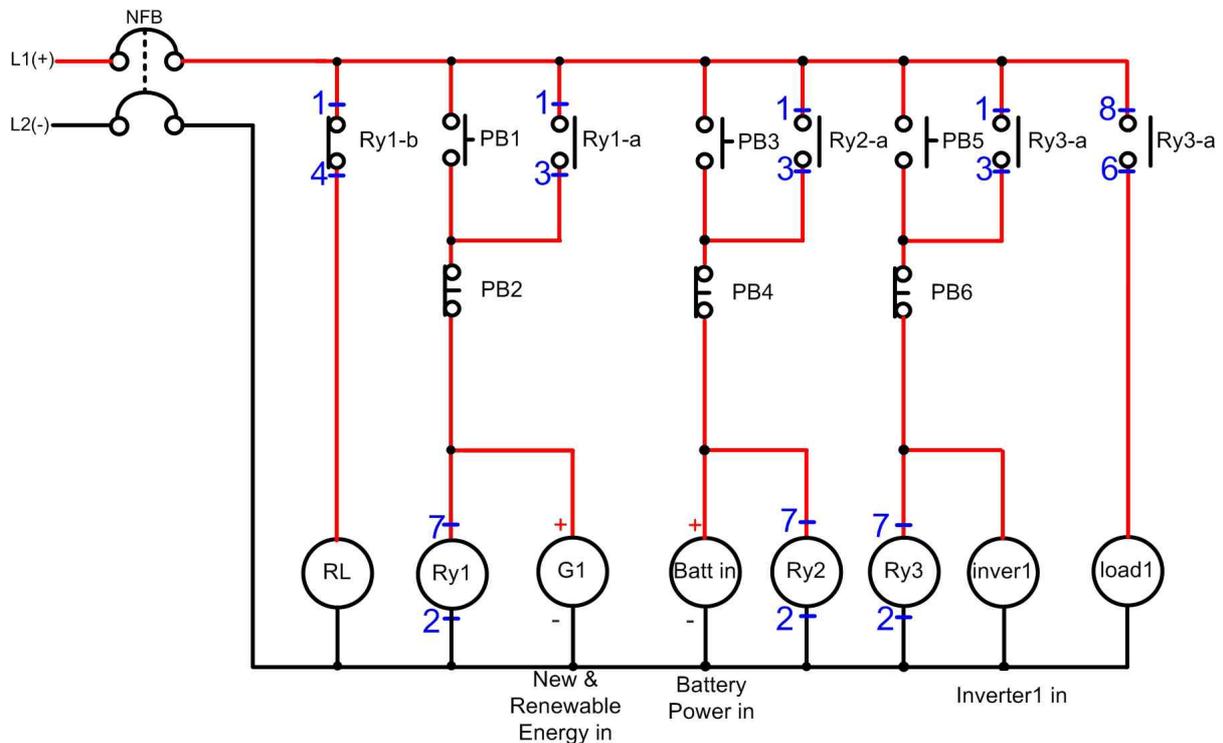
Experiment name	4. Stand-alone inverter circuit configuration training 1	Required time		
		8		
The Object of Experiment	① Wiring can be conducted based on designed circuit diagram. ② Stand-alone inverter circuit can be understood and wiring can be conducted.			
Experiment Equipment		Tool and Material	Spec of Tools	Q`nty
• Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL)		• Screw driver set • Nipper • Wire Stripper • Hook Meter	• #2× 6× 175mm • 150mm • 0.5~6mm ² • 300A 600V	1 1 1 group 1
Control Circuit				
<p>1. Control Circuit</p> <p style="text-align: center;"> New & Renewable Energy in Battery Power in Inverter1 in </p> <p> L1, L2 : Line Voltage N.F.B : No fuse circuit breaker inver1 : inverter G1 : Solar Power input Line RL: DC Lamp </p> <p> Ry : Relay PB1,3,5 : A contact pushbutton switch PB2,4,6 : B contact pushbutton switch Bat in : Battery input signal load1 : Load power output signal </p>				

2. Stand-alone inverter systems



- (1) Independent inverter system is not connected with power system of commercial, but it is the generating system used as independent power, so it is mostly used in the undeveloped region where commercial power system cannot be supplied and when independent power is required because of certain circumstance.
- (2) Because there are time differences between generating time and time that consumes electricity, most independent systems are equipped with battery, and it saves generated power to battery, and discharge the battery if necessary to use the power.
- (3) It is varied from small size to large size, and small sizes, such as table calculator or clock using solar battery cannot be called as the devices that use independent power system. Large size is used for emergency power of mountain cabin, villa, laboratory facility or emergency equipment. Because it is not related to commercial power, it can be operated independently when commercial power is blacked out due to disaster.

3. Explanation



- (1) Turn on the NFB breaker, and then red lamp will be on.
- (2) Push the PB1, and then red lamp will be off. Also, relay one and G1 mc will be excited, so it will be self-maintained due to relay one a contact point, and new renewable energy will be deployed, so it will be connected to charging controller throughout connecting panel.
- (3) Push PB3, and then relay two will be excited and self-maintained, and batt in mc will also be excited, so charging controller and battery will be connected.
- (4) Push PB5, and then relay three will be excited and self-maintained, and mc of inverter one will also be excited, so charging controller and battery will be connected. Because relay three a contact point is closed in same time, mc of load one will be excited, so power is supplied to load from inverter output power..
- (5) Push PB6, and then relay three and mc of inverter one will be demagnetized, so power supply to load from inverter output will be blocked, and battery and inverter connection will be blocked.
- (6) Push PB4, and then relay two and batt in mc will be demagnetized, so connection to charging controller and battery will be blocked.
- (7) Push PB2, and then relay one and G1 mc will be demagnetized, so supply of new renewable energy will be blocked and red lamp will be on.
- (8) Turn off the NFB breaker, and then red lamp will be off.



Solar Power Generation Experiment Equipment (KTE-7000SG)

New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

• Requirement

1. Prepare and check the test devices, tools and materials.
2. Independent inverter circuit can be understood and wiring can be conducted.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Explain the processes operated when inverter1 operating.
5. Use the test devices, tools, and materials, conduct thread wiring and operate.

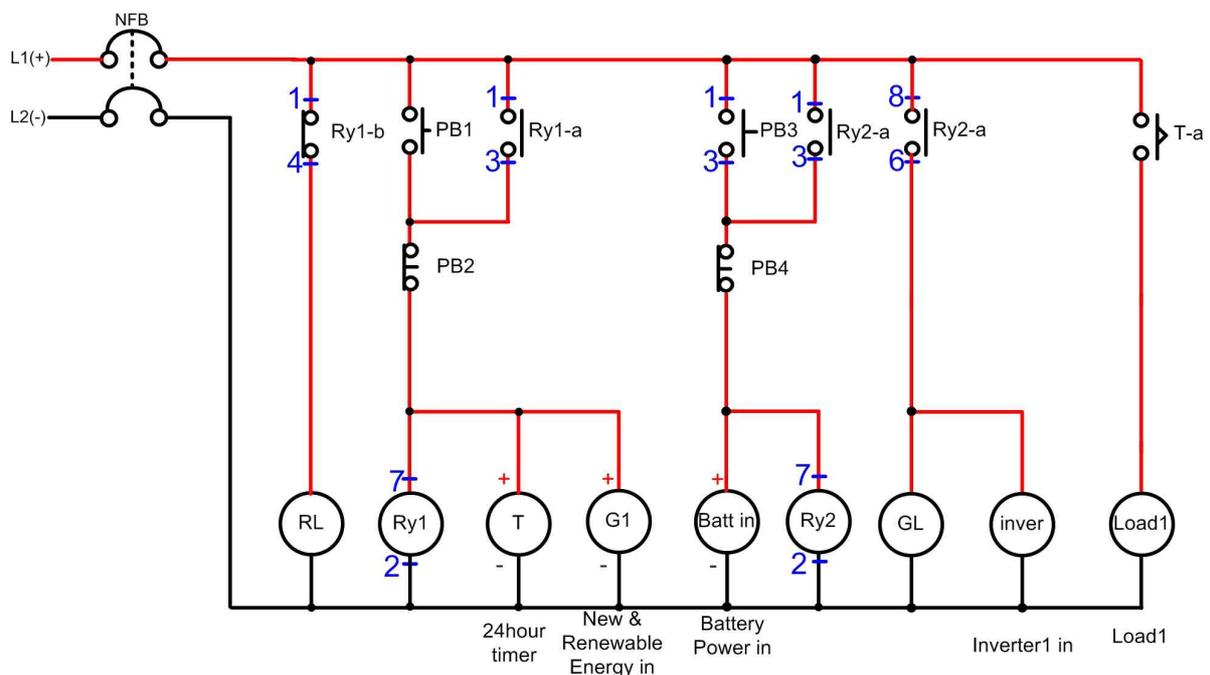
		Evaluation Item	Allot	Obtain	Remarks			
Valuation Basis	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
		Usage and arrangement of tool	5					
Time point (20)	Subtract () point in every () minute excess				Item	Work	Time	Total

Experiment name	5. Stand-alone inverter circuit configuration training for Solar street light	Required time
		8
The Object of Experiment	① Wiring can be conducted based on designed circuit diagram. ② Stand-alone inverter circuli can be understood and wiring can be conducted. ③ Solar street light equipment can be.	

Experiment Equipment	Tool and Material	Spec of Tools	Q`nty
<ul style="list-style-type: none"> • Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL) 	<ul style="list-style-type: none"> • Screw driver set • Nipper • Wire Stripper • Hook Meter 	<ul style="list-style-type: none"> • #2× 6× 175mm • 150mm • 0.5~6mm² • 300A 600V 	1 1 1 group1

Control Circuit

1. Control Circuit



L1, L2 : Line Voltage

N.F.B : No fuse circuit breaker

inver1 : Stand-alone inverters

RL, GL : DC Lamp

G1 : Solar Power input Line

S/S : Selector switch

Ry : 8pin, 11pin Relay

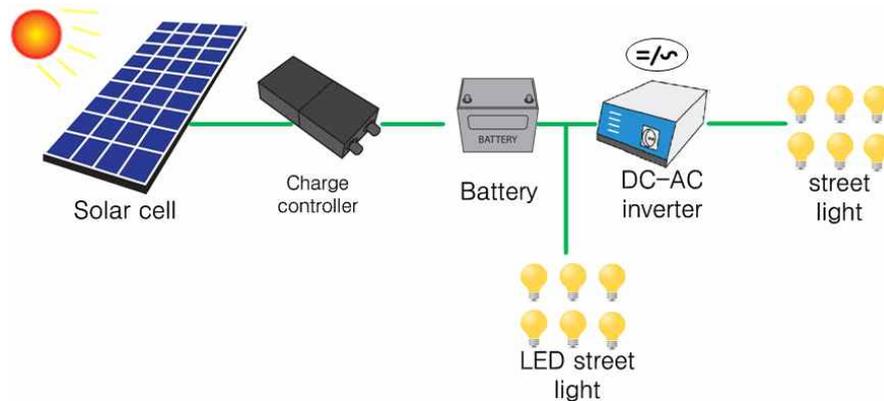
PB1,3: A contact pushbutton switch

PB2,4: B contact pushbutton switch

Bat in : Battery input signal

load1 : Load power output signal

2. Stand-alone inverter system solar street light



(1) Calculation of solar generating material capacity

1) Understand of electronic device that will be used.

- The most important thing when designing solar generating system is what electronic device will be used for how many hours in a day.
- Power consumption (w) of electronic device
- Understanding of voltage (v)- dc and ac of electronic device
- Daily average usage (Hr)

2) Calculation of system power consumption

(2) Method for selecting solar cell module.

1) Calculate the daily power consumption

Daily power consumption (whr) = power consumption (w) x daily using time

2) Calculate the average value of generating capacity needed for one day.

Daily generating capacity (w) = daily power consumption (whr) ÷ 3.5hr (average duration of sunshine in korea)

3) Decide the necessity solar battery module capacity considering generating efficiency (coefficient of output loss preservation)

Necessity solar battery module (w) = daily necessity generating capacity x 1.2 (coefficient of output loss preservation)

-If ac product is applied, multiply inverter loss preservation coefficient (1.2~1.25) depending on dc-ac inverter efficiency. Efficiency of inverter varies with inverter.

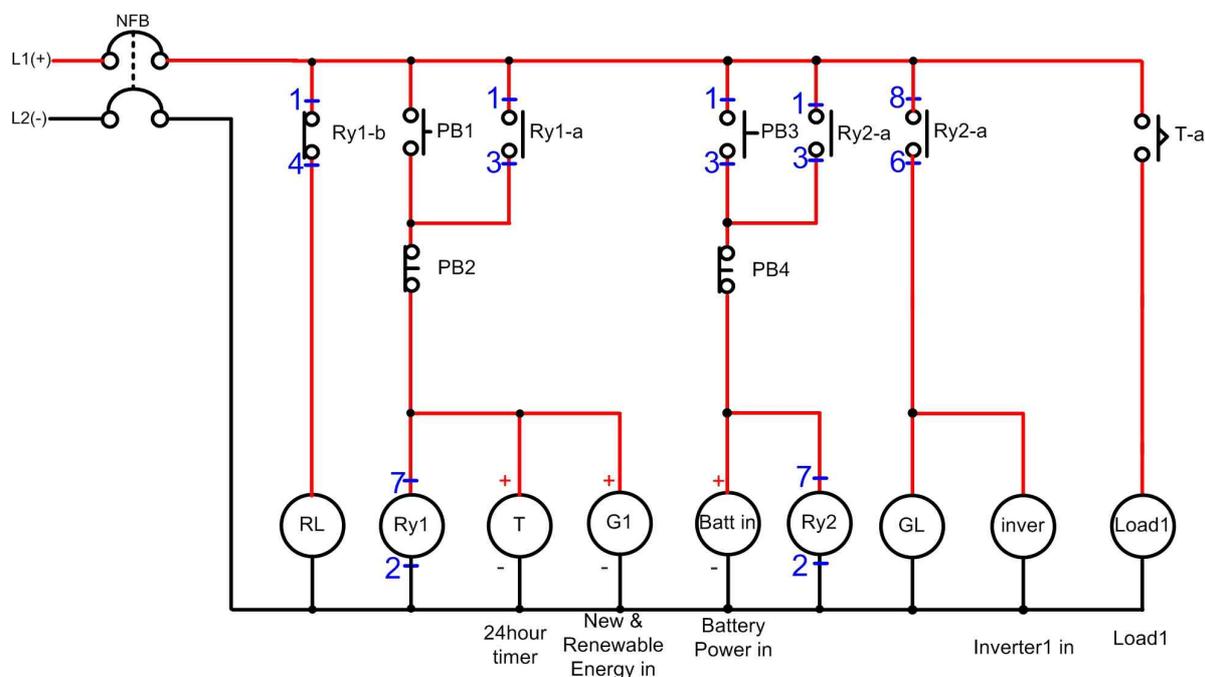
(3) Selecting method of battery

Necessity battery capacity (ah) = daily power consumption (whr) ÷ battery voltage (normally 12v) x number of sunless days x 1.25 (coefficient of battery discharging loss preservation)

- What is number of sunless days?

“It means "number of days that sun does not shine during all day", and for solar ray generation, electricity is not generated when cloudy day with less sunshine or raining day from solar battery module. These days called as number of sunless days, and this should be considered when selecting a battery. Normally calculated from 3 to 7.

3. Explanation



- (1) Turn on the NFB breaker, and then red lamp will be on.
- (2) Push the PB1, and then red lamp will be off. Also, relay one, green lamp and timer will be excited, so it will be self-maintained due to relay one a contact point, and new renewable energy will be deployed, so it will be connected to charging controller throughout connecting panel.
- (3) Push PB3, and then relay two will be excited and self-maintained, and batt in mc will also be excited, so charging controller and battery will be connected. Because green lamp will be on in same times and inverter mc will be excited, battery and inverter will apply an electric current.
- (4) If a contact point is closed depending on timer setup, load one mc will be demagnetized, so power is supplied from inverter output to load, and if a contact point is opened, power supply to load will be blocked.
- (5) Push PB4, and then relay two and batt in mc will be demagnetized, so source controller and battery connection will be blocked. Green lamp will be off in same time, and because inverter mc will be demagnetized, battery and inverter connection will be blocked.
- (6) Push PB2, and then relay one, timer and green lamp mc will be demagnetized, so supply of new renewable energy will be blocked, and red lamp will be on.
- (7) Turn off NFB, and then red lamp will be off.



Solar Power Generation Experiment Equipment (KTE-7000SG)

New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

• Requirement

1. Prepare and check the test devices, tools and materials.
2. The use of stand-alone inverters can explain the purpose and effect.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Timers can be used to describe the process behavior.
 - (3) Explain the processes operated when pb2 is pushed.
5. Use the test devices, tools, and materials, conduct thread wiring and operate.

		Evaluation Item	Allot	Obtain	Remarks			
Valuation Basis	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
		Usage and arrangement of tool	5					
Time point (20)	Subtract () point in every () minute excess				Item	Work	Time	Total

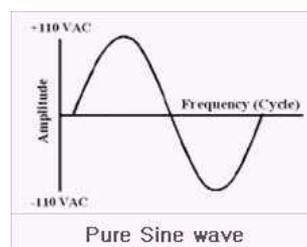
Experiment name	6. Stand-alone inverter circuit configuration training 2			Required time
				8
The Object of Experiment	① Wiring can be conducted based on designed circuit diagram. ② Stand-alone inverter circuli can be understood and wiring can be conducted. ③ Selecting method and efficiency relationship of inverter depending on load power usage capacity can be understood and explained.			
Experiment Equipment	Tool and Material	Spec of Tools	Q`nty	
<ul style="list-style-type: none"> Solar Power Generation Experiment Equipment (KTE-7000SG) New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) New & Renewable Energy PLC Training Kit (KTE-7000PL) 	<ul style="list-style-type: none"> Screw driver set Nipper Wire Stripper Hook Meter 	<ul style="list-style-type: none"> #2× 6× 175mm 150mm 0.5~6mm² 300A 600V 	1 1 1 group1	
Control Circuit				
<p>1. Control Circuit</p>				
L1, L2 : Line Voltage N.F.B : No fuse circuit breaker inver1 : Stand-alone inverters inver2 : Stand-alone inverters RL : DC Lamp G1 : Solar Power input Line		Ry : 8Pin Relay PB1,3,5 : A contact pushbutton switch PB2,4,6 : B contact pushbutton switch Bat in : Battery input signal load1,2 : Load power output signal S/S : Selector switch		

2. Selection of a stand-alone inverters



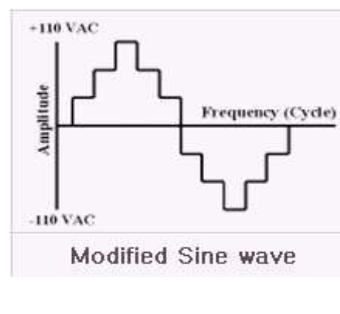
1) Selecting method and efficiency relationship of inverter depending on load power usage capacity can be understood and explained. Because electricity generated from solar generating system is dc, it should be converted to ac voltage if it is intended to use in house or sell to grid. This can be divided into independent inverter and grid-connected inverter. Independent inverter is used regardless of grid, and inverter that sells the electricity to grid (power company) is called as grid-connected inverter. Independent inverter is divided into sine wavelength inverter and pure sine wavelength.

a. Pure Sine Wave Inverter



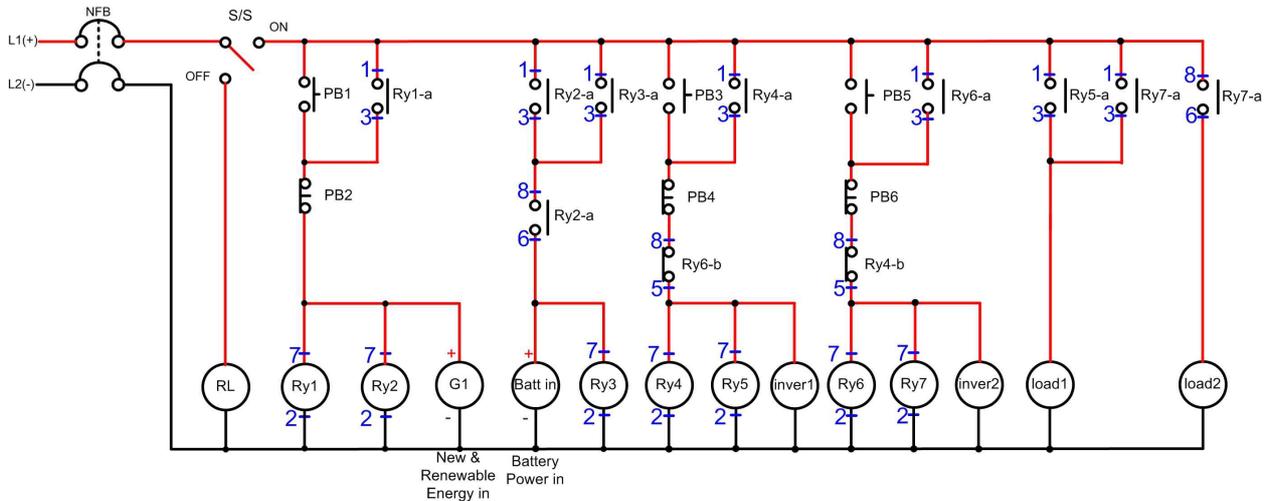
-It is the inverter that makes the sine wavelength and sends clean sine wavelength for wavelength of electricity supplied to house from grid (KOPEC). Electricity of this wavelength can be used in all ac electronic devices used in house, and independent solar generating system, measuring device, medical device, communication device, fluorescent light and computer should choose the sine wavelength inverter.

b. Modified Sine Wave Inverter



- It is similar to sine wavelength, but distortion of wavelength, if it reaches to rated power, phenomenon that wavelength is distorted occur, so surge is caused, and noise and image noise will occur. Because it is modified wavelength, it may not be used in sensitive electronic devices, and products that this wavelength can be used are non-sensitive motor, light and electric heater.

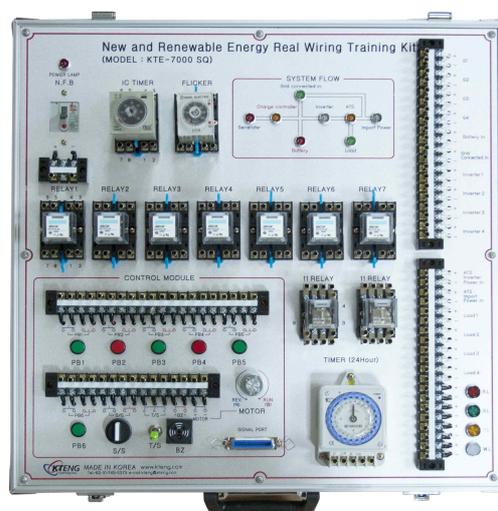
2. Explanation



- (1) Turn on NFB breaker.
- (2) Turn off selector switch, and then red lamp will be on.
- (3) Turn on selector switch, and then red lamp will be off.
- (4) Push the pb1, and then relay one, relay two and g one mc will be excited, so it will be self-maintained due to relay one a contact point, and new renewable energy will be deployed, so it will be connected to charging controller throughout connecting panel. Relay three will be excited in same times, and it will be self-maintained, and batti in mc will be excited, so charging controller and battery will be connected.
- (5) Push PB3, and then relay four, relay five and inverter one mc will be excited, so battery and inverter one will apply an electric current, and in same times, because a contact point of relay 5 will be closed, load one also will be excited, so power is supplied from inverter one output to load one. At this time, even if pb5 is pushed, relay 6, relay 7, and inverter two mc will not be operated because b contact point of relay four is opened by creating interlock circuit.
- (6) Push PB4, and then relay four, relay 5 and inverter one mc will be demagnetized, so battery and inverter connection will be blocked, and because load one mc will be excited, power supply from inverter one output to load will be blocked.
- (7) Push PB5, and battery and inverter will apply an electric current for each other because relay six, relay seven and inverter two mc will be excited, and in same times, because a contact point of relay seven will be closed, load one and load two will be excited too, so power is supplied from inverter two output to load. At this time, even pb3 is pushed, interlock circuit is created, so because b contact point of relay six is opened, relay four and inverter one mc will not operated.
- (8) Push PB6, and then relay six, relay seven and inverter two mc will be demagnetized, so battery and inverter connection will be blocked, and because load one and load two mc will be excited, power supply from inverter two output to load will be blocked.
- (9) Push PB2, and then relay one, relay two and g one mc will be demagnetized, so supply of new renewable energy will be blocked. Because a contact point of relay three is closed, batt in mc and relay three is in self-maintained state, and connections of charging controller and battery will be maintained. At this time, if push pb3 or pb5, power is supplied to load.
- (10) Turn off NFB breaker, and then batt in mc and relay three will be demagnetized, so connections of charging controller and battery will be also blocked.



Solar Power Generation Experiment Equipment (KTE-7000SG)



New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

• Requirement

1. Prepare and check the test devices, tools and materials.
2. The use of stand-alone inverters can explain the purpose and effect.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Explain the processes of inverter1.
 - (3) Explain the processes of inverter2.
5. Use the test devices, tools, and materials, conduct thread wiring and operate.

Valuation Basis	Evaluation Item		Allot	Obtain	Remarks			
	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
Usage and arrangement of tool		5						
Time point (20)	Subtract () point in every () minute excess			Item	Work	Time	Total	

Experiment name	7. Stand-alone inverter circuit configuration training 3	Required time		
		8		
The Object of Experiment	① Wiring can be conducted based on designed circuit diagram. ② Stand-alone inverter circuli can be understood and wiring can be conducted. ③ Selecting method and efficiency relationship of inverter depending on load power usage capacity can be understood and explained.			
Experiment Equipment	Tool and Material	Spec of Tools	Q`nty	
• Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL)	• Screw driver set • Nipper • Wire Stripper • Hook Meter	• #2× 6× 175mm • 150mm • 0.5~6mm ² • 300A 600V	1 1 1 group1	
Control Circuit				
1. Control Circuit				
L1, L2 : Line Voltage N.F.B : No fuse circuit breaker inver1 : inverter1 inver2 : inverter2 RL, GL, YL : DC Lamp ATS in1 : ATS inverter power in ATS in2 : ATS import power in T/S : Toggle Switch		Ry : 8pin, 11pin Relay PB1,3,5 : A contact pushbutton switch PB2,4,6 : B contact pushbutton switch Bat in : Battery input signal load1,2 : Load power output signal S/S :Selector switch G1 : Solar Power input Line		

2. Charging controller



Main function of charging controller is to use maximum capacity of battery through normal charging of battery and extent the battery life, so it is applied to both solar and wind power generator. Function of charging controller is to prevent the reverse direction flow of current and overcharge. Some of them have functions that block the overload and over-discharge or display function that shows charging status and flow of power.

(1) Reverse direction flow prevention function

- If day becomes sunshine less, current may flow reverse from battery to solar panel. At this time, by using blocking diode that connects bipolar elements in series or using mosfet element that has less power loss, it can make that current flows only from solar panel to battery.

(2) Overcharge prevention function:

- What will happen if voltage is supplied from solar panel continuously when battery is charged completely? At this time, as battery voltage will be increased excessively, water will be dissolved to oxygen and hydrogen, and gas will occur. From this process, loss of distillate water will be caused while gas is ignited, so it may cause explosive. As a result, battery will be deteriorated and life cycle will be shorten. To prevent overcharge, block the current if battery voltage reaches to certain level.

(3) Over-discharge prevention function.

- Connect the current again if voltage of battery drops to less than certain voltage. This is called as voltage regulating, and it is the basic function of all charging controller.

A. On.off method

-Some controllers repeat the block or connect current flows to battery completely to control the current flow. This is called as on/off control method.

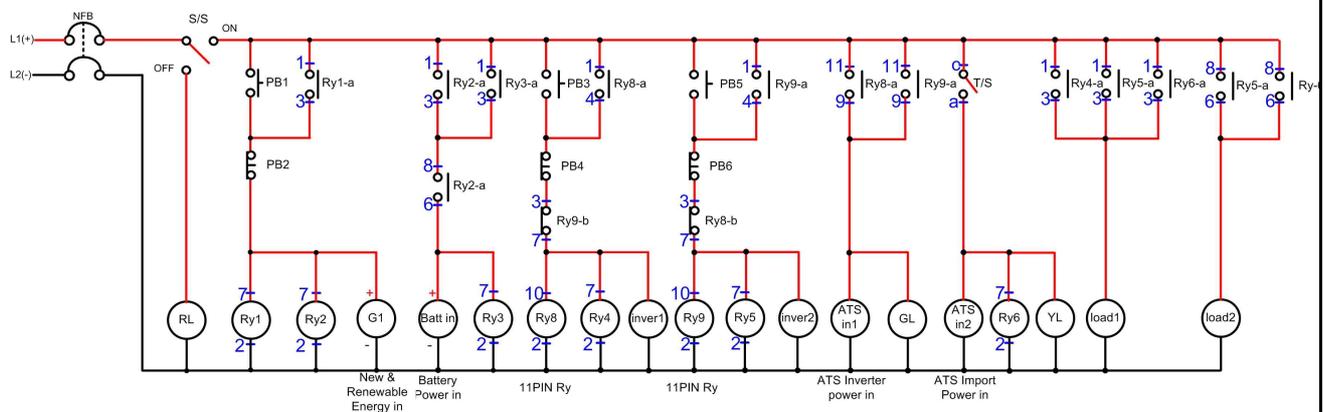
B. Pwn method

-If battery is charged completely, it will go to second step, in second step, voltage that is about to maintain the battery will be dropped. This is called as trickle charge. It only charges with amounts that water drop falls. Two steps charging control is meaningful in the environment that power usage is too much or too less, that is, charging/discharging is not stable.

C. Maximum power point tracking (MPPT) method

-It is also known as, maximum power point tracking. The most biggest difference with above method is that it matches the voltage of battery with voltage generated in panel to obtain maximum charging efficiency. This is similar principle that matches optimum ratio of engine rotating and wheel rotating numbers using gear transmission. Specially, it can obtain the maximum 30% of charging efficiency increasing effect in winter season than normal pwm method.

2. Explanation



- (1) Turn on NFB breaker.
- (2) Turn off the selector switch, and then red lamp will be on.
- (3) Turn on selector switch, and then red lamp will be off.
- (4) Push the pb1, and then relay one, relay two and g one mc will be excited, so it will be self-maintained due to relay one a contact point, and new renewable energy will be deployed, so it will be connected to charging controller throughout connecting panel. Relay three will be excited in same times, and it will be self-maintained, and batti in mc will be excited, so charging controller and battery will be connected.
- (5) Push pb3, and then relay four, relay eight and inverter one mc will be excited, so battery and inverter one will apply an electric current, and in same times, because a contact point of relay four will be closed, load one also will be excited, so power is supplied from inverter one output to load one. At this time, even if pb5 is pushed, relay 5, relay 9, and inverter two mc will not be operated because b contact point of relay 8 is opened by creating interlock circuit.
- (6) Push pb4, and then relay four, relay 8 and inverter one mc will be demagnetized, so battery and inverter connection will be blocked, and because load one mc will be excited, power supply from inverter one output to load will be blocked.
- (7) Push pb5, and battery and inverter will apply an electric current for each other because relay nine, relay 5 and inverter two mc will be excited, and in same times, because a contact point of relay 5 will be closed, load one and load two will be excited too, so power is supplied from inverter two output to load. At this time, even pb3 is pushed, interlock circuit is created, so because b contact point of relay nine is opened, relay four and inverter one mc will not operated.
- (8) If turn on the toggle switch, and then ats in two mc and relay six will be excited, and then yellow lamp will be on. At this time, commercial power is transmitted to ats master section.
- (9) If commercial power is transmitted to ats master section, power supply of load and load two will be changed from inverter output power to commercial power after 30 seconds. This process is automatic.

- (10) If turn off the toggle switch, and then ats in two mc and relay six will be excited, and then yellow lamp will be off. At this time, connections between commercial power and ats will be blocked, and power supply of load one and load two will be changed to inverter output power. This process is automatic.
- (11) Push pb6, and then relay six, relay nine, relay f and inverter two mc will be demagnetized, so battery and inverter connection will be blocked, and because load one and load two mc will be excited, power supply from inverter two output to load will be blocked.
- (12) Push pb2, and then relay one, relay two and g one mc will be demagnetized, so supply of new renewable energy will be blocked. Because a contact point of relay three is closed, batt in mc and relay three is in self-maintained state, and connections of charging controller and battery will be maintained. At this time, if push pb3 or pb5, power is supplied to load.
- (13) Turn off NFB breaker, and then batt in mc and relay three will be demagnetized, so connections of charging controller and battery will be also blocked.



Solar Power Generation Experiment Equipment (KTE-7000SG) New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

• Requirement

1. Prepare and check the test devices, tools and materials.
2. The use of stand-alone inverters can explain the purpose and effect.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Explain the processes of inverter1.
 - (3) Explain the processes of inverter2.
 - (4) It explains the processes of operation when turn on t/s tp supply the commercial power.
5. Use the test devices, tools, and materials, conduct thread wiring and operate.

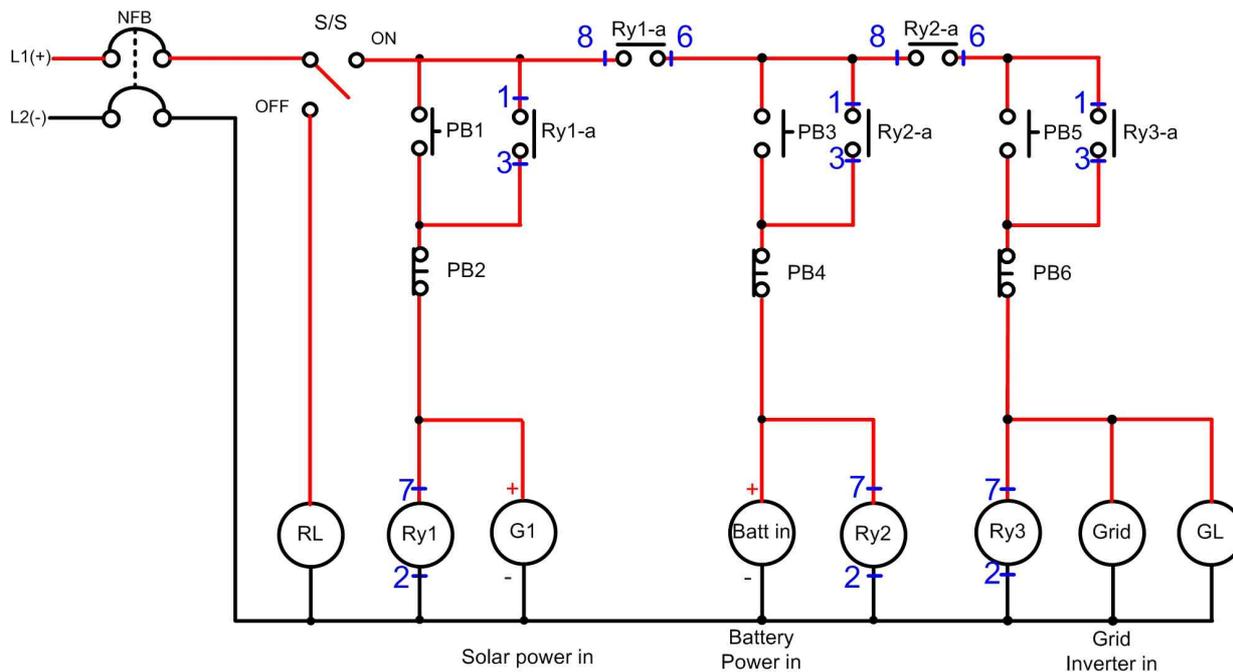
		Evaluation Item	Allot	Obtain	Remarks			
Valuation Basis	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
		Usage and arrangement of tool	5					
Time point (20)	Subtract () point in every () minute excess				Item	Work	Time	Total

Experiment name	8. Solar power systems and Grid connected inverter circuit configuration 1	Required time
		8
The Object of Experiment	① Solar Power system can be understood and wiring can be conducted. ② Grid-connected inverter system can be understood, and wiring can be conducted.	

Experiment Equipment	Tool and Material	Spec of Tools	Q`nty
<ul style="list-style-type: none"> • Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL) 	<ul style="list-style-type: none"> • Screw driver set • Nipper • Wire Stripper • Hook Meter 	<ul style="list-style-type: none"> • #2× 6× 175mm • 150mm • 0.5~6mm² • 300A 600V 	1 1 1 group1

Control Circuit

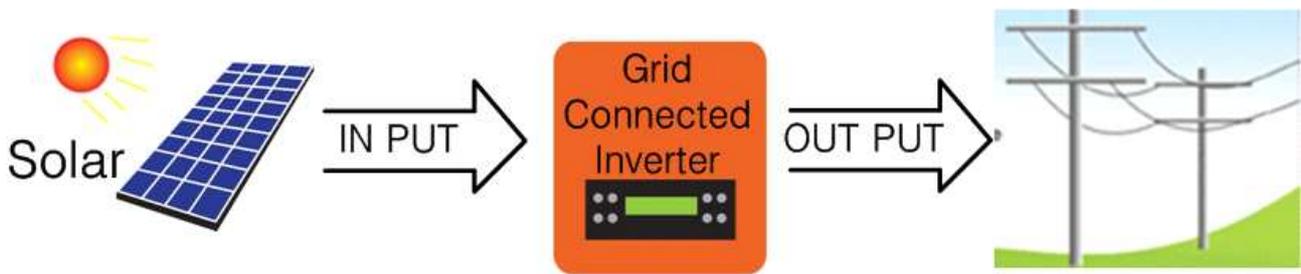
1. Control Circuit



L1, L2 : Line Voltage
 N.F.B : No fuse circuit breaker
 G1 : Solar Power input Line
 Grid : Grid connected inverter
 RL, GL : DC Lamp

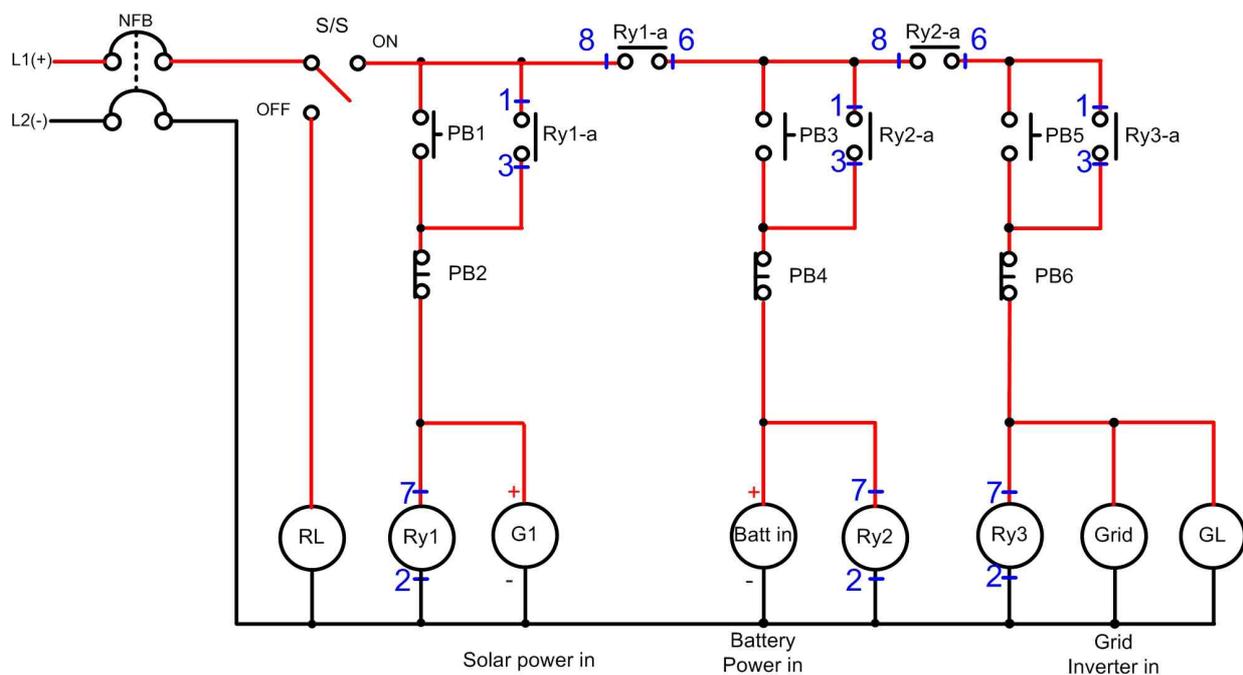
Ry : 8pin Relay
 PB1,3 : A contact pushbutton switch
 PB2,4 : B contact pushbutton switch
 Bat in : Battery input signal
 S/S : Selector switch

2. Grid connected inverter system



- (1) What is grid-connected inverter system? Grid-connected inverter system supplies the remaining power from power supply of load, by connecting with commercial power system.
- (2) Hardware configuration of grid-connected inverter consists of input section made to be supplied the dc safely from solar battery, power convert section that converts dc to ac, transformer that transforms the sizes of electric heating and voltage, main control panel to control each part, sensor and relay board that detects various signals and generates the contact point output for protection motion, auxiliary power to supply the dc power needed for system and display and keypad that displays various indicators and is for setup/control.
- (3) Unlike independent, grid-connected inverter system does not use the battery, and because it is the system that supplies the power remained from load directly to grid and equipped with grid-connected inverter, it can save the battery cost, so maintenance cost will be cheaper.

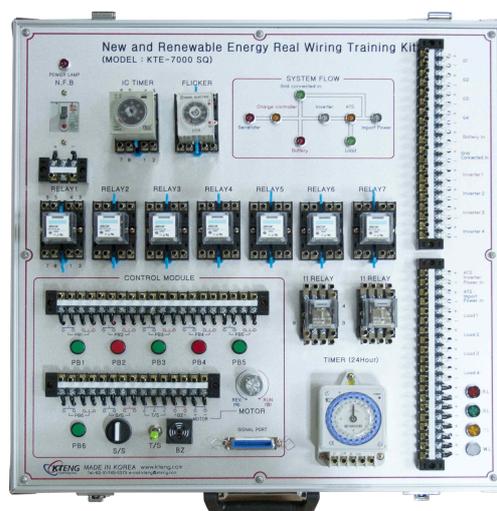
3. Explanation



- (1) Turn on NFB breaker
- (2) Turn off selector switch, and then red lamp will be on.
- (3) Turn on selector switch, and then red lamp will be off.
- (4) Push the pb1, and then relay one, g one mc and g two mc will be excited, so it will be self-maintained due to relay one a contact point, and new renewable energy will be deployed, so it will be connected to charging controller throughout connecting panel.
- (5) Push the pb3, and then relay two will be excited, so it will be self-maintained, and charging controller and battery will be connected.
- (6) Push the pb5, and then relay three will be excited, so it will be self-maintained, and green lamp will be on, so grid mc will be excited, and battery and grid-connected inverter will be connected, so power generated to commercial power is reverse supplied.
- (7) Push pb4, and then relay two and batt in mc will be demagnetized, so source controller and battery connections will be blocked.
- (8).Push pb2, and then relay one, g one mc, and g two mc will be demagnetized, so supply of new&renewable energy will be blocked.
- (9) Trun off the NFB breaker.



Solar Power Generation Experiment Equipment (KTE-7000SG)



New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

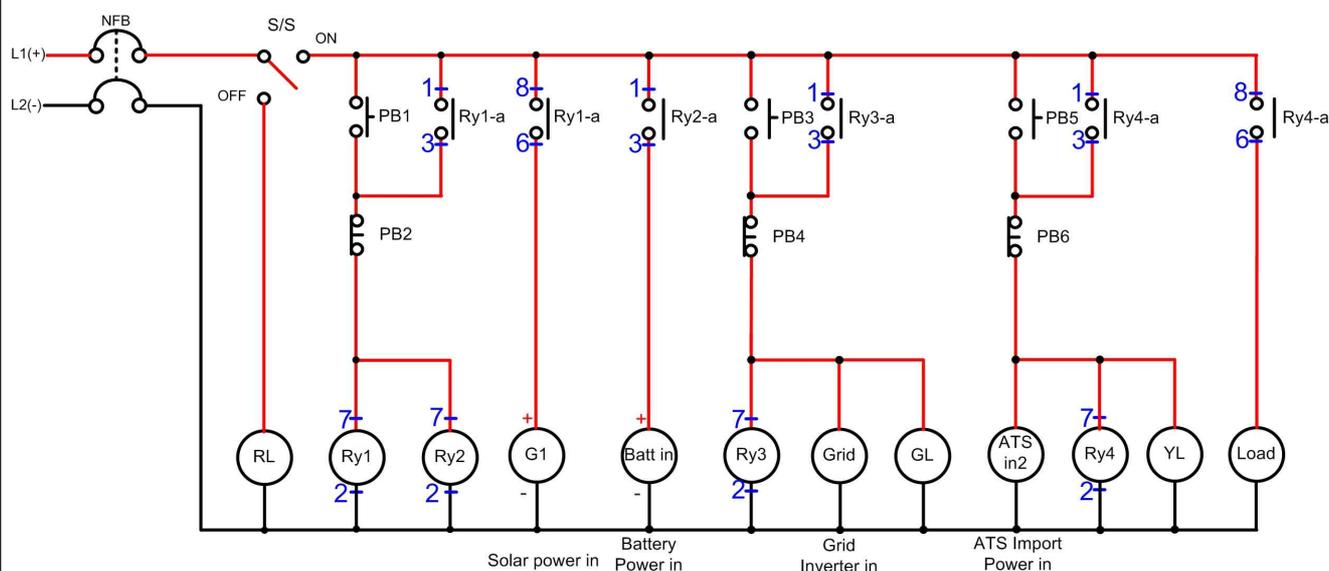
• Requirement

1. Prepare and check the test devices, tools and materials.
2. Using purpose and effects of grid-connected inverter can be explained.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Explain the processes operated when pb3 is pushed.
5. Understand and can explain the solar power system.
6. Use the test devices, tools, and materials, conduct thread wiring and operate.

		Evaluation Item	Allot	Obtain	Remarks			
Valuation Basis	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
		Usage and arrangement of tool	5					
Time point (20)	Subtract () point in every () minute excess				Item	Work	Time	Total

<p>Experiment name</p>	<p>9. Solar power systems and Grid connected inverter circuit configuration 2</p>	<p>Required time</p>		
<p>The Object of Experiment</p> <p>① Solar Power system can be understood and wiring can be conducted. ② Grid-connected inverter system can be understood, and wiring can be conducted.</p>		<p>8</p>		
<p>Experiment Equipment</p>		<p>Tool and Material</p>	<p>Spec of Tools</p>	<p>Q`nty</p>
<ul style="list-style-type: none"> • Solar Power Generation Experiment Equipment (KTE-7000SG) • New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ) • New & Renewable Energy PLC Training Kit (KTE-7000PL) 		<ul style="list-style-type: none"> • Screw driver set • Nipper • Wire Stripper • Hook Meter 	<ul style="list-style-type: none"> • #2× 6× 175mm • 150mm • 0.5~6mm² • 300A 600V 	<p>1 1 1 group1</p>
<p>Control Circuit</p>				
<p>1. Control Circuit</p>				
<p>L1, L2 : Line Voltage N.F.B : No fuse circuit breaker G1 :Solar Power input Line Grid : Grid connected inverter RL, GL, YL : DC Lamp ATS in2 : ATS import power in</p>		<p>Ry : 8pin Relay PB1,3,5 : A contact pushbutton switch PB2,4,6 : B contact pushbutton switch Bat in : Battery input signal load : Load power output signal S/S : Selector switch</p>		

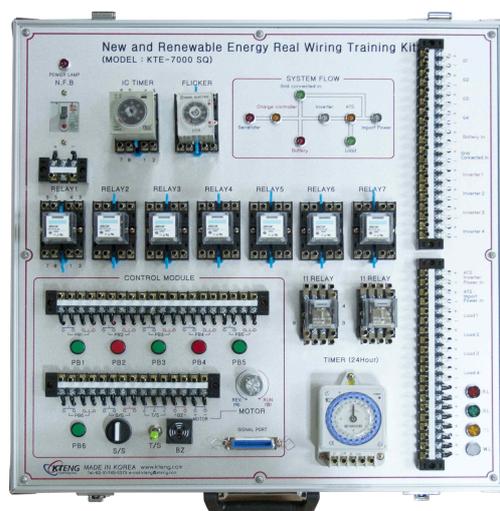
2. Explanation



- (1) Turn on NFB breaker
- (2) Turn off selector switch, and then red lamp will be on.
- (3) Turn on selector switch, and then red lamp will be off.
- (4) Push the pb1, and then relay one, relay two and g one mc will be excited, and G1 and G2 mc will be excited. So, new renewable energy is supplied, so it will be connected to charging controller throughout connecting panel.
- (5) Push pb3, and then because relay 3 and grid mc is excited, battery and grid-connected inverter is connected, so power generated to commercial power is reverse supplied. In same time, green lamp will be on.
- (6) Push the pb5, ats in two mc and relay four will be excited, and yellow lamp will be on, and at this time, commercial power is supplied to ats master section. Because a contact point of relay 4 is closed in same time, load mc will be also excited, so ats commercial power output is connected to load.
- (7) Push the pb6, and then ats in two mc and relay 4 will be demagnetized, so power supply to load will be blocked, and yellow lamp will be also off.
- (8) Push pb4, and then relay three and grid mc will be demagnetized, so connections of battery and grid-connected inverter will be blocked, and green lamp will be also off.
- (9) Push the pb2, and then relay one, relay two, g1 mc, g2 mc and batt in mc will be demagnetized, so connections of battery and grid-connected inverter will be blocked, and also supply of new renewable energy will be blocked.
- (10) Turn off the NFB breaker.



Solar Power Generation Experiment Equipment (KTE-7000SG)



New & Renewable Energy Real Wiring Training Kit (KTE-7000SQ)

• Requirement

1. Prepare and check the test devices, tools and materials.
2. Grid-connected inverter system can be understood.
3. Use the test devices, tools, and materials, create the circuit with thread wiring or banana jack.
4. Operation function of circuit can be explained.
 - (1) Explain the processes operated when pb1 is pushed.
 - (2) Explain the processes operated when pb3 is pushed.
 - (3) Explain the processes operated when pb5 is pushed.
5. Solar power system can be understood.
6. Use the test devices, tools, and materials, conduct thread wiring and operate.

Valuation Basis	Evaluation Item		Allot	Obtain	Remarks			
	Item point (70)	Configuration Circuit and operation	20					
		Real wiring circuit configuration	20					
		Configuration state	10					
		Understanding and description for circuit	20					
	Work point (10)	Work attitude and safe	5					
Usage and arrangement of tool		5						
Time point (20)	Subtract () point in every () minute excess			Item	Work	Time	Total	

© Installation and use of experimental device

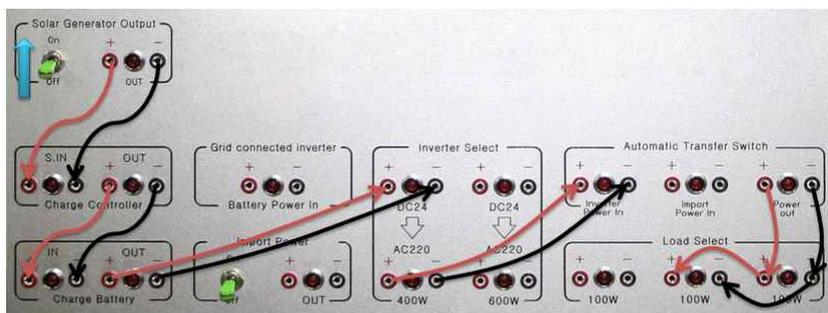
1. Installation of fixed pole solar generator

- (1) Fix the generator on flat surface or install it not to roll when operating.
- (2) Connect the power cable of solar module in series or parallel, and connect it to connecting board of solar power convert test system.

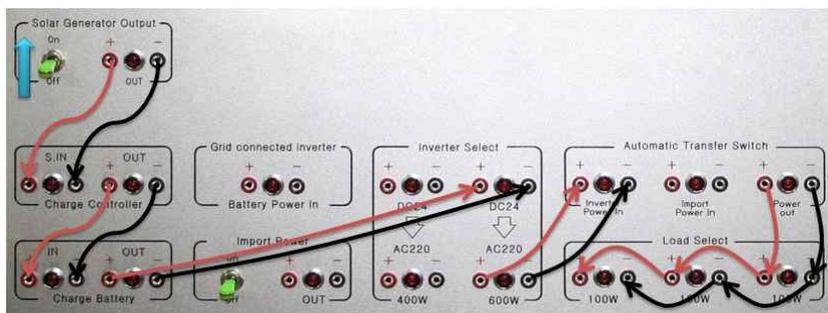
2. Installation of power convert test system.

Move the test system to the place where power has, and then connect the ac 220v power cable to power terminal on back of control board, and insert it to power outlet to supply the power to test system

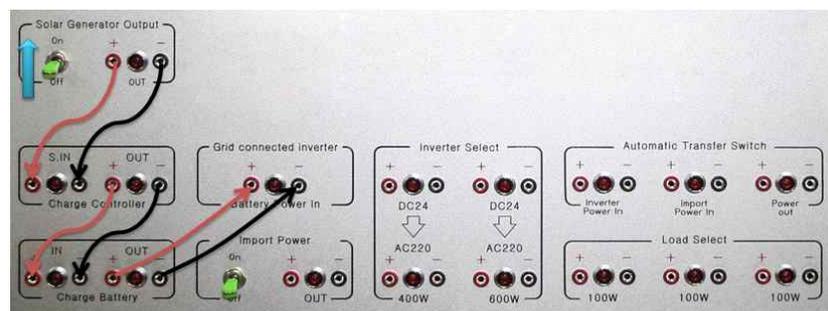
(1) Connecting 500w Stand-alone inverter system configuration



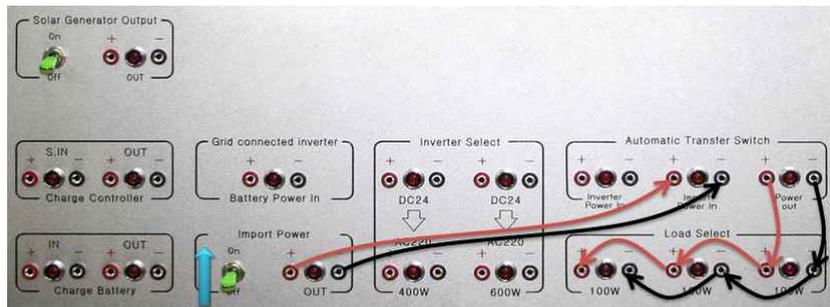
(2) Connecting 500w Stand-alone inverter system configuration



(3) Connecting Grid connected inverter system configuration



(4) Connecting Import power input system configuration



⊙ Cautions when using equipment

1. Power Supply

- (1) This test equipment use single-phase ac200v for main power.
- (2) Operation orders are; on the assumption that power code is connected, turn of the nfb and look at the circuit diagram for wiring the banana jacks. And then turn on the dc toggle switch in wind power and solar generating sections.
- (3) Because it uses dc24v for power supply when operating the equipment using banana jack, it is safe, but using power is dc, so caution is required when connecting + and - terminals.
- (4) Also, when connecting red + terminal, it should not touch the aluminium base because base and control panel of equipment is made of aluminium material.

2. Overall items

- (1) After read the manual carefully, use the equipment.
- (2) Trouble due to disassembly or alternation may be charged even if warranty a/s period is not expired.
- (3) If you have questions, please contact a head quarter.

© Certificate of Patent



CERTIFICATE OF PATENT

PATENT NUMBER 10-0952929 APPLICATION NUMBER 2009-0103301
 FILING DATE Oct. 29. 2009
 REGISTRATION DATE Apr. 07. 2010

TITLE OF THE INVENTION Complex Power Conversion Equipment

PATENTEE KTENG Co. Ltd., (141111-0*****)
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 Seongnam-si Gyeonggi-do Korea

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 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

Apr. 07. 2010

COMMISSIONER,
 THE KOREAN INTELLECTUAL PROPERTY OFFICE




CERTIFICATE OF UTILITY MODEL REGISTRATION

REGISTRATION NUMBER 20-0449478 APPLICATION NUMBER 2009-0014127
 FILING DATE Oct. 30. 2009
 REGISTRATION DATE Jul. 06. 2010

TITLE OF THE DEVICE Artificial Sunlight Equipment

OWNER OF THE UTILITY MODEL RIGHT KTENG Co. Ltd., (141111-0*****)
 601 Postechno B/D 234-1 Sangdaewon-dong Jungwon-gu
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DEVISER Kim, Chul Su
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THIS IS TO CERTIFY THAT THE DESIGN IS REGISTERED ON THE REGISTER OF THE KOREAN INTELLECTUAL PROPERTY OFFICE

Oct. 25. 2010

COMMISSIONER,
 THE KOREAN INTELLECTUAL PROPERTY OFFICE




CERTIFICATE OF UTILITY MODEL REGISTRATION

REGISTRATION NUMBER 20-0447670 APPLICATION NUMBER 2009-0008945
 FILING DATE Jul. 10. 2009
 REGISTRATION DATE Feb. 03. 2010

TITLE OF THE DEVICE Educational Energy Collection Equipment

OWNER OF THE UTILITY MODEL RIGHT KTENG Co. Ltd., (141111-0*****)
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 Seongnam-si Gyeonggi-do Korea

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Feb. 03. 2010

COMMISSIONER,
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NO. C-2009-000406

COPYRIGHT REGISTRATION

1. Work Title	Renewable Energy Automatic Control Work
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	Dec. 30. 2009
8. Announce date	
9. Reference	Owner : KTENG Co.,Ltd. Creative July. 14. 2008
10. Registration date	Dec. 30. 2009

This has been registered with regarding as article 53 in the law of copyright.

Jan. 08. 2010

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© Warrantee and A/S application sheet

Product Warrantee Certification

Fill out this sheet, and send by Fax or E-mail..

MODEL		
WARRENTTEE TERM	1 YEAR	
PURCHASING DATE	(M/D/Y)	
ORGANIZATION	SCHOOL	
	DEPARTMENT	

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