



U-3ARC TRAINING WEBINAR N°38

Inverter Split Air-conditioners

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Create a beautiful
life for human
beings

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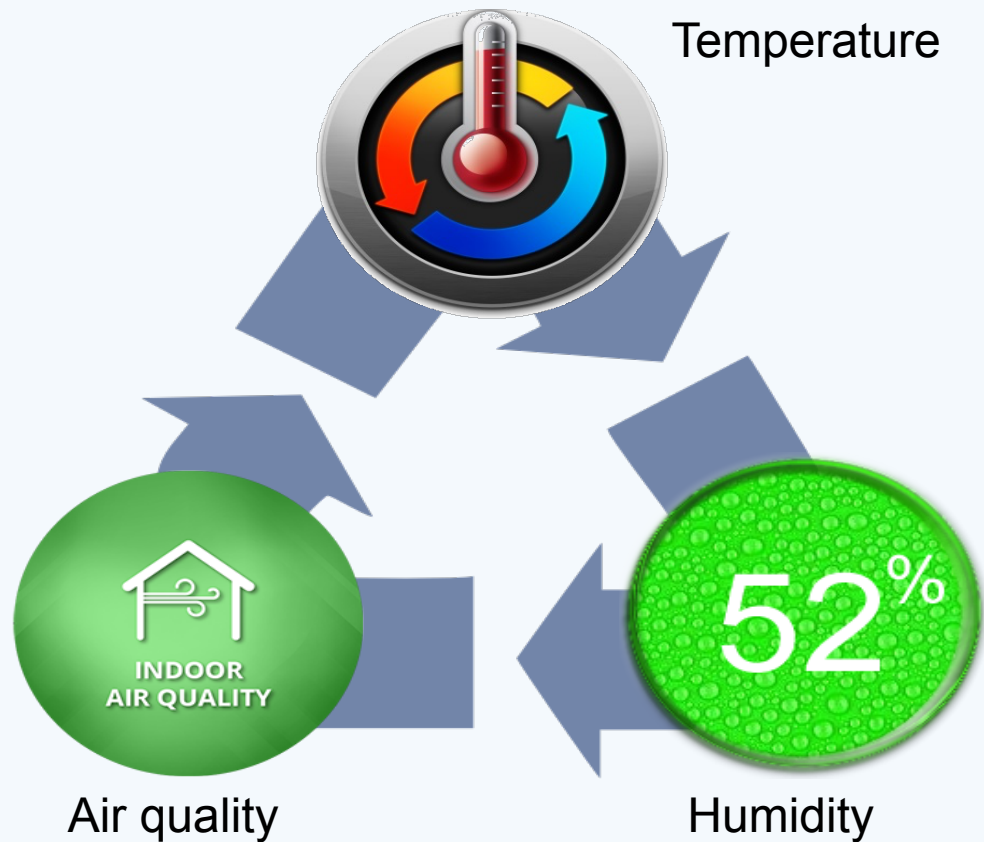
Troubleshooting



Principle of Air Conditioner

■ Air conditioning

- The process of treating air to meet the requirements of a conditioned space by controlling **air temperature, humidity, air quality** and distribution.



**Distribution
Comfortable Air**





Principle of Air Conditioner

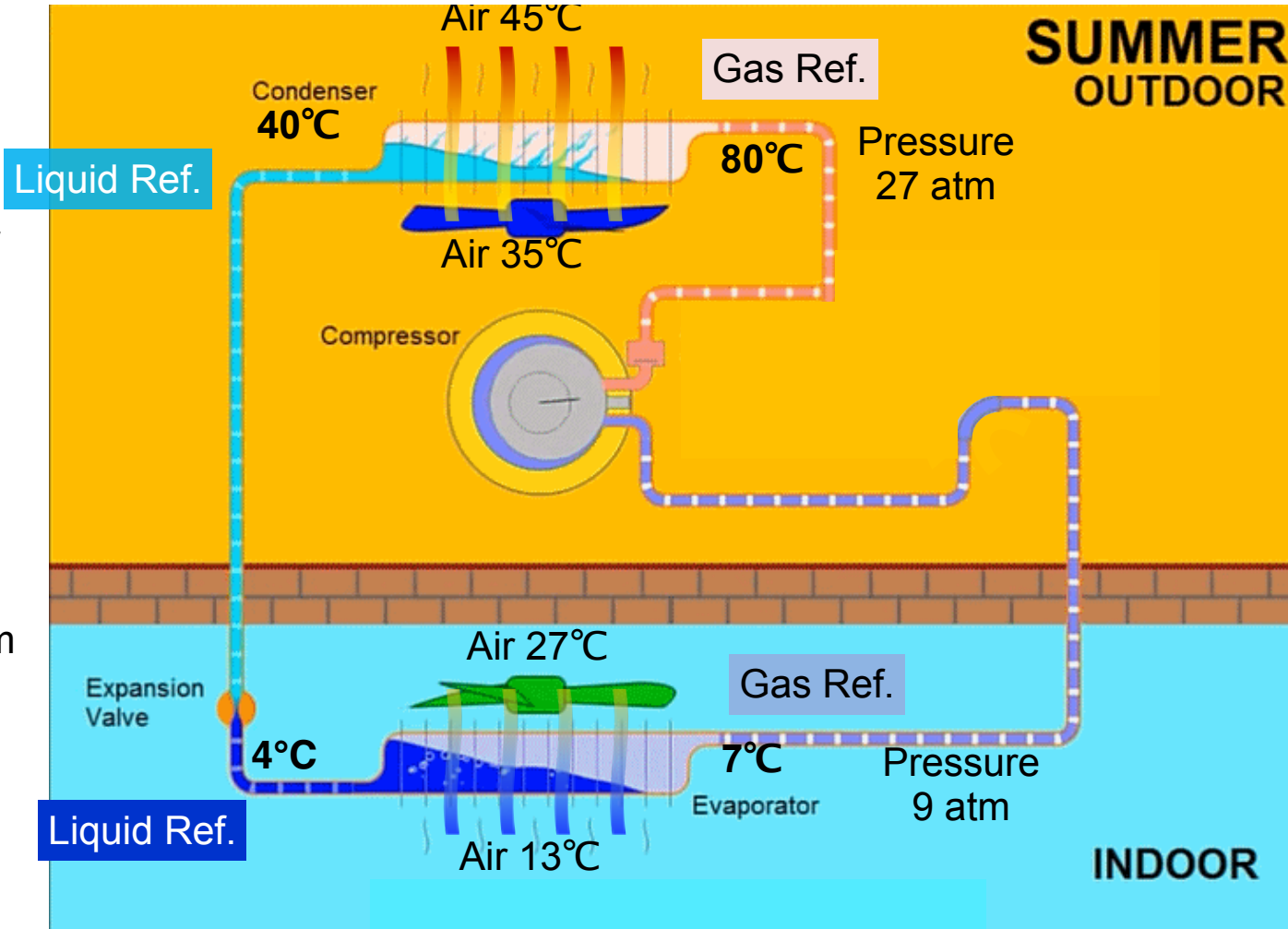
- Core Components : Evaporator, Condenser, Expansion Device & Compressor.

•Condenser

The hot refrigerant gas is converted to liquid by discharging heat to the air in the compartment.

•Expansion Device

It removes pressure from the liquid refrigerant to allow expansion or change of state from a liquid to a vapor in the evaporator



•Compressor

The purpose is to circulate the refrigerant in the system. When it's compressed, it's pressure & Temp gets high.

•Evaporator

Here refrigerant liquid is converted to gas by absorbing heat from the air in the conditioned space.

Why we need inverter A/C?



Do you have such experience when you use a normal air conditioner?



Cool down
so slowly...

Cold and hot
from time to
time...

Too noisy...

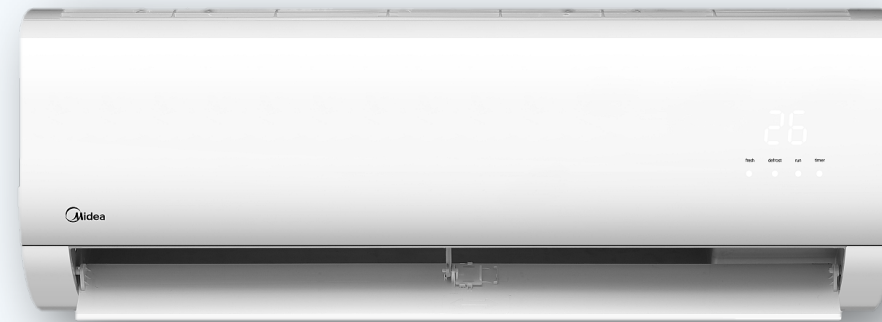
High power
consumption
...



Why we need inverter A/C?



Expect an air conditioner to drive all the troubles away?



Rapid cooling

Comfortable

Low cost

Low noise

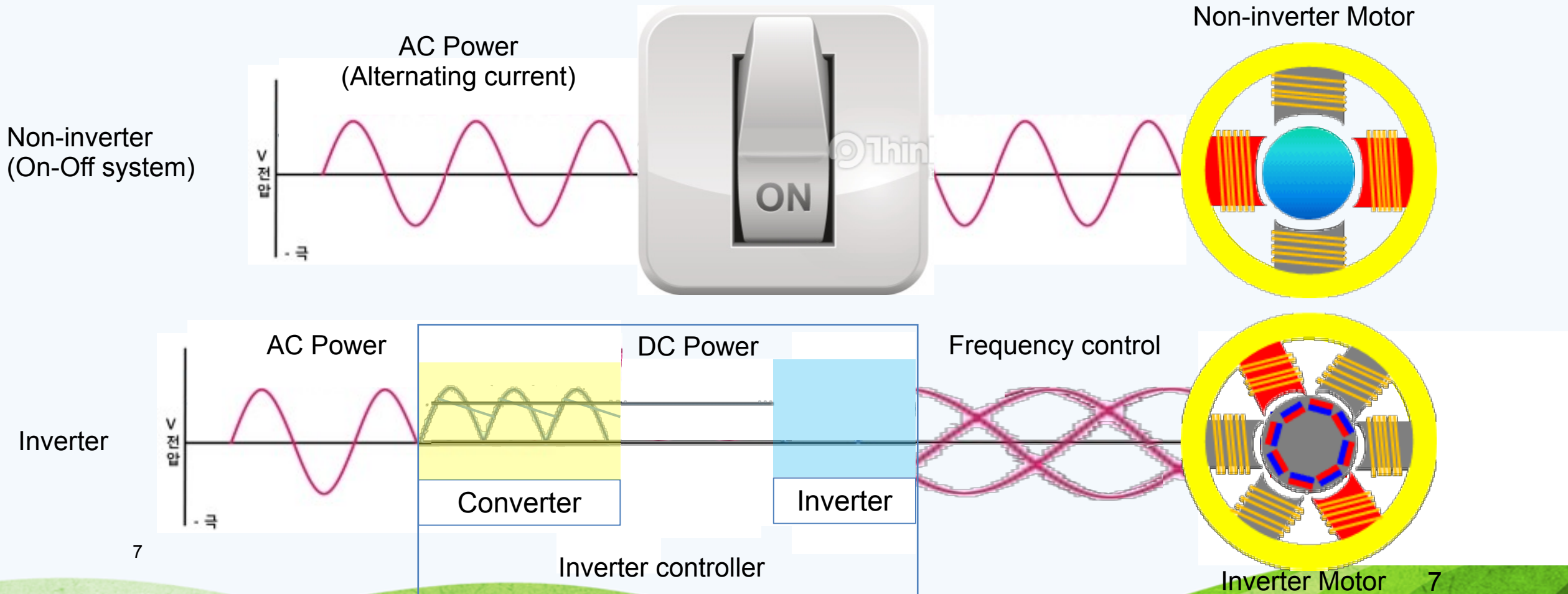




Inverter Technology

■ What is the Inverter ?

- Inverter : An **electric apparatus** that changes **direct current** (DC) to **alternating current** (AC)



How does inverter A/C work?



Principle of inverter compressor

$$n = \frac{60f}{p}$$

n—speed of compressor

f—frequency of power supply

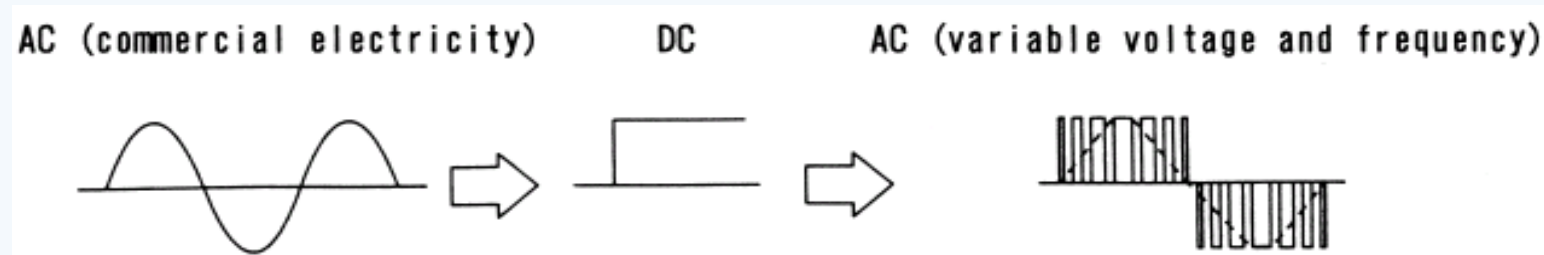
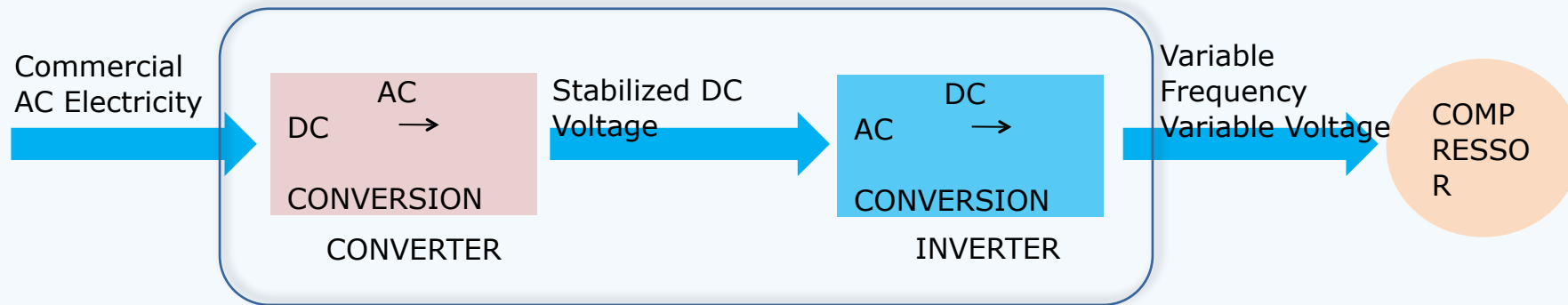
p—poles of compressor motor
(Cannot be changed)

Rotating speed “**n**” of the compressor will be changed in accordance with “**frequency**”

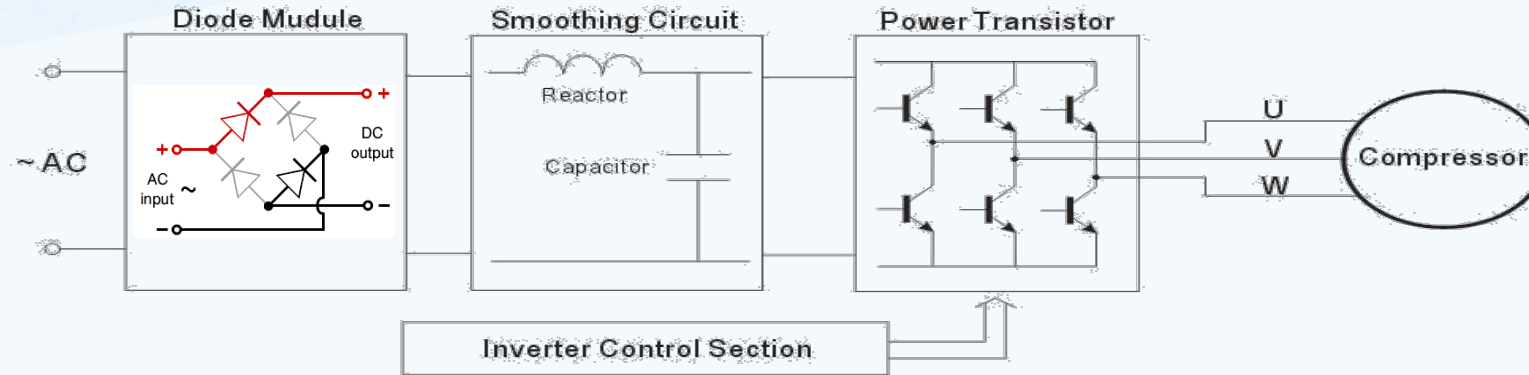
How does inverter A/C work?



An inverter simply converts Direct Current (DC) to Alternating Current (AC). In air conditioning systems, inverters are largely referred to as devices which convert commercial AC electricity to AC with adjustable frequency and voltage. Converter which converts AC to DC forms part of such devices. The rotational speed of compressor can be altered freely by inverter.

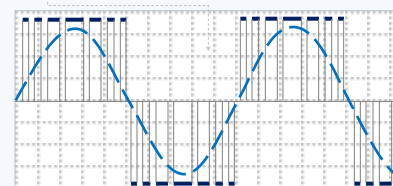
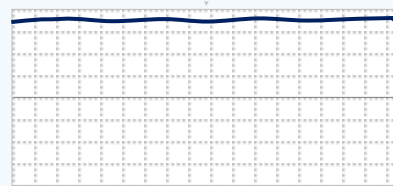
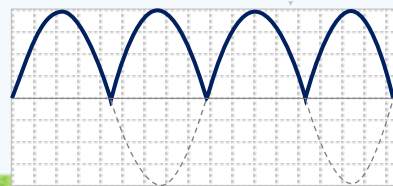
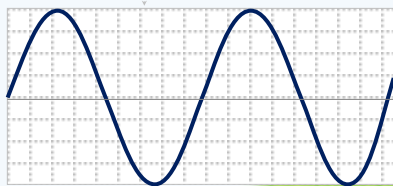
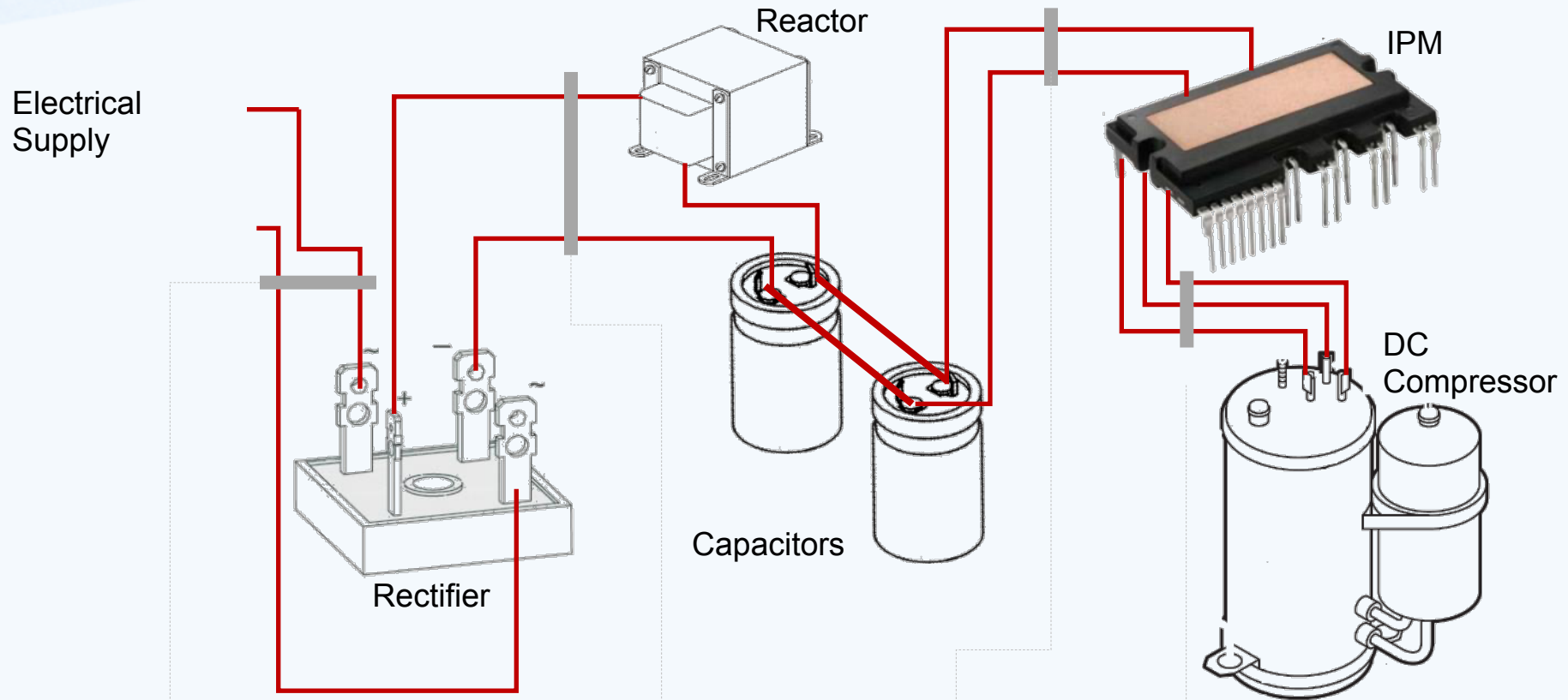


How does inverter A/C work?



Name	Function	
Diode Module	Rectify AC and convert it to DC	
Smoothing Circuit Capacitor	Make DC smoother by charging and discharging	
Reactor	Decrease ripples	
Power Transistor	Make AC of approximate sine waves by dividing DC	
Control Section	Emit signals to switch on the power transistor when operation and frequency setting commands are received.	

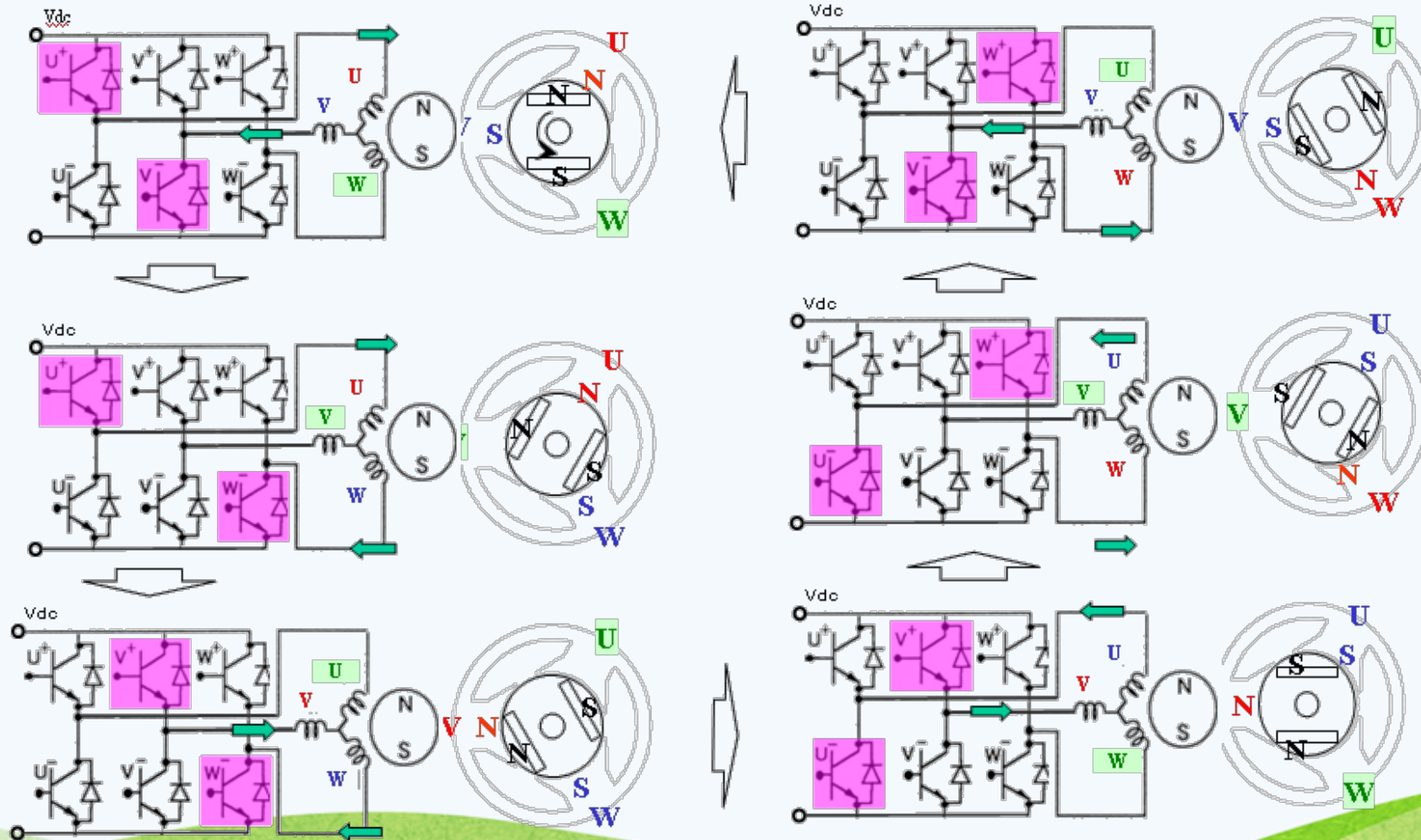
How does inverter A/C work?



How does inverter A/C work?



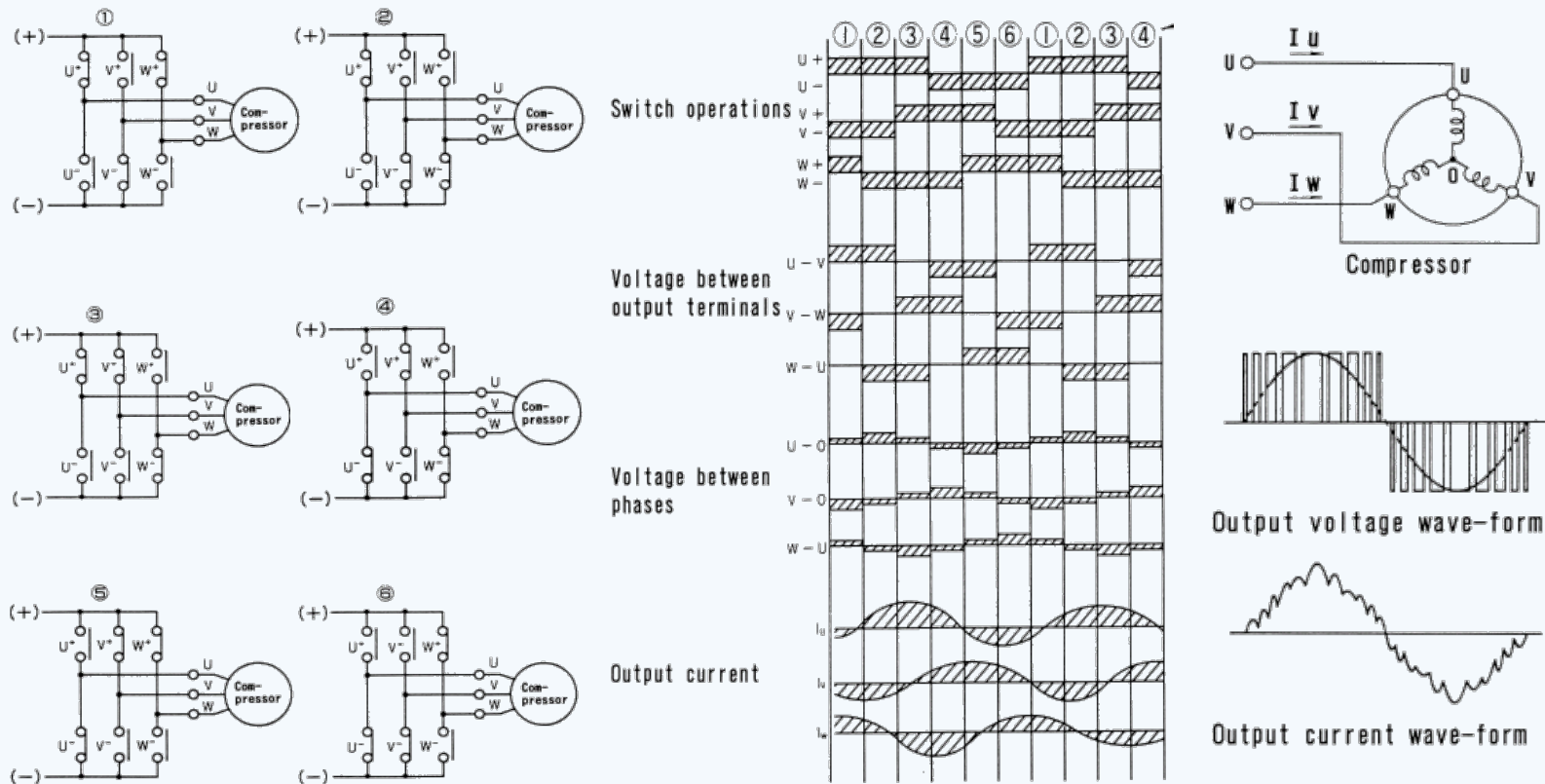
Six IGBT(Insulated Gate Bipolar Transistor) and some protection electric circuit consist of Inverter module.



How does inverter A/C work?



Six IGBT(Insulated Gate Bipolar Transistor) and some protection electric circuit consist of Inverter module.

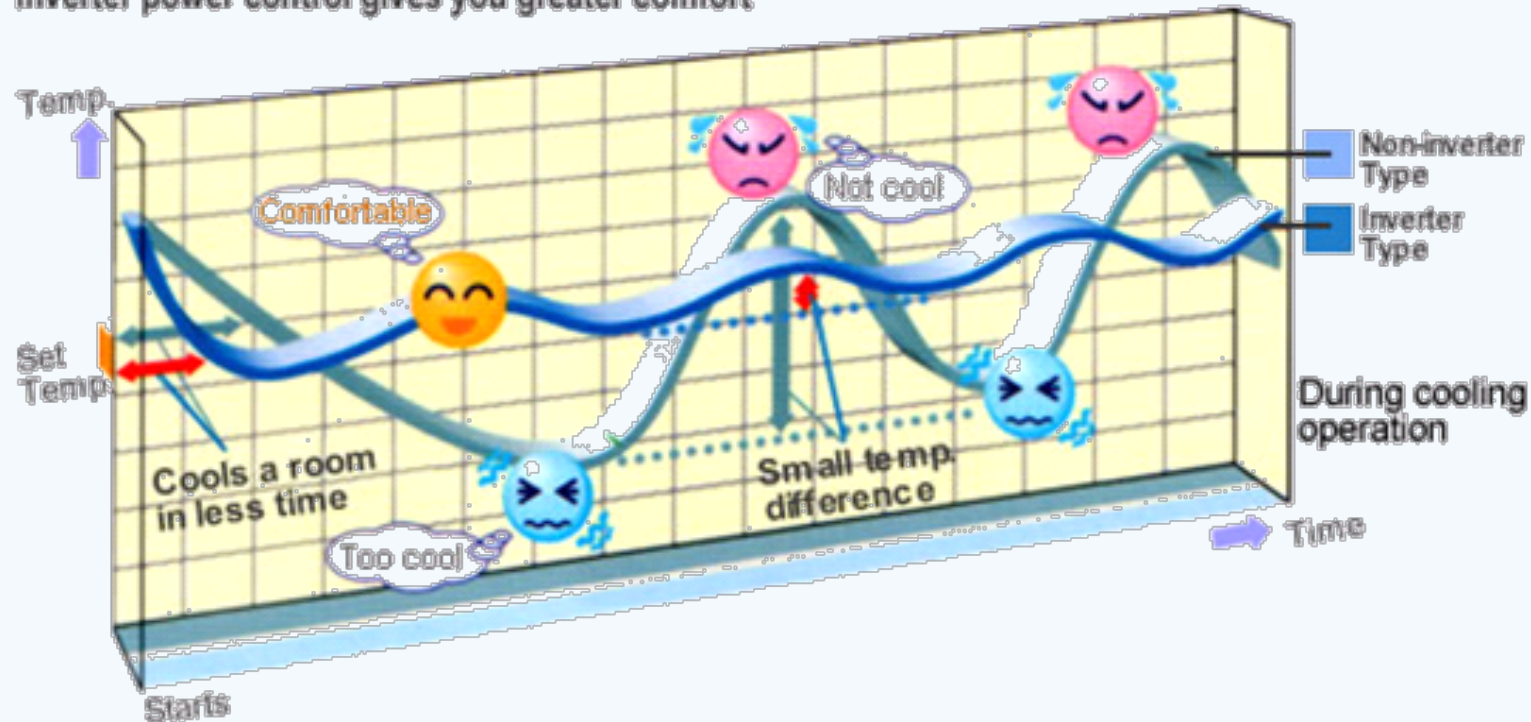


What does inverter bring us?



✓ Comfortable

Inverter power control gives you greater comfort



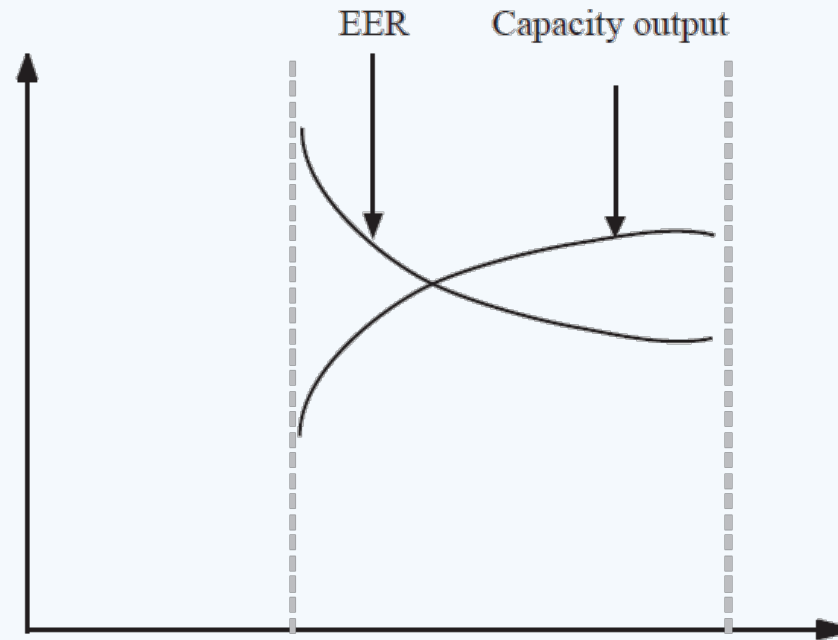
Inverter AC has two distinct comfort advantages over non-inverter AC:

- Fast cooling & heating to reach the desired temperature quickly.
- Steadily maintain operating temperature with minimal fluctuation.

What does inverter bring us?



✓ Energy Saving



Inverter AC runs at low frequency with higher EER for most of time, greatly reduce energy consumption.

What does inverter bring us?

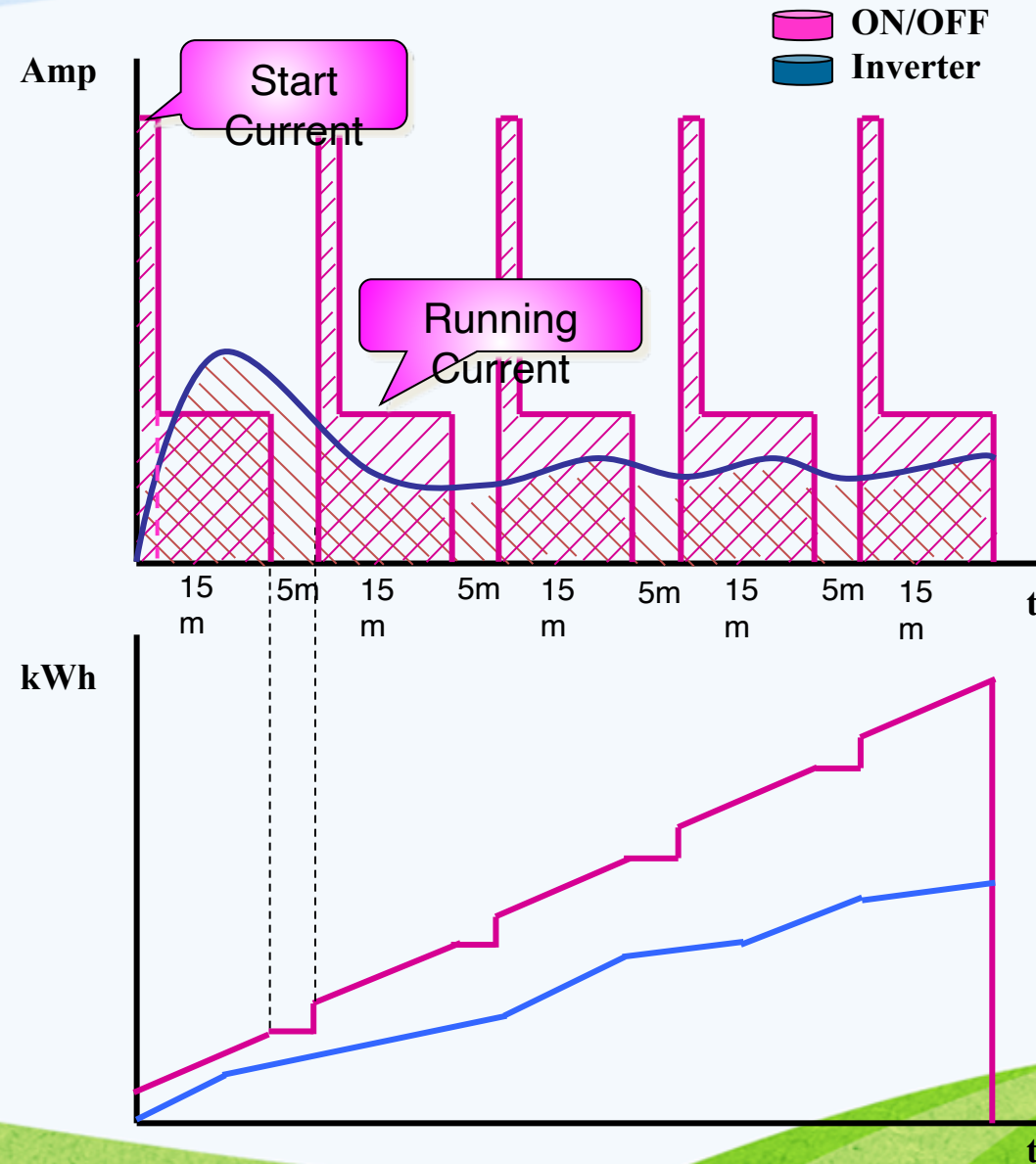


✓ Energy Saving

ON/OFF: Every compressor start is with huge current. Running current is always full load.

Inverter: AC runs at full load for tens of minutes after start. Most of time it runs at lower frequency. Power consumption reduces rapidly.

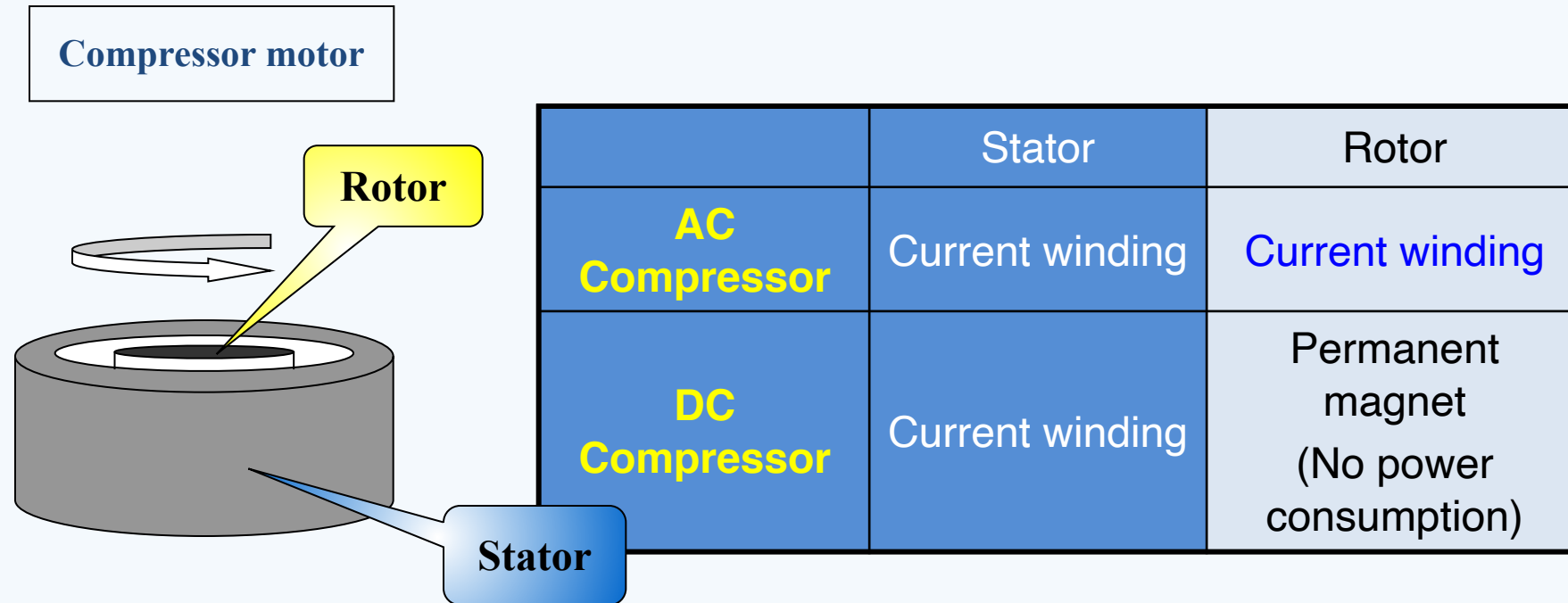
In general situation, an inverter A/C can save **30-40%** power than normal ON/OFF A/C unit.



What does inverter bring us?



✓ Energy Saving

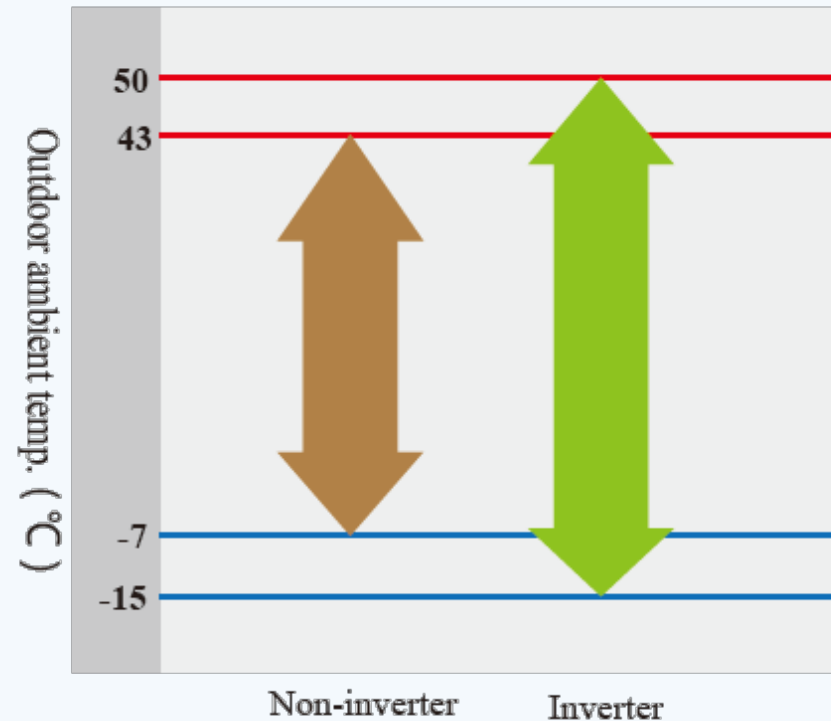


Inverter A/C equipped with DC compressor which rotor is made of permanent magnet. Not like AC compressor, the rotor of DC compressor does not consume electrical power.

What does inverter bring us?



✓ Wide Operation Range



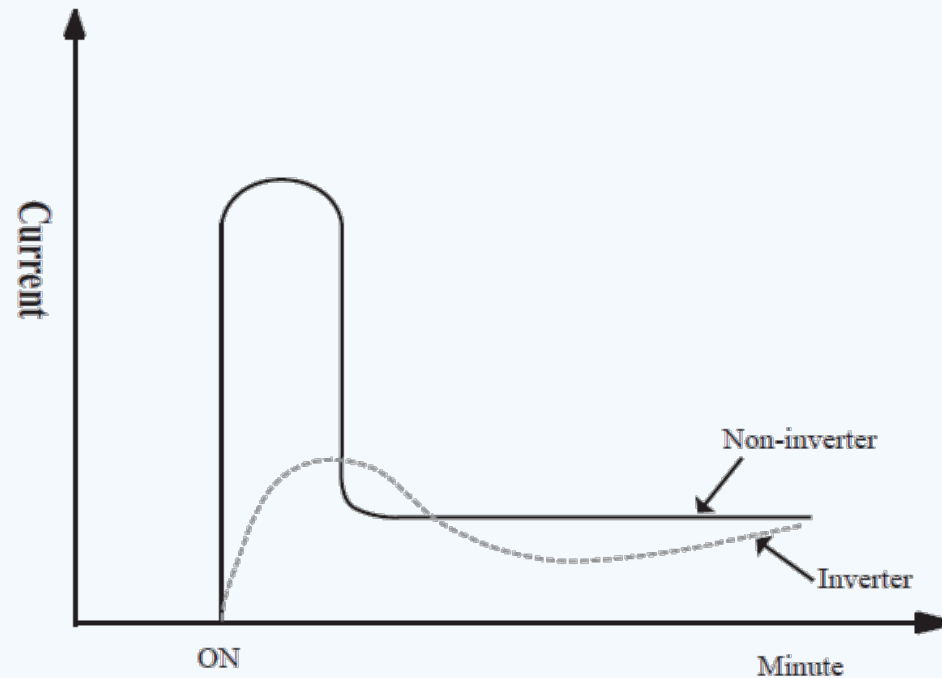
The powerful BLDC inverter compressor and outdoor BLDC fan motor are used to adjust the air flow and volume, to ensure wider and efficient operation.

What does inverter bring us?



✓ Safety

No voltage peaks from inverter compressor, starting current of inverter is much lower than that of non-inverter.



What does inverter bring us?



With inverter driven AC systems, cooling and heating can be adjusted freely in accordance with the load in any given room by controlling the rotary speed of compressors, while with non-inverter AC systems such adjustment is not possible because the rotary speed of compressors is fixed by the power supply frequency.

Main differences between inverter and non-inverter

Item	Non-inverter AC	Inverter AC
1. Time to reach pre-set temp.	Relatively long due to fixed capacity.	Short because of increase capacity.
2. Fluctuations after reach pre-set temp.	Major fluctuations due to start/stop operations.	Minor fluctuations due to load-adaptable operations
3. Sudden current flow when the compressor is started	5 ~ 6 times rated value.	1.5 times rated value due to gradual frequency increase at the start.
4. Low temp. range during heating	Decrease in capacity.	Decrease in capacity compensated by increased rotational speed.
5. Defrosting time	Relatively long due to fixed capacity.	Short due to maximum capacity operations
6. Unit composition	Relatively simple.	Extra parts required.
7. Trouble diagnosis	Relatively easy.	Complicated.

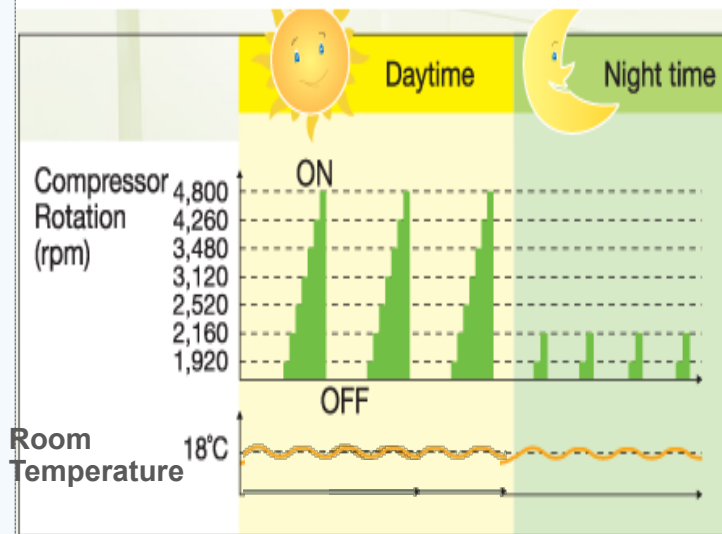


Inverter Technology

■ Features and benefits-Comparison with Non-Inverter.

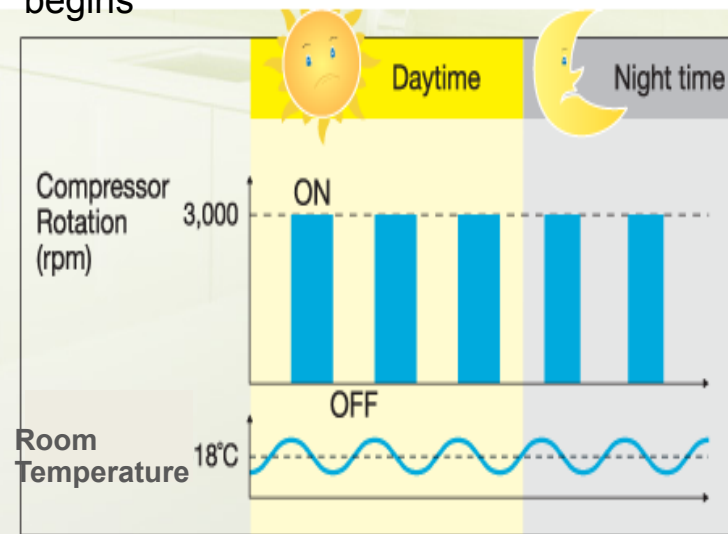
Inverter

Cooling power is raised or lowered as needed.
The indoor is maintained at more constant temperature and no energy wasted.



Non-Inverter

The same level of cooling power is used.
When the temperature drop operation shuts off.
When the temperature rises, cooling begins



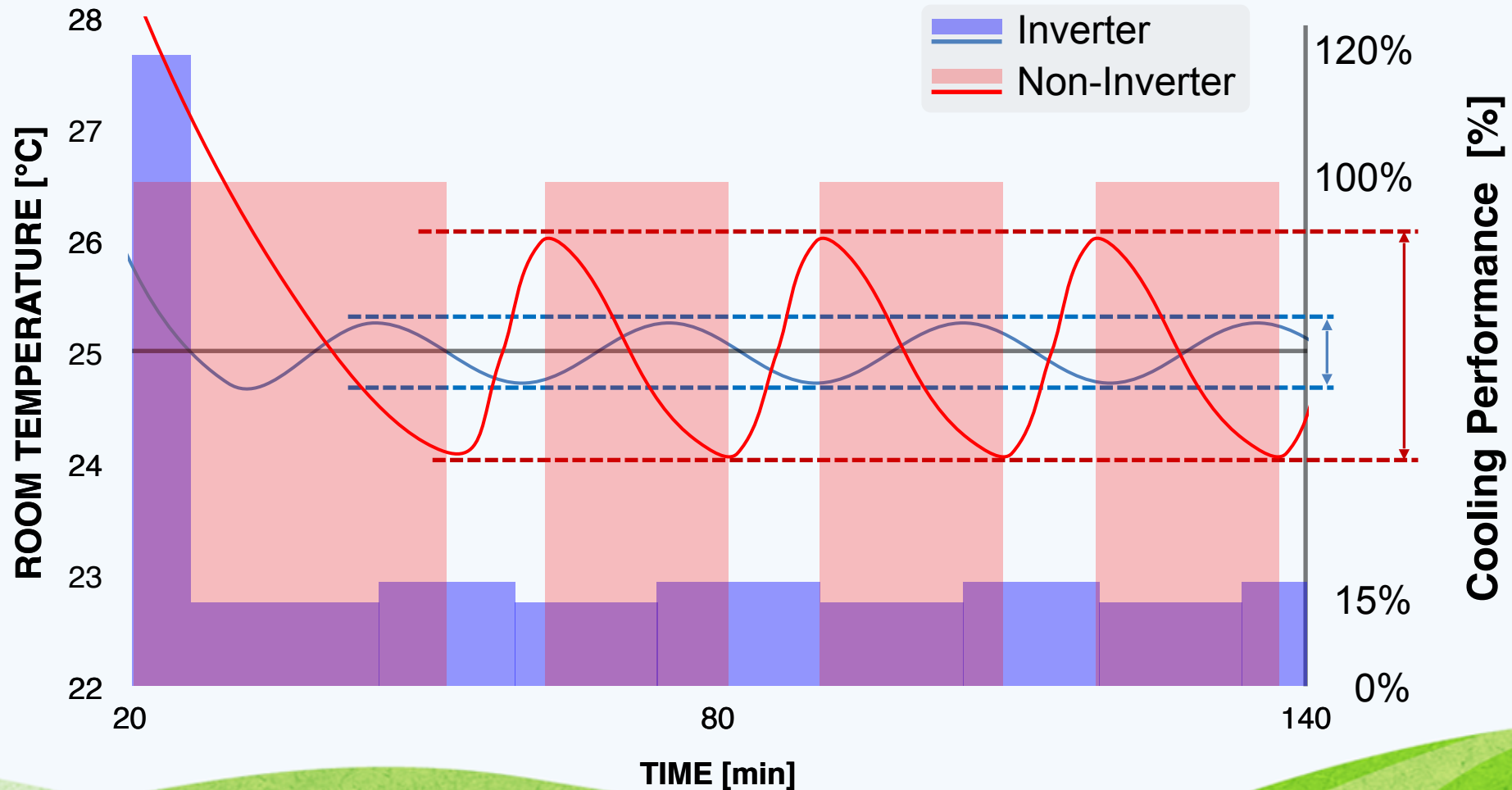
1. **Fast Cooling** by compressor rotation speed up
2. **Constant Temp.** Control by variable speed control
3. **Saving Energy and Cost** by optimized cooling capacity control
4. **Less noise**
5. **Durability**



Inverter Technology

- A Comparison of temperature control in Inverter and Non-Inverter

Inverter air conditioner has less temperature fluctuation by adjust speed

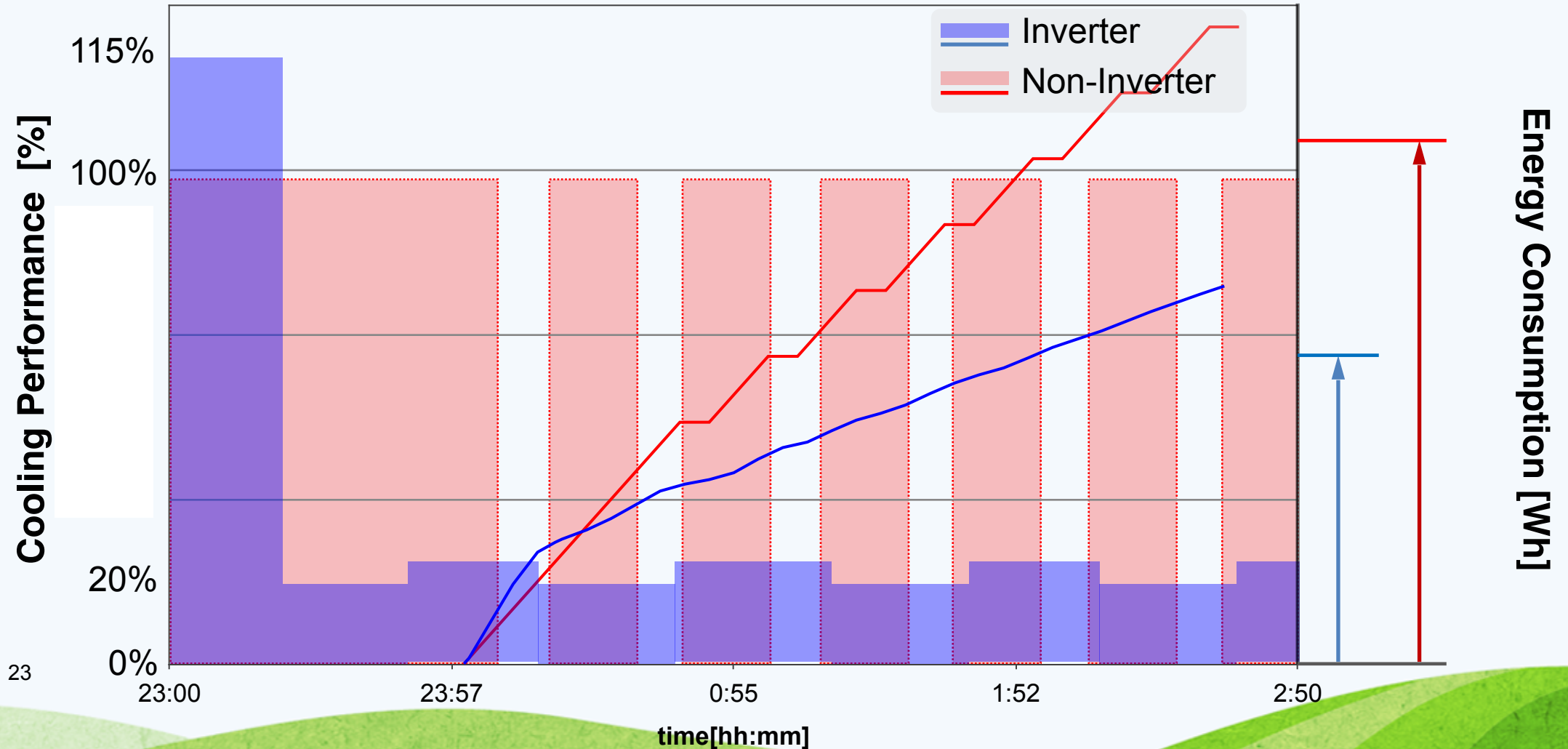




Inverter Technology

- A Comparison of temperature control in Inverter and Non-Inverter

Inverter system gives energy saving without frequently on and off



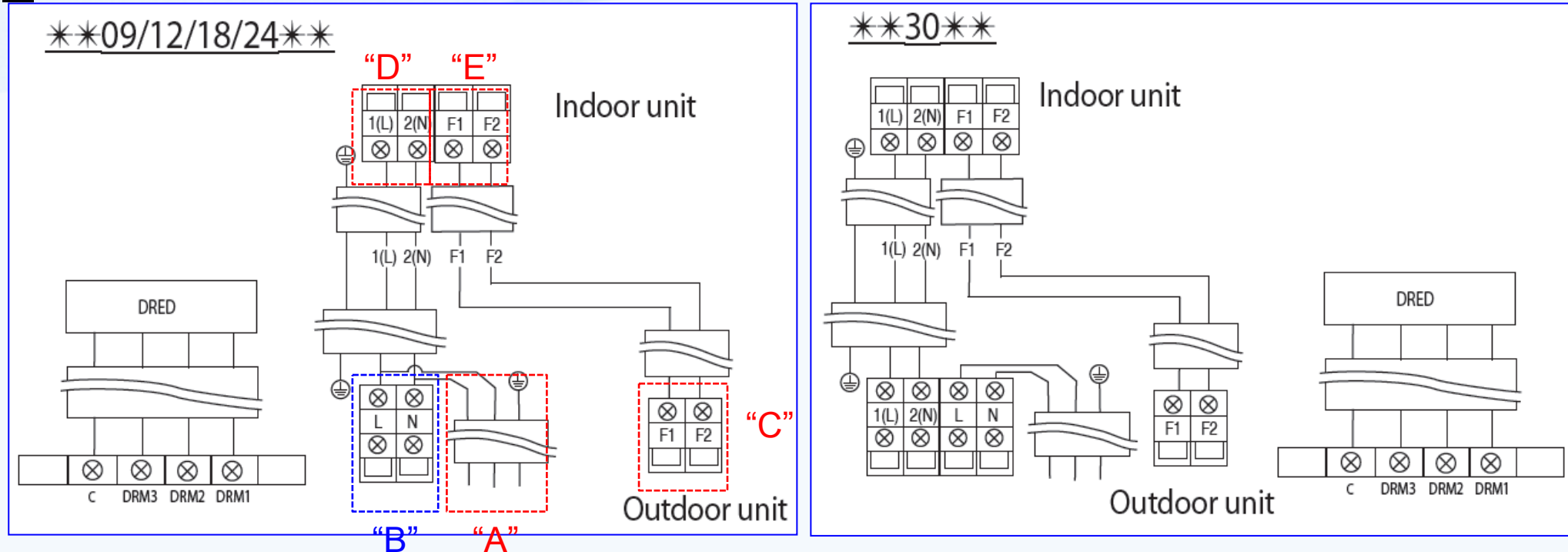


Troubleshooting

Troubleshooting



Communication Error



Note : The important installation guideline that installer must keep

1. If AC power("A") is connected to communication line("C"), PBA of outdoor unit will be damaged.

It is necessary that you should see information attached around terminal block carefully

A few installers had already made mistake of wiring and resulting in replacement of outdoor units

→ This is not a product problem but wrong wiring connection by installer.

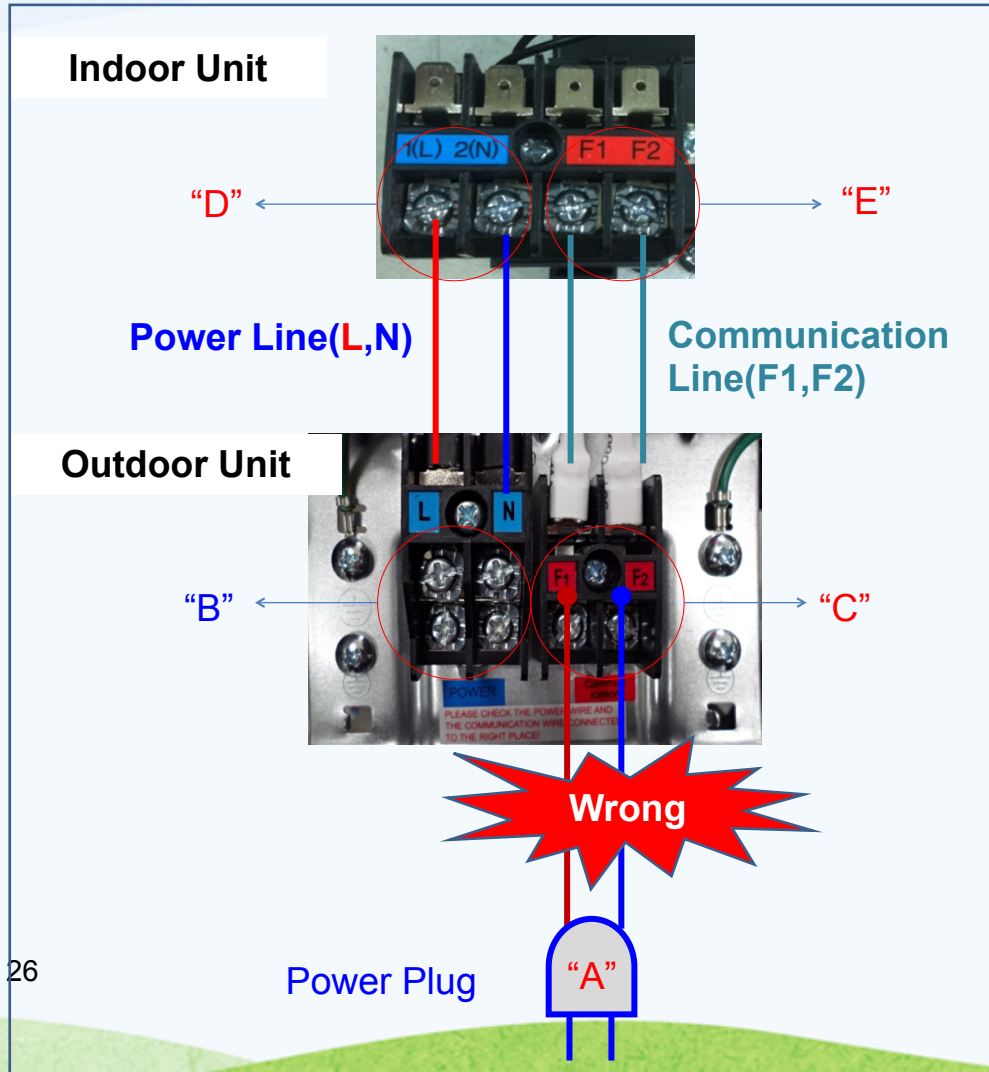
2. ²⁵When you connect AC power("B") from the outdoor unit to communication line("E") in the indoor unit,

Error on the display of indoor unit will be shown. (No PBA of indoor unit will be damaged) → Reconnect AC power("B") to power line("D")



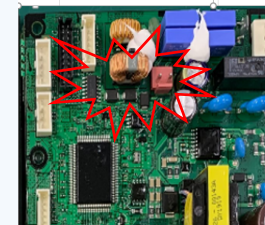
Troubleshooting

- Communication Error
 - Example 1 of Mis-Wiring Connection



- a. When AC Power(“A”) is connected to Communication Line(“E”, F1&F2), **Outdoor PBA would be damaged**
→ **Outdoor PBA should be replaced and paid by installer’s responsibility**

PF#2 PBA



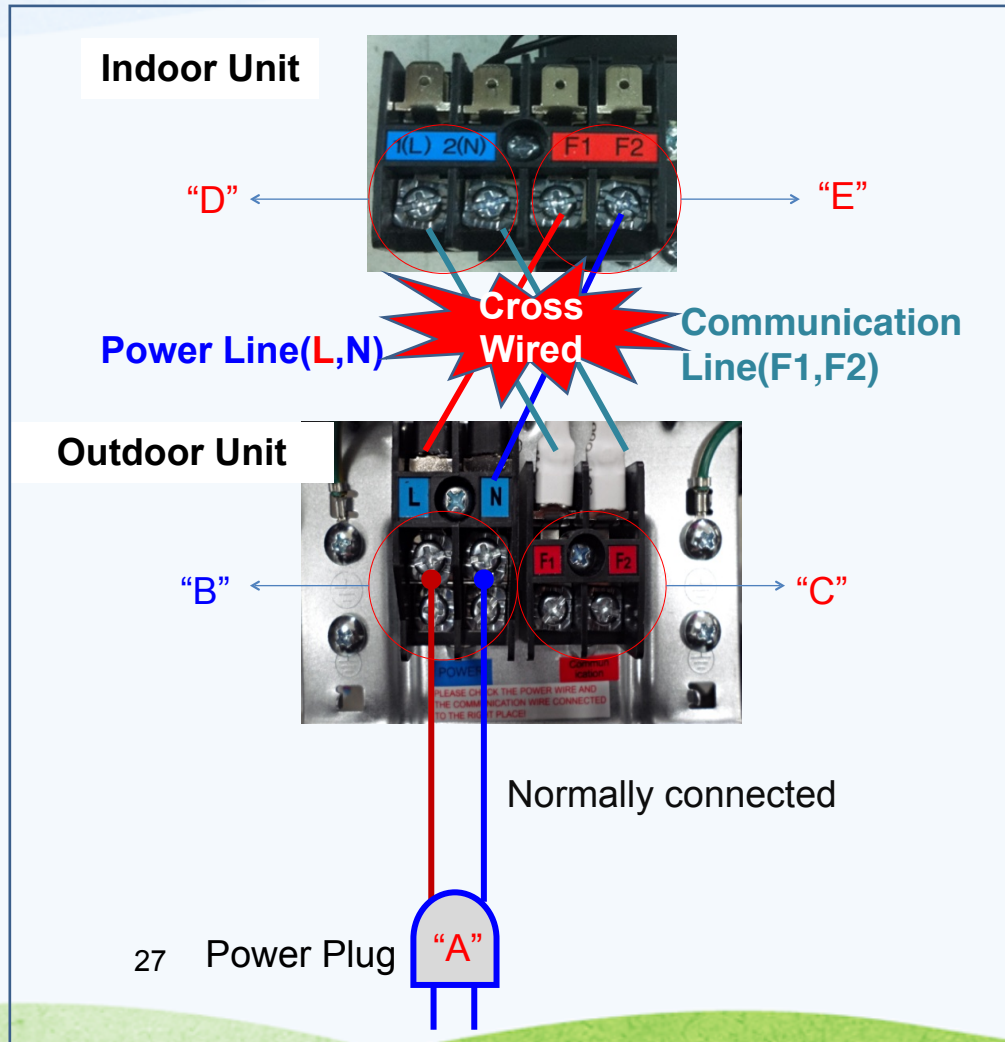
PF#3 PBA



Troubleshooting



- Communication Error
 - Example 2 of Mis-Wiring Connection



- a. When AC Power(“B”, L&N) is connected to Communication Line(“E”, F1&F2), Error Occurs. (No Damage to PBA)
→ Reconnect it correctly
- a. When Communication wire between “C” and “E” is not connected, Error Occurs. (No Damage to PBA)
→ Reconnect it correctly
- a. When Power Line between “B” and “D” is not connected → No power (No signal of indoor unit)
→ Connect it correctly

Troubleshooting



- Sensor is out of order
 - Indoor temperature sensor is out of order

Indoor display

7 SEG DISPLAY	DESCRIPTION
C121	Indoor room temp sensor error

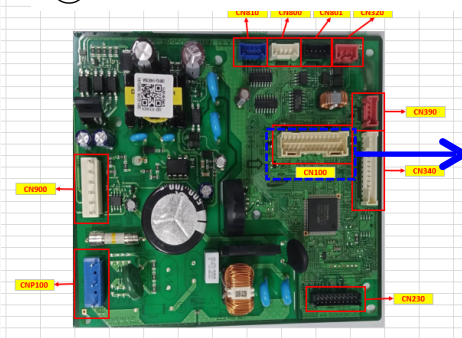
Check List

- ① Check the indoor temperature sensor's connection in PBA.
- ② Check the indoor temperature sensor located at indoor heat exchanger refer to below pictures.
- ③ Sensor resistance value with respect to indoor temperature refer to below Table.

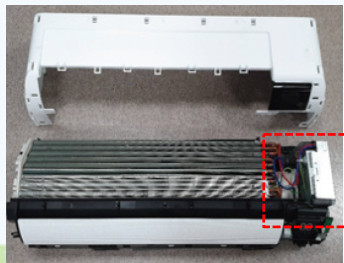


Check the sensor's resistance value using ohm meter device. If resistance value is over the 10 kΩ at 25°C , **temperature sensor is out of order**

. Check the connected sensor's voltage with power on, measuring voltage value over the 4.8V or under 0.5V, **PBA is out of order**



Sensor connection (CN100)



Indoor room sensor location

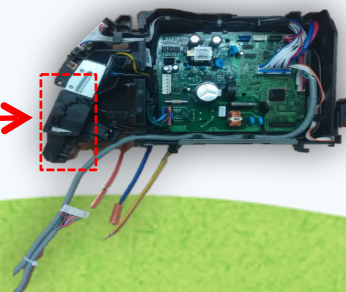


Table. Resistance value of indoor room temperature sensor

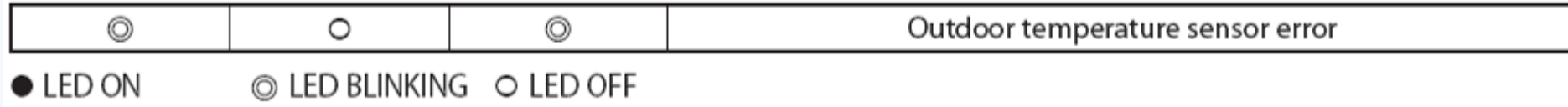
Predicted Indoor Temperature	Measured sensor resistance value
20°C	12.09 kΩ
25°C	10.00 kΩ
30°C	8.31 kΩ
35°C	6.94 kΩ
40°C	5.83 kΩ

Troubleshooting



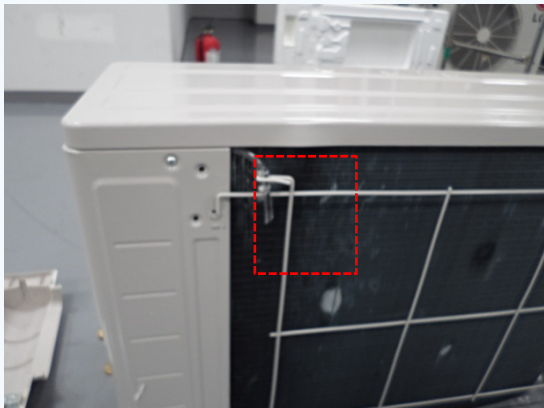
- Sensor is out of order
 - Outdoor temperature sensor is out of order

Outdoor display



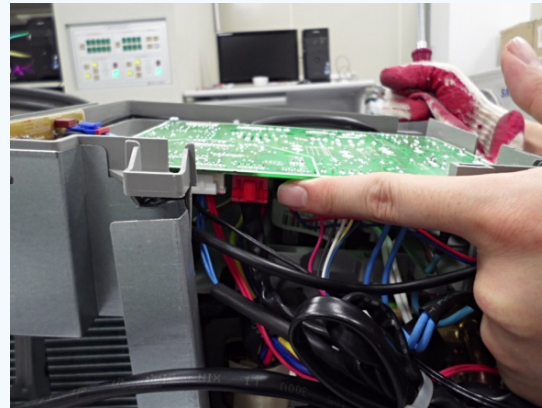
Check List

- ① Check the temperature sensor's connection in PBA.
- ② Check the sensor is placed on outdoor sensor's holder, properly.
- ③ Check the sensor's resistance value refer to below Table



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Check the outdoor sensor's location



Check the outdoor sensor's wire connection.

Table. Resistance value of temperature sensor

Predicted outdoor Temperature	Measured sensor resistance value
20°C	12.09 kΩ
25°C	10.00 kΩ
30°C	8.31 kΩ
35°C	6.94 kΩ
40°C	5.83 kΩ

Troubleshooting



- *Fan speed and Drain pump is out of control*

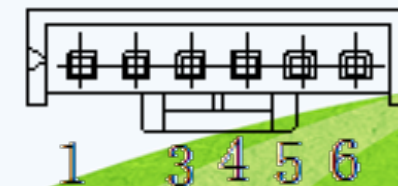
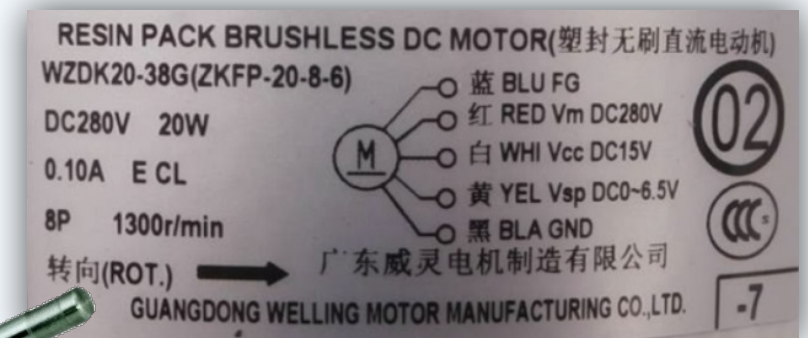
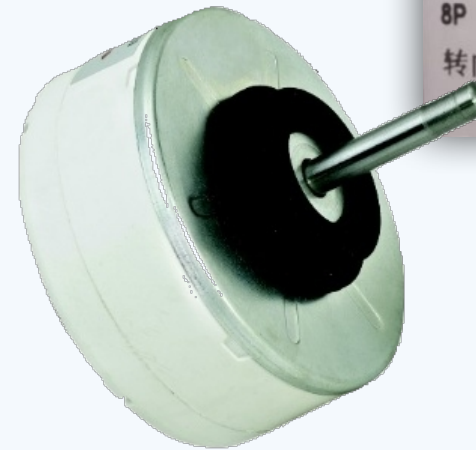
Fan motor problem (DC motor that control chip inside the motor)

and when the unit is in standby, measure the voltage of pin1-pin3, pin4-pin3 of fan motor connector. If the value of the voltage is not in the range showing in below table, the PCB must/has problems and need to be replaced.

DC motor voltage input and output:

NO.	Color	Signal	Voltage
1	Red	Vs/Vm	280V~380V
2	---	---	---
3	Black	GND	0V
4	White	Vcc	14-17.5V
5	Yellow	Vsp	0~5.6V
6	Blue	FG	14-17.5V

30

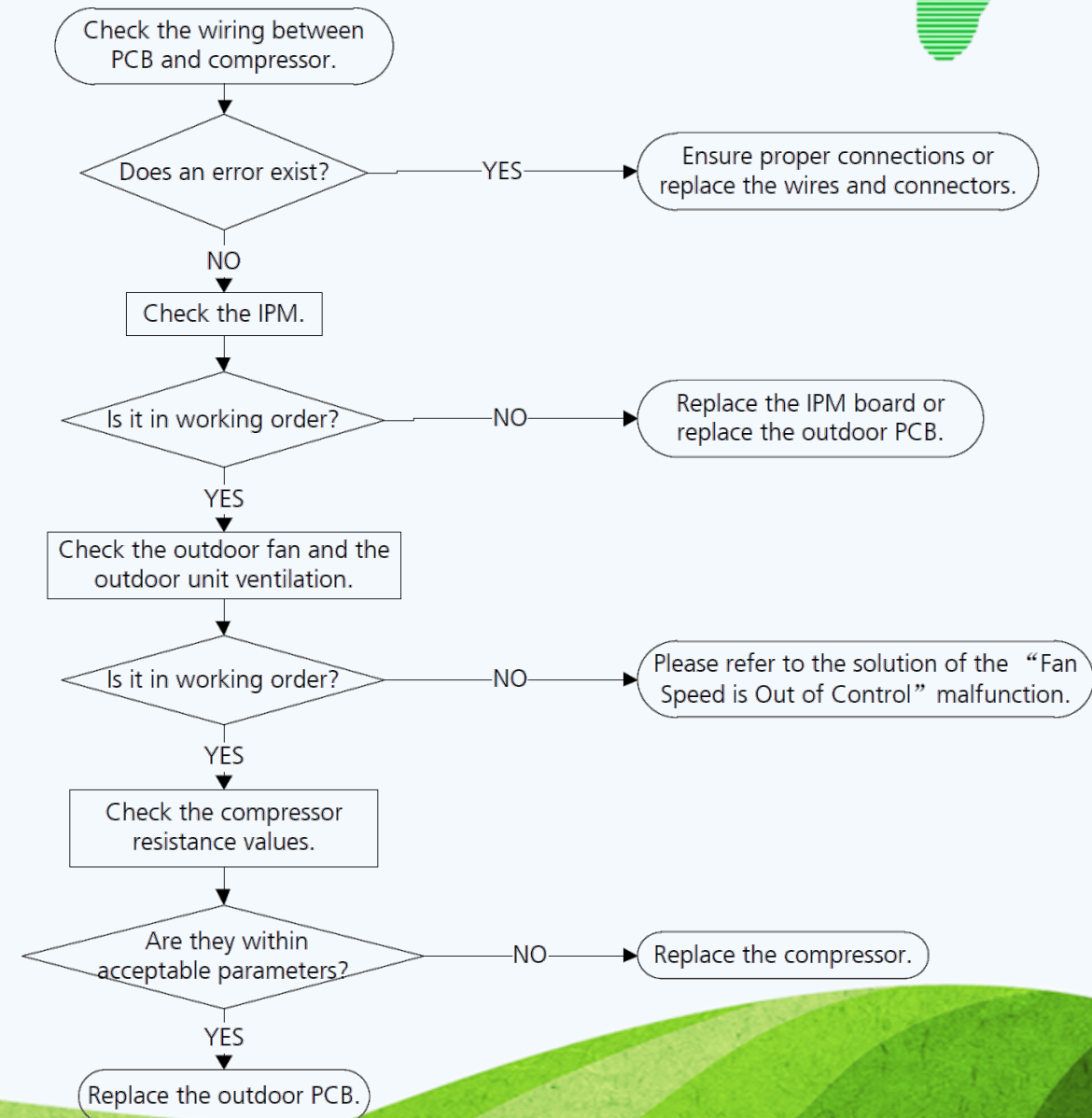


Troubleshooting.



• IPM over-strong current protection)

Error Code	P0 (PC 00)
Malfunction decision conditions	When the voltage signal that IPM send to compressor drive chip is abnormal, the display LED will show “P0” and AC will turn off.
Possible causes	<ul style="list-style-type: none"> • Wiring mistake • IPM malfunction • Faulty outdoor fan motor • Compressor malfunction • Faulty outdoor PCB



Troubleshooting.



- Inverter compressor drive error*

Code	Meaning	Possible Reasons	Service Suggestion (in order)
PC 40	Communication error between main control chip and drive chip	PCB is broken by corrosion or bad process. MCU or driven chip is broken.	Change the IPM PCB if there is one Change the main PCB
PC 41	Error of current sampling circuit of compressor	PCB is broken by corrosion or bad process	Change the IPM PCB if there is one Change the main PCB
PC 43	Lack phase protection	a) PCB is broken by corrosion or bad process, IPM is broken; b) Bad connection: loose connection at UVW connector or compressor terminal. c) Bad compressor: broken circuit inside the compressor motor	1) Check the connection wire between PCB and compressor 2) Change the IPM PCB or main PCB 3) Change the compressor or outdoor unit
PC 44	Zero speed protection	a) Bad compressor: Stuck, partial demagnetization, internal minor short-circuit. b) Compressor is not compatible.	Change the compressor or outdoor unit.
PC 45	Suddenly power lost	Power wires loose connection.	Check the power connection wires.
PC 42	Compressor start failure	a) PCB is broken by corrosion or bad process; b) Bad compressor: Stuck, partial demagnetization, internal minor short-circuit.	1) Make sure the outdoor is ventilated well 2) Make sure all the valves are opened 3) Check the wires
PC 46	Compressor speed out of control	c) Compressor is not compatible. d) Refrigeration system: blockage, valve closed, stuck EEV	4) Check system pressure to make sure no leakage or too much refrigerant 5) Change the IPM PCB and main PCB
PC 49	Over current of compressor	e) Bad heat ventilation of outdoor unit; f) Power voltage sudden rise or drop a lot	6) Change the compressor or outdoor unit



THANKS FOR YOUR ATTENTION