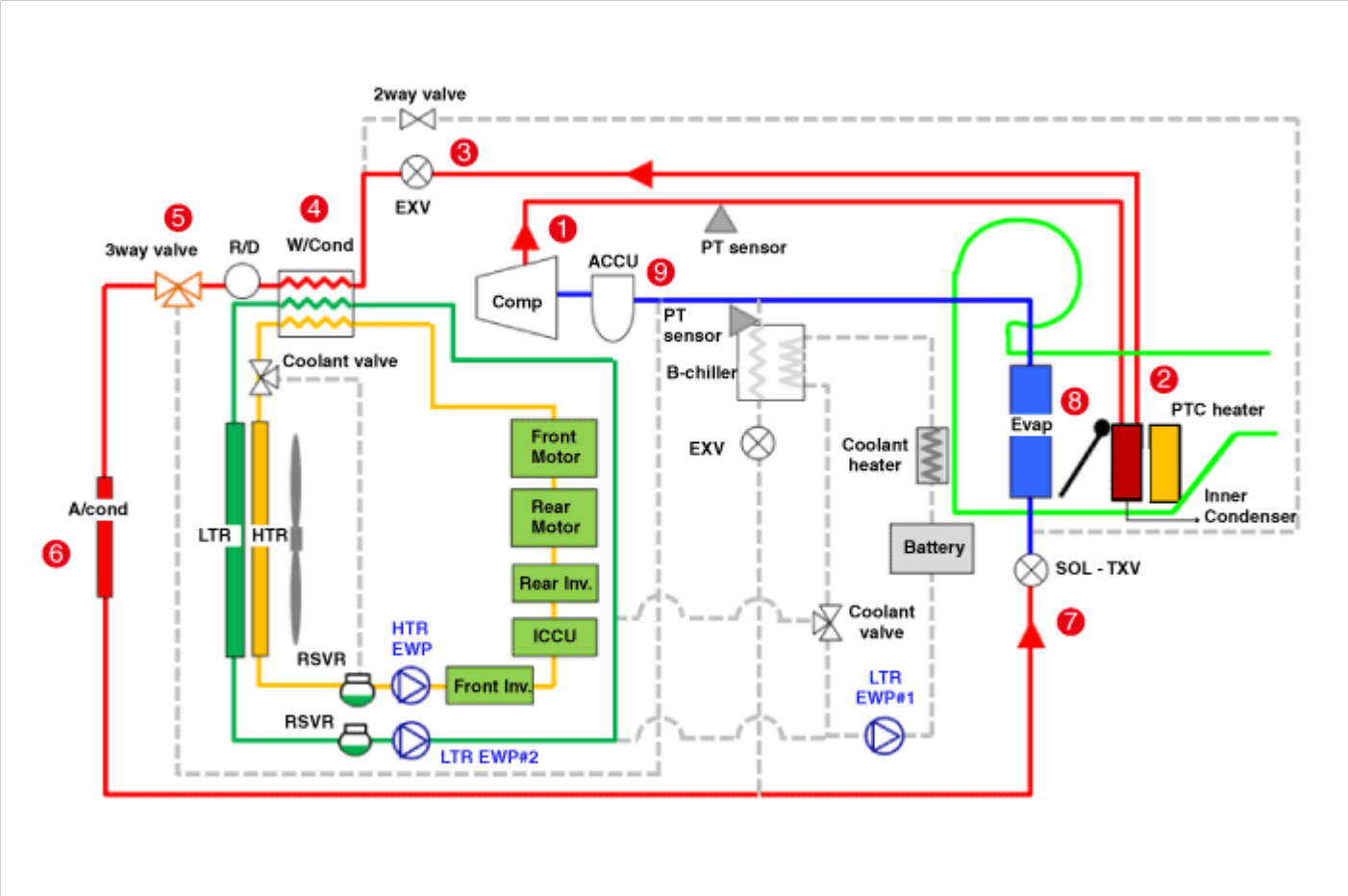
- Description and Operation

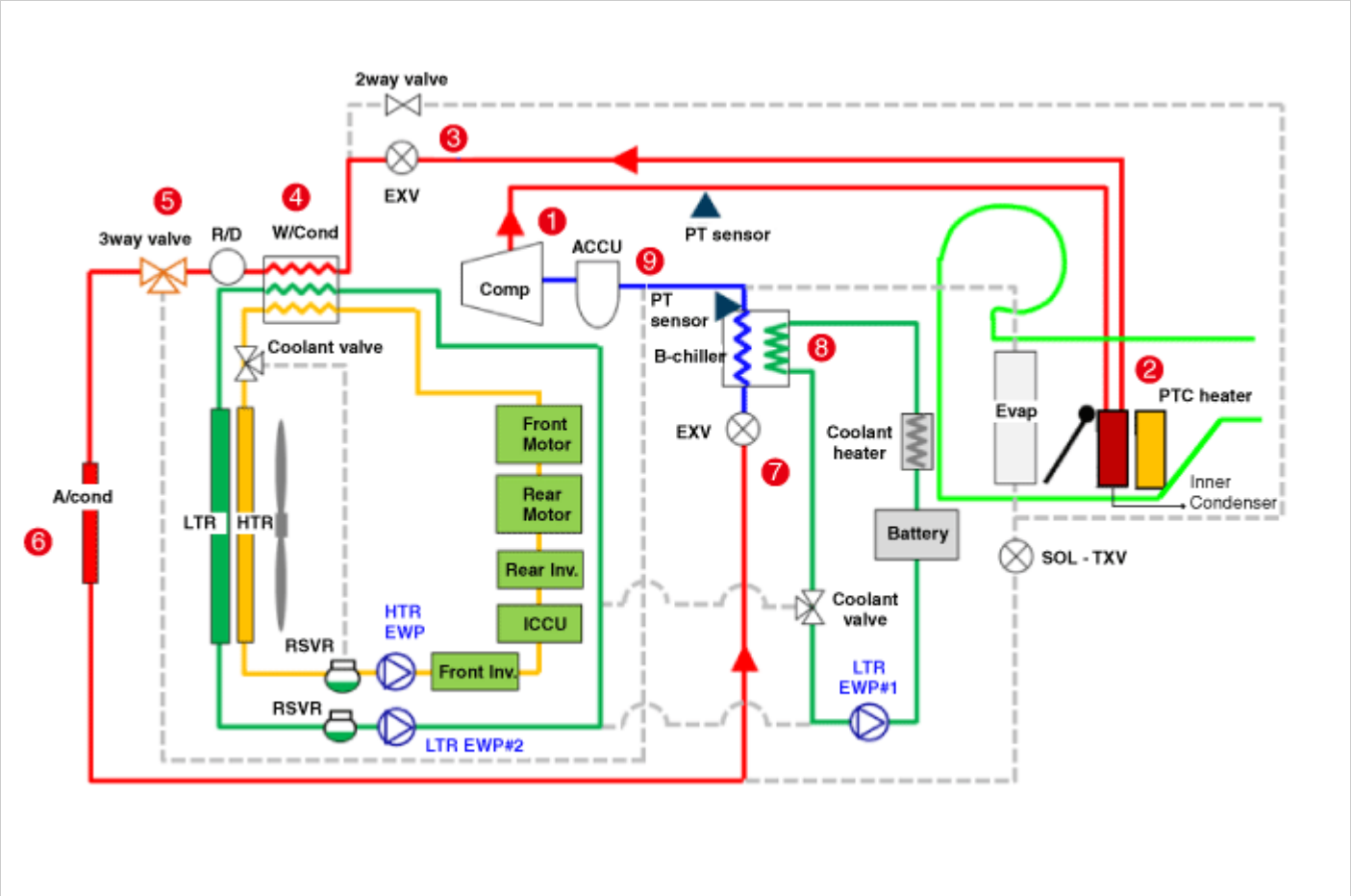
Heat pump is configured to enable cooling and heating by circulating the flow of refrigerant.
This process minimizes battery consumption when heating and increases drive distance for EV.

[Cooling Mode (A/C Mode)]



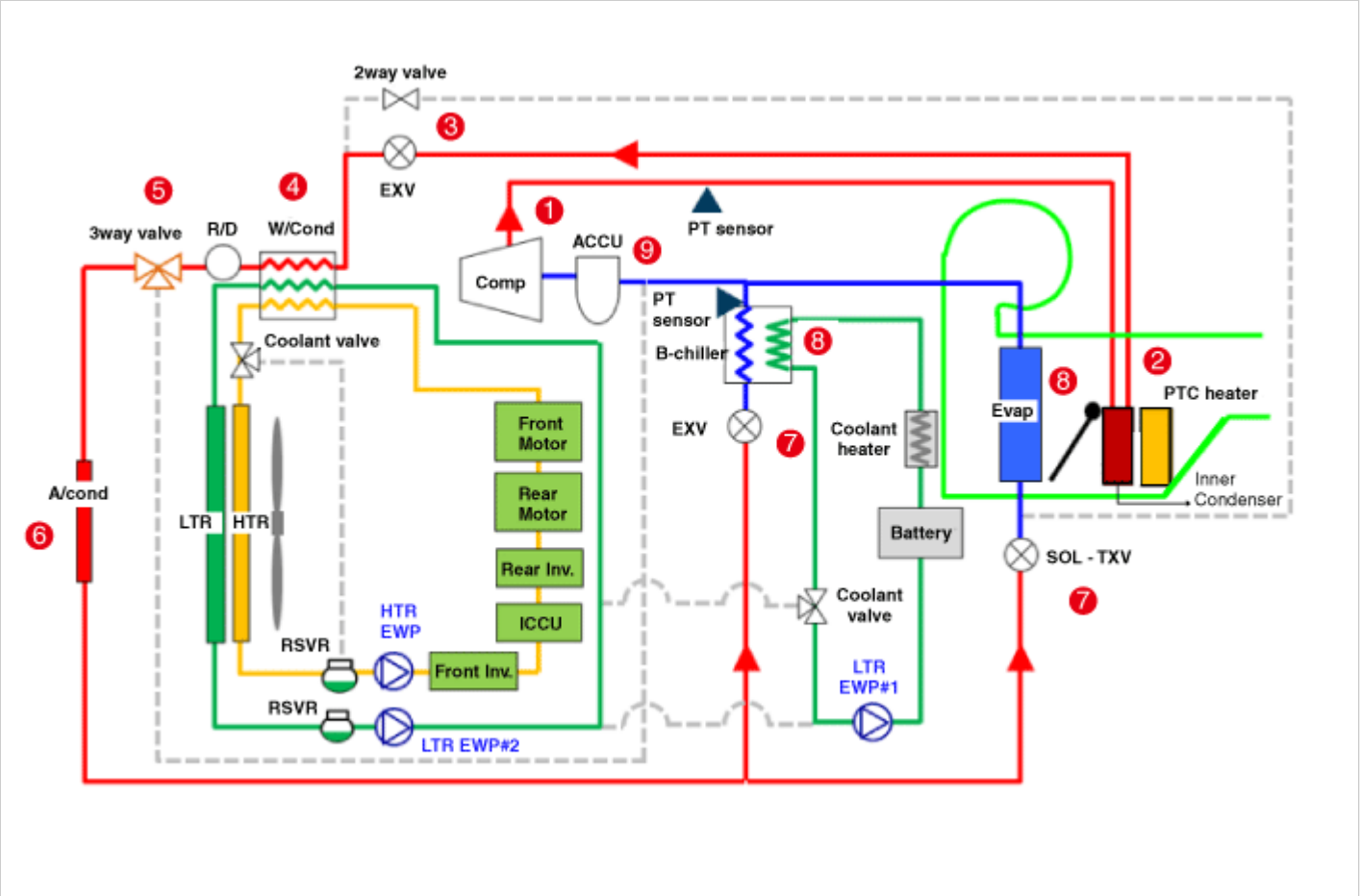
1. Electric air conditioner compressor : It is operated by an electric motor and converts the gas refrigerant of low-temperature/low-pressure into the gas of high-temperature/high-pressure and sends it to the indoor condenser.
2. PTC Heater : High voltage electric heater for indoor heating
3. EXV : In cooling mode, it by-passes the refrigerant.
4. R/D water-cooled condenser : It condenses the gas refrigerant of high-temperature/high-pressure to make the liquid refrigerant of high-temperature/high-pressure .
5. 3-way valve : It controls the refrigerant to move it to the condenser.
6. Condenser : It condenses the refrigerant which was condensed in the R/D water-cooled condenser once more.
7. SOL-TXV : It converts the liquid refrigerant of high-temperature/high-pressure into the low-temperature/low-pressure to facilitate phase change.
8. Evaporator : It cools air by using the vaporizing effect of the refrigerant.
9. Accumulator : It separates the gas/liquid of the refrigerant so that only the gaseous refrigerant can flow into the compressor.

[Cooling Mode (Battery Cooling Mode)]



1. Electric air conditioner compressor : It is operated by an electric motor and converts the gas refrigerant of low-temperature/low-pressure into the gas of high-temperature/high-pressure and sends it to the indoor condenser.
2. PTC Heater : High voltage electric heater for indoor heating
3. EXV : In cooling mode, it by-passes the refrigerant.
4. R/D water-cooled condenser : It condenses the gas refrigerant of high-temperature/high-pressure to make the liquid refrigerant of high-temperature/high-pressure .
5. 3-way valve : It controls the refrigerant to move it to the condenser.
6. Condenser : It condenses the refrigerant which was condensed in the R/D water-cooled condenser once more.
7. EXV : It converts the liquid refrigerant of high-temperature/high-pressure into the low-temperature/low-pressure to facilitate phase change.
8. Chiller : It lowers the coolant temperature by the heat exchange of the battery coolant and refrigerant.
9. Accumulator : It separates the gas/liquid of the refrigerant so that only the gaseous refrigerant can flow into the compressor.

[Cooling Mode (A/C + Battery Cooling Mode)]



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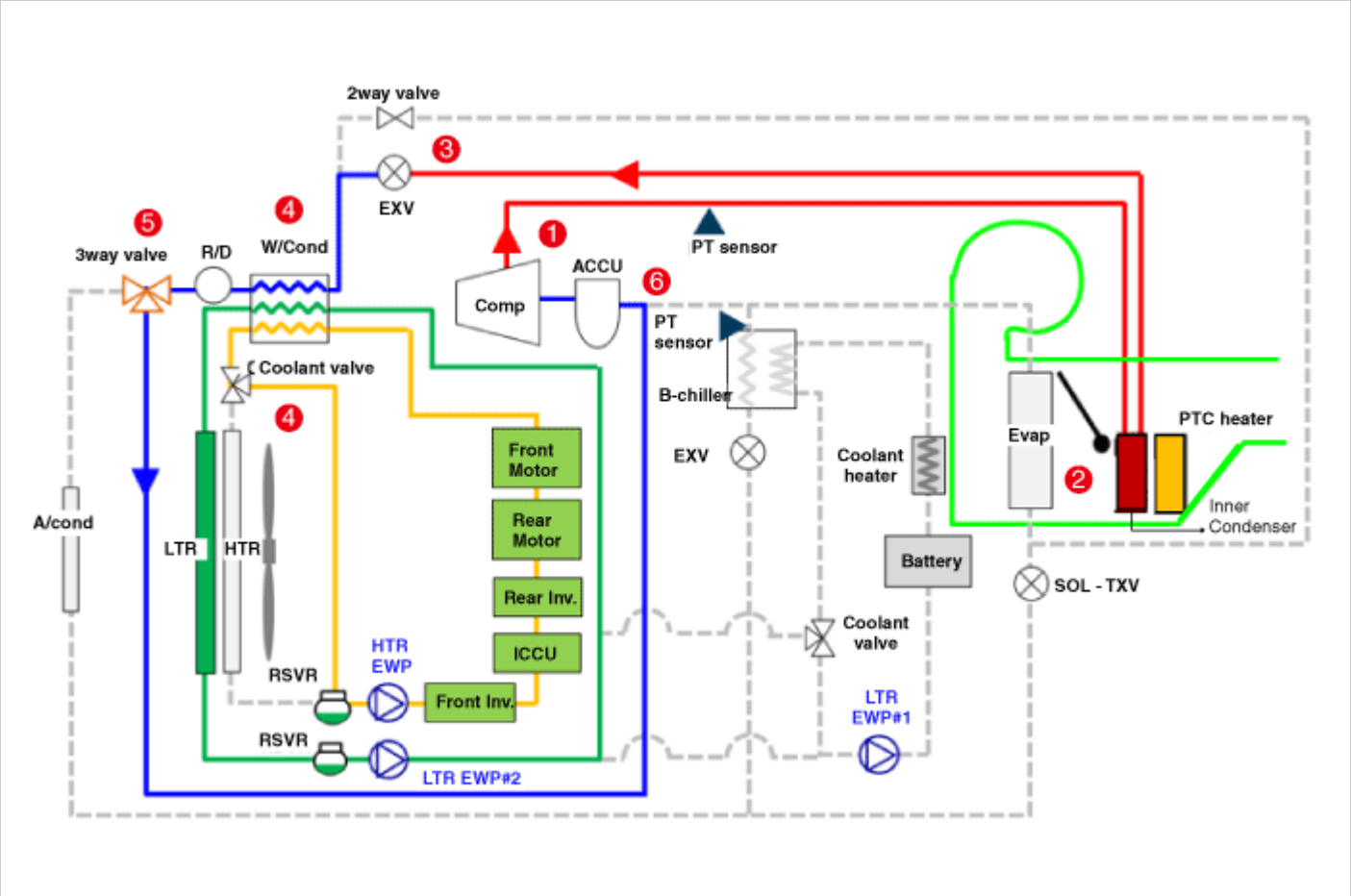
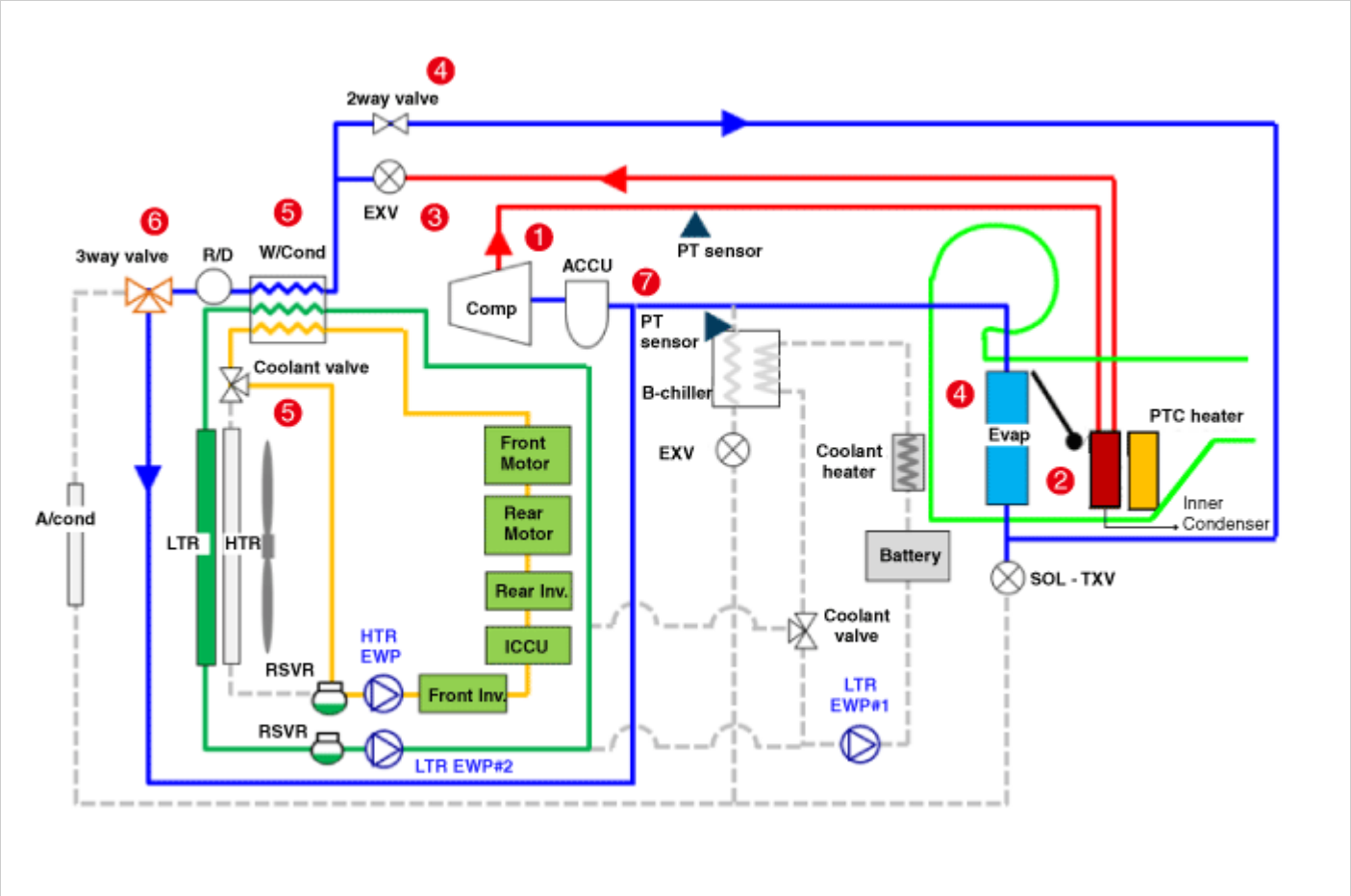
5. 3-way valve : It controls the refrigerant to move it to the condenser.
6. Condenser : It condenses the refrigerant which was condensed in the R/D water-cooled condenser once more.
7. EXV : It converts the liquid refrigerant of high-temperature/high-pressure into the low-temperature/low-pressure to facilitate phase change. (It operates when cooling battery)
8. Evaporator : It cools air by using the vaporizing effect of the refrigerant.
9. Accumulator : It separates the gas/liquid of the refrigerant so that only the gaseous refrigerant can flow into the compressor.

[Heating Mode (Cabin Heating Mode)]



1. Electric air conditioner compressor : It is operated by an electric motor and converts the gas refrigerant of low-temperature/low-pressure into the gas of high-temperature/high-pressure and sends it to the indoor condenser.
2. Evaporator : It cools air by using the vaporizing effect of the refrigerant.
3. EXV : In heating mode, it converts the liquid refrigerant of high-temperature/high-pressure into the low-temperature/low-pressure to facilitate phase change.
4. R/D water-cooled condenser : It expands the liquid refrigerant of low-temperature/low-pressure into the gaseous refrigerant of low-temperature/low-pressure.
5. 3-way valve : It controls the refrigerant to move it to the accumulator.
6. Accumulator : It separates the gas/liquid of the refrigerant so that only the gaseous refrigerant can flow into the compressor.

[Heating Mode (Cabin Heating + Dehumidification Mode)]



1. Electric air conditioner compressor: It is operated by an electric motor and converts the gas refrigerant of low-temperature/low-pressure into the gas of high-temperature/high-pressure and sends it to the indoor condenser.
2. Evaporator: It cools air by using the vaporizing effect of the refrigerant.
3. EXV: In heating mode, it converts the liquid refrigerant of high-temperature/high-pressure into the low-temperature/low-pressure to facilitate phase change.
4. 2-way valve: It controls the liquid refrigerant of low-temperature/low-pressure to move it to the evaporator.
5. R/D water-cooled condenser: It expands the liquid refrigerant of low-temperature/low-pressure into the gaseous refrigerant of low-temperature/low-pressure.
6. 3-way valve: It controls the refrigerant to move it to the accumulator.
7. Accumulator: It separates the gas/liquid of the refrigerant so that only the gaseous refrigerant can flow into the compressor.