1. WHAT’S CONDENSING UNITS?
The Condensing Unit is the official name for the outdoor HVAC unit. Condensing Units can either be an air conditioning unit or a heat pump. A typical HVAC Condensing Unit has:

- A Compressor to increase the pressure of refrigerant to keep liquid refrigerant moving along
- A Fan for blowing the outside air through the heat exchanger to help cool the refrigerant
- A Condensing Coil to help send the heat carried by the refrigerant to the outside

2. HOW MANY TYPE OF CONDENSING UNIT?
There are three other condensers used in HVAC systems

- Water-cooled
- Air-cooled
- Evaporative

3. WHAT APPLICATIONS CONDENSING UNIT USE FOR?
   3-1. Air cooled
   If the condenser is located on the outside of the unit, the air cooled condenser can provide the easiest arrangement. These types of condensers eject heat to the outdoors and are simple to install.

   Most common uses for this condenser are domestic refrigerators, upright freezers and in residential packaged air conditioning units. A great feature of the air cooled condenser is they are very easy to clean. Since dirt can cause serious issues with the condensers performance, it is highly recommended that these be kept clear of dirt.

   3-2. Water cooled
   Although a little more pricey to install, these condensers are more efficient type. Commonly used for swimming pools and condensers piped for city water flow, these condensers require regular service and maintenance.

   They also require a cooling tower to conserve water. To prevent corrosion and the forming of algae, water cooled condensers require a constant supply of makeup water along with water treatment.

   3-3. Evaporative
   While these remain the least popular choice, they are used when either water supply is inadequate to operate water cooled condenser or condensation temperature is lower that can achieved by air cooled condenser. Evaporative condensers can be used inside or outside of a building and under typical conditions, operate at a low condensing temperature.

   Typically these are used in large commercial air-conditioning units. Although effective, they are not necessarily the most efficient.

4. WHAT’S RIGID DC CONDENSING UNIT?
RIGID DC Condensing Unit is also named a direct expansion system. It is the most compact design refrigerant system. The system contains mini compressor, heat transfer, a condenser, filter drier
or expansion valve, and other tiny quality refrigeration parts. RIGID DC Condensing unit is able to apply to various application. For example, a refrigerator uses a condenser to get rid of heat extracted from the interior of the unit to the outside air. A direct cooling design eliminates the use of a secondary coolant loop and uses the refrigerant to directly cool the desired payload via a cold plate (to match customer's various system). In the cold plate of a direct expansion system, the refrigerant undergoes an isothermal phase change, which offers extremely tight temperature control across the cold plate. So RIGID DC Refrigeration Unit System provides active thermal management for laser, industrial, medical, semiconductor and military applications.

1. Super small volume: 19.5x16x17 cm (7.85x6.3x6.7 inch)
2. Super light weight: 3kgs (6.6lbs)
3. Use variable speeds dc compressor
4. DC condensing unit run on: 12V, 24V and 48V
5. Low vibration with anti-vibration cushion
6. High temperature working condition, can work on battery, solar power, car power.

5. WHAT APPLICATION NEED RIGID DC CONDENSING UNIT?

RIGID direct condensing unit is world’s smallest size and very compact. It particularly designed for laser manufacturers, laboratory, hospital lab, large end users and system integrators. RIGID patent mini dc compressor drives the refrigerant directly through the laser cold plate. This concept eliminates the need for a water cooling loop (water pump, reservoir and associated tubing) resulting in a greatly simplified cooling system. The minimum evaporating temperature and the condensing temperature allows RIGID condensing units apply to application (LBP, MBP and HBP).

Low Back Pressure systems such as freezers have evaporator temperatures below -20°C (-4°F). Medium Back Pressure systems such as food coolers or beverage dispensers have evaporator temperatures higher than -20°C (-4°F). High Back Pressure systems such as chillers and air conditioners have evaporator temperatures higher than -5°C (+23°F).
6. RIGID DC CONDENSING UNIT PARAMETERS

6.1 Cooling Capacity
This is usually defined as the specified nominal cooling capacity at normal working conditions of the system in watts, according to evaporating and condensing temperatures. The capacity is determined by the mass flow rate of refrigerant, which depends on the condensing unit compressor’s displacement, RPM, and volumetric efficiency. RIGID compact dc condensing unit refrigeration capacity ranges from 30W to 250W.
6.2 Refrigerant Type
Refrigerant selection can be made on the basis of availability, performance, and ecological considerations. RIGID refrigeration unit has been verified for use with R134a refrigerant.

6.3 Ambient Temperature
RIGID dc condensing units are usually intended for indoor use, and a minimum of +5°C is required in order for proper lubrication. In 2017, RIGID has successfully developed T-tropical series mini compressor, which is able to work in 52 degree ambient temperature.

6.4 Electrical Power Available
RIGID dc condensing units are used in mobile or portable refrigeration systems. Its DC power is produced by batteries, fuel cells, vehicle alternators, solar panels, or from an AC inverter power supply. The compressor must be selected for use according to the DC voltage available. RIGID compressors are available in 12V, 24V and 48V versions.

6.5 Size and Cooling
RIGID dc condensing units are extremely small, high-performance for end users direct refrigeration devices. Its size is only 7.85x6.3x6.7 inch and weighting only 6.6 lbs. Current models produce as much as 30W to 250W.

RIGID DC Condensing Unit Specification & Parameters:

<table>
<thead>
<tr>
<th>Product Name</th>
<th>DC Condensing Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Principle</td>
<td>Direct Expansion System</td>
</tr>
<tr>
<td>Application</td>
<td>Direct Cooling or Refrigeration</td>
</tr>
<tr>
<td>Lubricating Oil</td>
<td>Polyol Ester</td>
</tr>
<tr>
<td>Compressor Type</td>
<td>RIGID Mini DC Compressors, R134A</td>
</tr>
<tr>
<td>Displacement</td>
<td>1.4cc, 1.9cc and 3.25cc per revolution</td>
</tr>
<tr>
<td>ASHRAE Cooling Capacity</td>
<td>300, 460 and 550W respectively</td>
</tr>
<tr>
<td>Speed</td>
<td>Variable 2,000–6,500 rpm</td>
</tr>
<tr>
<td>Motor</td>
<td>Brushless, DC Motor</td>
</tr>
<tr>
<td>Nominal Input Voltage</td>
<td>12V, 24V or 48V DC</td>
</tr>
<tr>
<td>Maximum Current</td>
<td>10A, 8.5A and 4.2A respectively</td>
</tr>
<tr>
<td>Evaporator Temperature Range</td>
<td>-40 to +25 °C</td>
</tr>
<tr>
<td>Other cooling parts</td>
<td>No Pumps and Reservoir</td>
</tr>
<tr>
<td>Cooling System Configuration</td>
<td>Hermetically sealed system, no water leaks</td>
</tr>
<tr>
<td>Driver Board</td>
<td>Included (Sine Wave version)</td>
</tr>
</tbody>
</table>
7. RIGID DC CONDENSING UNIT APPLICATIONS

Nowadays, more and more the leading laser manufacturers are exploring a new cooling kit or module for laser direct expansion cooling. Here, RIGID DC Condensing Unit contains R134A refrigerant and oil before shipping. The refrigerant flows directly through end user’s cold plate (Table 1. Table 2.) with the circulation being driven by the compressor. The advantages are multifold. This method eliminates the need for a liquid recirculating pump, fluid reservoir and associated tubing and connectors – sources of failures and leaks. The efficiency is improved by removing the losses associated with cooling a liquid and energy savings of driving a pump. Furthermore, our dc condensing unit widely apply to small refrigerator, electronics, kitchen appliances, precise instrument cooling.

RIGID DC Condensing Unit is very well-received by the market. Numerous refrigerated appliances can benefit from the size and weight reduction of a compressor. Some of the relevant refrigerated appliances are listed below:

- Laser chiller
- Electronics
- Kitchen appliances
- Precise instrument
- Lab cold plate
- Small refrigerator
- Drawers/Refrigerated
- ... ... and other advanced direct cooling devices

Table 1. Cold plate Cooling for Laboratory
Table 2. Refrigerant Cold Plate Cooling Better Alternative to Peltier

8. WHY CHOOSE RIGID DC CONDENSING UNIT?

RIGID DC Condensing Unit has the world's smallest size (7.85x6.3x6.7 inch and weighting only 6.6 lbs.) It adopts patent mini dc compressor. The miniature refrigeration technology is now advanced for effective application to laser systems that require active cooling with high efficiency. Plus, RIGID also provide OEM and ODM service to meet customer's specific requirements. We are able to provide custom-designed compact cooling systems to meet original equipment manufacturer (OEM) and end user conditions, and a wide range of laser thermal management applications. Applying direct refrigerant cooling further miniaturizes the cooling system, improves efficiency and reliability. By using RIGID's cutting edge technologies, there are some clever ways to cool laser, glycol, liquid and other precise instruments.

Compact and Reliable Laser Cooling Solution
9. Rigid DC Condensing Unit Working Principle

RIGID DC Condensing Unit are consist of miniature dc compressor, driver board, micro channel condenser, filter drier, capillary or expansion valve and other small refrigeration components. It doesn’t contain evaporator.

It is a cooling sub system, also named direct expansion system. Its contained R134A refrigerant absorbs heat directly at the heat source, minimizing the size and component count of the system. Our direct cooling system provides direct expansion cooling. The compressor drives the refrigerant directly through the evaporator. This concept eliminates the need for a water cooling loop (water pump, reservoir and associated tubing) resulting in a greatly simplified cooling system.

There are 3 steps for this new type cooling (See attached chart)

1- At end user’s evaporator, heat from the ambient air evaporates the liquid R134A refrigerant to chill the air.

2- RIGID tiny dc compressor circulates the refrigerant gas and compresses it increasing its pressure, and making the gas hot, similar in effect to an air pump when inflating the tire of bicycle.

3- At the condenser, ambient air cools and liquefies the hot refrigerant gas, which then reenters the refrigerant cycle. As seen in a domestic refrigerator, the inside is kept cool as heat is expelled.
10. WHAT COMPONENTS INCLUDED IN DC CONDENSING UNIT?

RIGID tiny compressor is very well-received by the market. Numerous refrigerated appliances can benefit from the size and weight reduction of a compressor. Some of the relevant refrigerated appliances are listed below: