

# APPLICATION NOTE – 1019

*Topic:* PROPER INSTALLATION OF SCRs WILL EXTEND LIFE

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## INTRODUCTION

The review of “How to” install an SCR and the understanding of “Why” proper installation and mounting is important will help assemblers and technicians perform a better job. In turn, following the proper procedure will help insure a longer life of the SCR.



**Figure 1 – Typical Mechanical Packages used by SCR manufacturers**  
(Photo courtesy of Darrah Electric)

As shown in Figure 1, there are many types of mechanical packages used by the SCR manufacturers today. This Application Note will only cover the most commonly used – the SCR Module and the Hockey-Puck SCR. Other mechanical packages such as Stud-Mount are typically only used for repair and not used in new designs. As most everyone knows, the life expectancy of electronic equipment is directly related to it’s operating temperature. The cooler it operates the longer the life.

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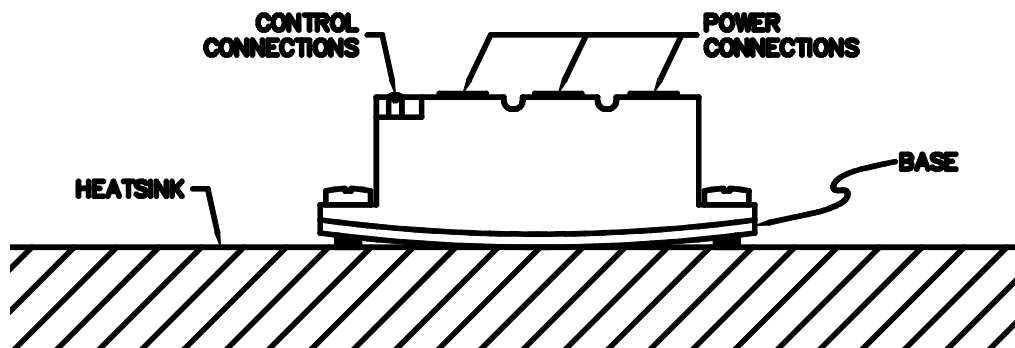
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## TYPES OF SCR PACKAGES

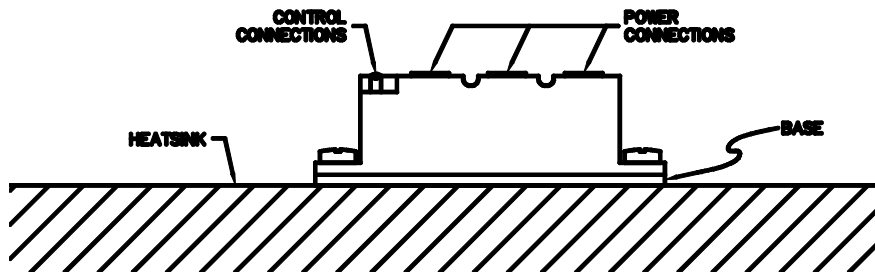
**SCR Module** - The SCR Module may contain only one or two SCRs, one or two diodes, or a full set of six SCRs and or diodes configured as a 6-pulse rectifier. The most commonly used module contains two SCRs. This type of module can be used alone in a single-phase AC application or three can be arranged for three-phase AC or DC applications.

SCR Modules use a slightly curved base. Figure 2 is a diagram showing the curved base exaggerated. The actual curve is not visible to the eye.



**Figure 2 – Dual SCR Module (curved base is exaggerated for demonstration)**

As shown in Figure 3, the SCR Module's base flattens and ensures a proper thermal connection when it is tightened to the heatsink properly. The SCRs in these modules are electrically isolated from the base. As a result, no electricity is conducted through the base to the heatsink. This mechanical connection is entirely for thermal conductivity. Ensure Heatsink Thermal Compound is used on the Module's base.



**Figure 3 – Dual SCR Module mounted properly**

The electrical power connections are small-machined threaded inserts or thin busbars depending upon the SCR Module manufacturer. The proper torque on these connections ensures proper power flow. A connection too loose will cause the connection point to overheat and cause premature failure. Overtightening can stress the module internally and cause it to fail. Consult the manufacturer for proper torque ratings for both the electrical connections and the base mounting.

The control terminations (Gate and Cathode) are important also. Failure to make reliable connections can cause the SCR to misfire and eventually fail or cause problems with other equipment.

**Hockey-Puk SCR** - The Hockey-Puk SCR gets its name from the resemblance to an actual hockey-puk. The mounting of a Hockey-Puk SCR is even more critical than it is on an SCR module. Figure 4 shows the Cathode Pole Face and a cross-sectional view of a Hockey-Puk SCR. As shown, the Hockey-Puk is made up of several parts. They are:

- Cathode Pole Face
- Anode Pole Face
- Silicon Wafer
- Ceramic or Plastic Housing
- Gate and Cathode Connections

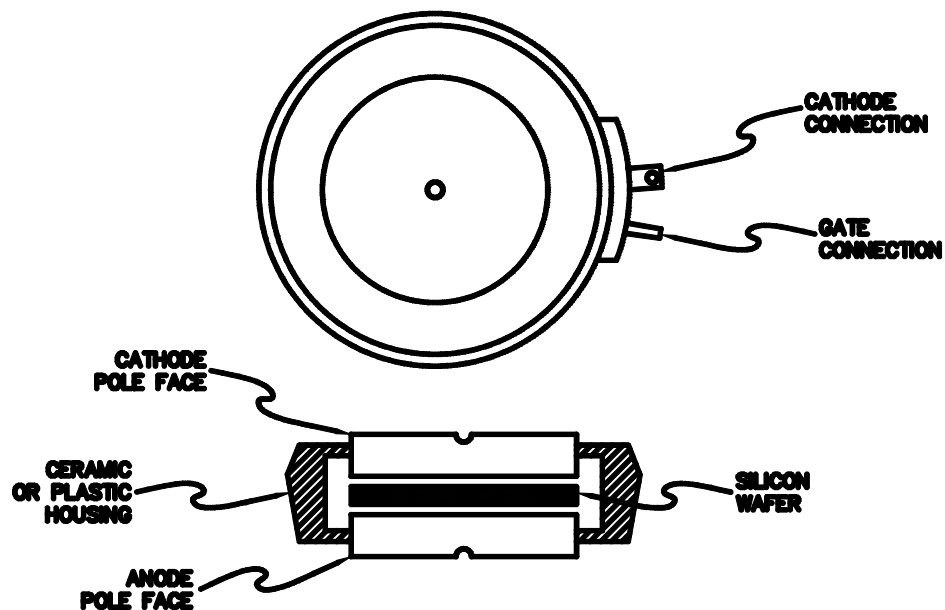
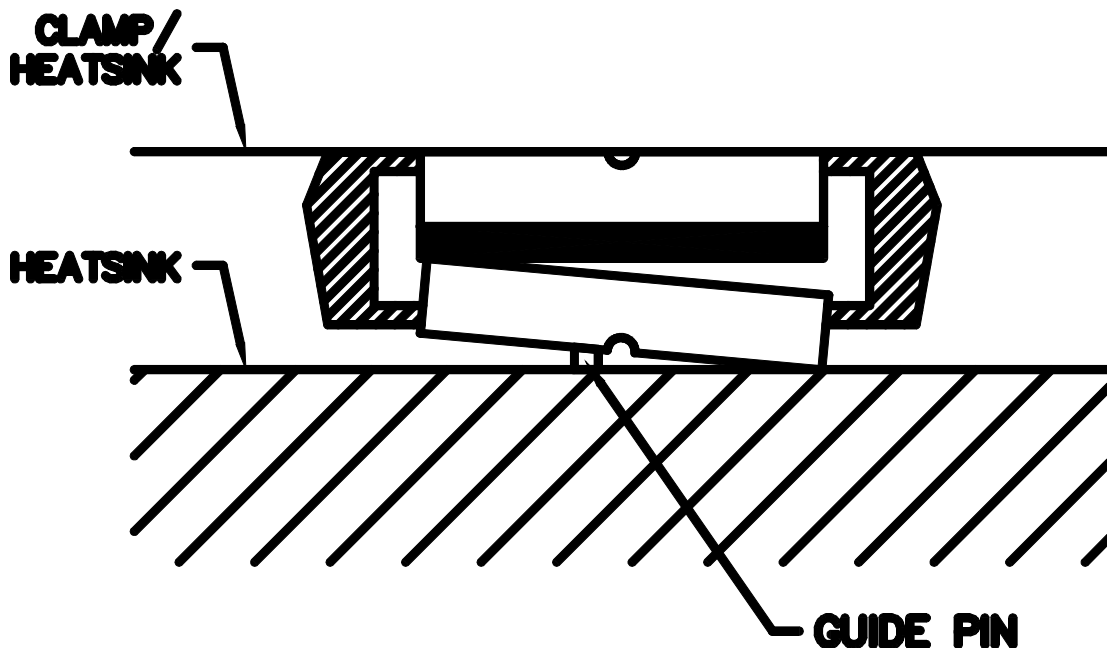


Figure 4 – Cathode Pole Face and Cross-Section of a Hockey-Puk SCR

As seen in the cross-sectional view of the Hockey-Puk, the Silicon Wafer appears to be floating between the Cathode and Anode Pole Faces. In an actual Hockey-Puk, the Silicon Wafer is held in the center with a soft membrane. However, the Silicon Wafer is not directly connected to the Pole Faces. When the Hockey-Puk is clamped between two surfaces (usually heatsinks) the two Pole Faces are squeezed together and make connection to the Silicon Wafer. The small hole shown in the Cathode Pole Face is used for centering the Hockey-Puk on the mounting surface.

The exact centering of the Hockey-Puk on the mounting surface is important. As seen in Figure



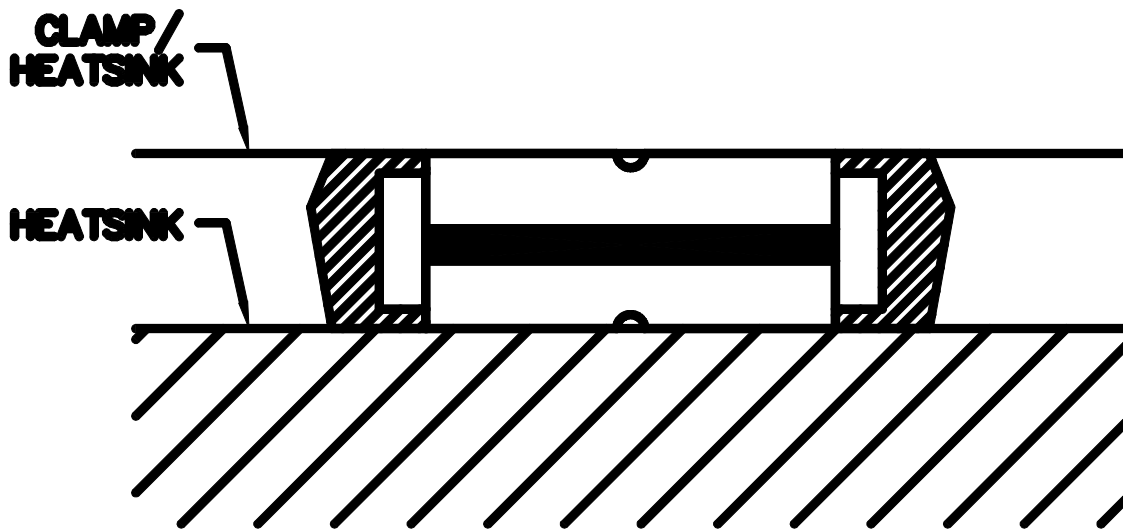
**Figure 5 – Improper Alignment of the Centering Pin**

5, the improper alignment of the centering pin will cause the SCR's Pole Face to not properly seat on the mounting surface. In addition, notice the Silicon Wafer is not properly seated inside the Hockey-Puk. Unlike the SCR Module, the mechanical connections are for electrical current conduction as well as thermal. When in use, electrical current flows from one mounting surface to one Pole Face to the Silicon Wafer to the other Pole Face and finally to the other mounting surface. By using your imagination, picture all of the electrical current and thermal heat traveling from the SCR to the mounting surfaces via the small areas that are touching. Also imagine the

electrical current traveling through the small area of the Silicon Wafer that is touching.

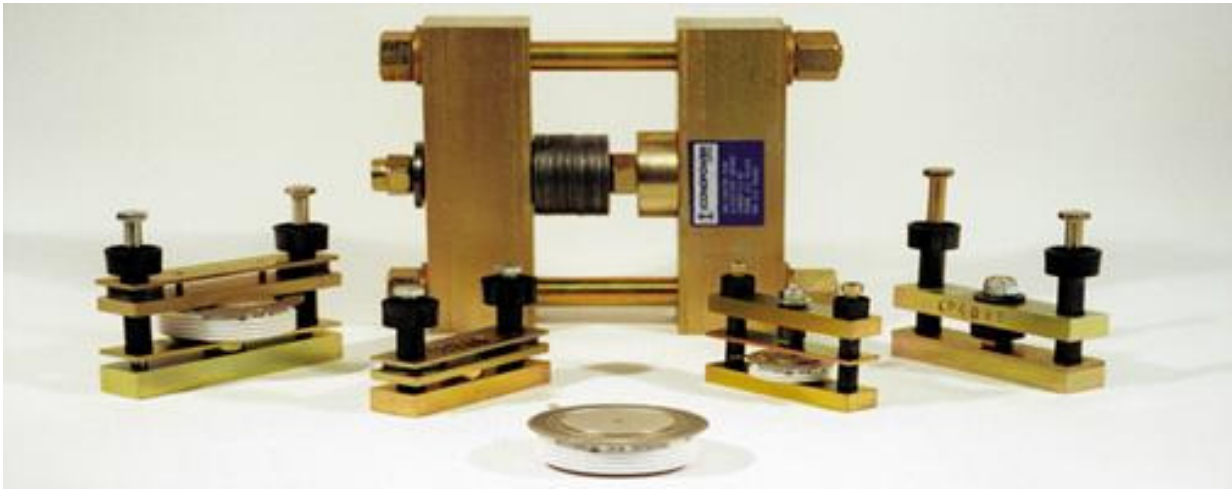
Figure 6 shows the Hockey-Puk SCR installed properly. It is extremely important that the complete surface area of the mounting surfaces, the Pole Faces and the Silicon Wafer are touching entirely.

As seen in Figure 6, the Hockey-Puk's two surfaces are completely aligned. All surfaces are touching perfectly. The electrical current and the heat will travel from one complete surface to the next complete surface. The Pole Faces are parallel to each other. When properly installed, the Hockey-Puk SCR will operate cooler and operate for a much longer time.



**Figure 6 – A properly mounted Hockey-Puk SCR**

Hockey-Puk SCRs require a mechanical device that clamps the SCR together with its mounting surfaces. It is called an Heatsink Mounting Clamp. The Clamp is selected based upon the desired mounting pressure, the diameter of the SCR and the distance from one Mounting Surface to the other. The higher the power rating of the SCR, the higher the mounting force required. The clamping force information is available from the SCR manufacturer. There are different types of Clamps available from different manufacturers. Some have spring gauges and some have pre-calibration indicators. Gauges with pre-calibration indicators are the most common.



**Figure 7 – Pre-Calibrated SCR Clamps**  
(Photo courtesy of Iconopower)

Figure 7 shows typical pre-calibrated Heatsink Clamps. The use of pre-calibrated Clamps eliminates the need for special torque wrenches or tools. The clamping force is established when the pre-calibration indicator is loose. This is by far the most popular type of Clamp in use today because of the ease of use and the elimination of special tools. Spring type Clamps either require special tooling or are temperamental. The pre-calibrated Clamps use stacks of Belleville Washers to pre-determine the clamping force.

As you see in Figure 7, there are many shapes and sizes of SCR clamps to cover the many different sizes of Hockey-Puk SCRs. Note the different number of Belleville washers on each of the clamps.

It is important to use these clamps properly. Failure to do so will cause the SCR to prematurely fail. Use the following steps for proper installation:

1. Loosely assemble all of the components. Ensure heatsink thermal compound was used on the SCR Pole Faces.
2. Finger-tighten the two Clamp bolts.
3. Verify the top and bottom mounting surfaces are parallel to each other, like shown in Figure 6, not as shown in Figure 5.
4. Verify the SCR is centered in the assembly. The locating pin should be in the hole on the mounting surface.

5. Use a wrench to tighten the two bolts one-quarter turn alternately until the pre-calibration indicator is loose to the touch.

As mentioned for both the SCR Module and the Hockey-Puk SCR, Heatsink Thermal Compound must be used between the surfaces. This compound ensures the proper heat flow and electrical conductivity. These compounds are readily available from a number of sources. The compound used on the SCR Module can be simply a good thermal conductor. However, the compound used on Hockey-Puk SCRs must be a good thermal and electrical conductor.

#### **DIFFERENT MANUFACTURES OF SCR MODULES**

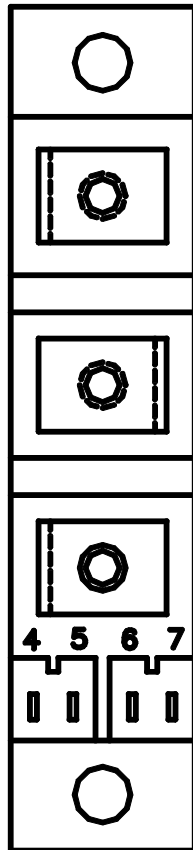
Until recently, HDR had always used Eupec as our SCR of choice. Lately, due commercial issues, HDR has added International Rectifier (IR) as an accepted alternate to Eupec. Each of these SCR modules has the same electrical specifications and quality. Unfortunately there are slight differences between the two manufactures. The Gate and Cathode connections for SCR 2 are reversed between the two manufactures. Refer to Figure 8 on page 7 for clarification of the SCR modules used on 120A and below SCR units. The "white" or "striped" wire is normally connected to the Gate terminal.

#### **CONCLUSION**

The proper installation of an SCR is important to avoid premature failure. Extreme care should be taken when installing any mechanical package. Make sure all signal connections are in the proper location and fastened properly. However, the installation of a Hockey-Puk SCR requires the most care and skill. Failure to install or connect the SCR properly can cause the SCR to fail prematurely.

# EUPEC

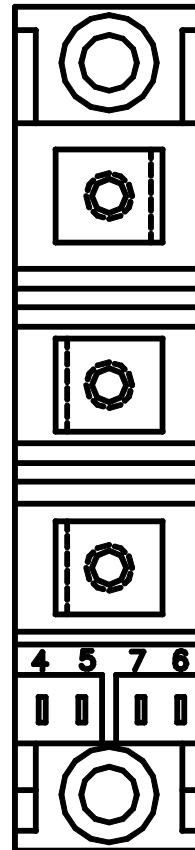
(TT92N14K0F)



- 4 - GATE SCR 1
- 5 - CATHODE SCR 1
- 6 - GATE SCR 2
- 7 - CATHODE SCR 2

# IR

(IRKT91/14A)



- 4 - GATE SCR 1
- 5 - CATHODE SCR 1
- 6 - GATE SCR 2
- 7 - CATHODE SCR 2

**NOTE: SCR 2 GATE & CATHODE TERMINALS ARE REVERSED BETWEEN SCR MANUFACTURES.**

**Figure 8 - Mechanical packages for Eupec and IR SCR Modules**