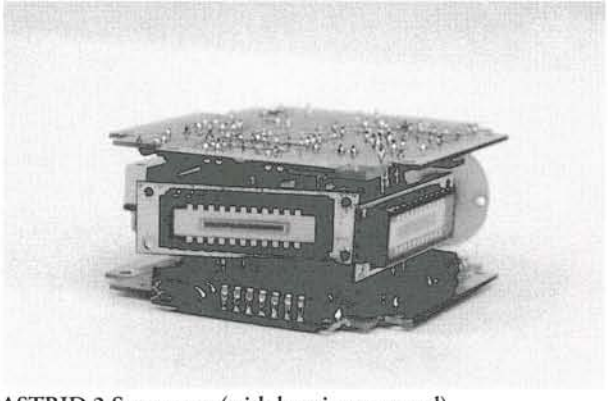
PSD – A useful component in space

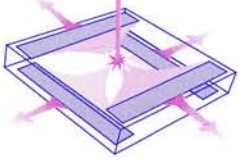
On a spacecraft in orbit around Earth, or flying into deep space, the Position Sensing Detector technology truly comes to its advantage. The mechanically simple and robust detector offers high reliability in the harsh space environment, with extreme temperatures, radiation of different kinds and high vibration levels when rocket engines are burning.



ASTRID 2 Sun sensor (with housing removed)

Almost every satellite, big, small or micro sized, carries one or several sun sensors, as one of the most important attitude control parameters is to know the sun location. There are mainly two types of sun sensors, Acquisition Phase Sun Sensors and Fine Pointing Sun Sensors. The first type has a very large field of view, with a limited accuracy. The primary use is to detect the sun directly after orbit injection, and make it possible for the attitude control system to turn the solar panels against the sun before the satellite runs out of battery power. It is also used during the flight as an emergency sensor if the satellite for a while looses the attitude control. The second type is used to fulfil more sophisticated pointing demands, when telescopes or other scientific instruments should point very accurately against distant objects. The pointing requirements can then be down to a few arc seconds.

ACR Electronic AB has in the past fifteen years designed and manufactured a number of sun sensors, the most recent types are: Two sun sensors on the successful Swedish satellite FREJA, launched 1992. One sensor was an Acquisition Phase Sun Sensor and the other a Fine Pointing Sun Sensor both were using a twodimensional SiTek PSD as sensor element. On the spinning micro satellite ASTRID 1, launched 1995, a different type of sun sensor was used to control the angle between spin axis and sun.



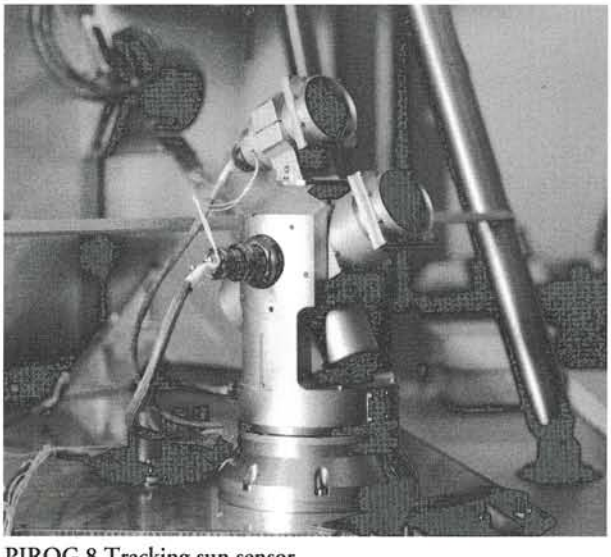
The sensor which covers almost the whole hemisphere uses two one-dimensional SITEK PSD:s. Two Fine Pointing Sun Sensors are qualified to be used on the next Swedish scientific satellite ODIN, planned to be launched 1998.

Finally, two Acquisition Phase Sun Sensors have been qualified for the next two micro satellites ASTRID 2 and ASTRID 3. ASTRID 2 will be launched early 1998 and ASTRID 3 has still no fixed launch date.

Beside the robustness of the PSD detector itself, it has also the advantage compared to one or two dimensional CCD:s, that the complexity of the supporting drive and readout electronics is significant reduced, which leads to smaller sensors with higher reliability. In particular, if the analog output signals can be used directly in a closed control loop, the component reduction is great.

The use of PSD:s on spacecrafts are of course not limited to sun sensors. The reliable components can have many other applications. One example is on ODIN, where a number of PSD:s are used in the main scientific instrument. They are to control the position of movable mirrors, which frequently shall return to a given position with high accuracy.

A more terrestrial application is the tracking sun sensors used on the high altitude balloon gondola PIROG. The sun sensor which contains 4 PSD:s tracks the sun automatically to an accuracy of a few arc seconds. It has flown and been recovered many times during ten years without any detector problems.



PIROG 8 Tracking sun sensor