CROSS-TRACK INFRARED SOUNDER (CrIS)

Weather prediction models require detailed observations from around the globe and from Earth’s surface to the top of the atmosphere to produce accurate forecasts. Harris Corporation’s CrIS instrument improves both the quality and quantity of temperature and moisture data collection, and is one of the top contributors to weather forecast accuracy worldwide.

CrIS is the world’s most advanced hyperspectral sounder and a key sensor on the National Oceanic and Atmospheric Administration’s (NOAA’s) Joint Polar Satellite System (JPSS). CrIS represents a significant enhancement over the legacy infrared sounder, the High Resolution Infrared Radiation Sounder, also built by Harris. CrIS breaks infrared energy emitted by the atmosphere into more than 2,000 channels compared to 19 previously, resulting in better vertical resolution or more data at more levels of the atmosphere. The more levels of data, the better the weather forecast.

The CrIS instrument, designed and built by Harris, is an advanced spectrometer that produces high-resolution, three-dimensional temperature and moisture profiles from space. These profiles improve the accuracy of weather forecasting models, especially for extreme weather 3–7 days in advance. CrIS also aids “nowcasting” for severe weather, including thunderstorms and tornadoes, and improves understanding of longer-term weather and climate phenomena, such as El Niño and La Nina.

CrIS ON JPSS
CrIS is planned to fly on all five JPSS satellites:
- Suomi-NPP (launched 2011)
- JPSS-1 (late 2017)
- JPSS-2 (2022)
- JPSS-3 (~2026)
- JPSS-4 (~2031)
CROSS-TRACK INFRARED SOUNDER

CrIS observes more than 2,000 infrared channels to provide detailed information about temperature and moisture around the globe, and from Earth’s surface to the top of the atmosphere. Numerous trade studies and mission analyses were conducted to optimize the instrument’s performance and cost.

A DETAILED LOOK AT CrIS

A Fourier transform spectrometer, CrIS provides atmospheric soundings with 2,211 spectral channels over three wavelength ranges: LWIR (9.14 - 15.38μm), MWIR (5.71 - 8.26μm), and SWIR (3.92 - 4.64μm). The instrument has an 8-centimeter clear aperture and utilizes plane mirror interferometer technology.

CrIS scans a 2,200 kilometer swath width, plus or minus 50 degrees, with 30 Earth-scene views. Each view consists of nine fields of view (FOVs) with 14-kilometer diameter spots in a 3x3 array. Each scan, with an 8-second repeat interval, includes views of a warm calibration point (the internal calibration target) and a cold calibration point (a deep space view).

The overall instrument data rate is less than 2.41 megabits per second. Harris uses only photovoltaic detectors for the CrIS instrument. The detectors are cooled to approximately 81 Kelvin using a four-stage passive cooler with no moving parts. They have a low-risk heritage design of over 50 space units.

CALIBRATION

Calibration of the interferometer is accomplished with both laser wavelength calibration and a neon bulb spectral calibration. The internal calibration target (ICT) consists of a highly emissive, deep-cavity blackbody, utilizing a flight-proven, Advanced Baseline Imager heritage design. Temperature knowledge of the ICT is better than 40 millikelvin. A passive vibration isolation system is included to allow instrument operation in a 50 milli-G environment. The instrument optics are thermally decoupled from both the structure and the instrument electronics. The overall instrument design is modular, which allows for parallel assembly and rapid instrument integration.

MODULAR ASSEMBLY

The CrIS instrument consists of six modular assemblies:

• The optical bench provides a stable structure for mounting all of the other assemblies.
• The scanner sequentially views the earth, the internal calibration target, and deep space, and directs the infrared energy into the interferometer.
• The interferometer breaks the infrared energy into spectral channels, much like the rainbow from a DVD surface.
• The photovoltaic focal plane arrays sense the infrared energy and provide electrical signals corresponding to the intensity of the infrared energy.
• The four-stage passive cooler is used to cool the focal plane arrays to minimize detection noise.
• The electronics assembly controls the instrument, and conditions and formats the detector signals for output to the spacecraft.

For more information, contact weathersolutions@harris.com or visit our website at harris.com/weather.