

**India's experience on stray light contribution in CCD payload of  
INSAT – 2E and technical approach used to avoid it on future satellites**

**Summary**

**This is India's response to Action item 28.01. CCD payload launched onboard  
INSAT-2E in April, 99 experienced problem of stray light and this note  
summarizes subsequent studies of the problem and action taken to avoid  
possibility of recurrence on future satellites.**

## **India's experience on stray light contribution in CCD payload of INSAT – 2E and technical approach used to avoid it on future satellites**

Indian national Satellites (INSAT) are a series multipurpose 3-axis stabilized geosynchronous satellites designed for telecommunications and meteorological applications.

INSAT-2E, launched in April 1999, carries two meteorological instrument, namely a Very High resolution Radiometer (VHRR) and a Charge Coupled Device (CCD) based multi-spectral scanner.

VHRR is a conventional meteorological scanning radiometer providing images in three spectral bands. Visible band (0.55  $\mu\text{m}$  – 7  $\mu\text{m}$  Vis) has a spatial resolution of 2 Km. at nadir while Water Vapour (5.7 $\mu\text{m}$ - 7.1 $\mu\text{m}$ ) and Thermal Infrared resolution of 8 km. each.

Full earth disc image is scanned in about 33 minutes. Additionally a quick-scan limited area coverage imaging mode [~ 5 minutes/frame] is provided for tracking short time scale weather phenomena like thunderstorm meso- scale systems etc.

CCD scanner is an innovative instrument providing day-time imaging capability in three spectral bands with a nadir resolution better than 1 Km. Simultaneous multi-band imaging is carried out in three bands namely Visible (0.62  $\mu\text{m}$  – 0.68  $\mu\text{m}$  , Vis) , Near Infrared (0.77 $\mu\text{m}$  – 0.86 $\mu\text{m}$ , NIR) and Short Wave Infra Red (1.55  $\mu\text{m}$  - 1.70  $\mu\text{m}$  , SWIR). These images are used for meteorology large-scale vegetation coverage mapping and snow-cloud discrimination.

Imaging geometry, controlled by an oscillating object plane scan mirror is very flexible. One image strip covering ~Km. north-south and ~ 6300 km. east-west at nadir is scanned in about one minute. The location of start position of the frame number of consecutive scan lines in a frame and number of frame repetitions are controlled by commanding from ground station. Each scan line consists of ~ 215 kpixels of data for each band.

Subsequent to launch of INSAT-2E satellite , image striping was observed in multi-band images of the CCD payload.

The striping pattern was correlated to the geometry of instrument views angle with respect to illumination pattern of the earth.

Two mirror systems require additional baffling to limit direct light entering the focal plane. Detailed studies on the images as well as instrument model indicated that the baffling provided for the CCD payload of INSAT-2E was not adequate to eliminate direct-light entry.

Additional baffling on the backside of secondary mirror has been incorporated to limit the direct-light entry in to the focal plane for similar instrument planned for INSAT-3A satellite.

**The baffle design is based on the ray-trace analysis and the experimental data obtained on actual flight model of INSAT-3A CCD payload.**

**With adequate baffling the stray light component has been reduced to less than 3% of albedo.**