IAF EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Sensors and Technology (3)

Author: Mr. manish mehta
Space Applications Centre (ISRO), India, mehta_manish@sac.isro.gov.in

Mr. Hanuman Prasad
Space Applications Centre (ISRO), India, prasadyh@sac.isro.gov.in
Mr. Mohmmad Waris
Space Applications Centre (ISRO), India, waris@sac.isro.gov.in
Mr. Nitin Upadhyay
Space Applications Centre (ISRO), India, nitin@sac.isro.gov.in
Ms. Dimple Garg
Space Applications Centre (ISRO), India, dimple@sac.isro.gov.in
Mr. Manish Kumar Dwivedi
Indian Space Research Organization (ISRO), India, mkdwivedi@sac.isro.gov.in
Mr. Aashish Agrawal
Space Applications Centre (ISRO), India, aashishagrawal@sac.isro.gov.in
Mr. Jiten Bhatt
Space Applications Centre (ISRO), India, jiten@sac.isro.gov.in
Mr. Rashmit Patel
India, rashmit@sac.isro.gov.in
Mr. Chandra Prakash Sharma
Space Applications Centre (ISRO), India, cpsharma@sac.isro.gov.in
Mr. Sandip Paul
Space Applications Centre (ISRO), India, san@sac.isro.gov.in
Mr. Sanjeev Mehta
Space Applications Centre (ISRO), India, smehta@sac.isro.gov.in
Mr. Ashish Mishra
Space Applications Centre (ISRO), India, mishra_ashish@sac.isro.gov.in
Mr. Somya Sarkar
Space Applications Centre (ISRO), India, sssarkar@sac.isro.gov.in

CHALLENGES IN REALIZATION OF LOW NOISE, HIGH PRECISION, HIGH SPEED, MINIATURIZED SENSOR ELECTRONICS FOR LWIR CAMERA OF GEO EARTH OBSERVATION SATELLITE

Abstract

India has been developing and deploying Geosynchronous Equatorial Orbit (GEO) based optical cameras for earth observation in wavelength bands spanning from Visible to Long-Wave Infra-Red (LWIR) for more than thirty years. Latest GEO mission, planned in 2021, has multispectral LWIR (6 bands in 7 12 m wavelength) camera realized with Integrated Detector Dewar Cooler Assembly (IDDCA). IDDCA has a 2-D array of HgCdTe (Mercury Cadmium Telluride) photodiodes with hybridized Silicon Read-out IC (ROIC), encapsulated in a vacuum sealed Dewar along with a cold shield and optical filters, cooled to

50K using linear Stirling cooler. Optics is passively cooled to 240K to control background signal. Camera has mechanized blackbody as in-situ calibration source for periodic calibration in addition to deep space view. LWIR camera needs tighter temperature stability in terms of 15mK for IDDCA sensor, 100mK for optics and blackbody to achieve 250 mK NEdT at 300K target temperature.

LWIR Camera needs IDDCA specific electronics namely (a) Proximity Electronics (b) Front End Camera Electronics (FECE) (c) Cooler (IDDCA), Heaters Control and Drive Electronics (CHCDE) (d) Blackbody Motor Drive Electronics (BBMDE). (e) CCSDS standards based data formatter electronics. Proximity electronics is flexi-rigid PCB to control interconnection parasitics between sensor and FECE. FECE carries out signal conditioning of sensor output, which is at 4.48 MHz rate, time multiplexed analog output of six bands with amplitude in ratio of 2. Miniaturized, focal plane located FECE has IDDCA safety features like sequential power on/off to sensor, sensor protection against Single Event Latchup, prevention of sensor powering at higher temperature etc. CHCDE comprises (i) high gain, low noise signal processing circuits for 20 mK resolution of temperature sensors (ii) three digital PID controllers to generate PWM for IDDCA cooler and DC voltage for heaters as per temperature error (iii) power amplifier to drive 50Hz, 60W AC power to IDDCA and 8W DC power to heaters. All three varied blocks with contradictory performance requirements are realized in miniaturized single PCB. BBMDE employs micro-stepping to drive 10W stepper motor by 120 degree placed in front of optics, dwell and retrieve back to rest position. Electronics is qualified for GEO mission with reliability estimated for 15 years continuous operation as per MIL-HDBK-217.This paper brings out electronics design features with built-in programmability through telecommand, challenges faced during realization of low noise, mixed signal circuits co-located with high power and digital circuits and ground loop/return current interference during electrical integration.