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High-stability multi-CCD Focal Plane for ESA imaging missions

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Results are described from a high-stability multi-CCD focal plane assembly developed by MSSL for ESA, using new large-format CCDs from e2v technologies. Particular subjects of investigation are stability at the 10e-4 to 10e-5 level and crosstalk between CCDs as well as between nodes of each two-port CCD.

Space-based planetary-transit hunting and asteroseismology missions such as ESA's Eddington and NASA's Kepler require large multi-CCD focal planes in order to simultaneously observe a large number of objects to improve the odds of finding habitable planets. A second driving requirement is that the system must be extremely stable so that false detections are not generated. This places significant constraints (both in-orbit and for the ground-based tests described here) on, for example, temperature stability and electronics stability. Other significant requirements are wide dynamic range (16-bit digitisation, using a CCLRC CCD signal processor ASIC) and a moderately high readout rate of ~1.2Mpix/s per output chain (Eddington has in total ~3 focal planes each with 12 output chains).

Although Eddington is currently not in ESA's approved mission list, MSSL has received an ESA contract to develop a demonstration FPA with realistic constraints on parameters such as performance (e.g. stability, noise), mass, power, and component selection (radiation hardness etc.). This work provides real world data for future ESA studies. In addition, the demo-FPA electronics has been designed to be compatible with the Gaia-RVS focal plane, another system which requires multiple CCDs, low noise and stability. The demo-FPA is populated with three e2v CCD42-C0s, a member of the CCD42 family specifically developed for Eddington under ESA contract.

The demo-FPA system is described here, including the new high-accuracy temperature-control system and the high-throughput spacewire digital data links. Results are described from the tests performed on the demo-FPA, specifically stability, noise and both inter- and intra-CCD crosstalk. Finally, the application of the system to the Gaia-RVS focal plane (which uses e2v electron-multiplying low-light-level CCDs) is described.

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