

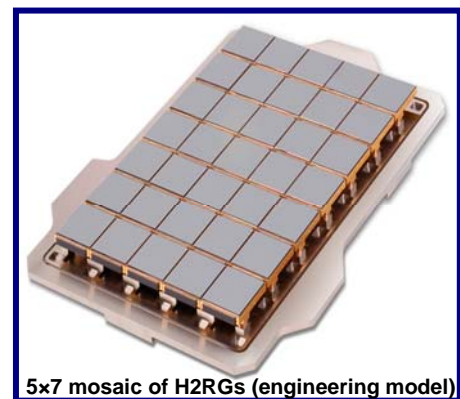
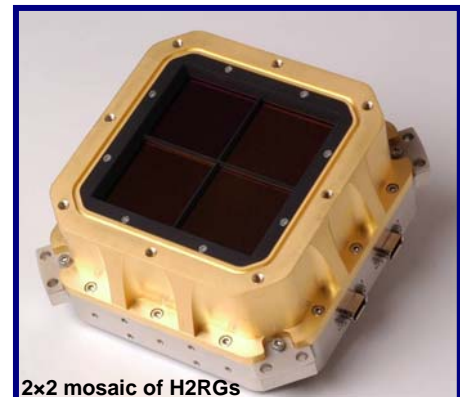
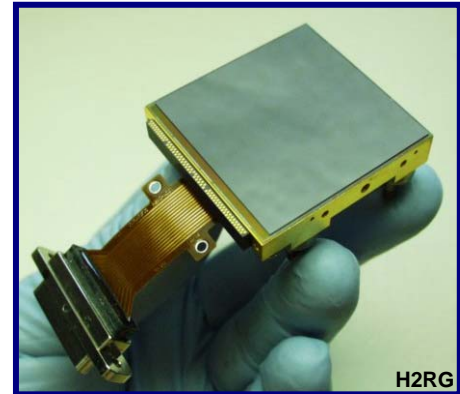
# Teledyne Imaging Sensors

## HAWAII-2RG™

### Visible & Infrared Focal Plane Array

The 2048×2048 pixel HAWAII-2RG™ (H2RG) is the state-of-the-art readout integrated circuit for visible and infrared astronomy in ground-based and space telescope applications.

- Large (2048×2048 pixel) array with 18 μm pixel pitch.
- Compatible with Teledyne Imaging Sensors (TIS) HgCdTe infrared (IR) and silicon PIN HyViSI™ visible detectors, providing sensing of any spectral band from soft X-ray to 5.5 μm.
- Substrate-removed HgCdTe enhances J-band quantum efficiency (QE), enables response through the visible spectrum, eliminates fluorescence from cosmic radiation absorbed in the substrate, and eliminates fringing in the substrate material.
- Reference rows and columns for common-mode noise rejection.
- Guide window output – windowing with simultaneous science data acquisition of full array. Programmable window which may be read out at up to 5 MHz pixel rate for guiding. Readout is designed to allow interleaved readout of the guide window and the full frame science data.
- Selectable number of outputs (1, 4, or 32) and user-selectable scan directions provide flexibility in data acquisition.
- Full-frame readout-rates from less than 0.1 Hz to 80 Hz
- Built with modularity in mind – the array is 4-side-butable to allow assembly of large mosaics of 2048×2048 H2RG modules, such as TIS' 4096×4096 mosaic FPA and larger mosaics.
- Fully compatible with the TIS SIDECAR™ ASIC Focal Plane Electronics.



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# HAWAII-2RG™ specification table for infrared arrays

| Parameter  | Unit | Value                        |                     |                             |
|--|------|------------------------------|---------------------|-----------------------------|
|  |      | 1.7μm                        | 2.5μm               | 5.3μm                       |
| Read-out integrated circuit (ROIC)   |      | HAWAII-2RG™                  |                     |                             |
| Number of Pixels <sup>(1)</sup>  | #    | 2048 x 2048                  |                     |                             |
| Pixel Size   | μm   | 18                           |                     |                             |
| Number of Outputs  | #    | Programmable 1, 4, 32        |                     |                             |
| Power Dissipation <sup>(2)</sup>   | mW   | ≤ 0.5                        |                     |                             |
| Detector Material  |      | HgCdTe                       |                     |                             |
| Detector Substrate   |      | CdZnTe - Removed             |                     |                             |
| Cutoff wavelength (50% of peak QE):<br>1.75μm: @ 120 K<br>2.5μm: @ 77 K<br>5.3μm: @ 37 K                                 | μm   | 1.65 - 1.80                  | 2.45 - 2.65         | 5.1 - 5.5                   |
| Mean Quantum Efficiency (QE) at 800 nm   | %    | ≥ 50 (goal is ≥ 70)          | ≥ 70 (goal is ≥ 80) |                             |
| Mean Quantum Efficiency (QE) at 1,000 nm   | %    | ≥ 50 (goal is ≥ 70)          | ≥ 70 (goal is ≥ 80) |                             |
| Mean Quantum Efficiency (QE) at 1,230 nm   | %    | ≥ 70 (goal is ≥ 80)          | ≥ 70 (goal is ≥ 80) |                             |
| Mean Quantum Efficiency (QE) at 1,500 nm   | %    | ≥ 70 (goal is ≥ 80)          | ≥ 70 (goal is ≥ 80) |                             |
| Mean Quantum Efficiency (QE) at 2,000 nm   | %    | 0                            | ≥ 70 (goal is ≥ 80) |                             |
| Mean Quantum Efficiency (QE) at 3,500 nm   | %    | 0                            | 0                   | ≥ 70 (goal is ≥ 80)         |
| Mean Quantum Efficiency (QE) at 4,400 nm   | %    | 0                            | 0                   | ≥ 70 (goal is ≥ 80)         |
| Median Dark current:<br>1.7μm: @ 0.25 V bias and 120 K<br>2.5μm: @ 0.25 V bias and 77 K<br>5.3μm: @ 0.18 V bias and 37 K | e-/s | ≤ 0.05 (goal is ≤ 0.01)      |                     |                             |
| Median Readout Noise, correlated double sampling (CDS) at 100 kHz pixel readout rate                                     | e-   | ≤ 30 (goal is ≤ 15)          | ≤ 18 (goal is ≤ 12) | ≤ 15 (goal is ≤ 12)         |
| Well Capacity at 0.25 V bias (0.175V bias for 5.3μm cutoff)  | e-   | ≥ 80,000 (goal is ≥ 100,000) |                     | ≥ 65,000 (goal is ≥ 85,000) |
| Crosstalk <sup>(3)</sup>   | %    | ≤ 2 (goal is ≤ 1)            |                     | ≤ 4 (goal is ≤ 2)           |
| Operability <sup>(4)</sup>   | %    | ≥ 95 (goal is ≥ 99)          |                     |                             |
| Cluster: 50 or more contiguous inoperable pixels   | %    | ≤ 1 (goal is ≤ 0.5) of array |                     |                             |
| SCA Flatness <sup>(5)</sup>  | μm   | ≤ 30 (goal is ≤ 10)          |                     |                             |
| Planarity <sup>(6)</sup>   | μm   | ≤ 50 (goal is ≤ 25)          |                     |                             |

(1) There are 2040 x 2040 pixels for light detection plus 4 rows and columns of reference pixels on each side of the array

(2) At 100 kHz pixel read-out rate, unbuffered, 4 outputs. Does not include external current source; power has to be optimized by the user with respect to the system in which the device is used

(3) Crosstalk includes both optical (charge diffusion) and electrical (interpixel capacitance) components

(4) A pixel is considered operable if QE ≥ 35%, dark current ≤ 0.1 e-/sec, and single correlated double sample (CDS) noise is ≤ 35 e-

(5) Maximum variation (peak-to-valley) to best fit plane

(6) Parallelism of best fit plane with respect to mounting plane