

## 1100S Camera

### Features

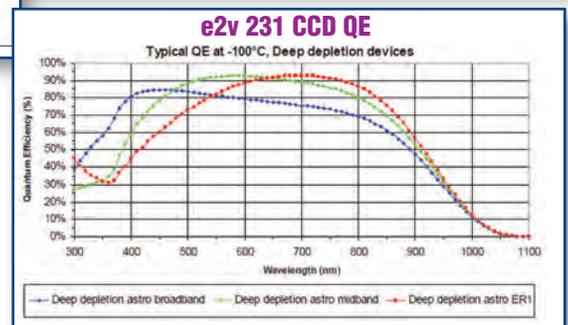
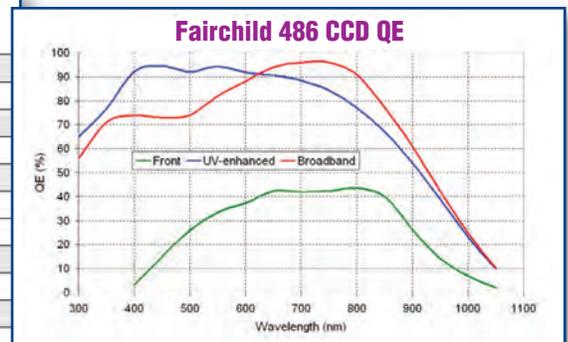
- **Cryo or thermoelectric cooling;** the 1100 is available cooled below  $-100^{\circ}\text{C}$  by cryo-cooling or as a TE camera cooled to  $-60^{\circ}\text{C}$
- **Multiple read speeds available;** common readout speeds start at 100kHz per port, and can go as high as 2MHz depending on the sensor selected
- **Lowest read noise in the industry;** sub 3e- RMS noise performance
- **High dynamic range;** low noise and high full-well imaging with 16-bit digitization provides large dynamic range performance
- **Sensors available;** the 1100 is typically installed with a large 4k x 4k 15 $\mu\text{m}$  pixel sensor but it can handle CCDs up to 10k x 10k 9 $\mu\text{m}$  pixels
- **Binning and region of interest imaging;** high performance with binning, and ROI imaging for small area high speed is provided
- **Multi-port readout;** four port readout is typical; more are supported if the CCD architecture allows
- **Fiber optic input;** 1:1 faceplates or magnifying tapers available bonded directly to the CCD
- **Shutter available;** shutters are available mounted on the camera without external control boxes and their operation can be configured by software
- **Fiber optic communication;** fiber optic cable to a computer through a proprietary PCI or PCIe card is standard; camera link is available as well
- **Software;** included with every camera is our SI Image software suite for camera control, data manipulation and archiving; native file format is FITS; C++ and LabView SDKs available upon request; Linux drivers exist in the public domain



SI's 1100S camera is designed for the highest performance in a very flexible configuration. Both TE and cryo cooling are available for short exposure high speed applications to the long integrations of astronomy.

The 1100 can handle practically any CCD available on the market today, but was designed for the large format 2k x 2k to 4k x 4k and larger sensors. Refer to the CCD manufacturer's website for updated QE data, but just a small example of the different backside AR coatings available from two potential manufacturers is shown below.

Typical Camera Performance 231-84 CCD	
Read noise 100kHz	2.1e-
Read noise 344kHz	2.7e-
Read noise 709kHz	5.3e-
Read noise 1.5MHz	9.7e-
Dark current $-90^{\circ}\text{C}$	0.0003e-/pixel/s
Full well	320ke-
Linearity	<1%, 400e- to 300ke-
CCD size	61.4mm x 61.4mm
CCD pixel size	15 $\mu\text{m}$
CCD pixel dimension	4096(H) x 4112(V)
Backside AR coatings available	Astro Broadband, Astro Midband, Astro ER1. Deep depletion silicon available

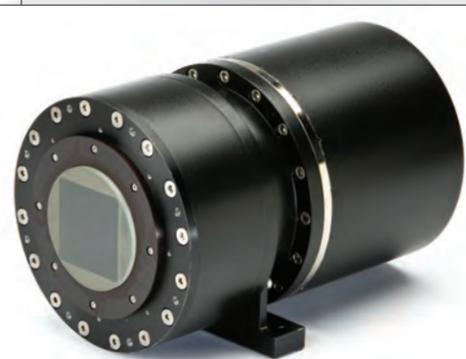
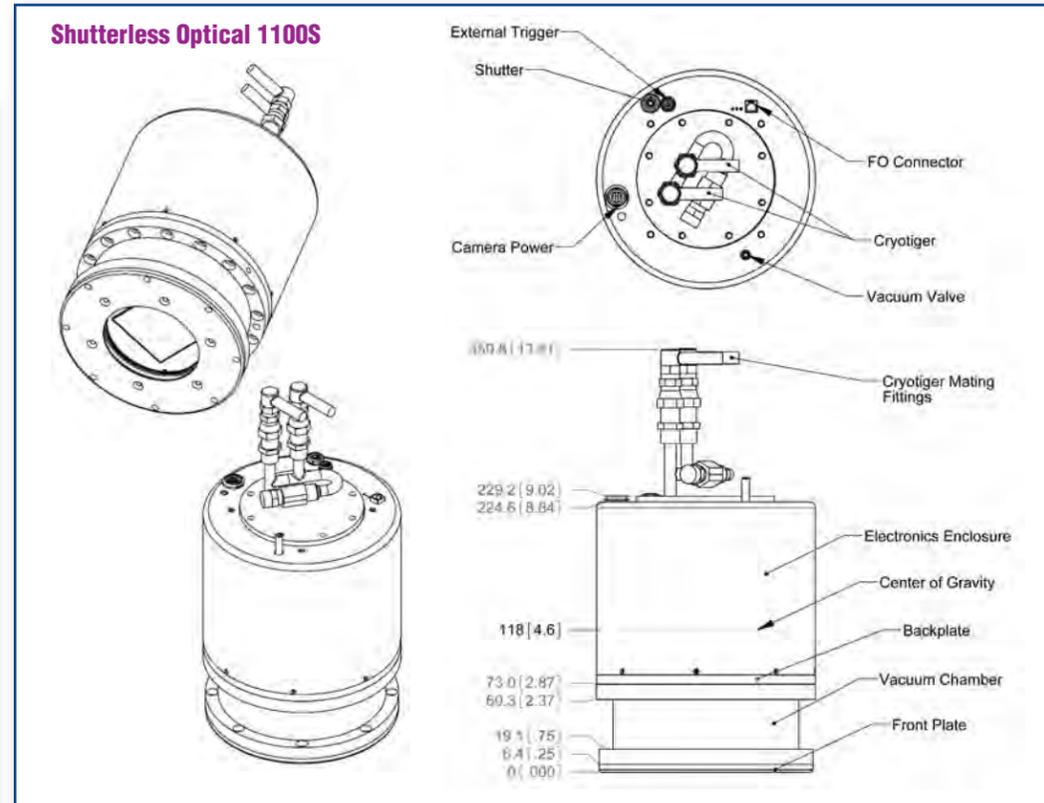
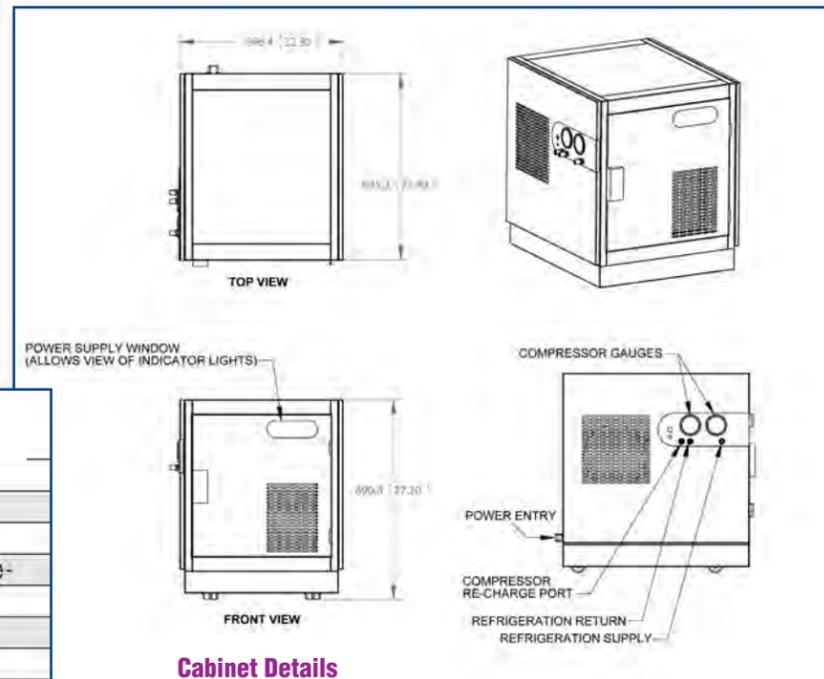


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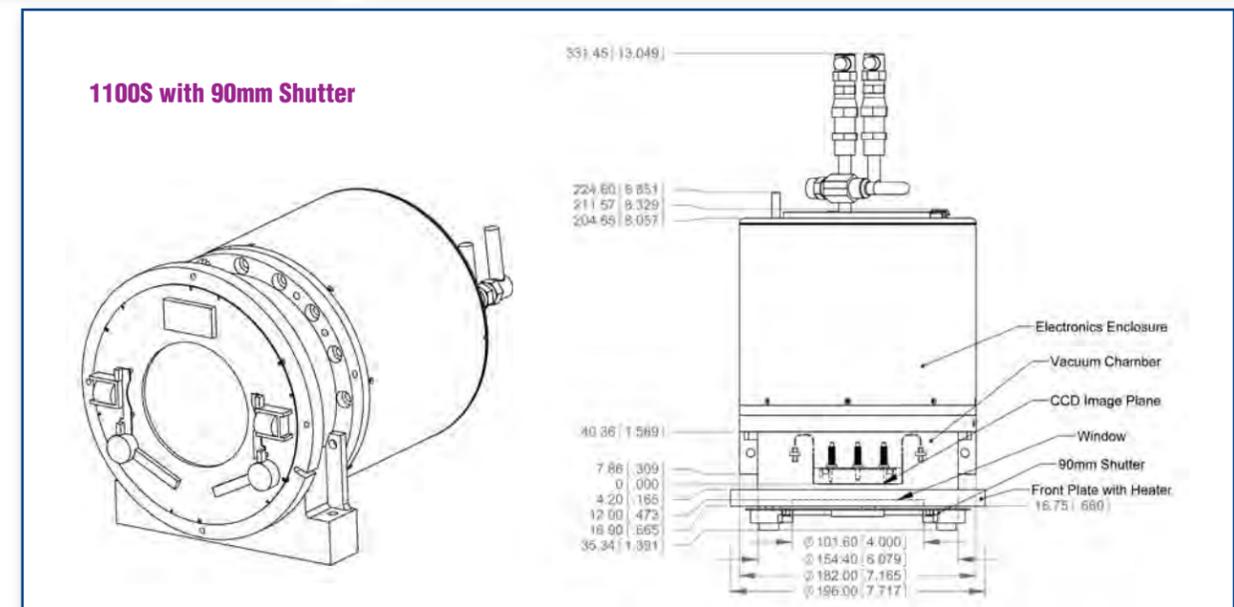
Typical Camera Performance 230-84 CCD (high speed)	
Read noise 500kHz	7.0e-
Read noise 1MHz	10.2e-
Read noise 2MHz	14.7e-
Dark current -60°C	0.01e-/pixel/s
Linearity	<1%, 200e- to 100ke-
CCD size	61.4mm x 61.4mm
CCD pixel size	15.0µm
CCD pixel dimension	4096(H) x 4112(V)
Backside AR coatings available	Midband, Broadband, and uncoated

Typical Camera Performance 44-82 CCD	
Read noise 100kHz	2.5e-
Read noise 400kHz	6.0e-
Dark current -100°C	0.0007e-/pixel/s
Linearity	<1%, 200e- to 100ke-
CCD size	30.7mm x 61.4mm
CCD pixel size	15.0µm
CCD pixel dimension	2048(H) x 4096(V)
Backside AR coatings available	Astronomy Broadband, Midband, Enhanced Red, Deep depletion silicon available as well



Typical Fiber Faceplate Specifications	
Fiber size	6µm
Magnification	1.0
EMA	Enhanced Statistical
Surface finish	20/10 Scratch-Dig
Flatness	2 waves max (1/2 wave goal)
Shear distortion	<0.0025 inches
Gross distortion	<1% in clear aperture
Blemishes	<0.003" <1% area 0.003-0.006" 8 max >0.006" none
Fiber optic specifications subject to change	

Camera Details	
Cryo cooling	One compressor housed in supplied cabinet with braided stainless steel lines running to camera head, up to 100'
Thermoelectric Cooling	One liter per minute @ 20°C water cooling required for most configurations and CCD temperatures down to -60° for most 4k x 4k sensors
Window details	Many AR coatings available with custom order. Typical Broadband specs: <1% Reflectivity per surface, 450-800nm
Window heater	Adhered to front window for cryo versions
CCD to mounting surface	~20mm, depends on CCD and options
Read speeds	Software selectable, customizable
Camera weight	About 12lbs, depending on options





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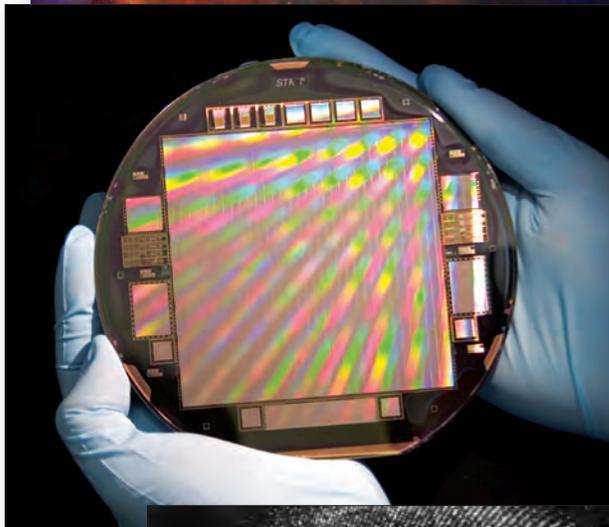


### **Astronomy**

The demanding requirements of astronomical observations, high sensitivity, low read noise, low dark current are all satisfied by the performance from an 1100S camera.

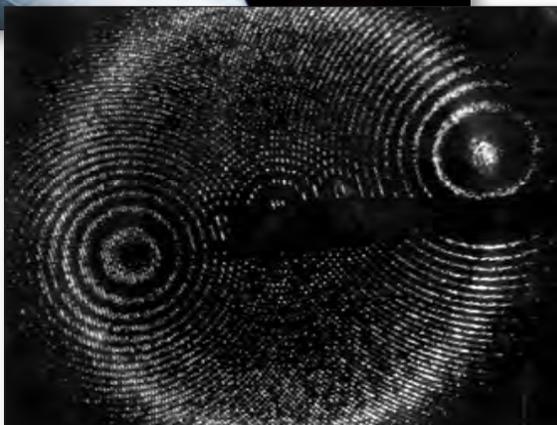
Astronomers around the world have utilized SI's renowned skills to satisfy the imaging requirements of their applications.

Photo: Daniel López, IAC  
Imaged with a 2k x 2k  
Spectral Instruments CCD Camera



### **The Sky Is the Limit**

Shown at left is the 10k x 10k 9µm pixel sensor, the largest CCD in the world, available for installation into the 1100 with 16 readout ports and as a front or back illuminated sensor.



### **X-Ray and High Energy Particles**

Large fiber optic taper reducers are frequently bonded to the 4k x 4k 15µm pixel sensor and mated to a phosphor for X-Ray work. Our cameras can be frequently found at synchrotron facilities and national laboratories around the world. The 1100S has been used in conjunction with mirrors and lenses to get the sensitive CCD and electronics out of the path of harmful radiation from the application and retain high resolution imaging.



### **Custom Cameras**

SI specializes in the manufacture of custom cameras for unique applications. Shown here is an 1100S with the CCD mounted perpendicular to the usual axis at the end of a long arm. The customer's final lens element is mounted as the entrance to the CCD vacuum chamber. All of this was accomplished while retaining cryo cooling levels of the 2k x 2k CCD.

