Strained Layer Superlattice (SLS) Camera
Statement of Work

1 Introduction

NASA has a requirement for a thermal imaging camera with a Strained Layer Superlattice (SLS) focal plane array (FPA) detector. The SLS Camera will be used for conducting laboratory and field measurements involving thermal and radiometric imaging at infrared (IR) wavelengths. These applications require a ruggedized camera assembly for integration and operation with facility and test equipment. The SLS Camera will be subjected to a range of environmental and imaging extremes. Technical specifications for camera features, operation and measurement performance are described in the following section.

2 Specifications

The SLS Camera shall meet or exceed the requirements described in the following sections.

2.1 Detector Configuration and Performance

2.1.1 Focal plane array (FPA) type: Strained Layer Superlattice (SLS)

2.1.2 FPA resolution: minimum of 640 horizontal X 512 vertical pixels

2.1.3 Pixel pitch: ≤ 20 µm

2.1.4 Quantum efficiency: ≥ 30% (spectrally averaged between 7.5 µm and 10 µm)

2.1.5 FPA detector 50% cut-off wavelength: ≥ 10 µm

2.1.6 Sensitivity: < 35 mKelvin NEDT at +25°C (7.5-10 µm)

2.1.7 FPA detector cooling by Stirling close-cycle cooler

2.1.8 Integration well capacity: ≥ 7 X 10^6 electrons

2.1.9 Pixel operability:

2.1.9.1 > 99.5% for central square region of the FPA containing at least 25% of the total pixels

2.1.9.2 > 99% for remaining pixels outside of the central square region of the FPA

2.2 Optical Components

2.2.1 Cold shield and field stop with no FPA corner pixel obscuration or vignetting by lens barrel or filter aperture

2.2.2 Custom long-pass cold filter with having the following transmission characteristics:

2.2.2.1 λ_1 at 80% of first peak transmission: 7.5 µm ±0.1 µm (refer to Figure 1):

2.2.2.2 Average transmission from 7.9 to 10 µm: ≥ 95%

2.2.2.3 Minimum transmission from 8.1 to 10 µm: ≥ 90%

2.2.2.4 Average transmission from 2.5 to 7.4 µm: < 0.1%

2.2.2.5 Slope, $(\lambda_1 - \lambda_c)/\lambda_c$: < 2.5%

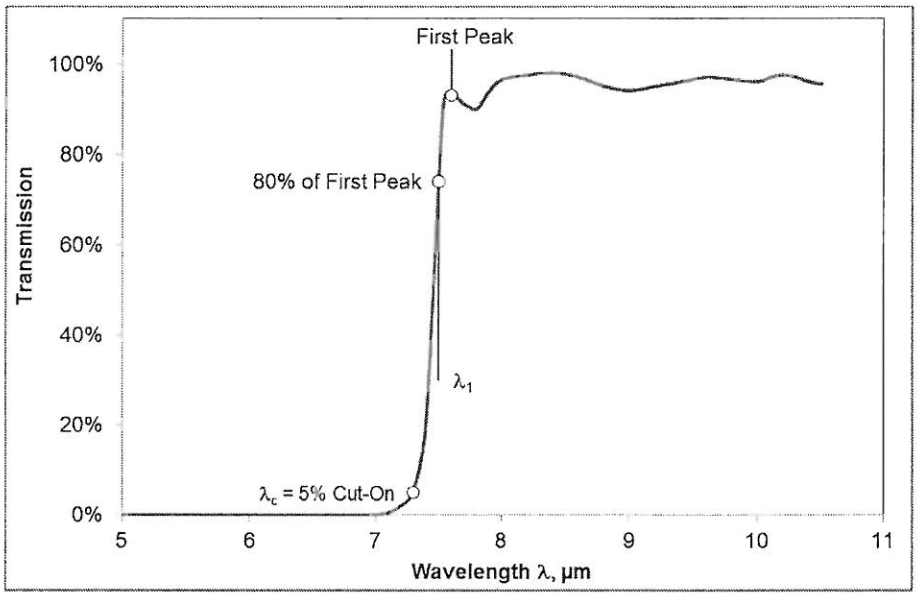

Figure 1 – Long-pass cold filter performance parameters

2.2.3 Motorized filter wheel to accommodate up to four, user-provided 25 mm diameter X 1 mm thick warm filters

2.2.4 Twist-lock bayonet lens attachment interface

2.2.5 Total of four lenses (refer to Table 1) with twist-lock bayonet attachment to camera housing:

Diagonal Field of View (DFOV)	Focus Range	Focusing Method	Average Transmission (7.5-10.5 µm)	Quantity Required
4° ±0.5°	≤ 30 ft to Infinity	Manual	≥ 85%	1
9° ±1°	≤ 10 ft to Infinity	Manual	≥ 90%	1
18° ±2°	≤ 3 ft to Infinity	Manual	≥ 95%	1
37° ±4°	≤ 1 ft to Infinity	Manual	≥ 95%	1

Table 1 – SLS Camera Lenses

2.3 On-board Electronics

2.3.1 Integration time adjustment:

2.3.1.1 Adjustable up to full frame rate

2.3.1.2 Multiple integration (superframing) mode with up to four separate, user-defined integration times

2.3.2 User-selected snapshot integration modes: integrate-while-read, integrate-then-read

2.3.3 Adjustable frame rate with maximum ≥ 200 frames/sec (full frame)

2.3.4 Built-in IRIG-B receiver for time-stamping individual image frames

2.3.5 Temperature sensors on the FPA detector and near the FPA cold finger, minimum

2.3.6 Independent image output formats:

2.3.6.1 Raw (non-NUC adjusted) 14-bit imagery with integration time and IRIG timestamp embedded in each frame

2.3.6.2 NUC-adjusted imagery in NTSC composite or HDMI video format

2.3.7 Data, Command Interfaces

2.3.7.1 Simultaneous 14-bit digital imagery output via Camera Link and Gigabit Ethernet

2.3.7.2 Serial communication between camera and host computer via Camera Link and Gigabit Ethernet

2.3.7.3 BNC input for frame synchronization, clock-in

2.3.7.4 BNC output for frame synchronization, clock-out

2.3.7.5 BNC connector for NTSC RS-170 composite video, or mechanically locked (bayonet, screw-down or similar) connector for HDMI video output

2.3.7.6 BNC input for IRIG-B time code signal

2.3.8 Electronic Memory Usage:

2.3.8.1 No internal storage media (magnetic or solid-state), or portable non-volatile (NV) memory (such as SD cards) shall be used for retaining raw or NUC-adjusted FPA images within the camera unit

2.3.8.2 Non-uniformity correction (NUC), calibration, and other image processing data shall be stored on either embedded volatile memory (NUC data is erased from volatile memory upon camera power-down), or portable NV memory (such SD cards)

2.3.8.3 Camera configuration settings shall be stored on either embedded or portable NV memory (such as SD cards); NV memory containing user-modifiable camera configuration information must be capable of being reset or restored to the factory default configuration by the user

2.3.9 Input power: 24 VDC with adapter for connection to 115 VAC/60 Hz source

2.4 Physical Features

2.4.1 Integrated camera and on-board electronics enclosed within a ruggedized housing

2.4.2 Maximum camera dimensions (excluding lens): 10 in. X 6 in. X 7 in.

2.4.3 Maximum camera weight (excluding lens): ≤ 15 lbs

2.4.4 Mechanical mounting: minimum of two ¼-20 threaded holes located on camera housing

2.5 Software Control and Operation

2.5.1 Discrete filter wheel position adjustment

2.5.2 NUC data creation and uploading to camera memory

2.5.3 Recording of IRIG time-stamped metadata (including FPA temperature, cold shield temperature, frame rate, integration time)

2.5.4 Camera non-volatile memory reset to the factory default configuration for user-modifiable settings

2.5.5 Graphical user interface (GUI) based software for live camera image display, camera image recording and camera control from a host computer (compatible with Microsoft Windows XP and Windows 7 operating systems)

2.5.6 Software developer's kit (SDK) for developing software for camera communication, configuration, control and image acquisition using a PC-based host computer running a Windows 7 operating system (32- and 64-bit processor compatible)

2.6 Environmental Compliance

2.6.1 Operating temperature: -25°C to +50°C

2.6.2 Storage temperature: -55°C to +80°C

2.6.3 Relative humidity: ≤ 95% (non-condensing atmosphere)

2.7 Shipping/Storage Case

2.7.1 Hard-shell shipping/storage case for containing and transporting camera with lens equipment

3 Documentation

The vendor shall furnish all required documentation necessary to configure, operate, and maintain the SLS Camera. The documentation shall include, but not necessarily be limited to:

3.1 Full description of software commands and data formats for camera set-up, communication, control, and image acquisition from a host computer

3.2 Certificate of volatility documenting the applicable presence or absence of data storage memory and media within the camera (refer to Section 2.3.8)

3.3 Acceptance test report with tabulated or graphical data including, but not necessarily limited to, the following information:

3.3.1 FPA pixel noise histogram (raw and NUC-adjusted pixels)

3.3.2 Measured NETD

3.3.3 Map of inoperative FPA pixels

3.3.4 Spectral response of FPA detector

3.3.5 Spectral transmission of lenses

4 Training

The Contractor shall provide training within 90 days of SLS Camera delivery to NASA.

5 Warranty

All hardware and software shall be warranted to be free of defects. The warranty shall cover all parts and labor for a period of one-year following SLS Camera delivery to NASA.