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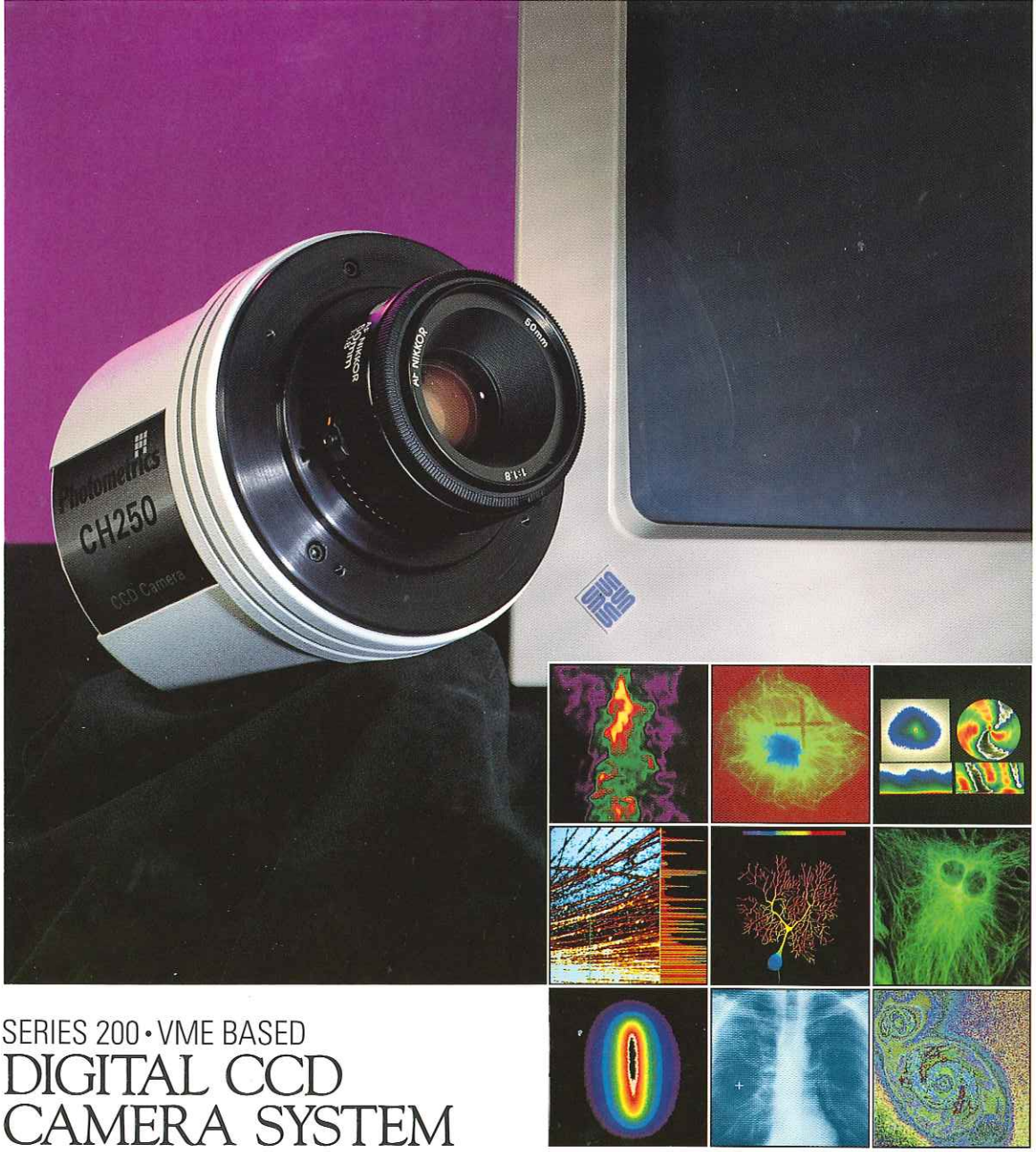
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SERIES 200 • VME BASED

DIGITAL CCD CAMERA SYSTEM

Photometrics

World Leader in High-Performance CCD Imaging

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Overview

The Photometrics VME BASED DIGITAL CCD CAMERA SYSTEM is a high-performance imaging system that combines cooled CCD technology with a fully integrated camera controller on a single VME card. Cooled CCD technology provides imaging performance far superior to conventional video or other CCD cameras. The system is designed for demanding research applications and offers low noise, wide dynamic range, linear response, low-light-level capability, and spectral response from UV to near IR. It is supplied complete with user-friendly software for camera control, image acquisition, and display for Sun computers.

COOLED CCD TECHNOLOGY

This system is a high-performance, digital camera that does not use conventional video formats. Specifically, the system does not suffer



Optional Cryogenically Cooled Camera Head

from the noise, dynamic range limitation, and resolution problems of conventional cameras. Because it does not produce a conventional video signal, it cannot be used with commercial frame grabbers. As a result, we provide a fully integrated system with a single card programmable controller that captures the digital image directly into host RAM.

The camera uses only scientific-grade CCDs, as opposed to low-performance television-type CCDs. In addition, the CCD is cooled to reduce dark noise and cosmetic defects. We offer a wide selection of CCDs which provide our customers with the best performance, cosmetic quality, and availability criteria. Our in-house CCD evaluation staff works directly with CCD manufacturers to continually test and monitor the performance of new imagers.

We classify all CCDs that we support according to whether or not we guarantee imager performance. Our *guaranteed* devices are screened and tested for cosmetic defects and functional specifications, such as noise level, full well capacity, and linearity. All functional tests are performed *in the customer's camera.* We guarantee many parameters for which other CCD and camera manufacturers only provide typical values. We also provide a detailed test report of camera system performance with *every* system shipped.

All CCDs are screened for cosmetic quality and are installed into cameras in a clean room environment. The CCD is housed in a vacuum chamber to prevent frosting and improve cooling efficiency in a newly designed Peltier-cooled (thermoelectric) or cryogenically-cooled camera head. Vacuum integrity is ensured through helium leak testing of the CCD vacuum chamber. The camera head is baked under vacuum for 60 hours to ensure reliability. An LCD digital readout on the electronics unit continuously indicates the CCD temperature and a servo control circuit stabilizes the CCD temperature to prevent any drift in performance. Heating and cooling LEDs indicate the status of the temperature controller.

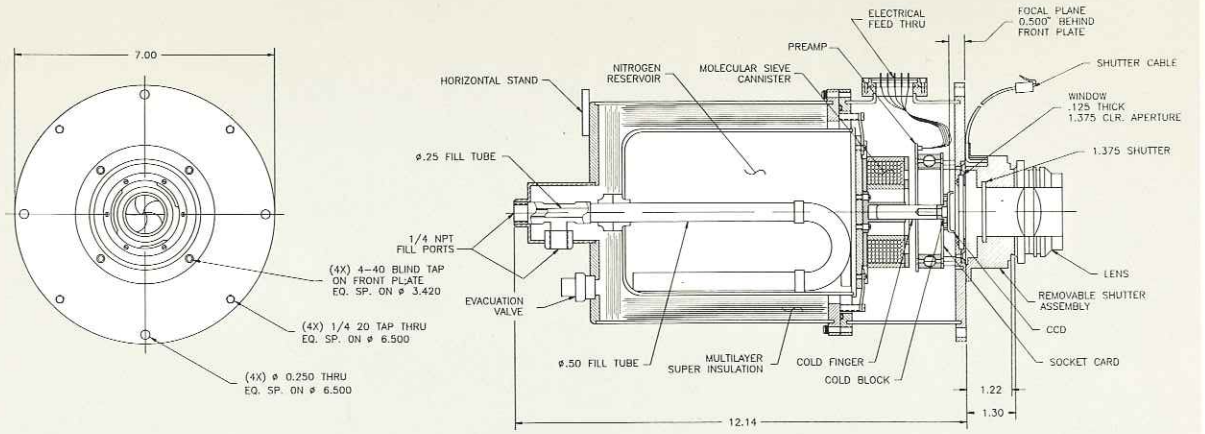
HIGH DYNAMIC RANGE

Whereas most video cameras provide a maximum dynamic range of 256 gray levels (8 bits per pixel), this cooled CCD system is configured with either 4,096 gray levels (12 bits), 16,384 gray levels (14 bits) or 65,536 gray levels (16 bits) per pixel. Every camera is tested to guarantee that the response is linear over the entire dynamic range so that accurate quantitative measurements can be performed.

IMAGE CAPTURE

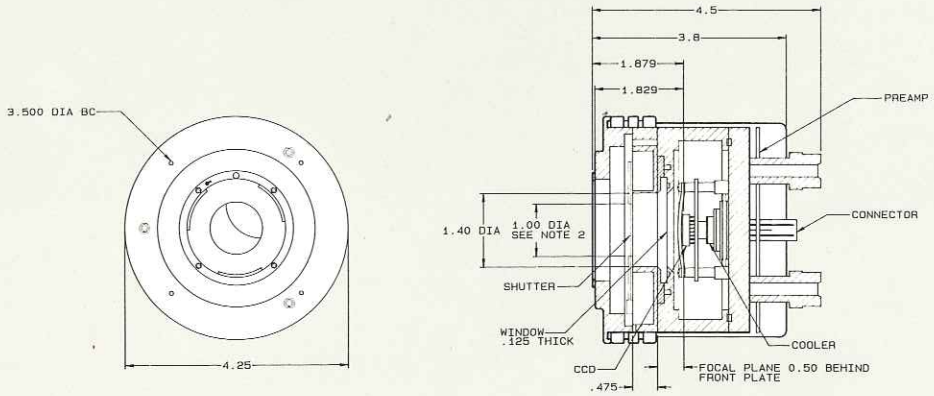
The camera is interfaced to the computer through a custom controller card that plugs directly into a VME slot on Sun, Silicon Graphics, and other VME computers. The system is supplied complete with software for camera control, image acquisition, and display on Sun computers. The software is written using the SunView environment. Source code for this software is provided as a guide for software development on other computers. In addition, certain third-party image processing software packages support the camera system—contact Photometrics for more details.

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▲ CRYOGENICALLY COOLED CAMERA HEAD (FRONT AND SIDE VIEWS)

▼ PELTIER-COOLED (LIQUID CIRCULATION) CAMERA HEAD (FRONT AND SIDE VIEWS)



Technical Specifications

Peltier-Cooled Camera Head

- CCD imager: See the current Photometrics CCD selection charts and manufacturer data sheets.
- Window: Anti-reflective-coated fused silica; 1 3/8-inch clear aperture, 0.128-inch thick
- A fiber optic faceplate is optionally available for direct optical coupling
- CCD temperature: CCD-dependent—see the current Photometrics CCD selection charts; stable to within ± 0.1°C
- Shutter: Removable; electromechanical 1-inch aperture; 7 ms open time; 10 ms close time; maximum repetition rate 2.5 Hz
- Optional shutter: Removable, electromechanical 1 3/8-inch aperture; 50 ms open time; 50 ms close time; maximum repetition rate 1 Hz
- Lens mount: Standard Nikon 35-mm bayonet mount
- Lens: Nikkor 50-mm; f/1.8
- Maximum distance from electronics unit: 5 feet (1.3 meters)
- Connectors: 37-pin D connector to camera electronics unit (5-foot cable included); two quick-release valves for liquid circulation (not applicable to air-cooled camera head)
- Size of the liquid circulation camera head: 3.875 inches (9.84 cm) long; 4.5 inches (11.4 cm) in diameter
- Size of the passive air-cooled camera head: 4 inches (10.16 cm) long; 5 inches (12.7 cm) in diameter
- Weight of the liquid circulation camera head: 2.5 pounds (1.1 kg)
- Weight of the passive air-cooled camera head: 3 pounds (1.36 kg)

Optional Cryogenically Cooled Camera Head

- CCD imager—see the current Photometrics CCD selection charts and manufacturer data sheets.
- Window: Anti-reflective-coated fused silica; 1 3/8-inch clear aperture, 0.128-inch thick
- CCD temperature: Selectable from -75° to the minimum stabilized CCD operating temperature—see the current Photometrics CCD selection charts; manually controlled; stable to within ± 0.1°C
- Shutter: Removable; electromechanical 1-inch aperture; 7 ms open time; 10 ms close time; maximum repetition rate 2.5 Hz
- Optional shutter: Removable, electromechanical 1 3/8-inch aperture; 50 ms open time; 50 ms close time; maximum repetition rate 1 Hz
- Lens mount: Standard Nikon 35-mm bayonet mount
- Lens: Nikkor 50-mm; f/1.8
- Cryogen hold time: Over 10 hours when filled with 0.5 liter of liquid nitrogen
- Orientation: Vertical or horizontal
- Maximum distance from electronics unit: 5 feet (1.3 meters)
- Connectors: 26-pin Bendix 26P connector to camera electronics unit (5-foot cable included)
- Size: 16.1 inches (40.9 cm) long, including shutter and lens; 7 inches (17.8 cm) in diameter without flange
- Empty weight: 7.5 pounds (3.3 kg)

Photometrics

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Technical Specifications (continued)

Camera Electronics Unit

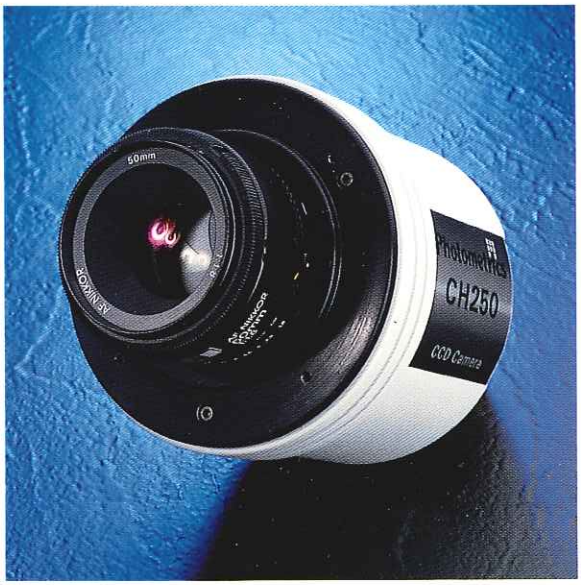
- Digitization options: Fixed at 12, 14, or 16 bits
- CCD readout speeds: Fixed at 40K, 50K, 200K, or 500K pixels/second (speed is dependent upon the digitization option)
- Front panel indicators: LCD temperature; heating, cooling, and power LEDs
- A TTL output signal indicates the status of the shutter
- External TTL shutter control input
- Manual shutter control (for frame transfer CCDs or CCD inspection)
- User-selectable temperature control is optionally available on Peltier-cooled systems, standard on cryogenically cooled systems
- Rear connectors: 37-pin D connector to camera head; 37-pin D connector to controller card (10-foot cable included); BNC TTL shutter status output (active low, jumper-selectable to active high); BNC - TTL shutter control input (active low, jumper-selectable to active high); 2.5-mm jack for manual shutter control switch; power input connector
- Size: 13 inches (33 cm) long, 6.25 inches (15.9 cm) high, 7.25 inches (18.4 cm) wide
- Weight: 9 pounds (4.1 kg)
- Power requirements: 100/110/220/240V switchable; 50/60 Hertz
- Operating environment: 0° to 50°C; 5 to 90 percent humidity non-condensing

Programmable VME Controller Card

- VME-bus plug-in controller card used for camera control and image capture—occupies one 6U or 9U slot in the host computer
- Complies with VME-bus standard, Rev. C.1
- Proprietary digital camera interface (8–bit control, 16-bit serial data)
- Two on-board microprocessors (Motorola 56001 and 68HC11) for control of all camera readout modes
- On-board dual-port VME DRAM image buffer (4 Mb expandable to 8 Mb; 32 Mb in the future)
- On-board firmware—permits binning and fast subarray readout
- User TTL I/O port with three input and four output bits
- External TTL trigger input synchronizes exposures to external events
- Single-high (6U) size card (9U adapter optional)
- Status LED display panel (not available with 9U adapter)
- Connectors: 25-pin D connector to electronics unit; 2.5 mm jack for external TTL trigger input (active low), 10-pin IDC for TTL I/O port
- Typical power requirements from host computer: 5V, 2.25A (8 Mb RAM)
- Operating environment: 0° to 40°C

Software

- Photometrics Quickview camera control software for the Sun is provided
- The software is user-friendly and mouse driven and includes image acquisition, archiving, and display capabilities for Sun computers using the SunView environment
- Source code is provided



Standard Peltier-Cooled Camera Head

Applications for the Peltier-cooled camera system include:

- Biological imaging
- Fluorescence microscopy
- Automated electrophoresis
- Transmission electron microscopy
- Medical radiology
- Industrial x-ray imaging
- Film digitization
- X-ray diffraction
- Laser-induced fluorescence
- Beam profiling
- High energy physics
- Streak tube readout
- Astronomical imaging
- Spectroscopy
- Underwater imaging

Applications for the cryogenically cooled camera system include:

- Astronomical imaging
- X-ray diffraction
- Laser-induced fluorescence
- Raman spectroscopy

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Features and Benefits

Scientific-grade, cooled CCD technology
- Unlike conventional video cameras, these systems provide a minimum of 4096 gray levels with extremely linear response for quantitative measurement or low-light applications.

Choice of CCD
- The user can choose architecture, resolution, and performance to suit the application.
- Only scientific-grade CCDs are used.
- Fiber optic reducers and fiber optic faceplates can be bonded to the CCD for direct optical coupling.

Guaranteed CCD performance
- Our *guaranteed* CCDs are fully characterized for both performance and defect specifications.
- The user is assured that the camera system meets specification—a detailed test report is provided.

12, 14, or 16 bits per pixel
- Small contrast changes can be detected over a wide range of light levels.

Peltier-cooled or cryogenically cooled CCD
- CCD cooling greatly reduces dark noise and cosmetic defects.
- Both cameras maintain their performance over a wide exposure range.
- The cryogenically cooled camera can be used for exposures up to hours due to its extremely low dark current.

Temperature stabilization circuit
- Ensures that the dark noise does not vary with time.
- Temperature stabilization can be disabled to provide uncontrolled maximum CCD cooling.

CCD vacuum chamber
- Prevents frosting and increases cooling efficiency.

MPP (multi-pinned-phase) technology
- MPP technology further reduces dark noise by a factor of about 20. Photometrics uses MPP technology on all CCDs which can be operated in this mode.

Optional METACHROME™ II coating
- This Photometrics proprietary coating extends CCD spectral response into the ultraviolet range.

Programmable single card VME controller
- Images are captured directly into on-board dual-ported RAM.
- The host can read image data *simultaneously* with image capture for increased throughput.
- On-board reconfigurable firmware controls the CCD, permitting binning and fast subarray readout.

Image acquisition software
- Image acquisition, archiving, and display capabilities for Sun computers using the SunView environment.
- User-friendly and mouse-driven.

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