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COOLED DIGITAL CCD IMAGING SYSTEMS

Photometrics manufactures digital CCD image acquisition systems for research and industry. These systems continue to make major contributions in fields as diverse as the life sciences, high energy physics, astronomy, spectroscopy, and deep water imaging.

The Photometrics product line offers a virtually unlimited combination of camera controllers, CCDs, camera heads, and cooling temperatures. Our technical sales staff can assist you in creating the system that best meets your needs.

Photometrics cooled imaging systems take full advantage of the performance qualities inherent in scientific-grade CCD imagers—geometric stability, 99.5% response linearity, up to 16-bit dynamic range, up to 50% quantum efficiency, and read noise as low as 5 electrons. Photometrics has developed a product line completely different from those incorporating conventional video cameras. Specifically, Photometrics CCD cameras use cooled scientific-grade CCDs, slow-scan readout, special signal processing techniques, MPP technology, and special clocking modes.

Why use scientific-grade CCDs?

Photometrics uses only the highest quality scientific-grade CCDs available in order to optimize noise performance, charge-transfer efficiency, quantum efficiency, and dynamic range. Our cameras support two-dimensional CCDs from a variety of manufacturers including Eastman Kodak, Thomson CSF, Tektronix, and Ford Aerospace. We also offer the Photometrics PM512 CCD. These CCDs typically have noise levels of 6 to 15 electrons and minimal cosmetic defects. Devices with resolution of up to 2k x 2k are supported by our Series 200 cameras. To achieve maximum quantum efficiency and uniform spatial sampling, Photometrics uses only full frame and frame transfer CCDs (with square pixels), as opposed to interline transfer devices.

Why use slow-scan readout?

All electronic circuitry generates undesirable noise. The wider the bandwidth (higher speed) at which a signal is processed, the more preamplifier (or system) noise is introduced into that signal. To reduce this noise, Photometrics cameras read data from CCDs at frequencies of 50, 200, or 500 kHz (or slow-scan compared to typical video system rates of approximately 5 MHz).

Why use special signal processing techniques?

Special signal processing techniques optimize the digitization process by reducing the noise associated with the random charge that remains in the CCD output node capacitor of the charge amplifier. This noise is many times higher than 6 to 15 electrons output noise of the typical scientific-grade CCD and is eliminated by techniques such as correlated double sampling and dual slope integration.

Why use MPP technology?

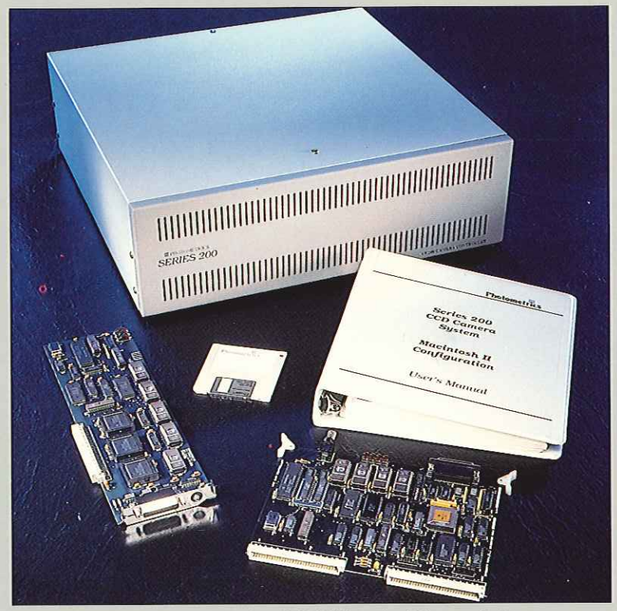
MPP (multi-pinned-phase) technology reduces the dark current generated during the integration by a factor of 20. In many cases, MPP technology provides performance equivalent to cryogenic cooling, in a thermo-electrically-cooled camera. (A PM512 CCD operated in MPP mode at -110°C has a dark current level of only 0.01 electrons/pixel/minute!) We use MPP technology on all CCDs that can operate in this mode.

Why use special clocking modes?

To increase the frame rate, a subarray can be read out rather than the full CCD. The speed increases in proportion to the reduction in the number of pixels digitized. Another specialized form of CCD readout is called binning. Binning enables you to combine charge in adjacent pixels on the CCD prior to digitization. The readout noise associated with the on-chip amplifier is incurred only once, thereby increasing the signal-to-noise ratio, but at the cost of spatial resolution. Both subarray readout and binning are fully programmable in the Series 200 system.

Why cool the CCD?

In the absence of light, the silicon CCD produces electron hole pairs at ambient temperatures. Produced by thermal energy (dark current), these pairs cannot be distinguished from pairs produced by photons from the image. Cooling the CCD eliminates virtually all signals generated by thermal energy, reducing the dark current by 50% for each 6°C decrease in temperature.



Series 200 offers a choice of Macintosh II, VME, or standalone controller.

THE SERIES 200 SYSTEM

The Series 200 is Photometrics top-of-the-line system, offering the greatest versatility in configuration. The basic system consists of three major components—camera controller, electronics unit, and CCD camera head. Each component is a modular building block that provides for flexibility in application.

Camera Controller

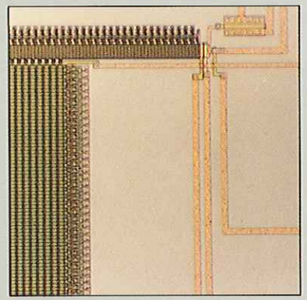
Three camera controllers support all Series 200 camera heads. The CC200 is a standalone intelligent controller that contains image storage memory and can perform image arithmetic. The CC200 can be operated off-line with a terminal or can transfer images to and from your host computer through a built-in IEEE-488 (GPIB) interface. IEEE-488 interfaces are available for computers such as IBM-compatibles and DEC™ VAX™ and MicroVAX™. Data can also be transferred to the host over a 16-bit-wide DMA (direct memory access) output port at pixel clock rates. Easy-to-use menu-driven software is available for use on your IBM®PC AT or XT.

As alternatives to the CC200, the VME200 and Nu200 controller boards provide CCD camera control on a single printed circuit board integrated into VME-based or Macintosh®II computers, respectively. Photometrics also supplies simple, user-friendly software packages that run on the Sun 3 and 4 or Macintosh II computers. This software enables camera control and image acquisition, display, and storage on the host computer. Images may be stored in full 12-, 14-, or 16-bit format, or in standard 8-bit TIFF format.

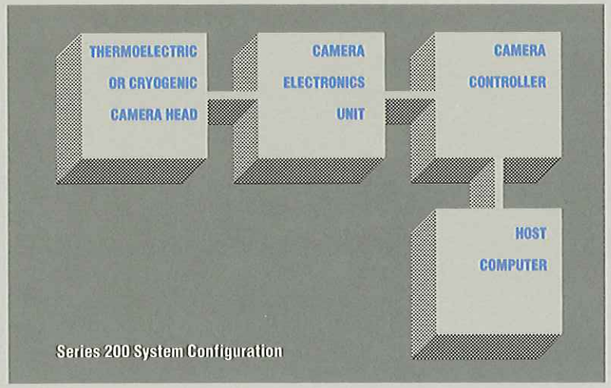
These software packages are intended as a tool for setting up the camera and verifying operation. For other applications (and for other VME-based host computers), the user can write software or purchase a third-party package that supports these controllers. Many vendors offer application-specific software packages designed for use with Photometrics cameras. Contact us for the current list of compatible software packages.

CCDs

The Series 200 system offers a selection of CCD imagers for each camera head. CCD selection is based on specific user applications. We continually evaluate and support the latest in scientific-grade CCDs available to our customers. Photometrics CCD Selection Chart provides specifications for CCDs that are currently available.



Photomicrograph of part of the PM512 CCD.



Series 200 System Configuration

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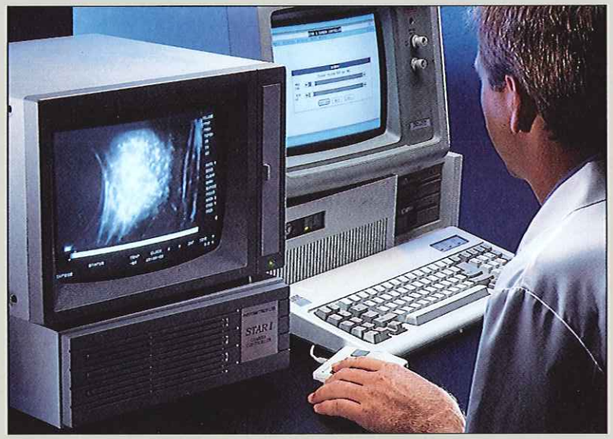
Camera Heads

Camera head selection is based on the level of cooling required and the selected CCD. A cryogenically cooled camera head provides the lowest possible dark current for applications where low light levels require exposures up to hours in duration, such as astronomy and Raman spectroscopy. Other Photometrics camera heads are cooled using three-stage thermoelectric coolers. These camera heads are ideal for applications where exposures are relatively short and extremely low cooling temperatures are not required.



Series 200 thermoelectric camera head.

All Series 200 camera heads digitize 12, 14, or 16 bits per pixel at rates from 50 to 500 kHz. They provide a cooled, dust-free environment for the CCD array and feature a UV-transparent window with an antireflective coating, a 50 mm, f/1.8 Nikon lens, a high speed shutter with 6 ms open and 5 ms close times, and a convenient mounting flange. Camera head options include a METACHROME™ II coating (to extend UV sensitivity down to 180 nm), fiber optic input window, and custom CCD masking for high-speed imaging.



STAR I camera system interfaced with an IBM PC AT computer.

THE LOW-COST STAR I SYSTEM

The STAR I is a standalone system that offers most of the performance features of cooled CCD imaging in a low-cost, compact package. The system's low read noise (15 electrons), dark current as low as 8 electrons/second/pixel, and exceptional charge transfer efficiency make it an ideal choice for OEM and end-user applications. This system consists of a camera head, controller, and monochrome video monitor. The camera head is based on a 384 x 576 scientific-grade CCD and regulates temperature down to -45°C. It is available with either a liquid- or air-cooled heat exchanger. The camera can be controlled locally from the video monitor using a mouse or can be interfaced directly with a host computer. Easy-to-use software is available for both the IBM XT/AT and the Macintosh II. METACHROME II UV-enhancement coating is optionally available for the STAR I CCD.

A COMMITMENT TO CUSTOMERS

At Photometrics, we provide our customers with the finest in high-performance electronic imaging equipment. All of our camera systems are built in-house with all camera heads assembled and tested in clean rooms. Each camera head is baked under vacuum for 60 hours in order to remove all residual materials that might adversely affect performance.

Photometrics provides assistance in the adaptation of digital CCD cameras to meet specific customer needs. We are an industry leader in CCD imaging and actively pursue research into new imagers and computer hardware to provide significant advances in digital CCD technology.

For further information on the Photometrics Series 200 or the STAR I, please call (602) 889-9933 or mail the attached postcard.

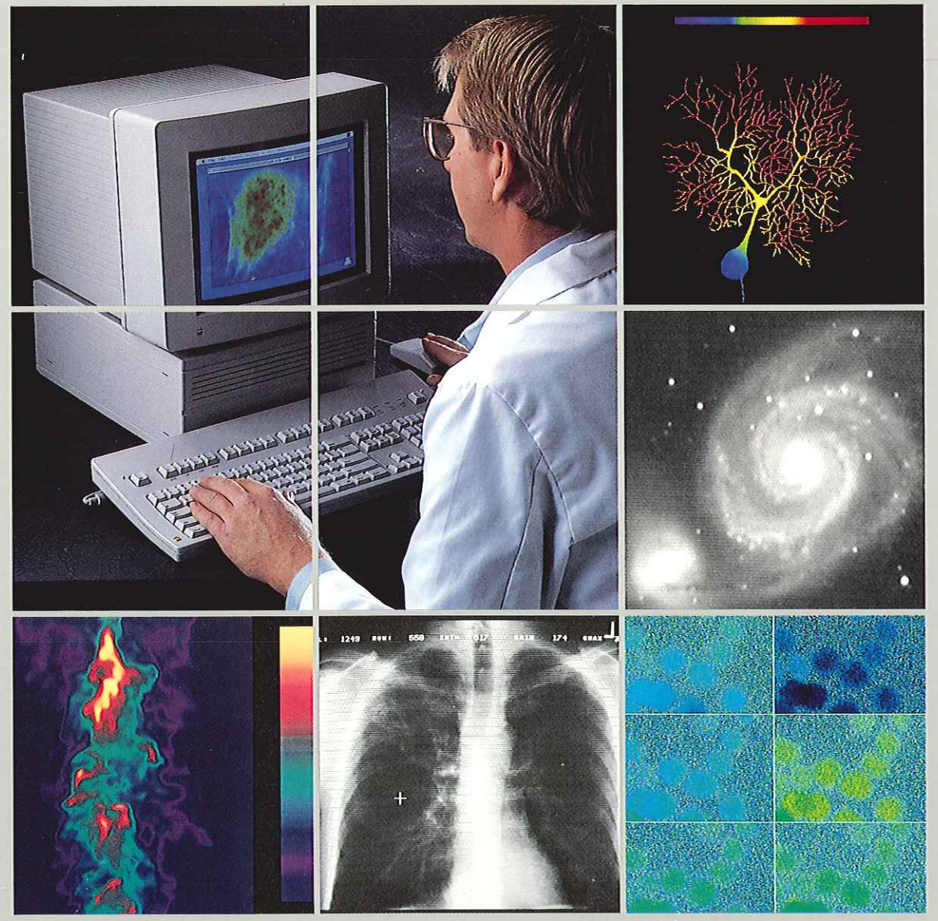
Cover photographs—Top right: FURA-2 map of Purkinje cells (courtesy D. Tank, AT&T Bell Labs). Center right: M51 galaxy image taken with STAR I camera. Lower right: Ratio images of [CL-] in RBL cells (courtesy R. Stump, University of New Mexico). Lower center: Digitized chest radiograph using 2k x 2k 12-bit camera. Lower left: Elastic (Rayleigh) pulsed laser scattering of a turbulent jet (10 ns, unintensified exposure) (courtesy M. Long, Yale University). Top left: Photometrics CCD image acquisition and processing are fully integrated with commercial workstations.

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Photometrics
World Leader in High-Performance CCD Imaging

Photometrics Ltd.
3440 East Britannia Drive • Tucson, Arizona 85706
FAX: [602] 573-1944 • Telephone: [602] 889-9933

Photometrics GmbH
Oskar-Coester-Weg 5 • D-8000 München 71 • West Germany
FAX: [0 89] 79 97 15 • Telephone: [0 89] 79 95 80



PRODUCT SUMMARY

Scientific Digital CCD Imaging

Photometrics
World Leader in High-Performance CCD Imaging

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

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