

# HVDUO-10M Digital Color Camera with Foveon X3<sup>®</sup> CMOS Color Image Sensor

## Description

The HVDUO-10M is a one-piece digital color camera capable of acquiring accurate, high-resolution color images using the Foveon<sup>®</sup> X3<sup>™</sup> Pro 10M CMOS color image sensor. The HVDUO-10M features 30-bit digital color output, real-time color processing, support for all sensor scan modes and a parallel LVDS interface. The HVDUO-10M is compatible with a wide range of standard optics and includes an automatic internal dark-frame shutter and controls for synchronized illuminators. The HVDUO-10M is well suited for industrial, scientific, cinema, medical and communications applications requiring high-quality color images.

## Features

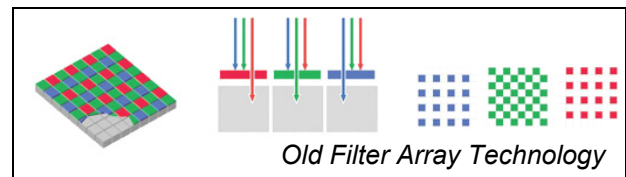
- 10.2 million photodetectors in a 2268 x 1512 x 3 matrix matches 3-chip color performance
- 9.12 micron square pixels accommodate an extensive selection of optics
- Flexible scanning methods support selection of resolution, raster size and speed from full resolution at >4 fps to a single line at 6.5 KHz
- Single-shot or continuous acquisition with selectable exposure offer optimum performance for still and motion images
- Camera control and image viewing software for Windows<sup>®</sup> facilitates rapid setup and acquisition
- Internal automatic shutter provides trouble-free dark frame acquisition
- 30-bit RGB output easily connects to a wide variety of framegrabbers
- A compact housing, single power supply and diverse mounting options simplify installation

## Sensor

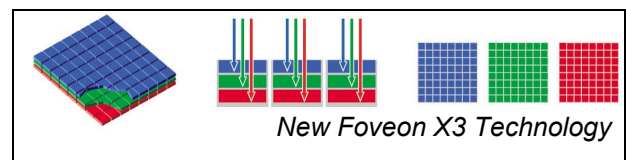
The HVDUO-10M camera provides true color performance through the use of the Foveon X3 Pro 10M CMOS color image sensor, which incorporates the exclusive Foveon X3 color separation technology. Unlike color filter mosaic sensors, the Foveon X3 Pro 10M image sensor detects full color at every pixel location.



In a typical mosaic sensor, each pixel is supplied with a filter that passes only one color band. One-half of the pixels detect green and only one-quarter detect red or blue. This wastes light and creates gaps in the color data, producing offsets among the color detection positions and artifacts when the missing data are estimated.



In image sensors using the Foveon X3 technology, three layers of photodetectors provide every pixel location with three stacked photodetectors so that every pixel location detects full color. No light is lost in filters and the detection locations for all three colors are coincident.



To make best use of the superior color detection capability of the X3 technology, the Foveon X3 Pro 10M image sensor also includes an extensive set of scan control registers to support scanning of selected rectangular regions of interest, grouping of pixels in both rows and columns and selective scanning of every  $n^{\text{th}}$  line to facilitate higher frame repetition rates.

The HVDUO-10M camera takes full advantage of these powerful sensor features by incorporating real-time color processing, full control of scan modes and three-channel, 12-bit video digitization.

## Raster Control

Through the use of eight controls, a large selection of rectangular areas may be scanned up or down, left or right, from the full 2268 x 1512 active raster to a single pixel and pixels may be grouped to provide seamless coverage at lower resolutions and higher speeds. All controls can be set independently.

**H & V Start** – Sets the number of the first column and row to be read out – can be any integer.

**H & V Count** – Sets the number of columns and rows to be read out – can be any integer.

**H & V Group** – Sets the number of columns and rows to be read out simultaneously – can be any power of two.

**H & V Jump** – Sets the spacing between the first line of groups of columns and rows – can be any positive or negative integer.

## Shutter Mode Control

The HVDUO-10M provides two shutter modes to accommodate a broad variety of still and motion imaging applications. In either mode, scanning may be set to run continuously or triggered frame by frame on demand.

**Still Shot** – The still shot mode provides superior image quality in applications where the illumination can be externally timed. This includes the use of strobe or pulsed LED illumination or external shuttering.

**Rolling Shutter** – The rolling shutter mode is used where the illumination is continuous either for acquisition of single images or for video operation. Exposure time may be set from one line to one second.

## Image Processing

Three-channel analog video from the sensor is digitized to 12 bits to maximize dynamic range. After digitization, the image data is processed in real time to produce accurate color output. Control is provided for two important video processing steps.

**Dark Frame** – The HVDUO-10M will automatically acquire a new dark frame whenever any setting is changed that invalidates the previous stored data. New dark frames may also be acquired manually at any time. An automatic internal dark frame shutter assures that the sensor is covered during the acquisition.

**Color Matrix** – Five color conversion tables for various lighting types are permanently stored in the camera. In addition, user-generated tables may be sent to the camera for special lighting or image processing situations.

## Image Timing

The HVDUO-10M operates from an internal crystal-controlled clock. Data is transmitted at constant frequency after a 49  $\mu\text{s}$  recharge period at the beginning of each line.

**Pixel Clock**  
24 MHz

### Frame Rate

The frame rate depends on the exposure settings. These are maximums for the rolling shutter mode with the exposure shorter than the frame time. Many more scan combinations are possible than these shown. Values are in frames per second.

Pixel Matrix	Frame Rate
2268 x 1512	4.5
1024 x 1024	10.5
640 x 480	27.5
567 x 378	36.4
2048 x 128	58.2

### Frame Triggering

Individual images may be acquired by triggered scanning. The precise scan and exposure timing and delay depend on mode, number of scan lines and exposure settings. A connector is supplied at the camera for real-time lighting synchronization.

# HVDUO-10M Digital Color Camera

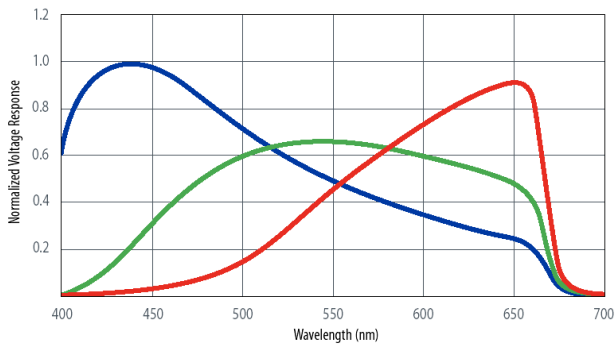
## Sensor Characteristics

### Pixel Geometry

Pixel Locations – 2268 columns x 1512 rows active  
Spacing – 9.12 x 9.12  $\mu\text{m}$  square  
Raster Area – 20.68 mm (H) x 13.79 mm (V) active  
Fill Factor – approximately 52%

### Spectral Response

The spectral characteristics of the sensor in the HVDUO-10M camera are determined by the absorption properties of silicon and are not subject to aging, bleaching or wear of filter materials.



These curves include the effects of a 400-660 nm visible bandpass filter. Approximate total quantum efficiency at 600 nm is 45% including visible pass filter losses and the effect of fill factor.

## Image performance

(At 25C, 0db gain)

Specification	Value
PRNU	$\pm 3 \text{ DN}_8$ (after dark subtraction)
FPN	$\pm 3 \text{ DN}_8$ (Row) $\pm 2 \text{ DN}_8$ (Column)
S/N Ratio	Limited by A/D converter
Dynamic Range	Limited by A/D converter
Sensitivity	Equivalent to ISO 100
Anti-blooming	3x to 100x, varies with mode

## Environmental Tolerance

Operating Temperature – 0 to +40C  
Humidity – 10 to 90%, non-condensing  
Storage Temperature – -20 to +60C

## Software

The camera includes a CD-ROM with all software necessary for setup and control through the

framegrabber serial port. Framegrabbers may require additional control and setup software.

### Control Software

The HanVision Camera Control Tool (HCCT) controls camera setup and operation.

- Runs under Windows 98/SE/ME/2000/XP
- Controls camera setup
- Loads and saves setup files
- Reads camera status

### Acquisition Software

The HanVision NeGUS acquisition and viewer software supplies basic image acquisition and analysis functions

- Save image, format: BMP
- Line profile display
- Zoom in and out
- Simple image processing: brightness, contrast and geometric transform
- Single and continuous grab

## Electrical Interface

### Power Supply

The HVDUO-10M includes a small packaged 5-volt regulated universal input supply for operation from 90-240 volt, 45-65 Hz mains. The power supply carries worldwide safety certifications.

### Digital Output

**Data Configuration** – 30-bit RGB output interfaces to parallel LVDS framegrabbers supporting four 8-bit input channels. Cables for various framegrabbers can be supplied on request.

**Data Control** – Supports LVAL, FVAL, Pixel Clock and bidirectional serial communications

**Light Source Control** – The HVDUO-10M camera provides output and optoisolated input connections for synchronization with pulsed illuminators or external shutters.

## Options

### Special Windows

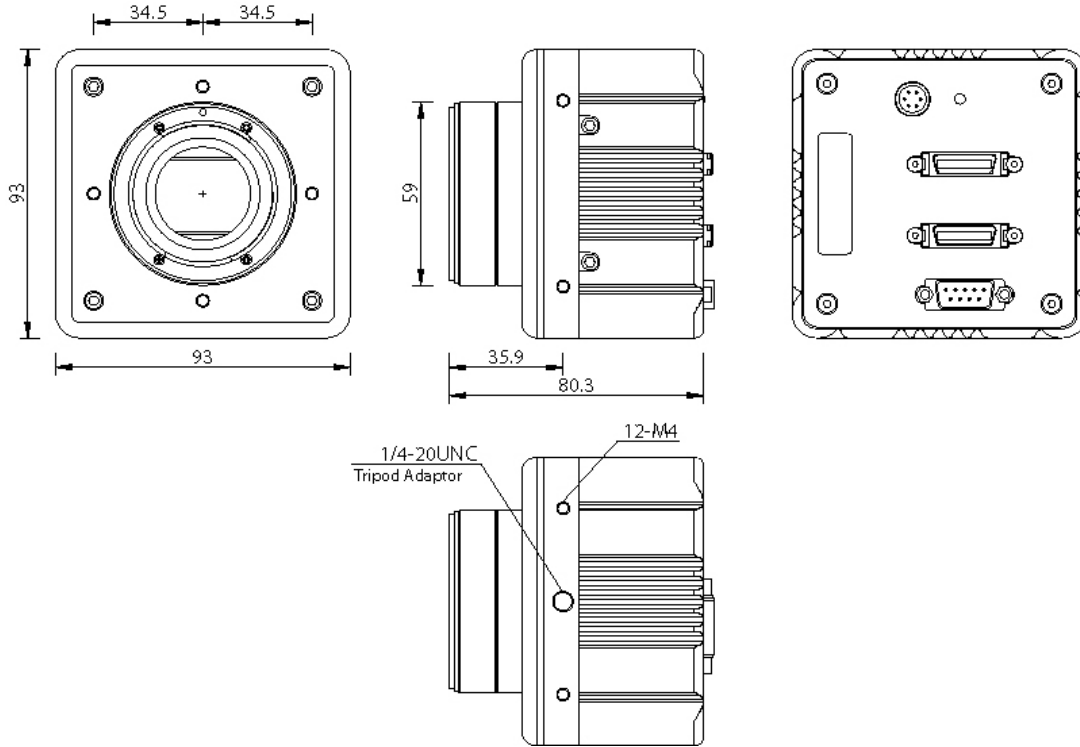
Sensors may be ordered with plain glass windows, removable windows (without warranty), fused silica windows or custom windows at modest extra cost.

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## Custom Interfaces

The modular construction of the HVDUO-10M facilitates implementation of custom interfaces.

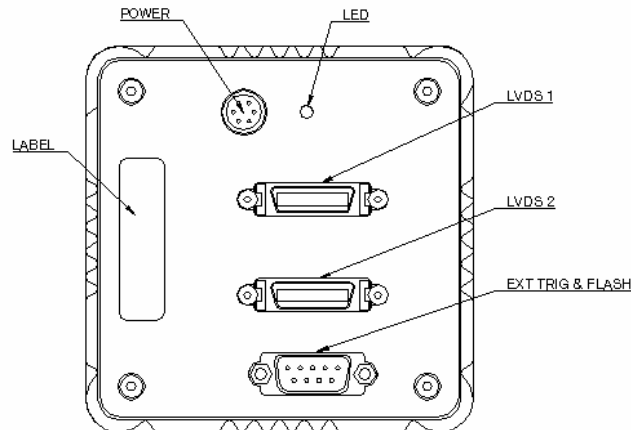
## Mechanical Configuration



## Optical Configuration

- Image Size: 20.68 mm (H) x 13.79 mm (V) active
- Sensor Window: 3 types: IR cut (400-660 nm); AR/AR (380-900 nm); removable glass (350-1100 nm)
- Lens Mount: Nikon "F" mount with internal filter holder, 46.5 mm back focal distance
- Sensor Alignment:  $\pm 0.01$  mm (H & V),  $\pm 2$  mrad (rotation),  $\pm 0.01$  mm (flatness)

## Rear Panel Connections



## HVDUO-10M Digital Color Camera

Power:	Connector - 6-pin Hirose HR-10A
	Input - 5 VDC $\pm$ 5%, 1A max, AC adapters available for all countries
	Consumption - 4 W (typical)
	Indicator - Green LED
Digital Video Out:	Format - 30-bit RGB, Parallel LVDS, 4 channels used
	Connector - 1- MDR-36P, 1-MDR-40P
External Triggering:	Signals - Frame trigger in, Flash sync out
	Connector - DB-9 Subminiature D, female

### Ordering Information

For orders placed with Alternative Vision, use the following part numbers:

Part No.	Description
3331-0005-01-00	24 MHz Camera – sensor with IR cut filter, grade 1, LVDS, DSM
3331-0005-02-00	24 MHz Camera – sensor with IR cut filter, grade 2, LVDS, DSM
3331-0005-03-00	24 MHz Camera – sensor with IR cut filter, grade 3, LVDS, DSM
3331-0005-04-00	24 MHz Camera – sensor with dual-side antireflectance filter, grade 1, LVDS, DSM
3331-0005-05-00	24 MHz Camera – sensor with dual-side antireflectance filter, grade 2, LVDS, DSM
3331-0005-06-00	24 MHz Camera – sensor with dual-side antireflectance filter, grade 3, LVDS, DSM
3331-0005-07-00	24 MHz Camera – sensor with removable glass window, grade 1, LVDS, DSM
3331-0005-08-00	24 MHz Camera – sensor with removable glass window, grade 2, LVDS, DSM
3331-0005-09-00	24 MHz Camera – sensor with removable glass window, grade 3, LVDS, DSM

\* DSM is the automatic dark shutter mechanism

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### For further information:

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#### Local Representative

HanVision reserves the right to make changes in configuration and specifications without prior notice to support improvements in components, performance or compatibility. Specifications are representative of camera performance but may not represent sensor limits.