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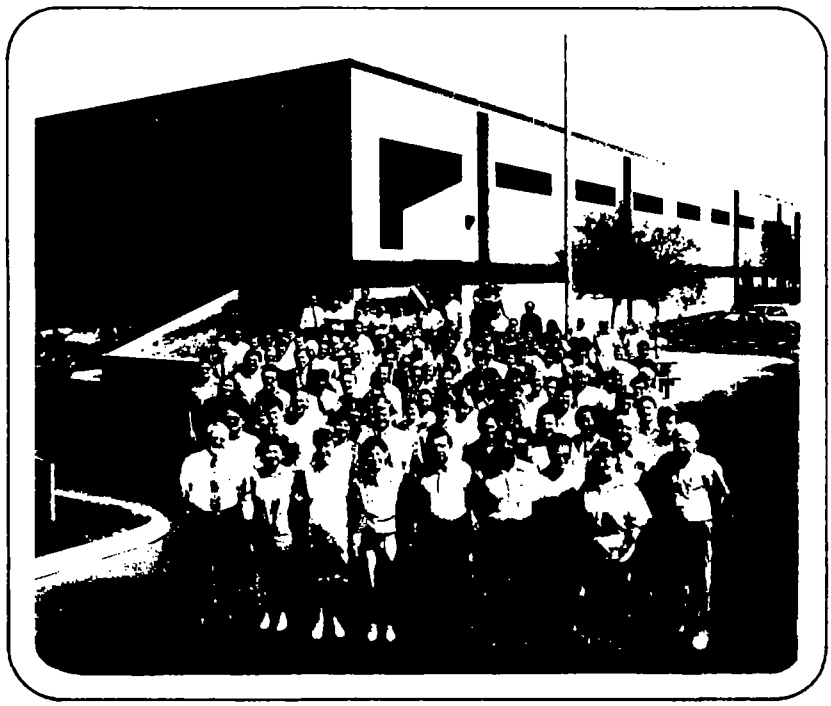
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COHU, INC.
ELECTRONICS DIVISION

Telephone: (619) 277-6700
FAX: (619) 277-0221



Corporate/Division Headquarters and Manufacturing Facility
5755 Kearny Villa Road, San Diego, California 92123
Mailing Address: P.O. Box 85623, San Diego, CA 92186-5623

A leading U.S. manufacturer of quality television products, Cohu, Inc., Electronics Division, is the oldest continuing manufacturer of closed circuit television cameras and systems in the world. We represent a single source for diverse CCTV products for the sciences, industry, and government. Applications include surveillance and security systems, high resolution cameras, miniature cameras, general purpose, environmental, low light level, machine vision, and many more.

This catalog represents our current line of CCTV cameras and equipment. Our unique model numbering system allows for specific cameras to be designated with a variety of options included. You will find this system explained under the ordering information for each camera series. If, however, you do not find a camera listed that describes your specific needs, you are encouraged to contact the factory and discuss your needs with one of our applications engineers. What you desire may already be available, or it may be possible to custom design a camera to fulfill your requirements.

Cohu is dedicated to satisfying our customer needs by bringing to the market high performance quality products which incorporate the very latest in technology and features—designed to provide years of satisfying service.



COHU INC
ELECTRONICS DIVISION

*The **Great American Name** in CCTV Advancements*

85-06 (7/90) July 1990 Printed in U.S.A

Thank you . . .

for your interest in Cohu video cameras and camera systems.

The enclosed literature will help you identify the exact Cohu camera or system for your requirement.

Should you need additional information, or if you wish to notify us of a change of address, please use the attached postage-paid reply card, or call us at (619) 277-6700.

We look forward to supporting you on your current project and with all your CCTV camera and system requirements.

Thank you,

Cohu, Inc., Electronics Division

COHU

Cohu, Inc., Electronics Division
5755 Kearny Villa Road • San Diego, California 92123
Telephone (619) 277-6700 • FAX: (619) 277-0221

Name_____

Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone (_____) _____

☐ Please change my address as noted above.

☐ I need additional information. My area of interest is:_____

_____

☐ Please have a sales representative contact me.

Comments: _____

_____

_____

88-02 (8:91)
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WARRANTY

Cohu, Inc., Electronics Division warrants equipment manufactured to be free from defects of material and workmanship. Any part or parts will be repaired or replaced when proven by Cohu examination to have been defective within two years from date of shipment to the original purchaser for standard CCD cameras and one year from date of shipment to the original purchaser for intensified CCD cameras and all other Cohu manufactured products. All warranty repairs will be performed at the factory or as otherwise authorized by Cohu in writing. Transportation charges to Cohu shall be prepaid by purchaser. This warranty does not extend to Cohu equipment subjected to misuse, accident, neglect, or improper application, nor repaired or altered by other than Cohu or those authorized by Cohu in writing. **Television image pickup tubes, image intensifiers, lenses and products manufactured by companies other than Cohu are warranted by the original manufacturer.** *This warranty is in lieu of all other warranties express or implied. Cohu shall not be liable for any collateral or consequential damages. A Return Authorization Number (R.A.#) must be obtained from Cohu prior to returning any item for warranty repair or replacement.*

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295 REPADRS PRINTED IN USA

Designed for OEMs!

BOARD LEVEL MONOCHROME CCD CAMERA

1100 SERIES

High Performance ½" or ⅓" On-Chip-Microlens Interline Transfer Imager

The Cohu board-level CCD camera has been designed to fit the needs of OEM customers who require high performance video in a compact package. The 1100 Series features a resolution of 768 (H) x 494 (V) active pixels, internal crystal or external synchronization, and 2 to 16 field/8 step integration or shuttering to 1/10000.

Configuring the 1100 Series for custom purposes is quite easy. A flexible cable allows for virtually any orientation of the sensor with respect to the control board. Measuring less than 2" x 4", this feature/size combination is ideal for machine vision and image processing applications.

The 1100 Series cameras feature a 1/2"-format on-chip microlens sensor, which improves sensitivity and provides increased dynamic range while reducing lag, blooming and dark current. For video applications prone to streaking problems, a 1000:1 overload capability allows transmission of clear video signals even when bright incidental light is present in the scene.

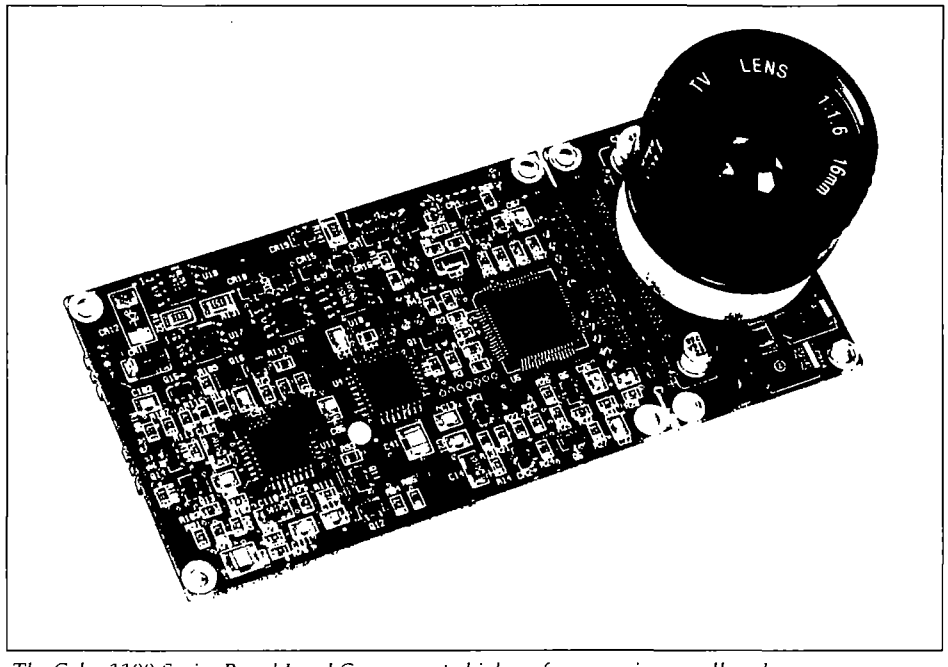
Both RS-170 and CCIR cameras have 20 dB of AGC for high sensitivity in low light-level applications.

This single board camera synchronizes from an internal crystal, or external horizontal/vertical source.

Asynchronous reset accepts an external trigger input to reset the camera to the beginning of the vertical interval (field 1, line 1). The first field of video information reads out 9.5 horizontal lines after triggering.

Four modes of operation can be selected: field (interlace and non-interlace), and frame (interlace and non-interlace). The integration time in the field mode is 16.6 ms for each field. Interlace mode sums two rows of pixels from each line, thus increasing the sensitivity. The non-interlace mode uses only field one, or one-half (242) the number of vertical pixels. The advantage of non-interlaced is using the same field of pixels every 1/60 second for repeatability. The integration time of each field in the frame (interlace) mode is 33.3 mS. for a vertical resolution of 485 pixels. Operating in the frame interlace mode and strobing will achieve full frame resolution of fast moving objects.

Cohu is ISO-9001certified.



The Cohu 1100 Series Board Level Camera puts high performance in a small package.

Cohu offers option boards that greatly expand the capabilities of the 1100 Series. These boards easily plug into the control board. Options include:

- Line Lock Sync - accepts 12 VAC reference input and synchronizes the camera to the phase of the line frequency.
- External Sync - accepts genlock input (composite horizontal/vertical sync) to synchronize the camera to the externally-supplied reference.
- Electronic Iris - automatically controls the integration of the sensor from 1/60 sec. to 1/15,000 sec. to compensate for changing scene illumination. This control smoothly steps through the entire range.
- Special Reset - allows resetting the camera and determining integration time with an external pulse. Integration time ranges from a minimum of 650 µS to a maximum limited only to the operator's subjective analysis of video information versus the rise in dark current.
- DC Iris - control auto iris lenses that do not have circuitry integral to the lens (aspherical).

FEATURES AND BENEFITS

- **High Resolution** — for better definition, error-free results
- **1/2" or 1/3" On-chip-microlens Interline Transfer Imager** virtually eliminates overload streaking, improves dynamic range and sensitivity.
- **Wide Dynamic Range** permits operation over a broad range of light levels.
- **High Signal-to-Noise Ratio** for clear, noise-free video.
- **Shutter** 1/60 to 1/10000 (8 steps)
- **Integration** from 2 to 16 fields
- **Field or Frame Modes**
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras.
- **Custom Mechanical Configurations** to support your design.

APPLICATIONS

- **Image Processing**
- **Machine Vision**
- **Process Control**
- **Quality Control**
- **Image Analysis**

Designed and manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

1100 SERIES BOARD LEVEL MONOCHROME CCD CAMERA

ORDERING INFORMATION

11X 2— X X X X / XXXX

Format	Power	Sync Options	Optical Filters	Lens Mounts	Options	Lens Options
2 1/2" RS-170 **5** 1/2" CCIR **3** 1/3" RS-170 **6** 1/3" CCIR	**2** 12 VDC, Standard	**1** Crystal/H&V Drive/Async Reset (Standard) **2** Genlock (revert to crystal) **4** Special Reset	**0** None	**0** None **1** CS **2** C/CS	**0** None **3** Electronic Iris - RS-170* **4** DC Lens Drive **5** Electronic Iris - CCIR* * For manual lens only. Do not use with fluorescent lighting.	Please consult factory for lens selections.

SPECIFICATIONS

ELECTRICAL

Pick up Device
1/2" or 1/3" Interline transfer, microlens sensor

Active Picture Elements
RS-170: 768 (H) x 494 (V)
CCIR: 752 (H) x 582 (V)

Pixel Cell Size - RS-170
1/2": 8.6 µm (H) x 9.8 µm (V)
1/3": 6.35 µm (H) x 7.4 µm (V)

Pixel Cell Size - CCIR
1/2": 8.4 µm (H) x 8.3 µm (V)
1/3": 6.5 µm (H) x 6.25 µm (V)

Total Pixel Elements
811 (H) x 508 (V)

Resolution
RS170: 580 horizontal TVL, 350 vertical TVL
CCIR: 560 horizontal TVL 450 vertical TVL

Synchronization
H & V
Crystal (RS-170A)
Asynchronous reset

Shutter
1/60 to 1/10000

AGC
20 dB range, auto or manual control

Signal-to-Noise
>55 dB (Gain 0, Gamma 1)
38 dB (Gain 20 dB, Gamma 1)

Gamma
.45 to 1.0, continually variable

Integration
2 - 16 fields

Lens Mount
C or CS (not included)

Auto Lens Output
Reference video provided to control auto-iris lenses

Sensitivity	**1/2"**	**1/3"**
Full video. No AGC:	.065 fc	.087 fc
	.65 lux	.87 lux
80% Video, AGC on:	.005 fc	.006 fc
	.05 lux	.06 lux
30% Video, AGC on:	.002 fc	.003fc
	.02 lux	.03 lux

Power
12 VDC, 3.6 W max. Standard; 115/230 VAC adapter optional

MECHANICAL

Dimensions
See illustration

Weight
1.50 oz. (44 g) without lens

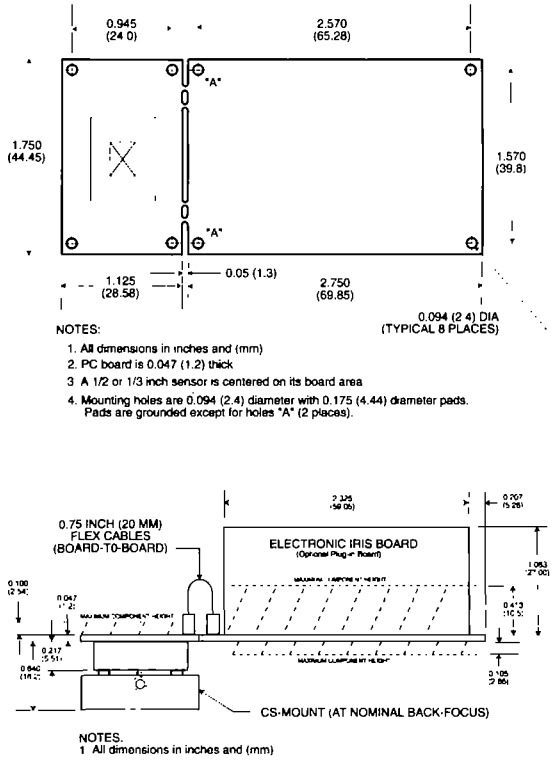
Ambient Operating Temperature Limits
-20° to 60° C (4° - 140° F)

Relative Humidity
to 95% non-condensing

Shock
15 g's any axis, non-operating condition, per MIL-E-5400T

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DIMENSIONS



ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

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Telephone: (619) 277-6700 • FAX: (619) 277-0221

COHU
Cohu, Inc./Electronics Division

NEW! *MS SERIES* - HIGH PERFORMANCE MONOCHROME CCD CAMERA

MS12/MS12E

½" On-Chip-Microlens Interline Transfer Imager

This Cohu monochrome CCD camera has been designed to fit the needs of OEM customers who require high performance video in a compact package. The MS12 features a resolution of 768 (H) x 494 (V) active pixels, internal crystal or external horizontal and vertical synchronization, 2 to 16 field/8 step integration, or 1/60 - 1/10,000 shuttering in eight steps.

It measures only 2" (W) x 1.5" (H) x 3.75" (L). This feature/size combination is ideal for scientific and image processing applications.

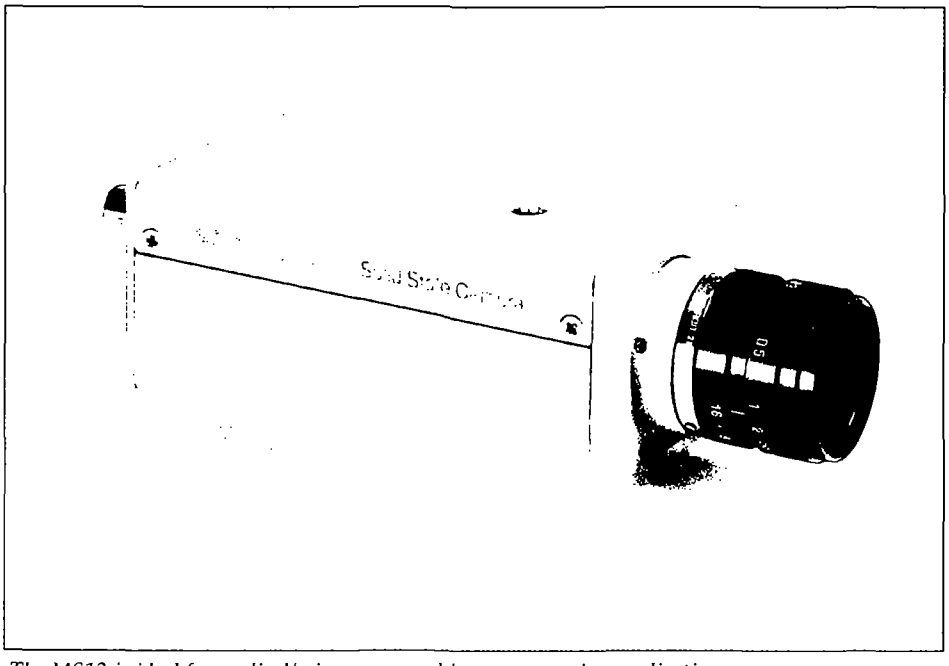
The MS12 Series cameras features a 1/2"-format on-chip microlens sensor, which dramatically improves sensitivity and dynamic range, and reduces dark current, lag, and blooming. For video applications prone to streaking problems, a 1000:1 overload capability allows transmission of clear video signals even when bright incidental light is present in the scene.

Both RS-170 and CCIR cameras have 20 dB of gain, manual or auto, for high sensitivity in low light-level applications.

The MS12 Series cameras synchronize from an internal crystal, or external horizontal/vertical source.

Asynchronous reset accepts an external trigger input to reset the camera to the beginning of the vertical interval (field 1, line 1). The first field of video information reads out 620 µS after triggering.

Four modes of operation are user-selectable: field (interlace and non-interlace), and frame (interlace and non-interlace). The integration time in the field mode is 16.6 ms for each field. Interlace mode sums two rows of pixels from each line, thus increasing the sensitivity.



The MS12 is ideal for medical/microscopy and image processing applications.

The non-interlace mode uses only field one, or one-half (242) the number of vertical pixels, for repeatability. The integration time of each field in the frame (interlace) mode is 33.3 mS, for a vertical resolution of 485 pixels. Operating in the frame interlace mode and strobing will achieve full frame resolution of fast moving objects.

APPLICATIONS

- **Image Processing**
- **Machine Vision**
- **Process Control**
- **Quality Control**
- **Image Analysis**

FEATURES AND BENEFITS

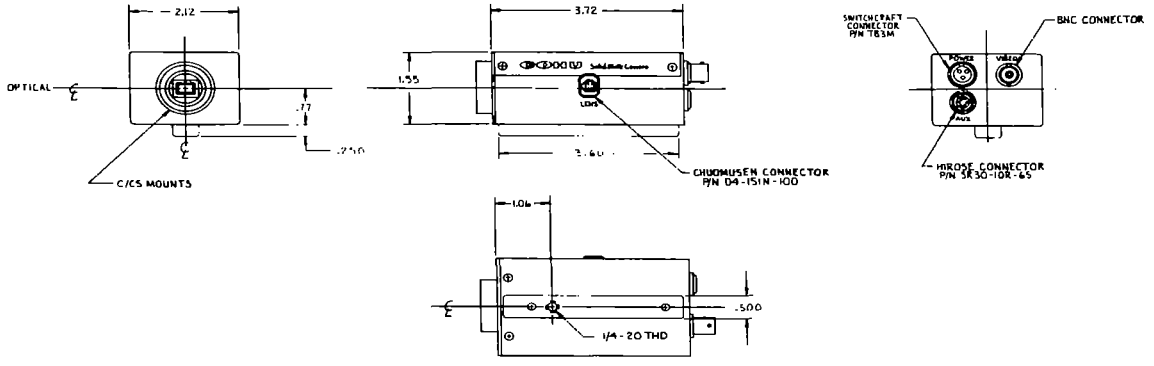
- **High Resolution** — for better definition, error-free results
- **1/2" On-chip-microlens Interline Transfer Imager** improves dynamic range and sensitivity and virtually eliminates overload streaking.
- **Wide Dynamic Range** permits operation over a broad range of light levels.
- **High Signal-to-Noise Ratio** for clear, noise-free video
- **Shutter** 1/60 to 1/10000 (8 steps)
- **Integration** from 2 to 16 fields
- **Field or Frame Modes**
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras
- **Two Year Warranty**
- **Asynchronous Reset** to capture random events

Designed and manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

MS12/MS12E MONOCHROME CCD CAMERA

DIMENSIONS



SPECIFICATIONS

ELECTRICAL

Pick up Device
1/2" Interline transfer, microlens sensor

Active Picture Elements
RS-170: 768 (H) x 494 (V)
CCIR: 752 (H) x 582 (V)

Pixel Cell Size
RS-170 8.4 µm (H) x 9.8 µm (V)
CCIR: 8.6 mm (H) x 8.3 µm (V)

Resolution
RS170: 580 horizontal TVL, ≥350 vertical TVL
CCIR: 560 horizontal TVL 450 vertical TVL

Synchronization
Internal:
Crystal (RS-170A)
External:
H & V
Asynchronous reset

Shutter
1/60 to 1/10000

AGC
20 dB range, auto or manual control

Signal-to-Noise
>55 dB (Gain 0, Gamma 1)
38 dB (Gain 20 dB, Gamma 1)

Gamma
.45 to 1.0, continually variable, preset to 1.0

Integration
2 - 16 fields

Lens Mount
Standard: CS
Accessory: C (PN:2010695-001)

Auto Lens Output
Reference video provided to control auto-iris lenses;

Lens Voltage
11 VDC

Sensitivity
Full video, No AGC: .065 fc (0.65 lux)
80% Video, AGC on: .005 fc (.05 lux)
30% Video, AGC on:.002 fc (.02 lux)

Power
Standard: Regulated 12 VDC, 3.6 W max.;
Accessory: 115/230 VAC to 12 VDC adapter (PN: 8368-4)

MECHANICAL

Connectors
Video Out: BNC;
12 VDC In: Switchcraft TB3M;
External Async Reset In, Vertical Trigger In, Horizontal Trigger In, Ground: Hirose SR30-10R-6S

Dimensions
See illustration

Ambient Temperature Limits
-20° to 60° C (4° - 140° F)

Relative Humidity
to 95% condensing

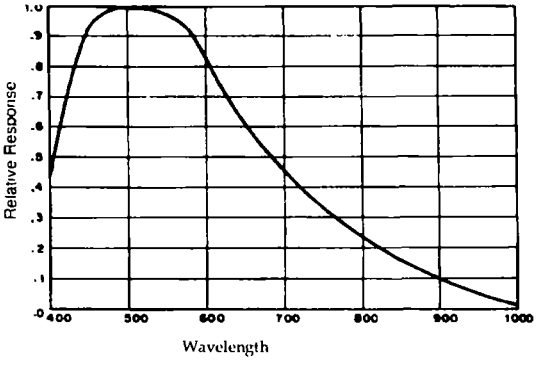
Shock
30 g's, 11 mS duration, 3 axes

Mounts
1/4-20 female thread top and bottom

ORDERING INFORMATION

MS12	Monochrome 1/2" CCD camera, 12 VDC, RS-170A
MS-12E	Monochrome 1/2" CCD camera, 12 VDC, CCIR
Lens	Please consult factory or authorized Cohu representative for selection

SPECTRAL RESPONSE



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ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

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Cohu, Inc./Electronics Division

MS12/MS12E Printed in U.S.A. (5/94)

NEW!

MONOCHROME CCD SURVEILLANCE CAMERA

2100 SERIES

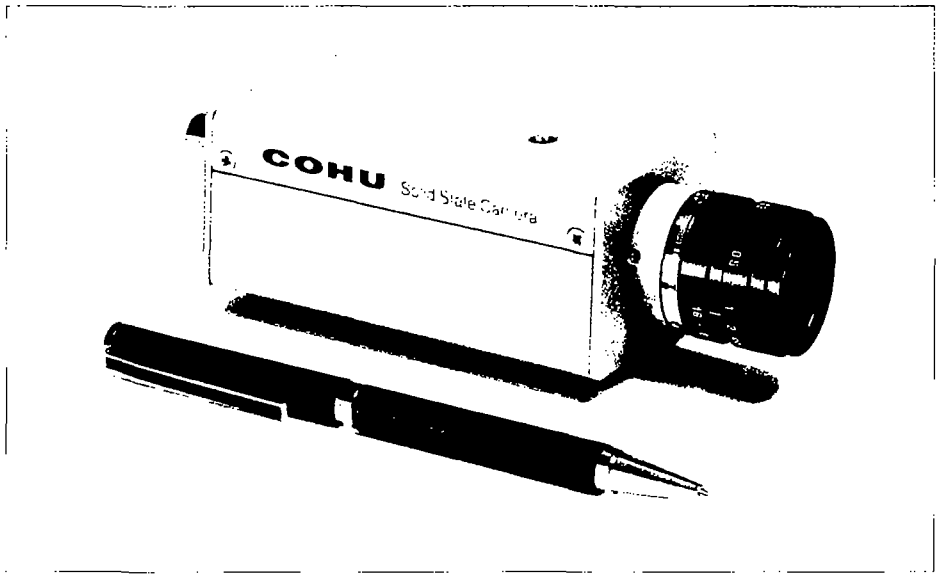
High Performance 1/2" On-Chip-Microlens Interline Transfer Imager

The new Cohu 2100 Series camera has been designed for the surveillance professional who demands a small camera of unequaled performance at a competitive price. In a package measuring only 1.5"(H) x 3.75" (D) x 2" (W), you get 580 horizontal line resolution, microlens sensor technology for dramatic sensitivity and dynamic range, and a price comparable to cameras with only half the performance.

This feature/size combination makes it ideal for indoor surveillance installations, or for outdoor use when housed in a Cohu environmental enclosure.

The features of the 2100 Series give it versatility, reliability, and value. Rugged, solid state construction provides high resistance to shock and vibration. An electronic shutter allows the camera to track rapidly moving subjects.

Mounting holes on the top and bottom of its housing mean easy installation, while its neutral color allows it to unobtrusively blend into the surroundings.



For size, features, and price, the Cohu 2100 Series is the ideal surveillance and security camera.

APPLICATIONS

- **Surveillance**
- **Covert Installations**
- **Access Control**
- **Transportation Systems**
- ***Gaming***
- **Robotic Vehicles**
- **Loss Prevention**
- **Image Processing**

The 2100 Series camera features a 1/2"-format on-chip microlens sensor, which improves sensitivity and dynamic range, while reducing dark current, lag, and blooming For video applications prone to streaking problems, a 1000:1 overload capability allows incidental light overloads up to 10 times that of other cameras.

RS-170 and CCIR models are available, and both have 20 dB of AGC for high sensitivity in low light-level applications.

Electronic iris provides eight f-stops of automatic light control. This electronic shutter provides control from 1/60 to 1/15,000 second. This is of particular importance when the images are fast-moving or the camera is mounted on a vibrating source.

From board-level design to its cast aluminum enclosure, you can expect the highest performance and value from the Cohu 2100 Series CCD camera.

FEATURES AND BENEFITS

- **High Performance** — for clear images and positive identification
- **1/2" On-chip-microlens Interline Transfer Imager** dramatically improves dynamic range and sensitivity and virtually eliminates overload streaking
- ***High Sensitivity*** *permits operation* over a broad range of light levels.
- **High Signal-to-Noise Ratio** for clear, noise-free video.
- **"C" or "CS" Lens Mount** expands your choice of lenses.
- **Choice of RS-170 or CCIR Models**
- **1000:1 *Overload Capability*** permits incidental light overloads up to ten times that of other CCD cameras.
- **Two-Year Warranty**
- **Made in U.S.A.** — direct factory support
- **It's a Cohu CCTV camera** — your assurance of quality, dependability, industry recognition, customer service, and ISO-9001 certification.

Designed and manufactured in the U.S.A.

COHU

Cohu, Inc./Electronics Division

2100 SERIES MONOCHROME CCD SURVEILLANCE CAMERA

ORDERING INFORMATION

21 X	2 - X	X	0	X /	XXXX
Format	**Power**	**Sync Option**	**Optical Filter**	**Options**	**Lenses**
2 1/2" RS-170 **5** 1/2" CCIR	**2** 12 VDC	**1** Crystal **2** Genlock (revert to crystal)	**0** None **1** IR	**0** None **3** Elec Iris (RS-170) **4** DC Iris **5** Elec. Iris (CCIR)	The versatility of this camera allows for a wide selection of lenses. Consult your Cohu representative for the lens that best suits your application.

SPECIFICATIONS

Pick up Device
1/2" Interline transfer, enhanced sensitivity

Picture Elements
RS-170: 768 (H) x 494 (V)
CCIR: 752 (H) x 582 (V)

Resolution
RS-170: 580 horizontal TVL, 350 vertical TVL
CCIR: 560 horizontal TVL, 450 vertical TVL

Synchronization
Internal: Genlock, Crystal
External:H&V, Asynchronous reset

Electronic Shutter
1/60 to 1/15,000 with elec. iris
1/60 to 1/10,000 switch selectable

Signal-to-Noise
>55 dB (gain 0, gamma 1)
38 dB (gain 20 dB, gamma 1)

Gamma
.45 to 1.0 continually variable

AGC
20 dB range, auto or manual control

Integration
2-16 frames

Dimensions
See illustration

Lens Mount
C (CS adaptor provided)

Auto Lens Output
Reference video provided to control auto-iris lenses

Lens Voltage
11 VDC

Sensitivity
Full video, No AGC: 0.065 fc (.65 lux)
80% Video, AGC on: .005 fc (.05 lux)
30% Video, AGC on:.002 fc (.02 lux)

Power
12 VDC, 3.6 W max. Standard 115 VAC/60 Hz optional

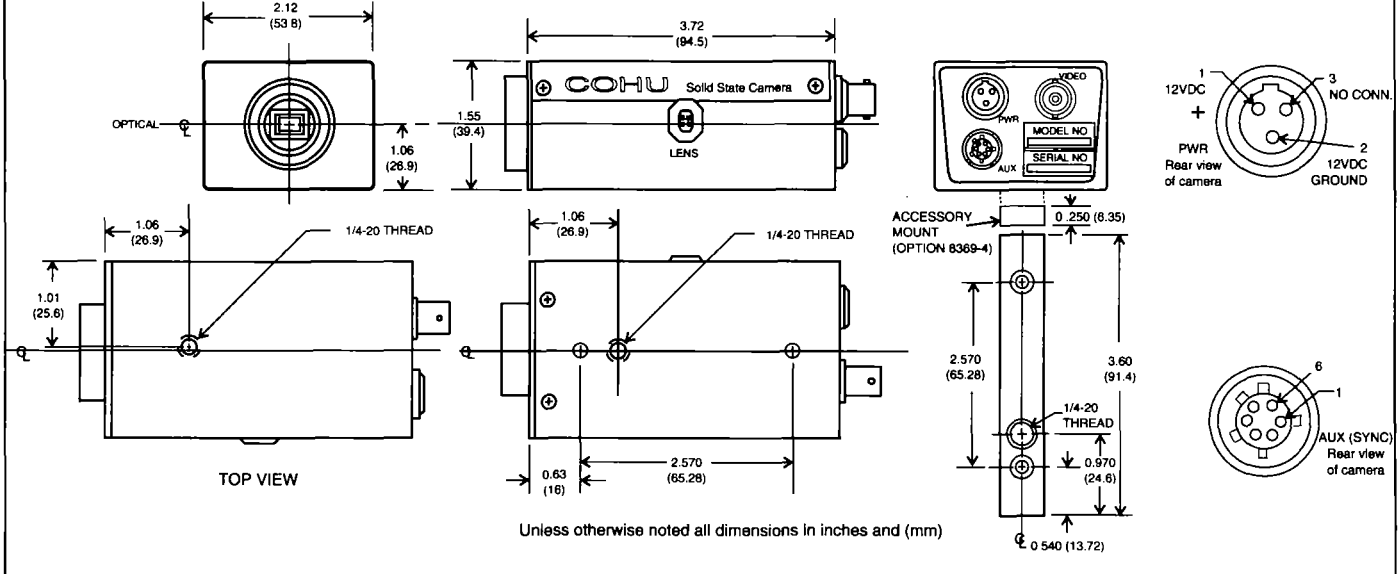
Ambient Temperature Limits
-4° F (-20° C) to 140° F (60° C)

Relative Humidity
to 95% non-condensing

Shock
30 g's, 11 mS duration, 3 axes

Mounts
1/4-20 female threads, top and bottom

DIMENSIONS



Unless otherwise noted all dimensions in inches and (mm)

ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

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Cohu, Inc./Electronics Division

2100 Series Printed in U.S.A. (2/95)

DIGITAL OUTPUT MONOCHROME CCD CAMERA

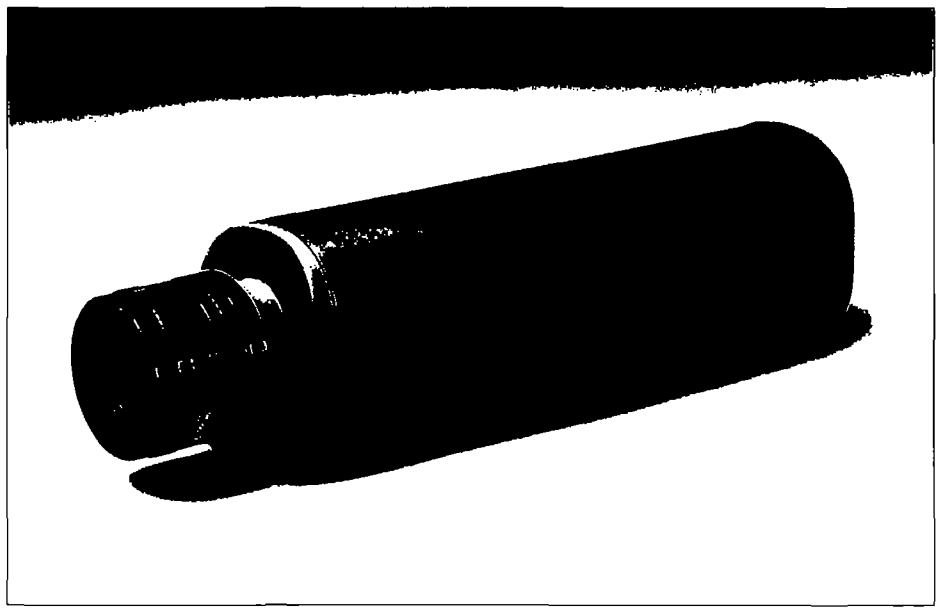
MODEL 4110

For Image Processing Without Pixel Jitter

Cohu's new Model 4110 Digital Video Camera is the first and only digital output CCD camera to combine a high-performance defect-free sensor and affordability in a single package. Designed to support both existing and future digital imaging applications, this exciting new camera is the culmination of close collaboration between Cohu and both users and manufacturers of image processing equipment.

The Model 4110 produces a digital output byte for each pixel and shares a pixel clock directly with the frame memory of the image processor board. The design eliminates the phase-lock-loop or genlock circuits usually employed with conventional analog to digital front end circuitry. This breakthrough allows an accurate digital reproduction of each pixel to be transferred to the processor and virtually eliminates pixel jitter. Imaging system noise is further reduced by moving the sensitive analog front end circuitry into the camera and away from the high-noise environment associated with the host computer's digital computing circuitry. The result is a much higher system Modulation Transfer Function (MTF) from the camera sensor to the image processor.

The new Model 4110 helps digitizer manufacturers conserve board space, providing room for additional functions and features.



Cohu Model 4110 Digital Video Monochrome CCD Camera

The Model 4110 is a vastly superior image acquisition camera for use with measurement systems. The virtual elimination of pixel jitter, the near perfect geometry of the CCD sensor array, and the optimum MTF efficiency make the 4110 the smart choice for dimensional measurement systems. The improved signal-to-noise ratio and broad dynamic range of true 8-bit precision, combined with the elimination of clamping, auto gain, post filtering, and auto black circuitry, make the Model 4110 the best choice for photometric purposes.

The Model 4110 uses a half-inch format, 739 x 484 sensor array. By using an image processing board with the same or greater processor memory, the Model 4110 will yield a higher system resolution than can be achieved with conventional analog cameras on similar systems.

Designed and manufactured in U.S.A., the rugged and highly reliable Model 4110 is backed by a two-year warranty.

APPLICATIONS

- **Measurement**
- **Image Processing**
- **Machine Vision**
  Pattern recognition
  Non-contact measurement
  Inspection
- **Microscopy**
- **Medical Imaging**
- **Robotics**
- **Laboratory Research**
- **Remote Sensing**

FEATURES AND BENEFITS

- **Highly Accurate Measurements** due to elimination of pixel jitter
- **Improved System Efficiencies** resulting from in-camera A/D conversion
- **Noise Reduction** resulting from advanced design features
- **Preservation of Near-Perfect Array Geometry** due to direct correspondence between sensor elements and processor memory
- **No Audible Noise** -- no array movement, no electromechanical components
- **Real Time, RS-170 Speed** at 14.31818 MHz clock
- **Maximized Resolution** due to improved MTF
- **Cost Effective** — priced well below cameras with similar capabilities.
- **1/2" Format CCD 739x484 Frame Transfer Array, Blemish-Free Sensor**
- **Simultaneous Analog Video Output**
- **Electronic Shutter** reduces blurring of fast-moving objects

Designed and Manufactured in the U.S.A.

COHU INC
ELECTRONICS DIVISION

MODEL 4110 DIGITAL OUTPUT MONOCHROME CCD CAMERA

ORDERING INFORMATION

411X — X X XX / XXXX

Power Options

0 ± 15v DC and +5v (w/o External Power Supply
5 115v AC (With External Power Supply)

Clock Options

1 14.31818 MHz Clock (Master)
2 10 MHz Clock (Master)
3 14.3 MHz (Slave)
4 10 MHz (Slave)
5 Externally Selectable 14.3 MHz Master/Slave

Filter Options

0 No I.R. Filter
1 With I.R. Cutoff Filter

Special Options

00 No Camera Cable
01 44-pin to 37-pin interface cable, 10 ft.*
02 44-pin to 25-pin interface cable, 10 ft*

* Special pinouts and cable lengths can be specified by customer.

Lens Options

0000 None

Manual Iris Lenses
AL04 4.5mm, f/2.0 (2/3")*
AL06 6.5mm, f/1.8 (2/3")*
AL08 8mm, f/1.4 (2/3")*
AL12 12.5mm, f/1.4 (1")
AL16 16mm, f/1.4 (2/3")
AL26 25mm, f/1.6 (2/3")
AL51 50mm, f/1.8 (2/3")
AL75 75mm, f/1.8 (1")

* Wide angle.

Please consult factory for other lens selections.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE

COMPATIBLE IMAGE PROCESSING BOARDS

Compatible image processing boards are available from the following manufacturers, listed in alphabetical order:

Coreco
Saint Laurent, Quebec
Phone: (800) 361-4914
From Canada: (514) 333-1301

Dipix
Ottawa, Ontario
Phone: (800) 724-5929
From Canada: (613) 596-4942

Epix, Inc.
Northbrook,IL
Phone: (708) 498-4002

Imaging Technology, Inc.
Woburn, MA
Phone: (800) 532-3500

Imagraph
Chelmsford, MA
Phone: (508) 256-4624

Matrox
Dorval, Quebec
Phone: (514) 685-2630

Perceptics Corporation
Knoxville, TN
Phone: (615) 966-9200

Recognition Concepts
Carson City, NV
Phone: (800) 243-8724

Tecon
Redmond, WA
Phone: (800) 232-5220

Univision Technologies, Inc.
Burlington, MA
Phone: (617) 221-6700

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90-81 (10-91)
October 1991

5755 Kearny Villa Road • San Diego, CA 92123
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COHU INC
ELECTRONICS DIVISION

IMPROVED PERFORMANCE!
Enhanced Signal-to-Noise Ratio (56 dB)
Greater Sensitivity (to 0.04 Lux)

CCIR SOLID-STATE MONOCHROME CCD CAMERA

MODEL 4710

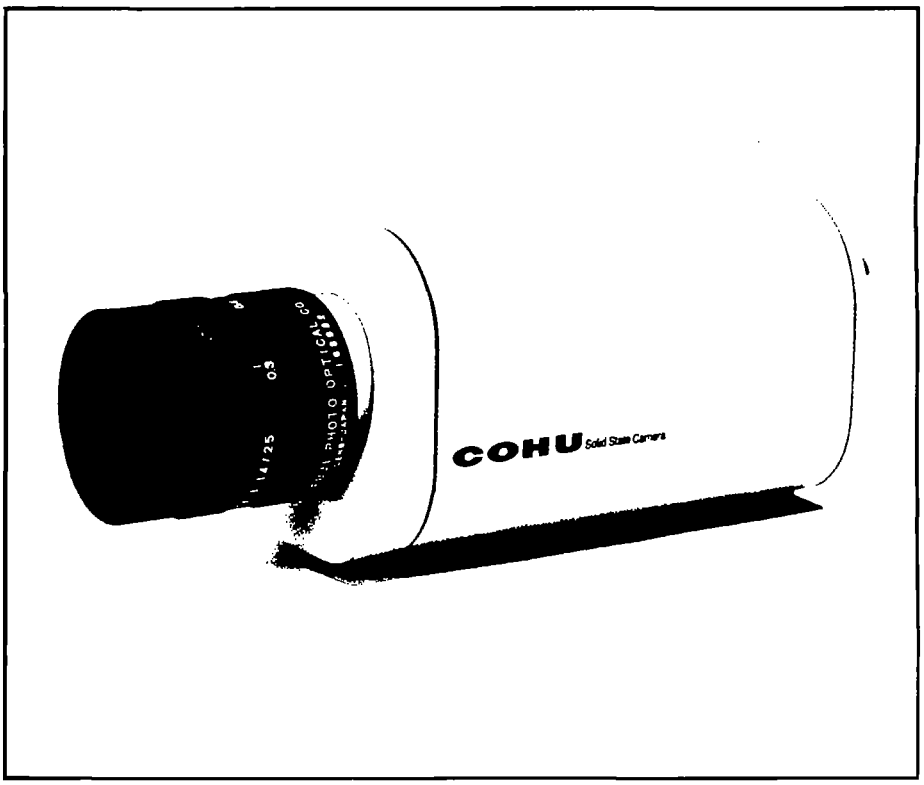
High Resolution, High Sensitivity and Low Noise

Cohu's Model 4710 solid-state cameras now offer even better performance for applications requiring low noise, high resolution and high sensitivity. Improved signal-to-noise characteristics result in a quieter picture, and better immunity to potentially harmful noise disturbances. The new Model 4710 also makes high resolution pictures attainable without geometric distortion, lag or image retention. The blemish-free imager provides pixel-to-pixel contrast variation of less than 5%.

Closely matching the sensitivity of standard silicon target imaging tubes, the Model 4710 CCD (Charge Coupled Device) image sensor uses the frame transfer method with over 400,000 picture elements and an active imaging area of 6.4mm by 4.8mm (1/2-inch format). Automatic Gain Control (AGC) adds further sensitivity for use under widely varying light conditions.

In addition to its superior performance, the new Model 4710 represents the ultimate in quality construction. Designed and manufactured in the U.S.A., these rugged CCD cameras have become the international standard for performance and reliability.

Available with a wide range of options, the Model 4710 is compact, lightweight and energy efficient. It is the ideal CCD camera for machine vision, image processing, robotics, process control, microscopy, and many other scientific and industrial applications.



Cohu Model 4710

FEATURES AND BENEFITS

- **High Resolution** for better definition of details, error-free results.
- **High Sensitivity** permits operation over a broad range of light levels.
- **Enhanced Signal-to-Noise Ratio** for clean, noise-free video.
- **Frame Transfer Imager** for minimized blooming characteristics.
- **No Lag or Image Retention** for fast, clean, precise images.
- **Zero Geometric Distortion** for consistent corner-to-corner linearity.
- **Low Power Consumption** for flexible system integration, energy savings, and minimal dissipation.
- **Adjustable C Mount** for maximum adaptability.
- **Quality, State-of-the-Art Design and Construction** for total, solid-state reliability and long life.
- **Wide Range of Options** for flexible system integration.
- **Auto Black** for maximum effective dynamic range.
- **AGC with Peak-Average Adjustment** for clear images in varying light level applications.
- **Blemish-Free Imager** for quality, blemish-free image.
- **IR Sensitive** for use in IR applications.

APPLICATIONS

- **Machine Vision**
  Pattern Recognition
  Non-Contact Measurement and Inspection
  Bar Code Reading
  Image Processing
- **Robotics**
  Automated Visual Control
- **EMI Environments**
  Subways
  High Voltage Areas
  Linear Accelerators
  NMR Units
- **Remote Piloted Vehicles**
  Land Based, Aircraft, Submersibles
- **Microscopy**
- **Medical Imaging**

Designed and manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

MODEL 4710 CCIR SOLID-STATE MONOCHROME CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Imager
Single CCD using frame transfer method
Image Area
6.4 x 4.8mm (corresponding to 1/2" tube)
Active Picture Elements
699(H) x 576(V)
Number of Picture Cells
732(H) x 290(V)
Cell Size
9.2 μm(H) x 16.8 μm(V)
Resolution
Horizontal 525 TV lines
Vertical > 415 TV lines
Sensitivity
See Table 1, below.
Contrast Variation @ 25°C
<5% overall
Scanning System
CCIR, 2:1 interlaced
Video Output
1.0 Vp-p 75 ohms unbalanced
Gamma
0.5 or 1.0 jumper selectable
AGC
6dB variable gain (peak-average adjustable)
Jumper-selectable — on/off
Auto Lens Drive
Peak-average adjustable (Separate auto lens video eliminates AGC/auto lens interaction)
Signal-to-Noise Ratio @ 25°C
56dB (gamma 1, gain 0 dB), unweighted, 8MHz bandwidth
Auto Black
Maintain set-up level at 7.5 + 5 IRE units if picture contains at least 10% black
Power Options
AC or DC 12V ± 10%
AC or DC 24V ± 5% (optional)
AC or 220/240V ± 10%, 50Hz with wall transformer
Power Consumption
4.2W
Grey Scale
Renders all shades of grey on EIA TV resolution chart, 1956

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -10° to 50°C (14° to 122°F)
Storage: -30° to 70°C (-22° to 157°F)
Humidity
Up to 95% relative humidity
Vibration
5 to 60Hz with 0.208cm/0.082 inches total excursion (15 g's @ 60Hz); from 60 to 1,000Hz, 5 g's rms random vibration without damage
Shock
30 g's in any axis under non-operating conditions per MIL-E-5400T, paragraph 3.2.24.6
Altitude
Sea level to equivalent of 3,048m/10,000 feet (508mm/20 inches of mercury)

MECHANICAL

Dimensions
See Figure 1.
Weight (less lens)
450 grams/15 ounces
Camera Mount
1/4-20 threaded holes
Lens Mount
"C" Mount
Lens
See Ordering Information.
Connectors
BNC Connector — Video out
Switchcraft TB4M — Lens Drive
Switchcraft TB3M — Power in
Hirose SR30-10R-6S (Auxiliary)

SENSITIVITY 2850K FACEPLATE ILLUMINATION

	With IR Filter	Without IR Filter
Usable with AGC	0.2 Lux (.02 fc)	0.04 Lux (.004 fc)
Full Video, Non-AGC	1.5 Lux (.15 fc)	0.25 Lux (.025 fc)
Full Video, AGC	0.7 Lux (.07 fc)	0.12 Lux (.012 fc)

Table 1

DIMENSIONS

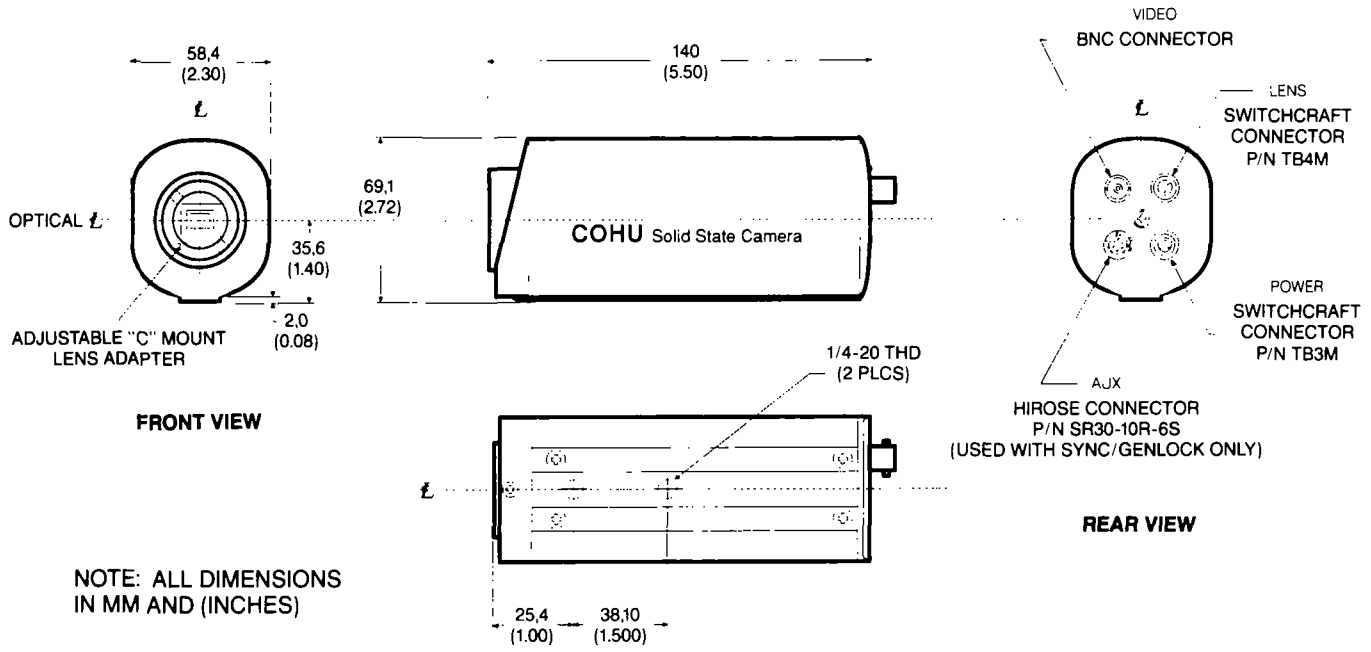
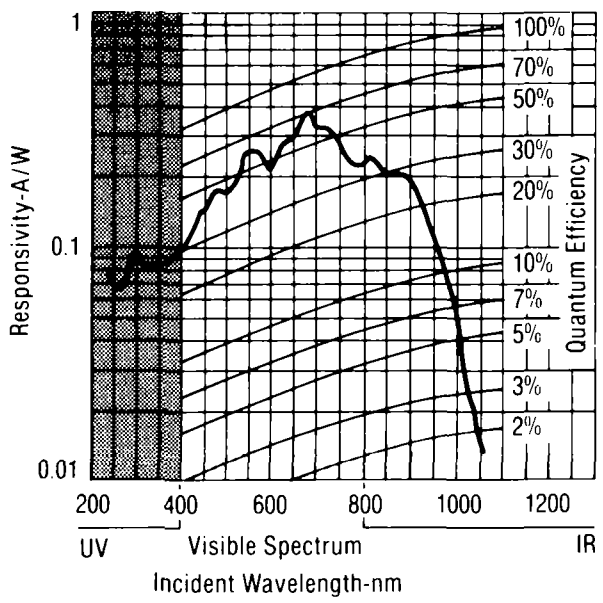


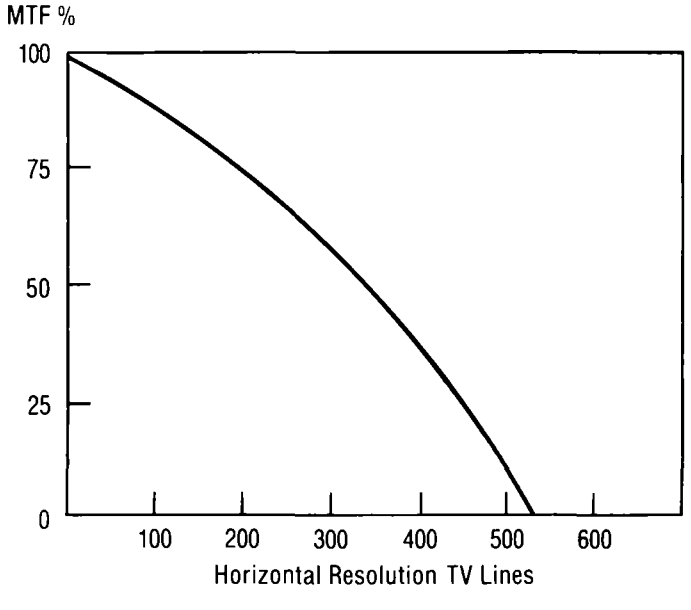
Figure 1

SPECTRAL RESPONSE



SHADED AREA INDICATES SPECTRAL RESPONSE WITH FACEPLATE REMOVED OR WITH A QUARTZ FACEPLATE INSTALLED. PLEASE CONSULT FACTORY FOR PRICES

MODULATION TRANSFER FUNCTION CURVE



MODEL 4710 CCIR SOLID-STATE MONOCHROME CCD CAMERA

ORDERING INFORMATION

471X — X XXX / XXXX

Power Options

2 12V ac 50 Hz or dc
3 220/240V ac, 50 Hz
4 24V ac 50 Hz or dc

Sync Options

2 Genlock, revert to crystal
3 Genlock, revert to linelock
5 CCIR Crystal
7 H & V Drive

Optical Filter

000 None
100 IR Filter

Lens Options

0000 None

Manual Iris Lenses
A014 12mm, f/1.2, 1/2"
AL04 4.5mm, f/2.0, 2/3"
AL06 6.5mm, f/1.8, 2/3"
AL08 8mm, f/1.4, 2/3"
AL09 9mm, f/1.3, 2/3"
AL16 16mm, f/1.4, 2/3"
AL26 25mm, f/1.6, 2/3"
AL51 50mm, f/1.8, 2/3"

Auto Iris Lenses
ES04 4.2mm, f/1.8, 1/2"
ES06 6mm, f/1.2, 1/2"
ES08 8mm, f/1.4, 2/3"
ES13 12mm, f/1.2, 1/2"
ES16 16mm, f/1.4, 2/3"
EH35 35mm, f/1.4, 2/3"

Please consult factory for other lens selections.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

OPTIONAL FEATURES

SYNC OPTIONS

The standard sync board contains a crystal-controlled oscillator to generate a 13.375 MHz reference frequency. A sync generator IC shapes the repetitive timing pulses used to control the movement of charge frames on the sensor board. This board also contains circuits to generate blanking, clamp, and sync pulses. These signals combine with the video signal on the video board to produce composite CCIR monochrome video.

The genlock board contains additional circuits to receive external input signals, including composite video, composite sync, and horizontal and vertical drive. These inputs are processed and supplied as reference signals to the genlock oscillator. In the absense of an externally applied signal, the camera is either crystal-locked or line locked, depending on the position of the crystal/line lock jumper. In the Line Lock Mode, the camera synchronizes to an external 50 Hz reference derived from the AC power line. In the CCIR Crystal Mode, the internal crystal-controlled oscillator provides back-up. The H and V Drive Input option allows the camera to synchronize to externally supplied horizontal- and vertical-drive signals.

POWER OPTIONS

The Model 4710 camera requires AC or DC 12V or 24V input power. For operation from a 220/240 VAC 50 Hz power source, an optional AC power pack is available.

OPTICAL FILTER

The Model 4710 is designed to be IR sensitive. For use in applications with undesirable IR conditions, the optional IR filter will cut off at 650nm.

LENS OPTIONS

In addition to the lenses listed above, Cohu provides a complete selection of lenses for specialized applications. Our applications engineers will help you determine the proper field-of-view, focal length, lens speed (f-stop), and size (image sensor format) for your application.

SPECIAL FEATURES

Cohu welcomes the opportunity to provide special features to better serve your particular application. Some examples of special features already provided include custom painting, silk screen and logo; remote head with 6' cable; imager faceplate removal for laser applications; imager tilt with customer-specified degree; and special connector pin configurations. Please contact Cohu for other special features.

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January 1991

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HIGHER SENSITIVITY-0.02 LUX!

CCIR SOLID-STATE CCD MONOCHROME CAMERA

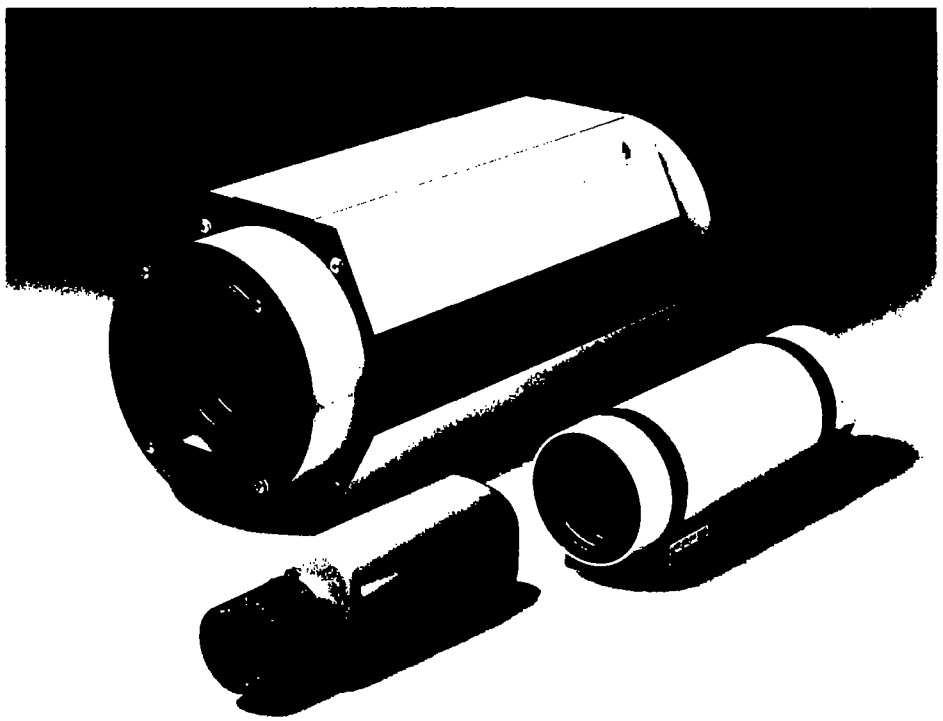
4720/4730/4760 SERIES

High Resolution
High Sensitivity

Cohu's solid-state cameras now offer even better performance for security/surveillance applications requiring high resolution and high sensitivity. Exceeding the sensitivity of standard silicon target imaging tubes, Cohu's CCD (Charge Coupled Device) image sensor uses the frame transfer method with over 400,000 picture elements and an active imaging area of 6.4mm by 4.8mm (1/2-inch format). Automatic Gain Control (AGC) adds further sensitivity for use under widely varying light conditions. In addition, high resolution pictures are attainable without geometric distortion, lag, or image retention.

Cohu's CCD cameras are available in three different housings. The 4720 Series comes in a low profile enclosure for general purpose, indoor applications. The 4730 and 4760 Series are for harsh environment applications. The 4730 is housed in a 3-inch barrel to minimize size and weight. The 4760 is housed in a 6-inch barrel to accommodate a 6:1 or 10:1 zoom lens. A UL Classified explosion-proof housing is also available as an option.

Cohu's CCD cameras represent the ultimate in quality construction. Designed and manufactured in the U.S.A., these rugged, energy-efficient cameras have become the international standard for performance and reliability. Available with a wide range of options, the 4720/4730/4760 Series is the logical choice for trouble-free security/surveillance applications.



Cohu CCIR Monochrome CCD Cameras

FEATURES AND BENEFITS

- **High Resolution** for better definition of details, error-free results.
- **High Sensitivity** permits operation over a broad range of light levels.
- **Enhanced Signal-to-Noise Ratio** for clean, noise-free video.
- **Frame Transfer Imager** for minimized blooming characteristics.
- **No Lag or Image Retention** for fast, clean, precise images.
- **Zero Geometric Distortion** for consistent corner-to-corner linearity.
- **Low Power Consumption** for flexible system integration, energy savings, and minimal dissipation.
- **Adjustable C Mount** for maximum adaptability.
- **Quality, State-of-the-Art Design and Construction** for total, solid-state reliability and long life.
- **Wide Range of Options** for flexible system integration.
- **Auto Black** for maximum effective dynamic range.
- **AGC with Peak-Average Adjustment** for clear images in varying light level applications.
- **Blemish-Free Imager** for quality, blemish-free image.
- **IR Sensitive** for use in IR applications.

OPTIONS

- **Line-Lock or Genlock**
- **Phase Adjustable Line-Lock**
- **External H & V Drive**
- **Clock Output** (13.375 MHz)
- **IR Filter**
- **Bright Light Limiter**
- **Source ID Generator**
- **Remote Control**
- **Heater**

Designed and Manufactured in U.S.A.

COHU INC
ELECTRONICS DIVISION

4720/4730/4760 CCIR SOLID-STATE CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Imager
Single CCD using frame transfer method
Image Area
6.4 x 4.8mm (corresponding to 1/2" tube)
Active Picture Elements
699(H) x 576(V)
Number of Picture Cells
732(H) x 290(V)
Cell Size
9.2 μm(H) x 16.8 μm(V)
Resolution
Horizontal 525 TV lines
Vertical > 415 TV lines
Sensitivity
See Table 1, back cover
Contrast Variation @ 25°C
<10% overall
Scanning System
CCIR, 2:1 interlaced
Video Output
1.0 Vp-p 75 ohms unbalanced
Gamma
0.5 or 1.0 jumper selectable
AGC
6dB variable gain (peak-average adjustable)
Jumper selectable — on/off
Auto Lens
Peak-average adjustable
(Separate auto lens video eliminates AGC/auto lens interaction)
Signal-to-Noise Ratio @ 25°C
52dB (gamma 1, gain 0dB), unweighted, 8MHz bandwidth
58dB (gamma 1, gain 0dB), weighted, CCIR
Auto Black
Maintain set-up level at 7.5 + 5 IRE units if picture contains at least 10% black
Power Requirements
AC or DC 12V ± 10%
AC or DC 24V ± 5% (optional)
AC 220/240V ± 10%, 50Hz with optional wall transformer
Power Consumption
4.2W

4720 SPECIFICATIONS

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -10° to 50°C (14° to 122°F)
Storage: -30° to 70°C (-22° to 157°F)
Humidity
Up to 95% relative humidity
Vibration
5 to 60Hz with 0.208cm/0.082 inches total excursion (15 g's @ 60Hz); from 60 to 1,000Hz, 5 g's rms random vibration without damage
Shock
30 g's in any axis under non-operating conditions per MIL-E-5400T, paragraph 3.2.24.6
Altitude
Sea level to equivalent of 3,048m/10,000 feet (508mm/20 inches of mercury)

MECHANICAL

Weight (less lens)
450 grams/15 ounces
Camera Mount
1/4 - 20 threaded holes
Lens Mount
"C" Mount, 16mm format
Type of Connector
BNC Connector — Video out
Switchcraft TB4M — Lens Drive
Switchcraft TB3M — Power in
Hirose SR30-10R-6S (Auxiliary)

4730 & 4760 SPECIFICATIONS

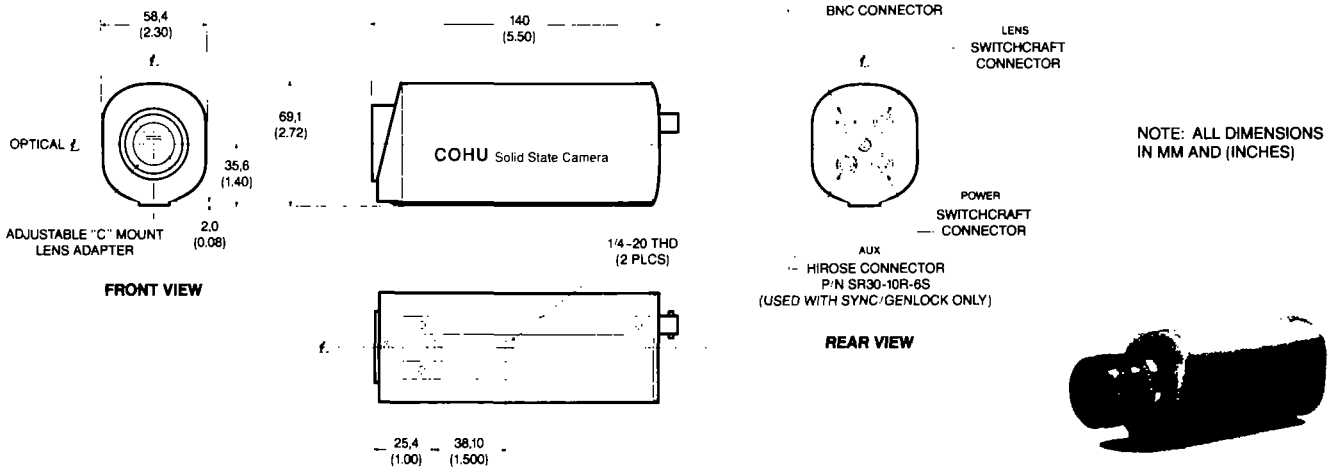
ENVIRONMENTAL

Ambient Temperature Limits
Operating: -10° to 60°C (14° to 140°F)
Storage: -30° to 70°C (-22° to 157°F)
With heaters ("L" Option): -40° to 60°C (-40° to 140°F)
Ambient Air Pressure
Sea level to equivalent of 3,048m/10,000 feet (508mm/20 inches of mercury)
Humidity
Up to 100% relative humidity MIL-E-5400T paragraph 3.2.24.4; equipped with standard Schrader tank valve (purge fitting) on camera housing to allow camera to be purged with dry nitrogen or other moisture eliminators, and to maintain housing interior at approximately 5 psi/.352 kg/cm^2
Vibration — 4730
5 to 60Hz with 0.051cm/0.020 inches total excursion (3.5 g's @ 60Hz)
60 to 1,000Hz, 3 g's rms random vibration without damage
Vibration — 4760
0.076cm/0.03 inches total excursion from 5 to 30Hz; peak random vibrations of 5 g's from 30 to 1,000Hz without damage or degradation
Shock
30 g's in any axis under non-operating conditions per MIL-E-5400T paragraph 3.2.24.6
Air Contaminants
Withstands exposure to sand, dust, fungus and salt atmosphere, per MIL-E-5400T paragraphs 3.2.24.7, 3.2.24.8, and 3.2.24.9
Explosion
MIL-E-5400T paragraph 3.2.24.10
Acoustic Noise
Operates in extremely high acoustic noise environment (150dB), e.g., close proximity to high-thrust rocket engine
Underwater Operation
Camera head operates to depth of 18.3m/60 feet with factory installed connector option available

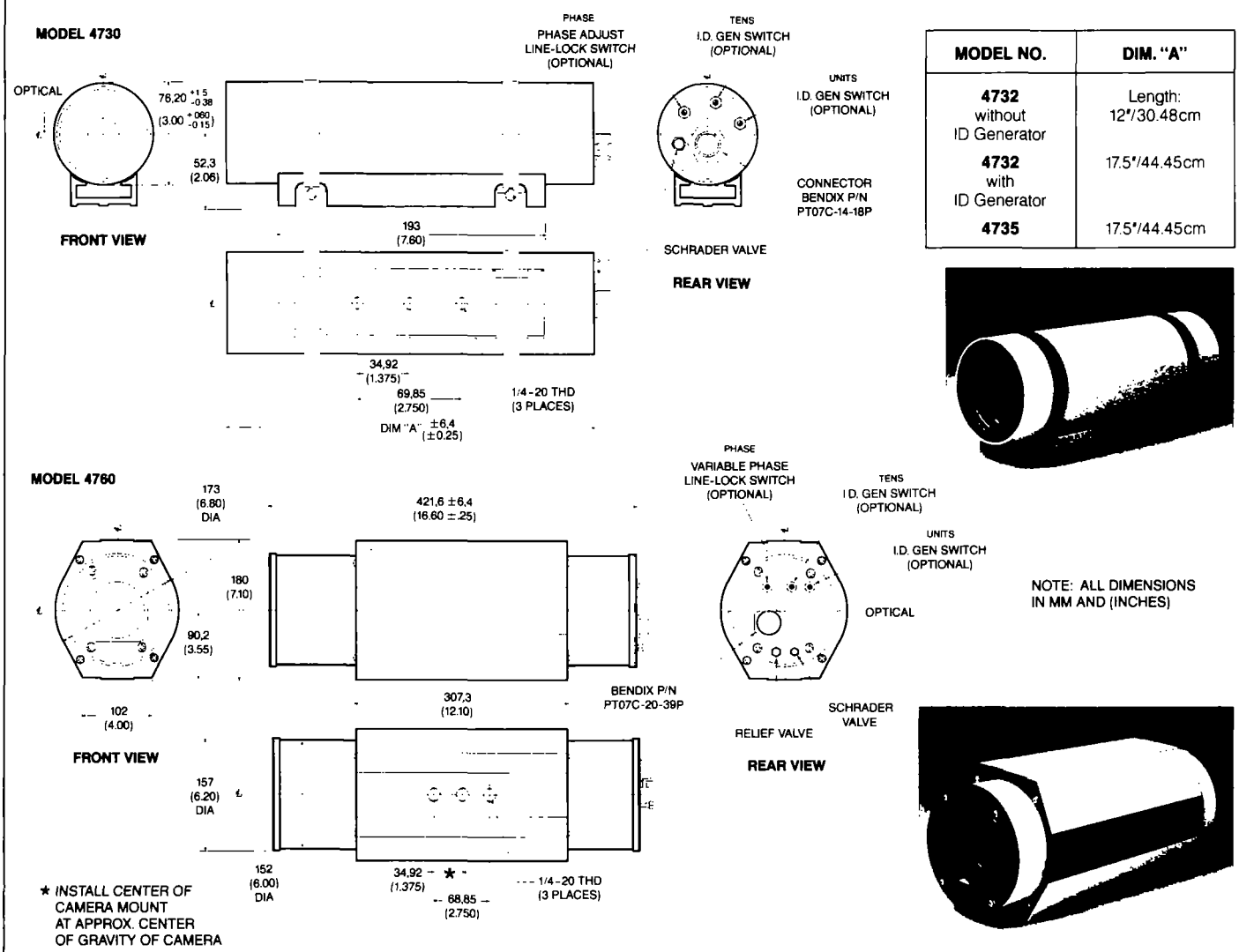
MECHANICAL

Weight (less lens)
4732 — 1.36 kg/3 lbs.
4735 — 1.81 kg/4 lbs.
4760 — 6.35 kg/14 lbs.
7.71 kg/17 lbs. (Z10D lens)
Type of Lens
A full range of C-mount fixed, auto-iris, and zoom lenses are available (see Ordering Information for Lens Options)
Rear Plate Connector
4730: Bendix PT07C-14-18P
4760: Bendix PT07C-20-39P
(Mating connector supplied; all functions, video, power, and remote controls through single connector)
Pressurized Fitting
Standard Schrader Valve
Purge/Relief Fitting
Pressure relief valve (4760 only)

4720 DIMENSIONS



4730 & 4760 DIMENSIONS



MODEL NO.	DIM. "A"
4732 without ID Generator	Length: 12"/30.48cm
4732 with ID Generator	17.5"/44.45cm
4735	17.5"/44.45cm

4720/4730/4760 CCIR SOLID-STATE CCD CAMERA

ORDERING INFORMATION

47X X - X X XX / XXXX X

Housing
- **0** None
- **2** General Purpose
- **3** Environmental Housing — 3"
- **6** Environmental Housing — 6"
- **7** UL Classified Explosion-Proof Housing CHX

Power Options
- **0** None
- **2** 12VAC or DC
- **3** 220/240V AC
- **4** 24VAC or DC

Sync Options
- **2** Genlock/XTAL
- **3** Genlock/LL
- ***4** Phase Adjust LL
- **5** CCIR Crystal
- **7** Ex H & V Drive

Optical Filter
- **0** None
- **1** IR Filter

Option Boards
- **00** None
- ***40** Bright Light Limiter
- ***50** Source I.D. Generator
- ***54** Source I.D. Generator & Bright Light Limiter

Lens Options

Manual Iris Lens (4720 Only)
- **0000** None
- **AL09** 9 mm, f/1.4
- **AL12** 12.5 mm, f/1.4
- **AL16** 16 mm, f/1.4
- **AL25** 25 mm, f/1.4
- **AL50** 50 mm, f/1.4
- **AL75** 75 mm, f/1.8

Auto Iris Lens
- **ES08** 8.5 mm, f/1.3
- **ES12** 12.5 mm, f/1.4
- **ES16** 16 mm, f/1.4
- **ES25** 25 mm, f/1.4
- **ES50** 50 mm, f/1.8
- **ES75** 75 mm, f/1.8

Zoom Lens (4760 only)
- **Z06D** 6:1, f/1.4
- **Z10D** 10:1, f/1.6

Other lens options are available

Options
- **L** Low Temperature Operation

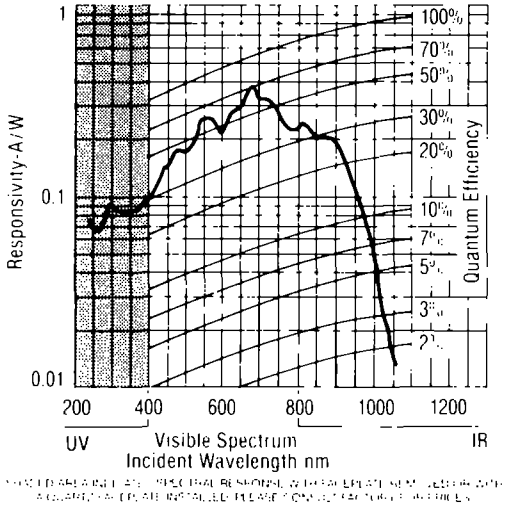
For Sunshields
- 4730 Series use SS-300
- 4760 Series use SS-522

For Remote Control
- Use 2380-090
- CA-246 (4730 Cable)
- CA-294 (4760 Cable)

***4730/4760 only**

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

SPECTRAL RESPONSE



MODULATION TRANSFER FUNCTION

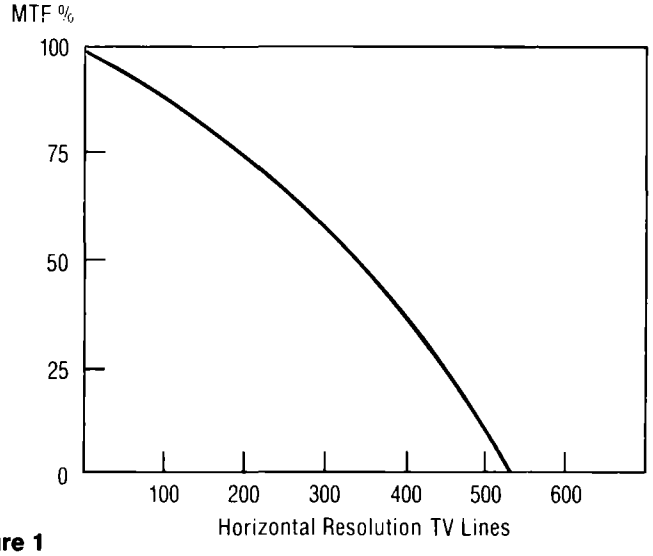


Figure 1

TYPICAL SENSITIVITY 2850K FACEPLATE ILLUMINATION

	With IR Filter	Without IR Filter
Usable with AGC	0.2 Lux (.02 fc)	0.02 Lux (.002 fc)
Full Video, Non-AGC	1.2 Lux (.12 fc)	0.10 Lux (.010 fc)
Full Video, AGC	0.6 Lux (.06 fc)	0.05 Lux (.005 fc)

Table 1

Printed in U.S.A.
87-10(1291)
October 1991

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P.O. Box 85623 • San Diego, CA 92186-5623
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COHU INC
ELECTRONICS DIVISION

NEW!

SOLID-STATE CCIR MONOCHROME CCD CAMERA

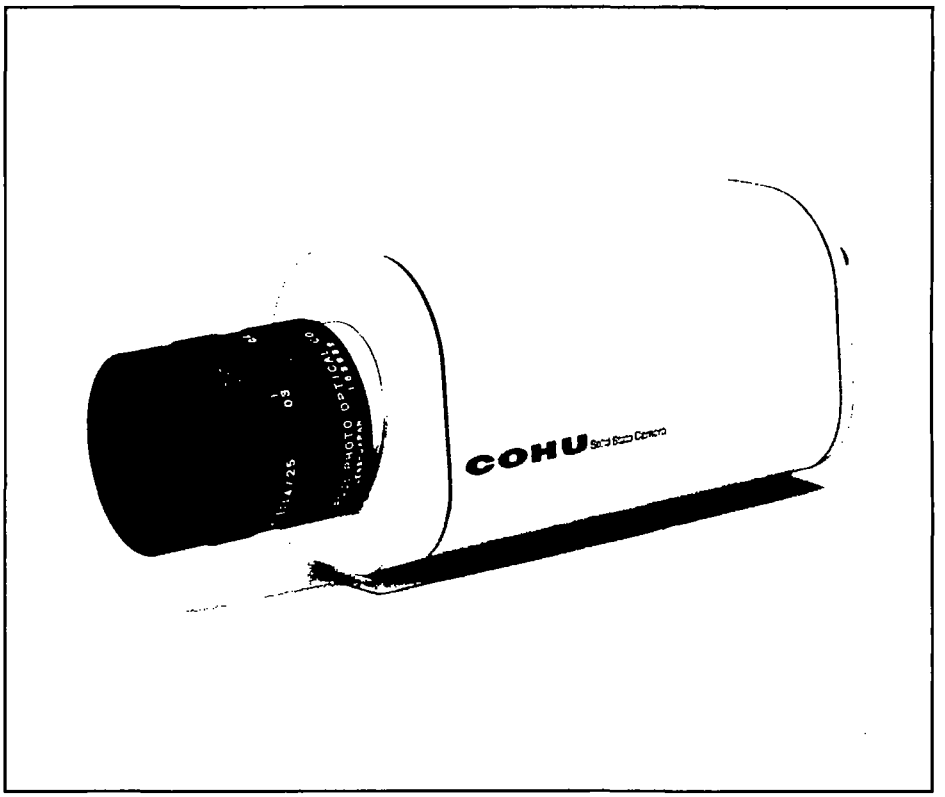
MODEL 4750

High Resolution
High Sensitivity

Cohu's Model 4750 solid state monochrome CCD cameras are cost effective general purpose cameras ideally suited for applications that require both high sensitivity and high resolution. High resolution pictures are attainable without geometric distortion, lag, or image retention. The 1/2" format CCD (charge coupled device) image sensor of the Model 4750 generates sensitivity that closely matches that of standard silicon target imaging tubes. These capabilities, along with its inherent rugged design and minimal maintenance, make this camera superior to many existing CCD or tube cameras.

Weighing just 450 grams, the Model 4750 is ideally suited for a broad range of security/surveillance applications. To provide high sensitivity in low-light areas, the Model 4750 features automatic gain control (AGC). The Model 4750 uses the frame transfer method and over 400,000 picture elements to generate a high-resolution image.

As with all Cohu CCD cameras, the Model 4750 is designed and manufactured in the U.S.A. A leading U.S. manufacturer of closed-circuit television cameras for over 40 years, Cohu is based in San Diego, California.



Cohu 4750 Series CCIR Monochrome CCD Camera

FEATURES AND BENEFITS

- **High Resolution** with 1/2-inch format sensor for sharper images
- **High Sensitivity** improves image in low light levels
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **Frame Transfer Imager** for minimized blooming characteristics
- **No Lag or Image Retention** for fast, clean, precise images
- **Wide Range of Options** for flexible system integration
- **AGC with Peak-Average Adjustment** for clear images in varying light conditions.
- **Low Power Consumption**
- **High Signal-to-Noise Ratio** provides better dynamic range
- **Auto Black** for contrast enhancement
- **Quality, State-of-the-Art Design and Construction** for total, solid-state reliability and long life
- **IR Sensitive** for use in IR applications.

APPLICATIONS

- **Perimeter Security**
- **General Surveillance**
- **Traffic Safety and Control**

Designed and manufactured in U.S.A.

COHU INC
ELECTRONICS DIVISION

MODEL 4750 CCIR MONOCHROME CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Pickup Area
6.4 x 4.8 mm (1/2-inch format)
Active Picture Elements
699(H) x 576(V) (frame transfer)
Number of Picture Cells
732(H) x 290(V)
Cell Size
9.2µm(H) x 16.8µm(V)
Resolution
Horizontal 525 TV lines
Vertical >415 TV lines
Sensitivity
2850 K faceplate illumination.
See Table 1.
Video Output
1.0 V p-p @75 ohms, unbalanced
Gamma
0.5 or 1.0 jumper selectable
AGC
6 dB variable gain, jumper selectable on/off, peak-average adjustable
Power Consumption
4.2W

Auto Black
Maintain set-up level at 7.5± 5 IRE units if picture contains at least 10% black
Signal-to-Noise Ratio
52 dB at gamma 1, 0 dB
8 MHz bandwidth, unweighted
58 dB at gamma 1, 0 dB
weighted, CCIR
Auto Lens Drive Signal
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction.
Synchronization
CCIR crystal, 13.375 MHz clock output (standard)
Genlock, external sync with crystal zero crossing line lock back-up (jumper selectable)
External H & V drive
Power Requirements
AC 230V ±10%, 50 Hz (optional, with wall transformer)
AC/DC 12V ±10%
AC/DC 24V ±5% (optional)

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –10 to 50 °C
(14° to 122° F)
Storage: –30 to 70 °C
(–22° to 157° F)
Humidity
Up to 95% relative humidity
Vibration (less lens)
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage
Shock (less lens)
Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6
Altitude
Sea level to equivalent of 3,048m/10,000 feet (508mm/20 inches of mercury)

MECHANICAL

Weight (less lens)
450 grams (15 ounces)
Dimensions
Please see Figure 1.
Camera Mount
1/4 - 20 threaded holes
Lens Mount
"C" mount, 16mm format
Connectors
BNC connector - Video Out
Switchcraft TB4M - Lens Drive
Switchcraft TB3M - Power In
Hirose SR30-10R-6S - Auxiliary

SENSITIVITY

	With IR Filter	Without IR Filter
Full Video, AGC Off	0.12 fc (1.2 lux)	0.010 fc (0.10 lux)
Full Video, AGC On	0.06 fc (0.6 lux)	0.005 fc (0.05 lux)
Usable Picture, AGC On	0.02 fc (0.2 lux)	0.002 fc (0.02 lux)

Table 1

DIMENSIONS

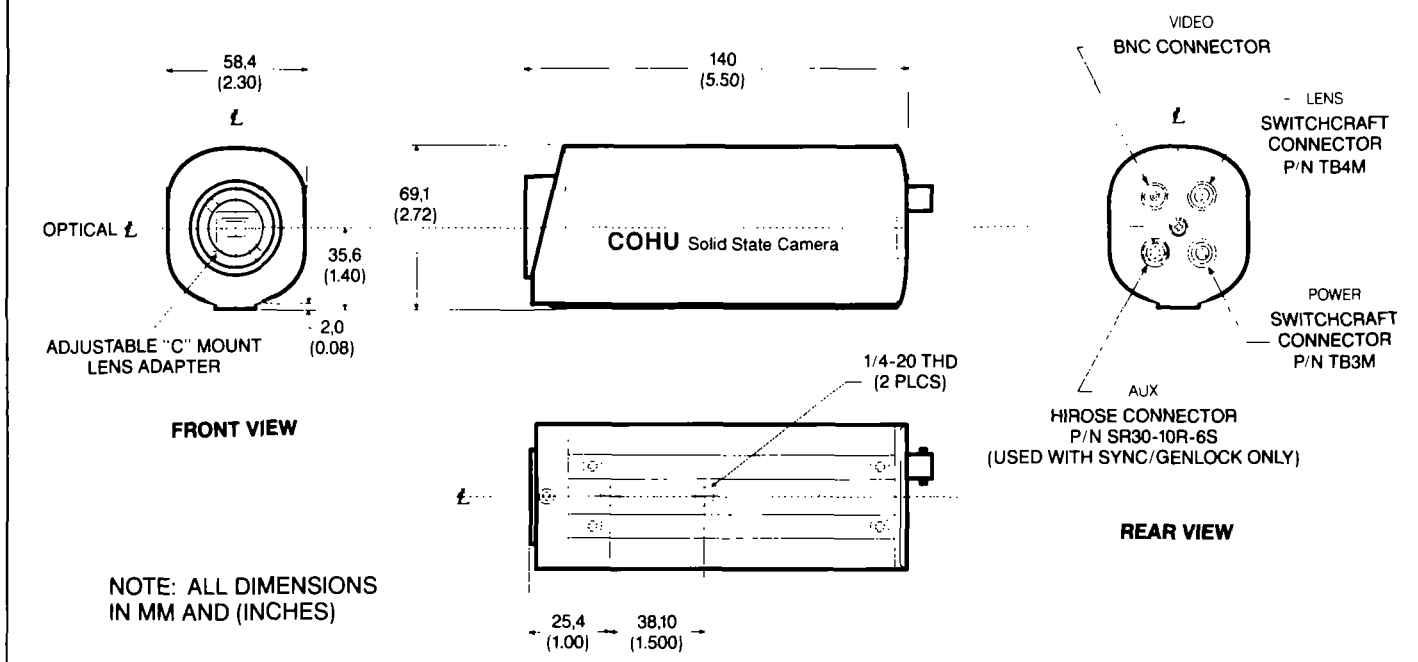
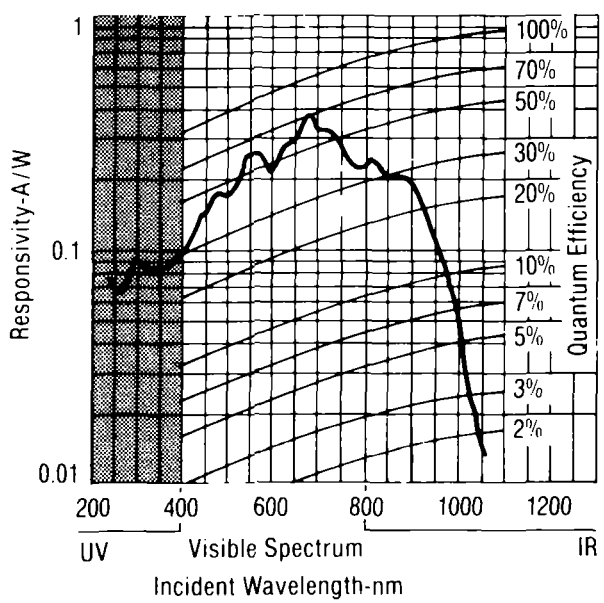


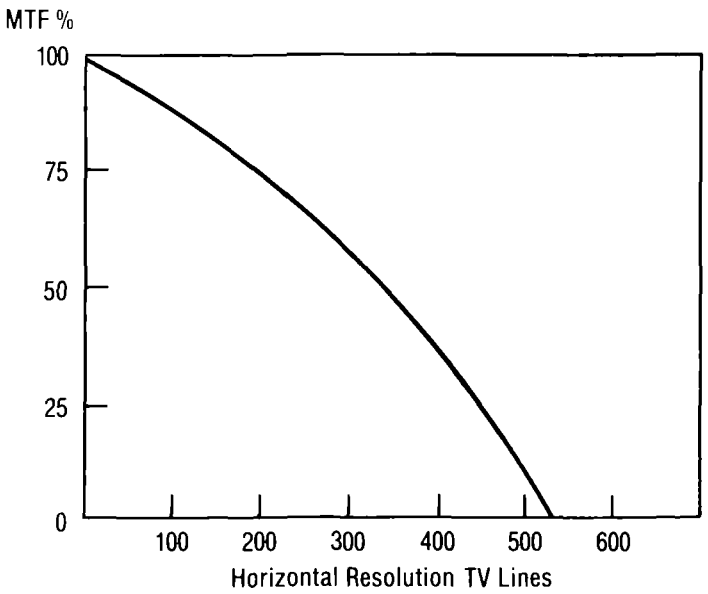
Figure 1

SPECTRAL RESPONSE



SHADED AREA INDICATES SPECTRAL RESPONSE WITH FACEPLATE REMOVED OR WITH A QUARTZ FACEPLATE INSTALLED. PLEASE CONSULT FACTORY FOR PRICES

MODULATION TRANSFER FUNCTION CURVE



MODEL 4750 CCIR MONOCHROME CCD CAMERA

ORDERING INFORMATION

475X	X	XXX	XXXX
Power Options	**Sync Options**	**Optical Filter**	**Lens Options**
2 12V AC/DC 50Hz	**2** Genlock (Revert to crystal)	**000** None	**0000** None
3 230V AC, 50 Hz	**3** Genlock (Revert to linelock)	**100** IR Filter	**Manual Iris Lenses**
4 24V AC/DC	**5** CCIR Crystal		**AL04** 4.5mm, f/2.0 (2/3")
	7 External H & V Drive		**AL06** 6.5mm, f/1.8 (2/3")
			AL08 8mm, f/1.4 (2/3")
			AL09 9mm, f/1.3 (2/3")
			AL16 16mm, f/1.4 (2/3")
			AL26 25mm, f/1.6 (2/3")
			AL51 50mm, f/2.8 (2/3")
			AL75 75mm, f/1.8 (1")
			Auto Iris Lenses
			ES05 4.8mm, f/1.8 (2/3")
			ES06 6mm, f/1.2 (1/2")
			ES08 8mm, f/1.4 (2/3")
			ES13 12 mm, f/1.2 (1/2")
			ES16 16mm, f/1.4 (2/3")
			ES28 28mm, f/1.2 (1/2")
			ES35 35mm, f/1.4 (2/3")
			Please consult factory for other lens selections.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

OPTIONAL FEATURES

SYNC OPTIONS

The genlock board contains circuits to receive external input signals, including composite video, composite sync, and horizontal and vertical drive. These inputs are processed and supplied as reference signals to the genlock oscillator. In the absence of an externally applied signal, the camera is either crystal-locked or line locked, depending on the position of the crystal/linelock jumper. In the Linelock Mode, the camera synchronizes to an external 50 Hz reference derived from the AC power line. In the CCIR Crystal Mode, the internal crystal-controlled oscillator provides back-up. The H & V Drive Input Option allows the camera to synchronize to externally supplied horizontal- and vertical-drive signals.

IR FILTER

The 4750 Series is designed to be IR sensitive. For use in applications with undesirable IR conditions, the optional IR filter will cut off at 650 nm.

Printed in U.S.A.
91-01 (2/91)
February 1991

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COHU INC
ELECTRONICS DIVISION

ADVANCED VIDEO TECHNOLOGY
Made in the U.S.A.

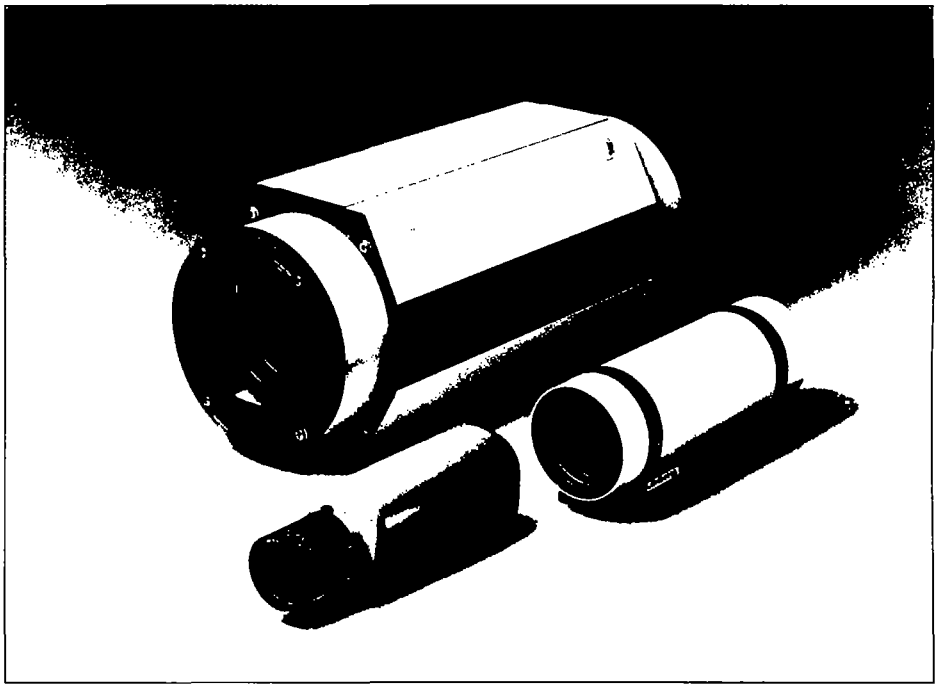
RS-170 MONOCHROME FRAME TRANSFER CCD CAMERAS

4800 SERIES

High Resolution
High Sensitivity

Cohu's 4800 Series RS-170 Monochrome Frame Transfer CCD cameras are ideal for applications that require both high resolution and high sensitivity. Currently installed in thousands of sites around the world, they support a wide range of security/surveillance and electronic imaging applications.

4800 Series CCD cameras are available in three different housings. The 4810 Series housing is designed for non-environmental security/surveillance, image processing, and other scientific or industrial applications. The 4830 Series and 4860 Series Environmental CCD Cameras are designed for harsh environment applications. They consist of a 4810 Series camera and lens installed in either a three-inch-diameter or six-inch-diameter sealed and pressurized environment-resistant housing. The six-inch housing will accommodate virtually any size zoom lens. An explosion-proof housing is also available as an option.



Cohu 4800 Series Frame Transfer CCD Cameras

4800 Series cameras provide high resolution pictures without geometric distortion, lag, or image retention. They provide sensitivity comparable to that of standard silicon target image tube cameras, and very low contrast variation. These capabilities, along with their reliable, rugged design and low maintenance, make 4800 Series cameras the ideal solution for high performance video requirements.

4800 Series cameras are designed and manufactured in U.S.A., and are backed by a full two-year warranty.

Cohu is uniquely positioned to respond quickly to special engineering requests for custom or modified products. We also offer complete system engineering services.

A leading U.S. manufacturer of video cameras and systems for over 40 years, Cohu is based in San Diego, California.

FEATURES AND BENEFITS

- **Sealed, Pressurized Environmental Models** withstand exposure to extreme temperatures, sand, dust, fungus, and salt atmosphere.
- **High Resolution** with ⅔-inch format frame transfer image sensor for sharper images
- **High Sensitivity** improves image in low light levels.
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **No Lag or Image Retention** for fast, clean, precise images
- **Wide Range of Options** for flexible system integration
- **Two-Year Warranty**
- **AGC with Peak-Average Adjustment** for clear images in varying light conditions.
- **High Signal-to-Noise Ratio** provides better dynamic range.
- **Auto Black** for contrast enhancement
- **Quality, State-of-the-Art Design and Construction** for total, solid-state reliability and long life
- **IR Sensitive** for use in IR applications
- **Over 367,000 Picture Elements**
- **Made in U.S.A.** — direct factory support, parts availability
- **Adjustable "C" Mount** for maximum lens adaptability

APPLICATIONS

- **Security/Surveillance**
  Perimeter Security
  Government and Military Facilities
  Unmanned Storage Facilities
  Nuclear Power Plants
  Hazardous Waste Management
  Correctional Facilities
- **EMI Environments**
  Subways
  High Voltage Areas
  Linear Accelerators
  NMR Units
- **Transportation Management**
  Traffic Safety and Control
  Bridges and Tunnels
  Mass Transit
  Airports and Train Stations
  Fare Collection Points
- **Image Processing**

4800 SERIES MONOCHROME CCD CAMERAS

SPECIFICATIONS

ELECTRICAL

Imager
Single CCD using frame transfer method
Pickup Area
8.8 x 6.6 mm (⅔-inch format)
Active Picture Elements
754(H) x 244(V) (frame transfer)
Cell Size
11.5µm(H) x 27µm(V)
Resolution
Horizontal 565 TV lines
Vertical >350 TV lines
Sensitivity
2850 K faceplate illumination.
See Table 1 on back page.
Contrast Variation @25°C
<5% overall
Video Output
1.0 V p-p @75 ohms, unbalanced
Gamma
0.5 or 1.0 jumper selectable
Gray Scale
Renders all shades of gray on EIA TV resolution chart, 1956
AGC
6 dB variable gain (peak-average adjustable)
Jumper selectable, On/Off.
Auto Black
Maintain set-up level at 7.5± 5 IRE units if picture contains at least 10% black
Signal-to-Noise Ratio @25°C
50 dB at gamma 1, 0 dB gain
8 MHz bandwidth, unweighted
55 dB at gamma 1, 0 dB gain, weighted
Auto Lens Drive Signal
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction.
Synchronization
EIA RS-170 crystal, 14.31818 clock output (standard)
Genlock, external sync with crystal or line lock back-up (jumper selectable)
Phase adjustable line lock (4830/4860 Series only)
External H & V drive
Power Requirements
AC/DC 12V ±10%
AC/DC 24V ±5%
AC 115/230V ±10%, 50/60 Hz with wall transformer for 4810
Power Consumption
4.2W
4830 Heater: 35W
4860 Heater: 50W

4810 SPECIFICATIONS

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –10 to 50 °C
(14° to 122° F)
Storage: –30 to 70 °C
(–22° to 157° F)
Humidity
Up to 95% relative humidity
Vibration (less lens)
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage
Shock (less lens)
Up to 30 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6
Altitude
Sea level to equivalent of 3,000m/10,000 feet (500mm/20 inches of mercury

MECHANICAL

Weight (less lens)
450 grams (15 ounces)
Dimensions
Please see dimensional drawings
Camera Mount
¼ - 20 threaded holes
Lens Mount
"C" mount, 16mm format
Connectors
BNC connector - Video Out
Switchcraft TB4M - Lens Drive
Switchcraft TB3M - Power In
Hirose SR30-10R-6S - Auxiliary

4830 & 4860 SPECIFICATIONS

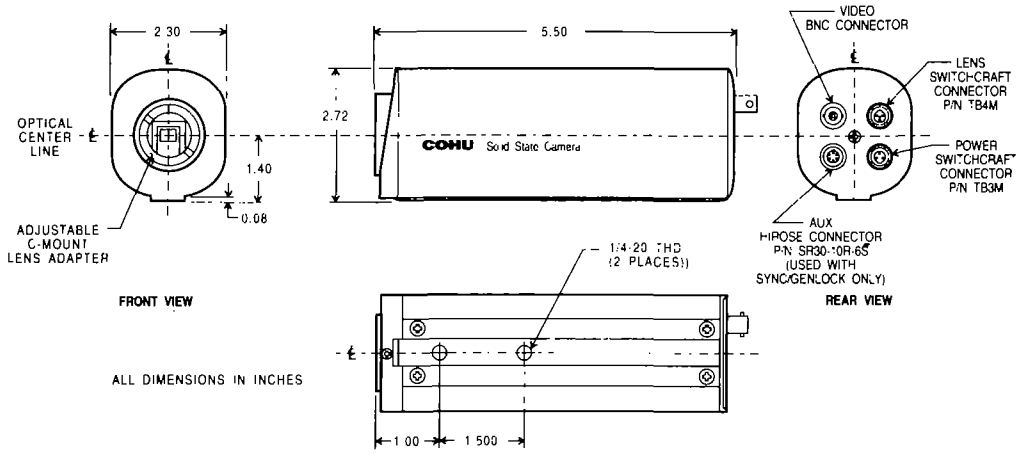
ENVIRONMENTAL

Ambient Temperature Limits
Operating:
–10 to 60°C (14 to 140°F)
–40 to 60°C (–40 to 140° F)
with optional heater
Storage:
–30 to 70°C (–22 to 157°F)
Ambient Air Pressure
Two atmospheres (sea level) to equivalent of 100,000 feet (3,000 meters), exceeding MIL-E-5400T paragraph 3.2.24.2, Class 3
Humidity
Up to 100% relative humidity, MIL-E-5400T paragraph 3.2.24.4. Equipped with standard Schrader tank valve (purge fitting) on camera housing to allow camera to be purged with dry nitrogen or other moisture eliminators, and to maintain housing interior at approximately 5 psi.
Vibration — 4830
50 to 60 Hz with 0.020 inches total excursion (3.5 g's @ 60 Hz). From 60 to 1,000 Hz, 3 g's rms random vibration without damage
Vibration — 4860
0.03 inches total excursion from 5 to 30 Hz; peak random vibrations of 5 g's from 30 to 1,000 Hz without damage or degradation
Shock
30 g's in any axis under non-operating conditions per MIL-E-5400T paragraph 3.2.24.6.
Air Contaminants
Withstands exposure to sand, dust, fungus, and salt atmosphere, per MIL-E-5400T, paragraph 3.2.24.7, 3.2.24.8, and 3.2.24.9
Explosion
MIL-E-5400T, paragraph 3.2.24.10
Acoustic Noise
Operates in extremely high acoustic noise environment (150 dB), e.g., close proximity to high thrust rocket engine
Underwater Operation
Camera operates to 60 feet in depth (18 meters) with factory installed connector option

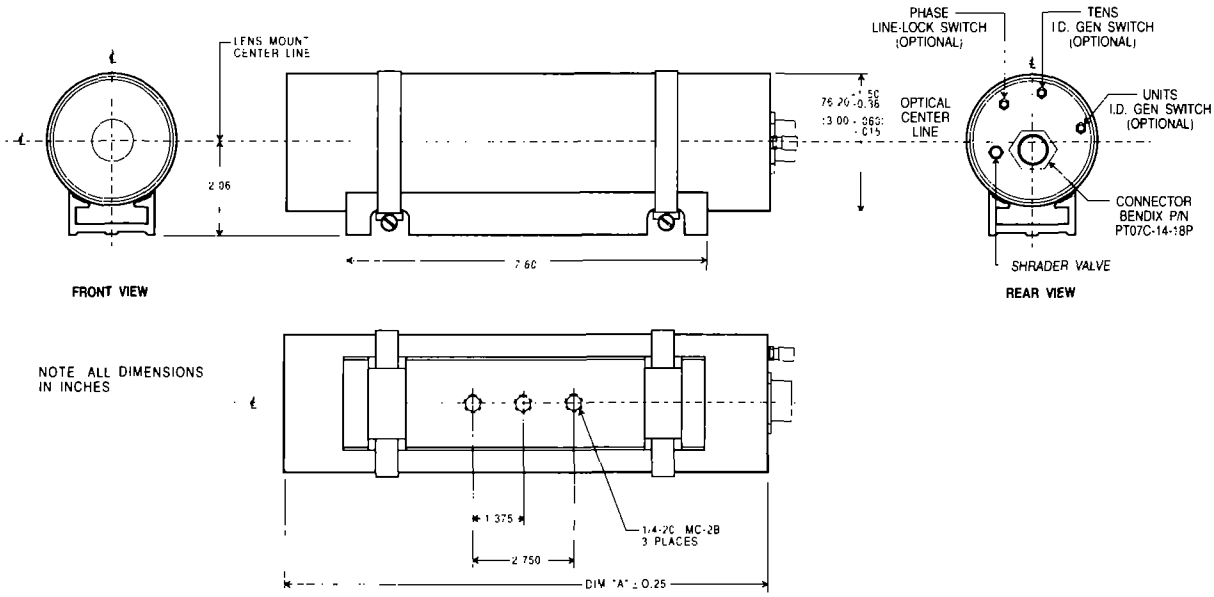
MECHANICAL

Weight (less lens)
4832 — 3 lbs.
4835 — 4 lbs
4860 — 14 lbs.
Type of Lens
A full range of C-mount fixed, auto-iris, and zoom lenses is available.
Purge/Relief Fitting
Pressure relief valve (4860 only)
Pressurized Fitting
Standard Schrader Valve
Rear Plate Connectors
4830 — Bendix PT07C-14-18P
4860 — Bendix PT07C-20-39P
(Mating Connector Supplied. All functions controlled through single connector.)

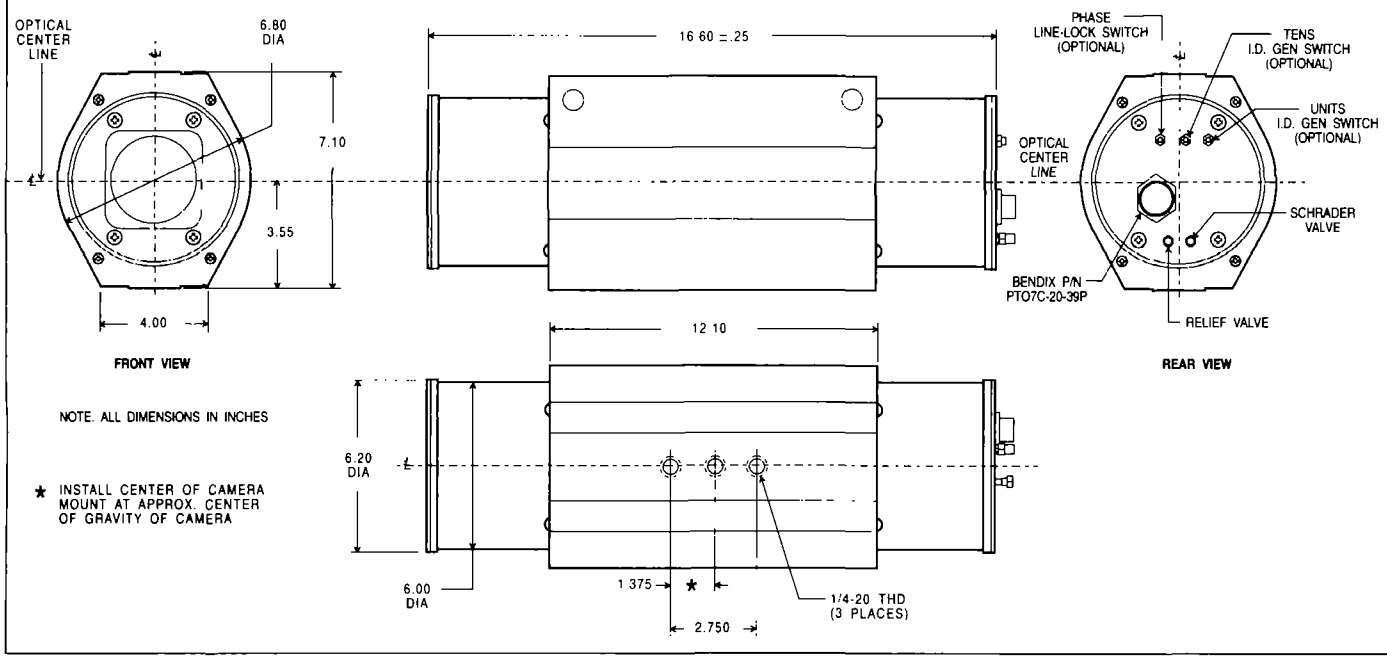
4810 SERIES DIMENSIONS



4830 SERIES DIMENSIONS



4860 SERIES DIMENSIONS



4800 SERIES MONOCHROME CCD CAMERAS

ORDERING INFORMATION

48X X — X X XX / XXXX X

Housing Options

1 General Purpose
3 3" Environmental
6 6" Environmental

Power Options

2 12V ac/dc
4 24V ac/dc
5 115V ac, 60 Hz (4810 Series supplied with ac wall adapter)

Sync Options

2 Genlock (Revert to crystal)
3 Genlock (Revert to linelock)
4 Phase Adjustable Line Lock (4830 and 4860 ac models only)
5 RS-170 Crystal
7 External H & V Drive

Optical Filter

000 None
100 IR Filter

Option Boards

00 None
***40** Bright Light Limiter
***50** Source I.D. Generator
***54** *Source* I.D. Generator and Bright Light Limiter

*** 4830/4860 only**

Lens Options

0000 None
Manual Iris Lens (4810 Series Only)
AL09 9mm, f/1.4, 2/3"
AL12 12mm, f/1.4, 1"
AL16 16mm, f/1.4, 2/3"
AL25 25mm, f/1.4, 1"
AL50 50mm, f/1.8, 1"
AL75 75mm, f/1.8, 1"

Auto Iris Lens
ES05 4.8mm, f/1.8, 2/3"
ES08 8mm, f/1.4, 2/3"
ES12 12.5mm, f/1.4, 1"
ES16 16mm, f/1.4, 2/3"
ES25 25mm, f/1.4, 1"
EH35 35mm, f/1.4, 2/3"
ES50 50mm, f/1.8, 1"
EH75 75mm, f/1.8, 1"

****Zoom Lenses (4860 Series Only)**
Z06J 6:1, 11.5--10mm, f/1.4, 2/3"
P06J 6:1 with presets, f/1.4, 2/3"
Z10H 10:1, 10--100mm, f/1.4, 2/3"
P10J 10:1 with presets, f/1.4, 2/3"

** Available on 24V ac models only as an "ER". Please consult factory for other lens selections.

Other Options

L Low Temperature Operation
For Sunshields
4830, use SS-300
4860, use SS-522
For Remote Control
Use 2380-090
CA-246 (4830 cable)
CA-294 (4860 cable)

All models UL listed except 4835 and 4865

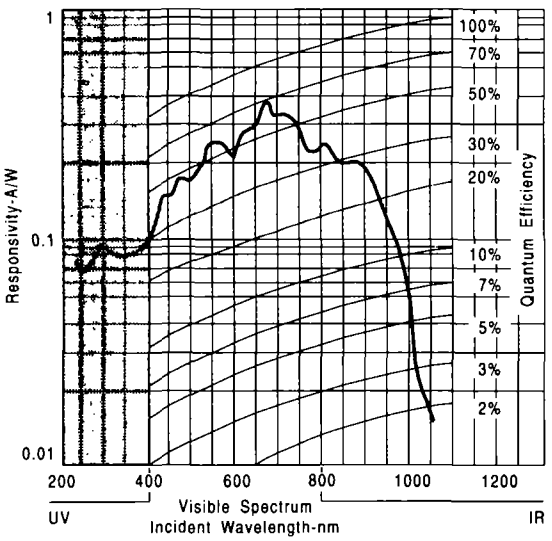
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SENSITIVITY

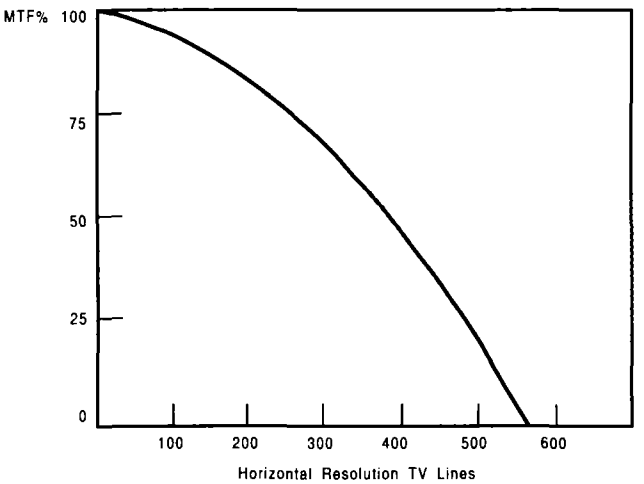
	With IR Filter	Without IR Filter
Full Video, AGC Off	0.2 fc (2 lux)	0.02 fc (0.2 lux)
80% Video, AGC On	0.07 fc (0.7 lux)	0.007 fc (0.07 lux)
30% Video, AGC On	0.02 fc (0.2 lux)	0.002 fc (0.02 lux)

Table 1

SPECTRAL RESPONSE



MODULATION TRANSFER FUNCTION



Printed in U.S.A.
91-4 (3/92) March 1992

Cohu, Inc., Electronics Division
5755 Kearny Villa Road • San Diego, CA 92123
Phone: (619)277-6700 • FAX: (619)277-6700 • TWX: 910-335-1244

COHU INC
ELECTRONICS DIVISION

TWO-YEAR WARRANTY!

SOLID-STATE CCD MONOCHROME CAMERA

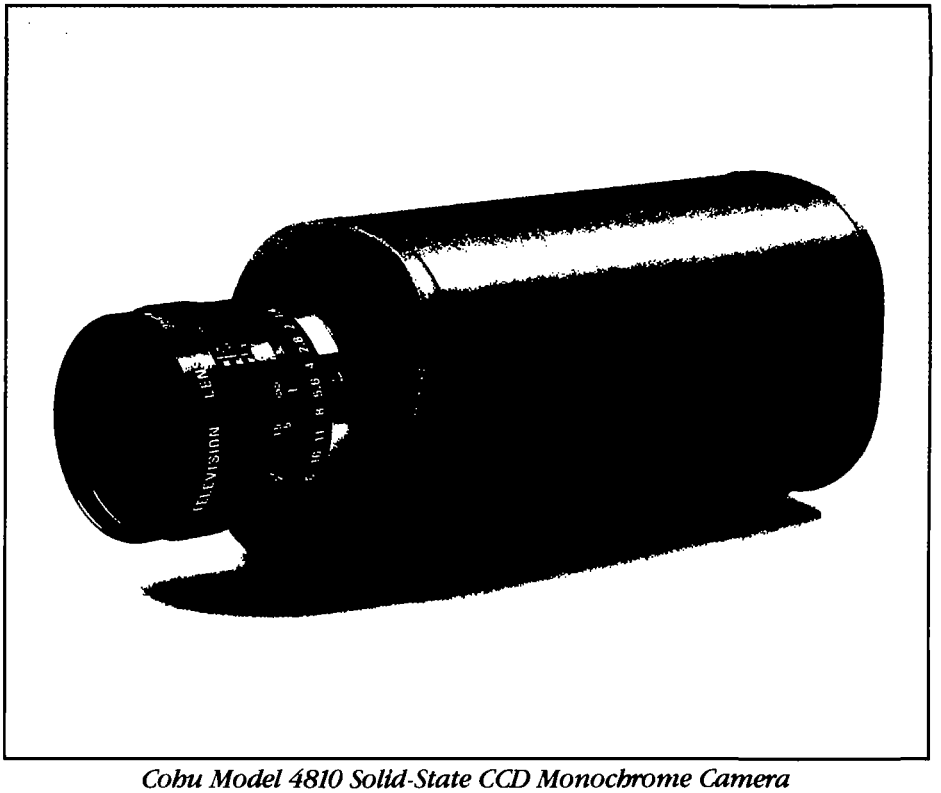
MODEL 4810

High Resolution and High Sensitivity

The Model 4810 solid-state cameras are ideal for applications that require both high resolution and high sensitivity. High resolution pictures are attainable without geometric distortion, lag or image retention. The 2/3-inch format CCD (Charge Coupled Device) image sensor of the Model 4810 generates sensitivity that closely matches standard silicon target imaging tubes. These capabilities, along with its inherent rugged design and minimal maintenance, make Cohu's Model 4810 superior to existing CCD or tube cameras.

Weighing just 15.5 ounces, the Model 4810 is suited for numerous applications including machine vision, image processing, robotics, process control and microscopy.

Automatic gain control (AGC) is incorporated in Cohu's Model 4810 to provide high sensitivity for use in low-light areas. The 4810 utilizes the frame transfer method and over 365,000 picture elements to generate a high resolution image with a contrast variation of <5%. Low power consumption allows flexible system integration and easy operation.



Cohu Model 4810 Solid-State CCD Monochrome Camera

OPTIONS

- **Synchronization**
  Genlock/Crystal
  Genlock/Line Lock
  Phase Adjust Line Lock
  RS-170 Crystal
  External H & V Drive
- **IR Filter**

FEATURES

- **High Resolution**
  754(H) x 488 (V) Picture Elements
- **High Sensitivity**
  (to .007fc/.07 Lux)
- **Auto Black for Wide Dynamic Range or Manual Adjustable**
- **AGC with Peak-Average Adjustment or Fixed Gain with Manual Adjustment**
- **Zero Geometric Distortion**
- **Selectable Gamma**
- **No Lag or Image Retention**
- **Low Power Consumption**
- **Blemish-Free Sensor**
- **Over 365,000 Picture Elements**
- **Adjustable C Mount**

APPLICATIONS

- **Machine Vision**
  Pattern Recognition
  Non-Contact Measurement and Inspection
  Bar Code Reading
  Image Processing
- **Robotics**
  Automated Visual Control
- **EMI Environments**
  Subways
  High Voltage Areas
  Linear Accelerators
  NMR Units
- **Remote Piloted Vehicles**
  Land Based, Aircraft, Submersibles
- **Microscopy**
- **Medical Imaging**
- **Security/Surveillance**

Designed and manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

4810 SERIES MONOCHROME CCD CAMERAS

SPECIFICATIONS

ELECTRICAL

Imager
Single CCD using frame transfer method

Pickup Area
8.8 x 6.6 mm (2/3-inch format)

Active Picture Elements
754(H) x 488(V) (frame transfer)

Cell Size
11.5µm(H) x 27µm(V)

Resolution
Horizontal 565 TV lines
Vertical >350 TV lines

Sensitivity
2850 K faceplate illumination.
See Table 1 below.

Contrast Variation @25°C
<5% overall

Video Output
1.0 V p-p @75 ohms, unbalanced

Gamma
0.5 or 1.0 jumper selectable

Gray Scale
Renders all shades of gray on EIA TV resolution chart, 1956

AGC
6 dB variable gain (peak-average adjustable)
Jumper selectable, On/Off.

Auto Black
Maintain set-up level at 7.5± 5 IRE units if picture contains at least 10% black

Signal-to-Noise Ratio @25°C
50 dB at gamma 1, 0 dB gain 8 MHz bandwidth, unweighted
55 dB at gamma 1, 0 dB gain, weighted

Auto Lens Drive Signal
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction.

Synchronization
EIA RS-170 crystal, 14.31818 clock output (standard)
Genlock, external sync with crystal or line lock back-up (jumper selectable)
External H & V drive

Power Requirements
AC/DC 12V ±10%
AC/DC 24V ±5%
AC 115/230V ±10%, 50/60 Hz with wall transformer

Power Consumption
4.2W

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –10 to 50 °C (14° to 122° F)
Storage: –30 to 70 °C (–22° to 157° F)

Humidity
Up to 95% relative humidity

Vibration (less lens)
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage

Shock (less lens)
Up to 30 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

Altitude
Sea level to equivalent of 3,000m/10,000 feet (500mm/20 inches of mercury

MECHANICAL

Weight (less lens)
450 grams (15 ounces)

Dimensions
Please see dimensional drawings

Camera Mount
1/4 - 20 threaded holes

Lens Mount
"C" mount, 16mm format

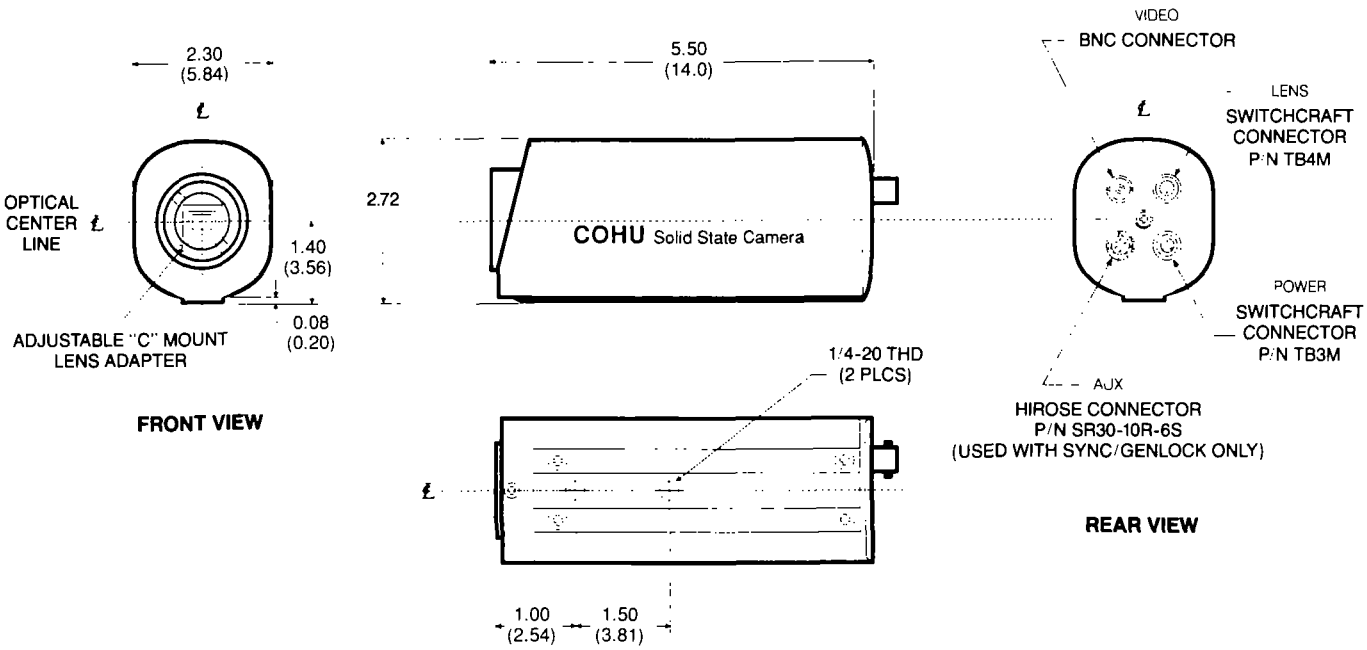
Connectors
BNC connector - Video Out
Switchcraft TB4M - Lens Drive
Switchcraft TB3M - Power In
Hirose SR30-10R-6S - Auxiliary

SENSITIVITY

	With IR Filter	Without IR Filter
Full Video, AGC Off	0.2 fc (2 lux)	0.02 fc (0.2 lux)
80% Video, AGC On	0.07 fc (0.7 lux)	0.007 fc (0.07 lux)
30% Video, AGC On	0.02 fc (0.2 lux)	0.002 fc (0.02 lux)

Table 1

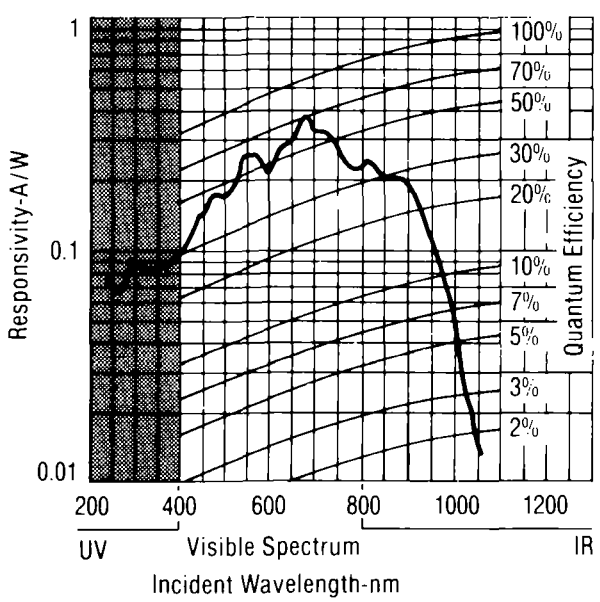
DIMENSIONS



NOTE: ALL DIMENSIONS IN INCHES AND (CM).

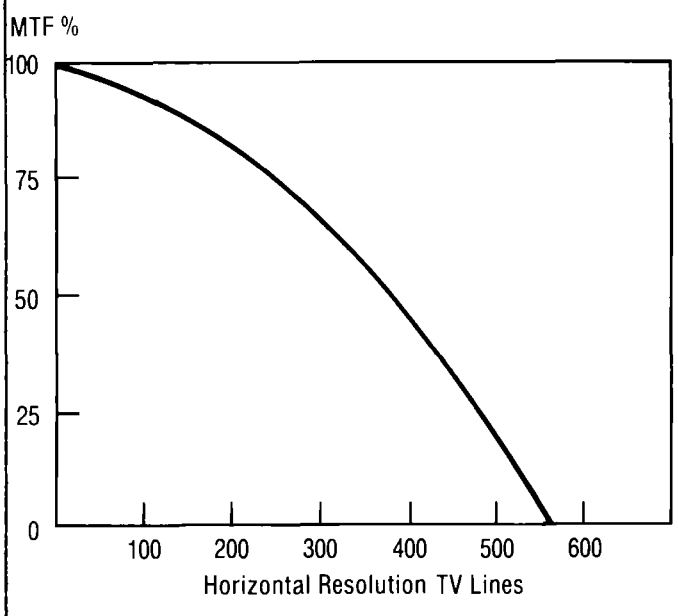
Figure 1

SPECTRAL RESPONSE



SHADED AREA INDICATES SPECTRAL RESPONSE WITH FACEPLATE REMOVED OR WITH A QUARTZ FACEPLATE INSTALLED. PLEASE CONSULT FACTORY FOR PRICES.

MODULATION TRANSFER FUNCTION



MODEL 4810 SOLID-STATE MONOCHROME CCD CAMERA

ORDERING INFORMATION

481X — X XXX / XXXX

Power Options

- **2** 12V ac/dc
- **4** 24V ac/dc
- **5** 115V ac, 60 Hz)

Note: 12V and 24V models include power mating connector. Model 4815 is the same as Model 4812 with an external 12V dc power pack.

Sync Options

- ***2** Genlock (Revert to crystal)
- ***3** Genlock (Revert to linelock)
- **5** RS-170 Crystal
- ***7** H & V Drive

* Includes Genlock, line lock, external H & V drive, and clock output

Optical Filter

- **000** None
- **100** IR Filter

Lens Options

0000 None

Manual Iris Lenses

AL09 9mm, f/1.4, 2/3"
AL12 12.5mm, f/1.4, 1"
AL16 16mm, f/1.4, 2/3"
AL25 25mm, f/1.4, 1"
AL50 50mm, f/1.4, 1"
AL75 75mm, f/1.8, 1"

Auto Iris Lenses*

ES08 8mm, f/1.4, 2/3"
ES12 12.5mm, f/1.4, 1"
ES16 16mm, f/1.4, 2/3"
ES25 25mm, f/1.4, 1"
ES50 50mm, f/1.8, 1"
EH75 75mm, f/1.8, 1"

* Auto iris lenses require lens connector P/N 1310356-104, which must be ordered separately when customer supplies own lens.

Warranty: Two years on CCD cameras; one year on lenses.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

OPTIONAL FEATURES

POWER OPTIONS

The Model 4810 camera requires AC or DC 12V or 24V input power. For operation from a 115/230 VAC 50/60 Hz power source, an optional AC power pack is available.

OPTICAL FILTER

The Model 4810 is designed to be IR sensitive. For use in applications with undesirable IR conditions, the optional IR filter will cut off at 650nm.

LENS OPTIONS

In addition to the lenses listed above, Cohu provides a complete selection of lenses for specialized applications. Our applications engineers will help you determine the proper field-of-view, focal length, lens speed (f-stop), and size (image sensor format) for your application.

SYNC OPTIONS

The standard sync board contains a RS-170 crystal-controlled oscillator to generate a 14.31818 MHz reference frequency. A sync generator IC shapes the repetitive timing pulses used to control the movement of charge frames on the sensor board. This board also contains circuits to generate blanking, clamp, and sync pulses. These signals combine with the video signal on the video board to produce composite monochrome video.

The genlock board contains additional circuits to receive external input signals, including composite video, composite sync, and horizontal and vertical drive. These inputs are processed and supplied as reference signals to the genlock oscillator. In the absence of an externally applied signal, the camera is either crystal locked or line locked, depending on the position of the crystal/line lock jumper. In the Line-Lock Mode, the camera synchronizes to an external 60 Hz reference derived from the AC power line. In the RS-170 Crystal Mode, the internal crystal-controlled oscillator provides back-up. The H and V Drive Input option allows the camera to synchronize to externally supplied horizontal- and vertical-drive signals.

SPECIAL FEATURES

Cohu welcomes the opportunity to provide special features to better serve your particular application. Some examples of special features include a 10dB S/N increase for 60dB total signal-to-noise ratio; custom painting, silk screen and logo; remote head with 6' cable; imager faceplate removal for laser applications; imager tilt with customer-specified degree; and special connector pin configurations. Please contact Cohu for other special features.

ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

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Phone: (619) 277-6700 • FAX: (619) 277-0221 • TWX: 910-335-1244

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Printed in U.S.A.

MICROLENS SENSOR TECHNOLOGY!

HIGH PERFORMANCE MONOCHROME CCD CAMERA

4910 SERIES

High Resolution
½" On-Chip-Microlens Interline Transfer

The 4910 Series High Performance Monochrome 1/2" CCD Cameras from Cohu offer high resolution and high sensitivity for use in a broad range of security/surveillance, scientific, and industrial video applications.

The 4910 Series cameras feature a 1/2"-format on-chip microlens sensor, which reduces dark current, lag, and blooming, while improving dynamic range and spectral characteristics. For video applications prone to streaking problems, a 1000:1 overload capability allows transmission of clear video signals even when bright incidental light is present in the scene.

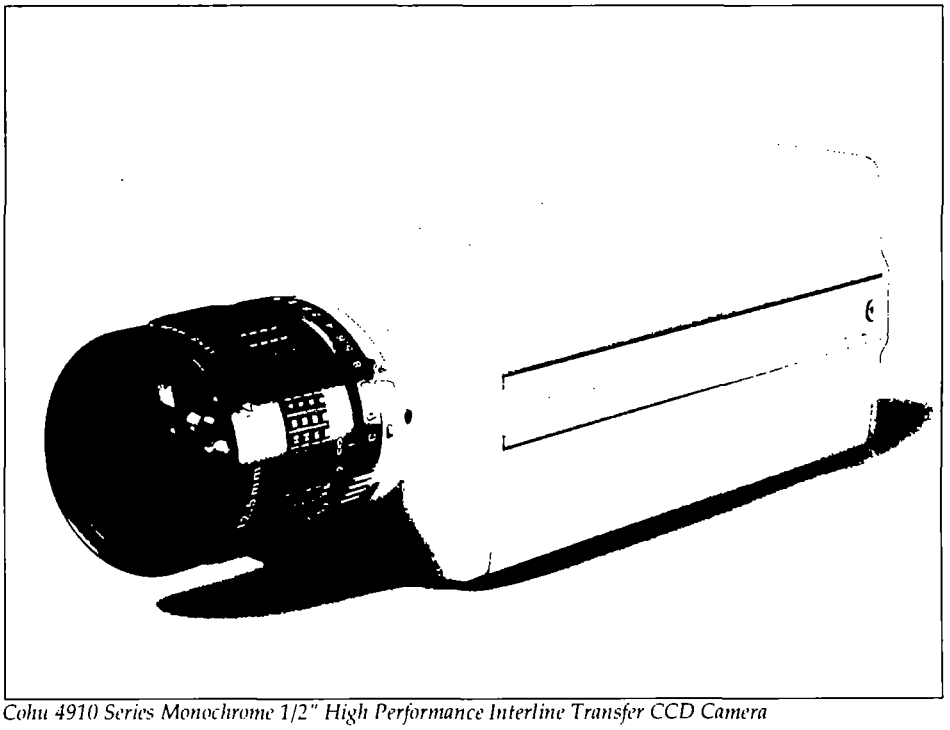
The 4910 Series design also incorporates a removable trim plate for side panel access to controls such as gamma, electronic shutter, and gain.

Available in RS-170 and CCIR models, the 4910 Series cameras feature 26 dB of AGC for high sensitivity in low light-level applications. They are rugged, yet lightweight and compact, making them ideal for easy system integration. And 4910 Series cameras are backed by a full two-year warranty.

A leading U.S. manufacturer of closed circuit video cameras and systems for more than 40 years, we welcome requests for special products and complete CCTV systems.

APPLICATIONS

- **Security/Surveillance**
  Military Installations
  Nuclear Power Plants
  Hazardous Waste Management
  Traffic Management
  Airports
  Mass Transit Systems
  Radar Tracking Systems
- **Image Processing**
- **Machine Vision**
- **Process Control**
- **Quality Control**
- **Image Analysis**



Cohu 4910 Series Monochrome 1/2" High Performance Interline Transfer CCD Camera

FEATURES AND BENEFITS

- **High Resolution** — for better definition, error-free results
- **Side-Panel Controls** provide convenience and precision
- **I/2" On-chip-microlens Interline Transfer Imager** virtually eliminates overload streaking, improves dynamic range
- **Eight-Speed Electronic Shutter** reduces blurred images of fast-moving objects
- **High Sensitivity** permits operation over a broad range of light levels
- **Choice of Synchronization Options** for greater versatility
- **High Signal-to-Noise Ratio** for clear, noise-free video
- **Asynchronous Reset** provides random vertical reset capability for production line applications
- **Optional Electronic Iris** automatically controls exposure from 1/60 sec. to 1/15,000 sec.
- **Blemish-Free Imager** — no dead pixels
- **Made in U.S.A.** — direct factory support
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras
- **No Lag or Image Retention** — provides fast, clean, precise images
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **26 dB AGC** for increased sensitivity at low light levels
- **Optional IR Filter**
- **"C" or "CS" Lens Mount** expands your choice of lenses
- **Top or Bottom Mounting** for easy installation
- **State-of-the-Art Design and Construction** for total, solid-state reliability and long life
- **Choice of RS-170 or CCIR Models**
- **Two-Year Warranty**

Designed and Manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

4910 HIGH PERFORMANCE MONOCHROME CCD CAMERA

ELECTRICAL

Image Area
6.4 x 4.8 mm (corresponding to 1/2" image tube)
Active Picture Elements
RS-170: 768H x 494V
CCIR: 752H x 582V
Imager Type
On-chip microlens sensor interline transfer CCD
Cell Size
RS170: 8.4 x 9.8 microns
CCIR: 8.6 x 8.3 microns
Resolution
RS170: 580 horizontal TVL, ≥350 vertical TVL
CCIR: 560 horizontal TVL 450 vertical TVL
Sensitivity (faceplate) @2850 K
Please see Table 1.
Electronic Shutter
Eight steps from 1/50 or 1/60 to 1/10,000 second (1/50 or 1/60, 1/125, 1/250, 1/500, 1/1,000, 1/2,000, 1/4,000, 1/10,000 second)
Integration
Integration period controllable through external input pulse
Grab pulse output
Field (1/60 or 1/50second) or Frame (1/30 or 1/25 second) integration selected by internal jumper
Video Output
1.0 V p-p @75 ohms, unbalanced
Gamma
variable 0.45 to 1.0
AGC
26 dB, variable gain
Signal-to-Noise Ratio
≥56 dB at gamma 1, gain 0 dB
38 dB at gamma 1, AGC On
Auto Lens
Separate lens video ratio tracks AGC peak/average adjustment to eliminate AGC/auto lens interaction
Power: +15V, 35 mA maximum
Synchronization
Genlock, revert to variable phase line lock with zero crossing detector
Genlock, revert to crystal
Crystal Lock
H & V Drive
Asynchronous Reset
Internal Clock Speeds
RS170: 28.6363 MHz
CCIR: 28.375 MHz
Power Requirements
12V ac or dc (standard)
24V ac or dc (optional)
115V ac (optional on RS-170 models, includes wall transformer and connector)
230V ac (optional on CCIR models, includes wall transformer and connector)
4.2 watts dc power consumption
LED Power Indicator, Green

MECHANICAL

Dimensions (less lens)
Please see Figure 1.
Weight (less lens)
18.5 ounces (0.52 kg)
Lens Mount
"CS" mount, 16mm format
"C" mount with adapter (furnished)
Camera Mounts
1/4 - 20 threaded holes, top and bottom
Connectors
Video (BNC)
Power (2 circuit screw terminal)
Lens (3 pin Mini-DIN)
External Sync (8 pin DIN)
Pin 1. External Vertical Trigger In
Pin 2. External Sync/Horizontal Trigger In
Pin 3. Grab Pulse Out (–)
Pin 4. Ground
Pin 5. Ground
Pin 6. Vertical Reset In
Pin 7. Grab Pulse Out (+)
Pin 8. Integrate Input

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -20 to 60° C (-4 to 140°F)
Storage: -30 to 70°C (-22 to 187°F)

Humidity
Up to 95% relative humidity

Vibration
Sine vibration from 10 to 2,000 Hz, 5G peak, all 3-axis, 1/2 hour per axis per MIL-E-54007, para. 3.2.24.5.1.2, fig. 2, curve IIIA. Random vibration from 10-2,000 Hz, 11G RMS all 3-axis, 1/2 hour per axis, meets MIL-E-5400T, para. 3.2.24.5.1.2A, category 6.
Shock
Up to 15 G in any axis under nonoperating conditions.

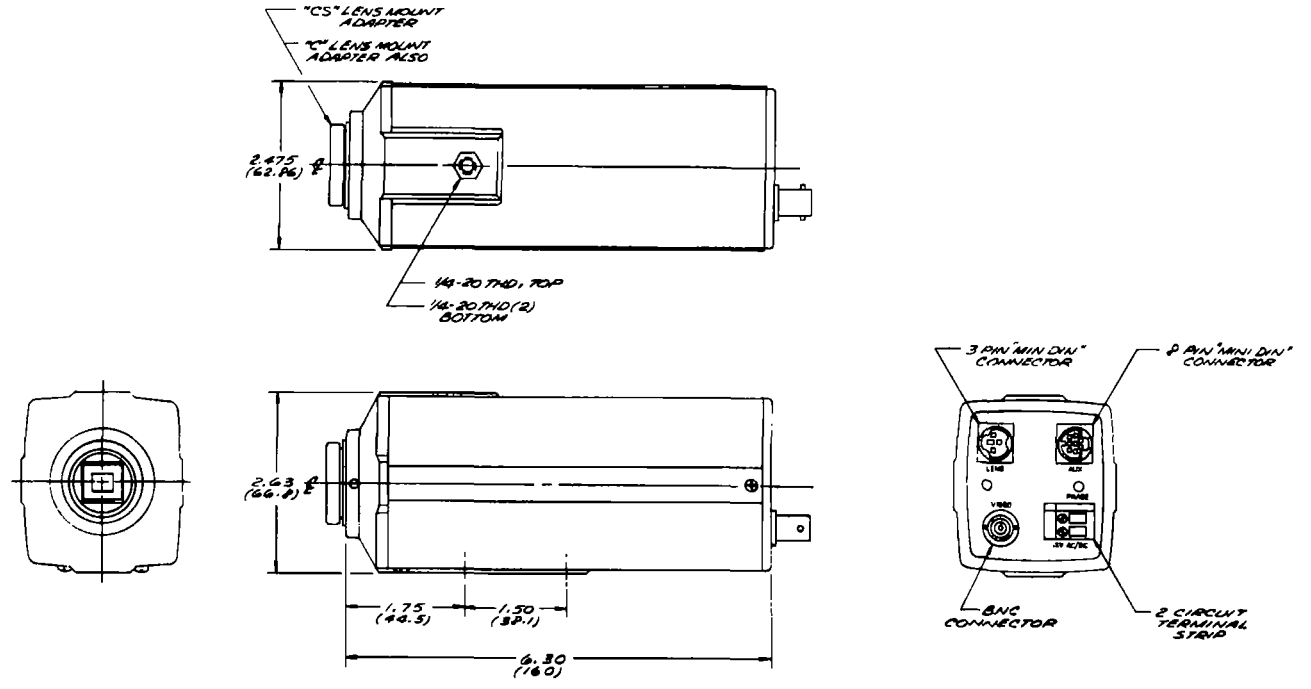
SENSITIVITY

	Full Spectrum	With IR Filter
Full Video, No AGC	0.065 fc (.65 lux)	0.25 fc (2.5 lux)
80% Video, AGC On (20 dB)	0.002 fc (.02 lux)	0.01 fc (0.1 lux)
30% Video, AGC On	0.0004 fc (0.004 lux)	0.0015 fc (0.015 lux)

Table 1

This model has been tested and found to comply within the FCC limits for Class "B."

4910 SERIES DIMENSIONS



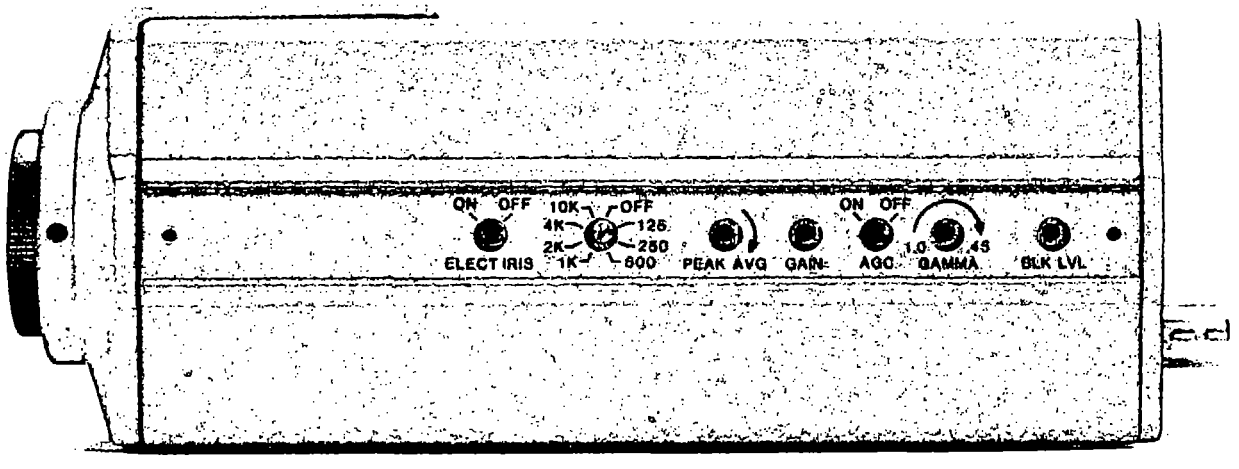
NOTE: DIMENSIONS IN INCHES (MM)

Figure 1

SIDE PANEL CONTROLS

An easily removable trim plate allows access to the following side-panel controls:

Electronic Iris ON/OFF
Eight-Step Shutter Timing
AGC Peak/Average
Gain
AGC ON/OFF
Gamma
Black Level



4910 SERIES HIGH PERFORMANCE MONOCHROME CCD CAMERA

ORDERING INFORMATION

491X— X X X X / XXXX

Power Options

- **2** 12V ac or dc
- **3** 230V ac, 50 Hz, with ac wall adapter (CCIR Models)
- **4** 24V ac or dc
- **5** 115V ac, 60 Hz, with ac wall adapter (RS-170 Models)

Sync Options

- **2** Genlock* (revert to crystal) RS-170
- **3** Genlock*(revert to variable phase line lock) RS-170
- **4** Asynchronous Reset RS-170
- **5** Genlock* (revert to crystal) CCIR
- **6** Genlock* (revert to variable phase line lock) CCIR
- **7** Asynchronous Reset CCIR

* Genlock can be composite sync or separate H & V Drive

Optical Filters

- **0** None
- **1** IR Filter (Non-removable)

Options

- **0** None (Standard TV Rate)
- **1** Frame Mode
- **3** Electronic Iris*

* Electronic Iris option is designed for use with manual iris lenses only. With this option, the camera operates in the field integration mode. Use of the electronic iris defeats electronic shutter positions

Module Options

- **0** None.

Lens Options

Manual Iris, CS Mount
- **A003** 3.7mm, f/1.6, 1/2"
- **A006** 6mm, f/1.4, 1/2"
- **A013** 12mm, f/1.4, 1/2"

Manual Iris, C Mount
- ***AL04** 4.5mm, f/2.0, 2/3"
- ***AL08** 8mm, f/1.4, 2/3"
- **AL16** 16mm, f/1.4, 2/3"
- **AL25** 25mm, f/1.4, 1"
- **AL50** 50mm, f/1.4, 1"
- **AL75** 75mm, f/1.8, 1"

* Wide Angle

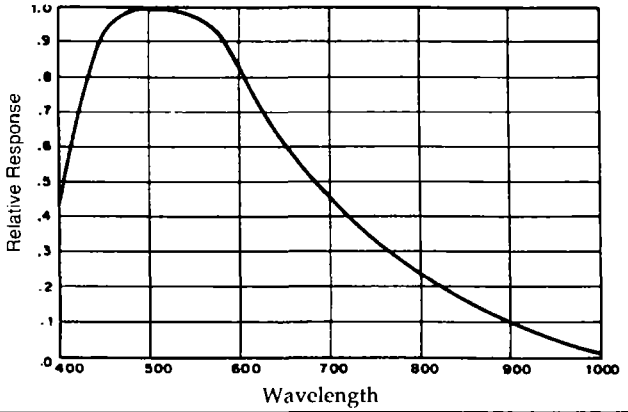
Auto Iris, CS Mount
- **EH04** 3.7mm, f/1.6, 1/2"
- **EH06** 6mm, f/1.4, 1/2"
- **EH13** 12mm, f/1.4, 1/2"

Auto Iris, C Mount
- **ES04** 4.2mm, f/1.8, 1/2"
- **ES05** 4.8mm, f/1.8, 2/3"
- **ES08** 8mm, f/1.4, 2/3"
- **ES12** 12.5mm, f/1.4, 2/3"
- **ES16** 16mm, f/1.4, 2/3"
- **ES25** 25mm, f/1.4, 1"
- **EH35** 35mm, f/1.4, 2/3"
- **ES50** 50mm, f/1.4, 1"
- **EH75** 75mm, f/1.8, 1"

Please consult factory for other lens selections.

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SPECTRAL RESPONSE



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COHU
Cohu, Inc./Electronics Division

Printed in U.S.A. 91-07 (7/93) July 1993

Performance and Reliability!

HIGH-PERFORMANCE MONOCHROME ENVIRONMENTAL CCD CAMERAS

4940 SERIES

High Resolution
½" On-Chip Microlens Sensor

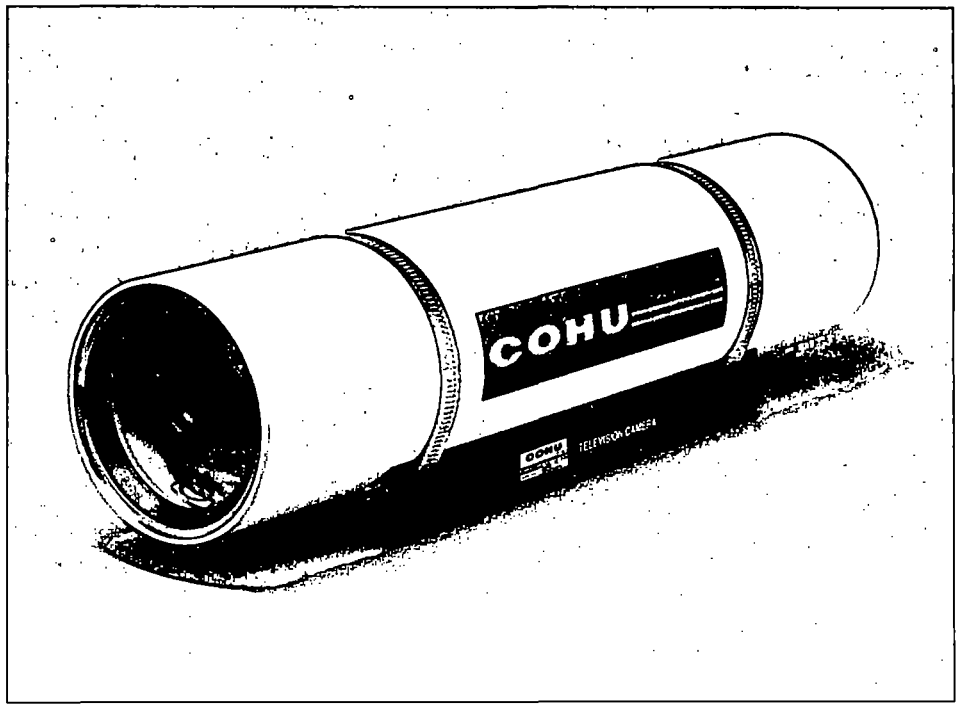
The 4940 Series High Performance Monochrome Environmental CCD Cameras from Cohu combine advanced video technology and rugged reliability for peak performance in harsh-environment security/surveillance applications.

The 4940 Series cameras feature a high-sensitivity on-chip microlens interline transfer imager, which reduces dark current, lag, and blooming while improving dynamic range and spectral characteristics. For video applications prone to streaking problems, a 1000:1 overload capability allows transmission of clear video signals even when bright incidental light is present in the scene.

The 4940 Series High Performance Monochrome CCD Cameras' 4.5" sealed and pressurized environmental housing provides maximum protection against rain, snow, dust, humidity, chemical pollutants, extreme temperatures, and other hazards.

Optional features include a fiber optic transmitter and a programmable source ID generator. An internal heater for low temperature operation is standard on all 115V models.

The 4940 Series High Performance CCD cameras are backed by a full two-year warranty. Cohu welcomes requests for special products and complete CCTV systems.



Cohu 4940 Series High Performance Monochrome Environmental CCD Camera

APPLICATIONS

- **Intelligent Vehicle-Highway Systems/Traffic Management**
- **Mass Transit Systems**
- **Security/Surveillance**
- **Military Installations**
- **Airports**
- **Industrial Process Monitoring**
- **Nuclear Power Plants**
- **Hazardous Waste Management**
- **Radar Tracking Systems**

FEATURES AND BENEFITS

- **Sealed, Pressurized Environmental Housing** protects against harsh environmental conditions
- **On-Chip Microlens Interline Transfer Imager** improves sensitivity, virtually eliminates overload streaking, and improves dynamic range.
- **High Resolution** — for better definition, error-free results
- **High Sensitivity** permits operation over a broad range of light levels.
- **Choice of Synchronization Options** for greater versatility
- **High Signal-to-Noise Ratio** for clear, noise-free video
- **Optional Fiber Optic Transmitter and Source I.D. Generator**
- **Made in U.S.A.** — direct factory support
- **Two-Year Warranty**
- **Internal Heater** for low temperature operation
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras.
- **No Lag or Image Retention** — provides fast, clean, precise images
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **26 dB AGC** for increased sensitivity at low light levels
- **Optional IR Filter**
- **"C" or "CS" Lens Mount** expands your choice of lenses.
- **State-of-the-Art Design and Construction**

Designed and Manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

4940 SERIES HIGH PERFORMANCE MONOCHROME CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Image Area
6.4 x 4.8 mm (corresponding to ½" image tube)

Active Picture Elements
RS-170: 768H x 494V
CCIR: 752H x 582V

Imager Type
On-chip microlens sensor interline transfer CCD

Cell Size
RS170: 8.4 x 9.8 microns
CCIR: 8.6 x 8.3 microns

Resolution
RS170: 580 horizontal TVL, 350 vertical TVL
CCIR: 560 horizontal TVL, 450 vertical TVL

Sensitivity (faceplate) @2850 K
Please see Table 1.

Electronic Shutter*
Eight steps from 1/50 or 1/60 to 1/10,000 second (1/50 or 1/60, 1/125, 1/250, 1/500, 1/1,000, 1/2,000, 1/4,000, 1/10,000 second)

Video Output
1.0 V p-p @75 ohms, unbalanced

Gamma
Variable 0.45 to 1.0

AGC*
26 dB, variable gain

Signal-to-Noise Ratio
≥56 dB at gamma 1, gain 0 dB
38 dB at gamma 1, AGC On

Auto Lens
Separate lens video ratio tracks AGC peak/average adjustment to eliminate AGC/auto lens interaction
Power: +15V, 100 mA maximum

Synchronization
Genlock, revert to variable phase adjustable line lock with zerocrossing detector
Genlock, revert to crystal
Crystal Lock
Internal Clock Speeds
RS170: 28.6363 MHz
CCIR: 28.375 MHz

Power Requirements
12V ac, 50/60 Hz
24V ac, 50/60 Hz
115V ac, 50/60 Hz
230V ac, 50/60 Hz

Power Consumption (by module)
4.2 watts camera
40 watts heater
1.5 watts lens

* Please see "Standard Features" box on back cover

SENSITIVITY

	Full Spectrum	With IR Filter
Full Video, No AGC	0.065 fc (0.65 lux)	0.25 fc (2.5 lux)
80% Video, AGC On	0.002 fc (0.02 lux)	0.01 fc (0.1 lux)
30% Video, AGC On	0.0004 fc (0.004 lux)	0.0015 fc (0.015 lux)

Table 1

This model has been tested and found to comply within the FCC limits for Class "B."

MECHANICAL

Dimensions
Please see Figure 1.

Weight (less lens)
10.8 pounds, (4.9 kg)

Lens Mount
"CS" mount, 16mm format
"C" mount with adapter (furnished)

Housing Mount
¼-20 threaded holes

Connectors
Please see Figure 1.

ENVIRONMENTAL

Ambient Temperature Limits
Operating:
-20 to 60 °C (–4 to 140 °F);
-40 to 60 °C (–40 to 140 °F) with heater
Storage:
-30 to 70 °C (-22 to 157 °F)

Humidity
Up to 100% relative humidity

Vibration
Sine vibration from 5 to 60 Hz with 0.082 inches total excursion (15 g's @ 60 Hz). Random vibration from 60 to 1,000 Hz, 5 g's rms ($0.027g^2$/Hz without damage.

Shock (less lens)
Up to 15 g's, 11ms, in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

Altitude
Sea level to equivalent of 3,000m/10,000 feet (508mm/20 inches of mercury)

Air Contaminants
Withstands exposure to sand, dust, fungus, and salt atmosphere, per MIL-E-5400T, paragraph 3.2.24.7, 3.2.24.8, and 3.2.24.9

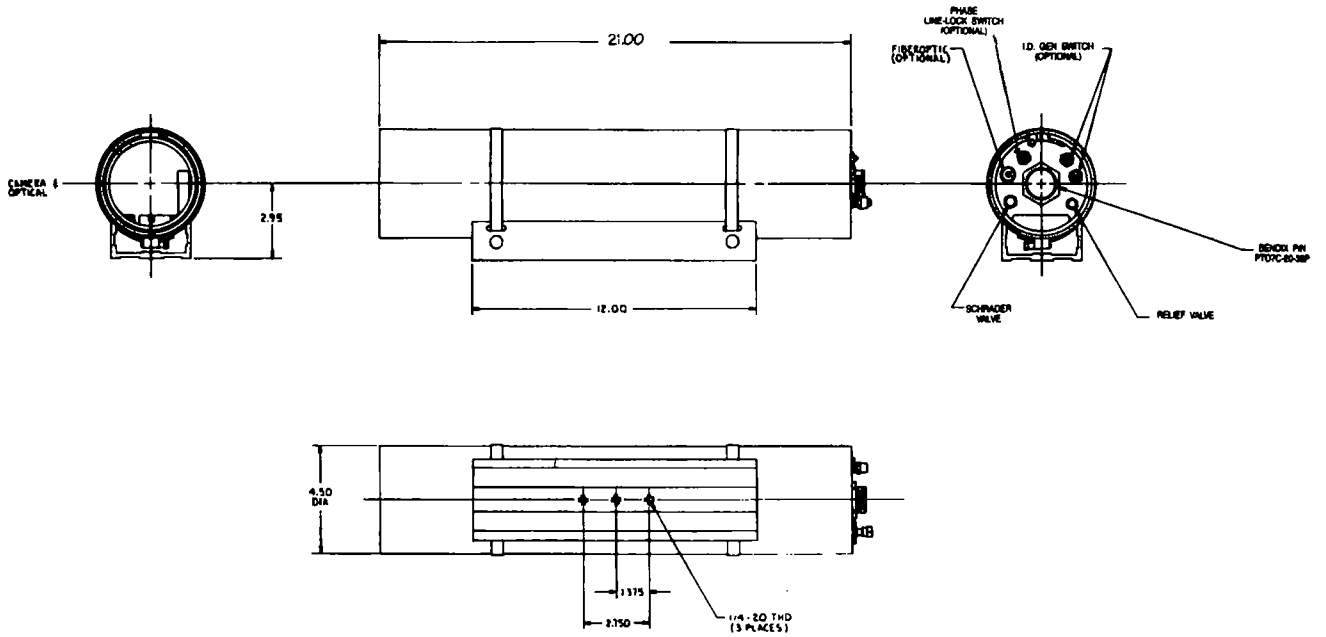
Explosion
MIL-E-5400T, paragraph 3.2.24.10

Acoustic Noise
Can withstand environments greater than 150 dB continuously for 30 minutes

EMI
FCC rules, Part 15, Subpart J, for Class A devices

Shock
Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

4940 SERIES DIMENSIONS



NOTE. DIMENSIONS IN INCHES (MM)

Figure 1

CONNECTOR CONFIGURATIONS

Pin	Function
A	12/24V ac in
B	Reserved for Position Reference Return
C	75 Ω Sync Termination
D	Reserved for Focus Position
J	Video Ground
K	Video Out
L	Ground (Overall Cable Shield)
M	External Sync In
N	Ground (Sync Coax Shield)
P	Ground (Lens Conductors Shield)
R	Zoom In
S	Focus In
T	Iris In
U	Ground (Zoom, Focus, Iris Common)
V	115V ac Camera Power, 60 Hz, Low
W	115V ac Camera Power, High
X	AC Ground
Y	Reserved for Zoom Position
Z	Ground
b	Reserved for Position Reference
c	Auto/Manual Iris Select
d	12/24V ac In
e	RXD (Programmable ID Generator)
f	Ground
h	TXD (Programmable ID Generator)
i	TXD (Programmable ID Generator)
k	Ground (Programmable ID Generator)
m	Heater Power, 115V ac Low
n	RXD (Programmable ID Generator)
r	Heater Power, 115V ac High

PROGRAMMABLE SOURCE ID GENERATOR

The optional Programmable Source ID Generator is a built-in electronic circuit which allows written messages to be superimposed over images displayed on CCTV monitors. Using a computer and RS-422 serial communication, a user types messages that will then appear on the monitor. Text is made up of block letters 28 horizontal TV lines in height. The letters are white with a black outline for maximum legibility. There are two modes of operation, as follows:

1. ID Mode: Up to two lines of text (24 characters per line, including spaces) can be stored in non-volatile memory. Text can be placed at the top or bottom of the monitor screen, and can be updated from a computer or a dumb terminal, making this a real-time updatable programmable ID generator. Stored text, which typically provides information such as the location of individual cameras in multi-camera systems, will be continuously displayed until it is updated.

2. Menu Mode: In this mode, up to 12 lines of 24 characters can be entered into volatile memory without affecting data stored in the ID Mode. A computer is required to enter data in this mode.

Special cables or connectors are available for programming the Programmable Source ID Generator. Please consult factory for details.

4940 SERIES HIGH PERFORMANCE MONOCHROME CCD CAMERA

ORDERING INFORMATION

494X — X X X X / XXXX

Power Options*

2 12V ac, 50/60 Hz

3 230V ac, 50/60 Hz**

4 24V ac, 50/60 Hz

5 115V ac, 50/60 Hz

* Heater for Low Temperature Operation is standard on 115V models. Heater on 12V and 24V models is a special order feature. Please consult factory.

**Please consult factory for availability.

Sync Options & Video Format

2 RS-170 Genlock (revert to crystal)

3 RS-170 Genlock (revert to phase adjustable line lock)

5 CCIR Genlock (revert to crystal)

6 CCIR Genlock (revert to phase adjustable line lock)

Optical Filters

0 None

1 IR Filter (non-removable)

Camera Options

0 Standard TV Rate (Field Integration Mode)

Module Options

0 None

1 Fiber Optic Transmitter

2 Programmable ID. Generator

3 Programmable I.D. Generator and Fiber Optic Transmitter (See notes on page 3.)

Lens Options

Auto Iris, CS Mount
EH04 3.7mm, f/1.6, 1/2"
EH06 6mm, f/1.4, 1/2"
EH13 12mm, f/1.4, 1/2"

Auto Iris, C Mount
ES04 4.2mm, f/1.8, 1/2"
ES05 4.8mm, f/1.8, 2/3"
ES07 8mm, f/1.4, 2/3"
ES08 8mm, f/1.4, 2/3"
ES12 12.5mm, f/1.4, 2/3"
ES16 16mm, f/1.4, 2/3"
ES25 25mm, f/1.4, 1"
EH35 35mm, f/1.4, 2/3"
ES50 50mm, f/1.4, 1"

Zoom Lenses
Z06R 6:1, f/1.0, 1/2"
***P06R** 6:1, f/1.0, 1/2"
Z10S 10:1, f/1.2, 1/2"
***P10S** 10:1, f/1.2, 1/2"
***Note: These lenses include follower pots.**

Please consult factory for other lens selections.

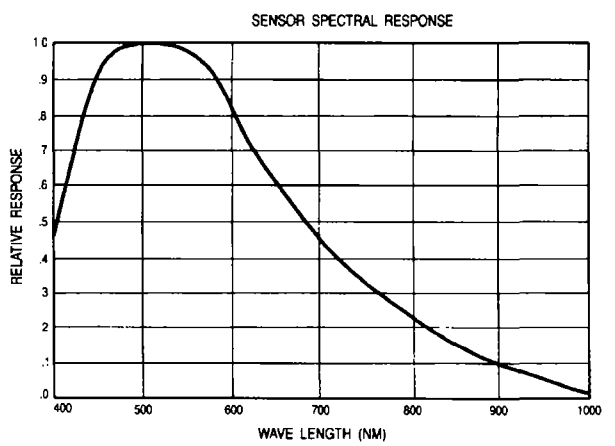
COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

NOTES ON STANDARD FEATURES

Electronic Shutter: Internal switches select shutter speeds or the number of integration fields, and enable or disable the external ON/OFF control of the internally-selected shutter or integration mode. These switches are set at the factory prior to sealing and pressurizing the environmental housing. The standard factory settings disable the external ON/OFF control and provide 1/60 second shutter speed. The switches can be set differently at the factory to customer specifications, or in the field by removing the camera from the housing.

AGC Peak/Average adjustment is made via an internal control, which is set at 0.45 at the factory prior to sealing and pressurizing the environmental enclosure. Customer may specify different setting.

SPECTRAL RESPONSE



ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

5755 Kearny Villa Road • San Diego, CA 92123
Telephone: (619) 277-6700 • FAX: (619) 277-0221 • TWX: 910-335-1244

COHU
Cohu, Inc./Electronics Division

Printed in U.S.A. 92-02 July 1993

ADVANCED VIDEO TECHNOLOGY
Made in the U.S.A.

FIRST GENERATION INTENSIFIED MONOCHROME CCD CAMERA

5510 SERIES

High Reliability, High Sensitivity, For Low Light Level Applications

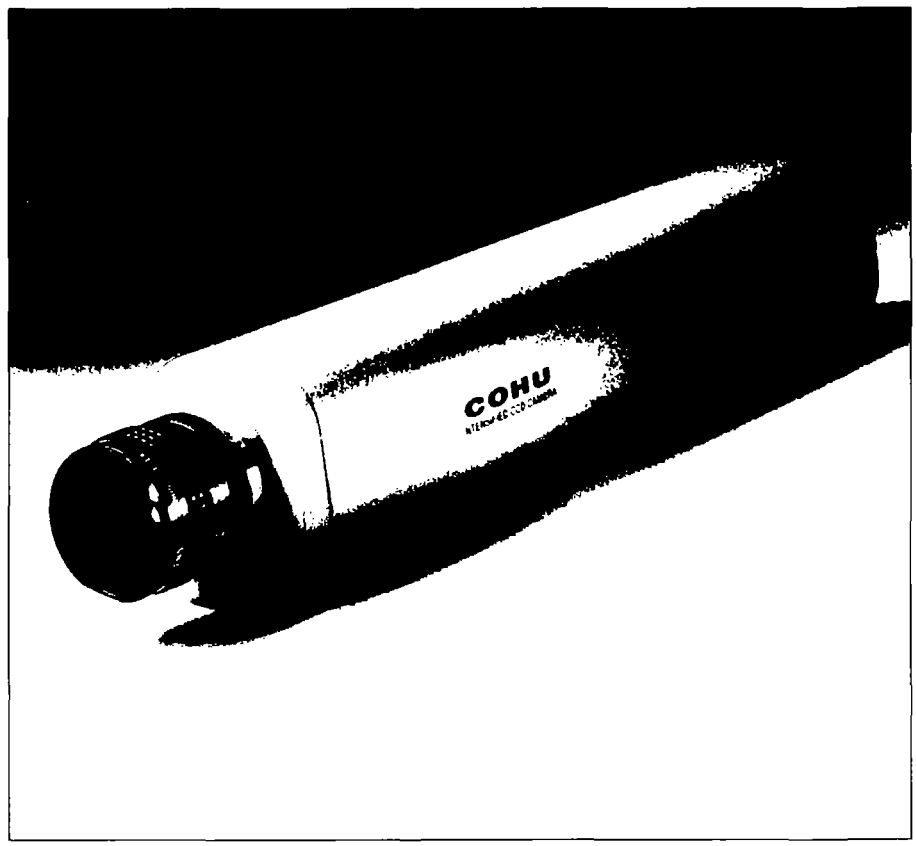
Designed for reliable, long-life operation in applications characterized by low light levels, the 5510 Series first generation intensified CCD camera provides a number of advantages over SIT cameras traditionally used for LLL applications.

The 5510 Series Intensified CCD (ICCD) camera uses a first generation image intensifier which is fiber-optically coupled to the CCD image sensor to provide clear images, even when a scene illumination is extremely limited.

When compared to high-maintenance SIT cameras, the 5510 Series ICCD camera offers significantly greater dependability because the camera employs a solid-state CCD image sensor. The camera is also smaller, consumes less power, and exhibits less lag than an SIT camera.

The 5510 camera is available in standard, as well as in sealed, pressurized environmental housings.

Designed and manufactured in the U.S.A., the 5510 Series is the ideal camera for economical, reliable, low light level video requirements.



Cohu 5510 Series Intensified Monochrome CCD Camera

FEATURES AND BENEFITS

- **High Sensitivity** improves image in low light levels.
- **Low Lag** for fast, clean, precise images.
- **High Signal-to-Noise Ratio** provides better dynamic range
- **Low Power Consumption** for flexible system integration, energy savings, and minimal dissipation.
- **Selectable AGC** allows better control under varying light conditions.
- **Made in U.S.A.** - direct factory support.
- **High Resolution** for sharper images.
- **Auto Black** for contrast enhancement.
- **Adjustable C Mount** for maximum adaptability.
- **Suitable Replacement for SIT Cameras**
- **RS-170 and CCIR Models**
- **Solid State Design** for long life and reliability.
- **Available in sealed, pressurized environment-resistant housings** for for use in outdoor and hostile environments.

APPLICATIONS

- **Security/Surveillance**
  Airports
  Mass Transit
  Power Plants
  Military Installations
- **Microscopy**
- **Medical Imaging**
- **Machine Vision**
- **Image Processing**

Designed and manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

5510 SERIES FIRST GENERATION INTENSIFIED CCD CAMERA

SPECIFICATIONS

ELECTRICAL

IMAGE INTENSIFIER

18 mm, Gen 1, electrostatic demagnifying 1" input image format

Geometric Distortion

≤ 6%within a circle not to exceed picture height

Spectral Response

S 25

IMAGER

Frame transfer CCD, 1/2" format

Active Picture Elements

RS-170: 739(H) x 484(V)
CCIR: 699(H) x 576(V)

Cell Size

RS-170: 8.5µm(H) x 19.5µm(V)
CCIR: 9.2µm(H) x 16.8µm(V)

GENERAL

Resolution (TV lines)

RS170: 480 horizontal, 350 vertical
CCIR: 460 horizontal, 400 vertical

Sensitivity

2854 K faceplate illumination. 80% video: 0.00005 fc. No AGC: 5 x 10 ^4. With 6dB gain: 2.5 x 10^4
Usable picture: 0.000015 fc at 30% video

Gamma

0.5 or 1.0 jumper selectable

Auto Black

Maintain set-up level at 7.5± 5 IRE units if picture contains at least 10% black

Signal-to-Noise Ratio @25°C

42 dB, unweighted, with AGC off and high voltage low, at .005 fc faceplate illumination (typical)

AGC

>20 dB, jumper selectable on/off

Auto Lens Drive Signal

Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction

Synchronization

EIA RS-170 crystal, 14.31818 MHz (or CCIR crystal 13.375 MHz) clock output (standard)
Genlock, external sync with crystal or zero crossing linelock back-up (jumper selectable)
Linelock
External H & V drive

Video Output

1.0 V p-p @75 ohms, unbalanced

Power Requirements

AC or DC 12V ±10% or 24V ±10%
AC 115V ±10% or 230V ±10% with wall transformer

ENVIRONMENTAL

Ambient Temperature Limits

Operating: –10 to 50 °C (14° to 122° F)
Storage: –30 to 60 °C (–22° to 140° F)

Altitude

Sea level to equivalent of 3.048m/10,000 feet (508mm/20 inches of mercury)

Humidity

Up to 95% relative humidity

MECHANICAL

Weight (less lens)

Less than 2.5 lbs

Dimensions

11.78" (L) x 2.30" (W) x 2.72" (H)

Lens Mount

"C" mount

Connectors

BNC connector - Video Out
Switchcraft TB4M - Lens Drive
Switchcraft TB3M - Power In
Hirose SR30-10R-7S - Auxiliary

Camera Mount

1/4 - 20 threaded holes

ORDERING INFORMATION

55X	X	—	X	X	X	X	/ XXXX
Housing	Power Options		Sync Options	Optical Filter	Option Boards	Format	Lens Options
1 General Purpose NOTE 6" environmental housings available as special options. Please consult factory.	2 12V ac/dc, 50Hz 3 230V ac, 50 Hz 4 24V ac/dc,60Hz 5 115V ac, 60 Hz		2 Genlock/Crystal 3 Genlock/Linelock 7 External H & V Drive/Crystal	0 None	00 None	0 RS-170 (EIA) 5 CCIR	0000 None Auto Iris ND (T-1500) Spot EH12 12.5mm f/1.4 EH25 25mm f/1.4 EH50 50mm, f/1.4 EH75 75mm f/1.8 Please consult factory for other lens selections

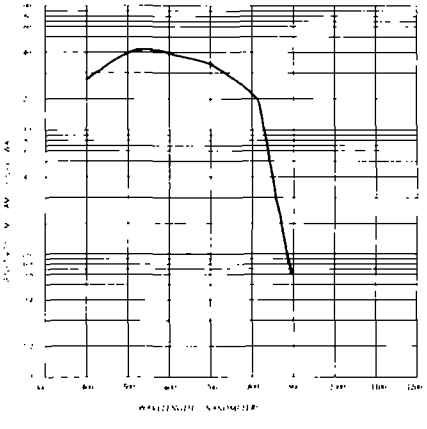
COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

OPTIONAL FEATURES

SYNC OPTIONS

The genlock board contains circuits to receive external input signals, including composite video, composite sync, and horizontal and vertical drive. These inputs are processed and supplied as reference signals to the genlock oscillator. In the absence of an externally applied signal, the camera is either crystal-locked or line locked, depending on the position of the crystal/linelock jumper. In the Linelock Mode, the camera synchronizes to an external 50 or 60 Hz reference derived from the AC power line. In the Crystal Mode, the internal crystal-controlled oscillator provides back-up. The H & V Drive Input Option allows the camera to synchronize to externally supplied horizontal- and vertical-drive signals.

SPECTRAL RESPONSE



Printed in U.S.A.
90-9411 (10/91)
May 1993

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FAX: (619)277-0221 • Telephone: (619)277-6700 • TWX: 910-335-1244
COHU
Cohu, Inc./Electronics Division

NEW!

RS-170 MONOCHROME 1/2" CCD CAMERA

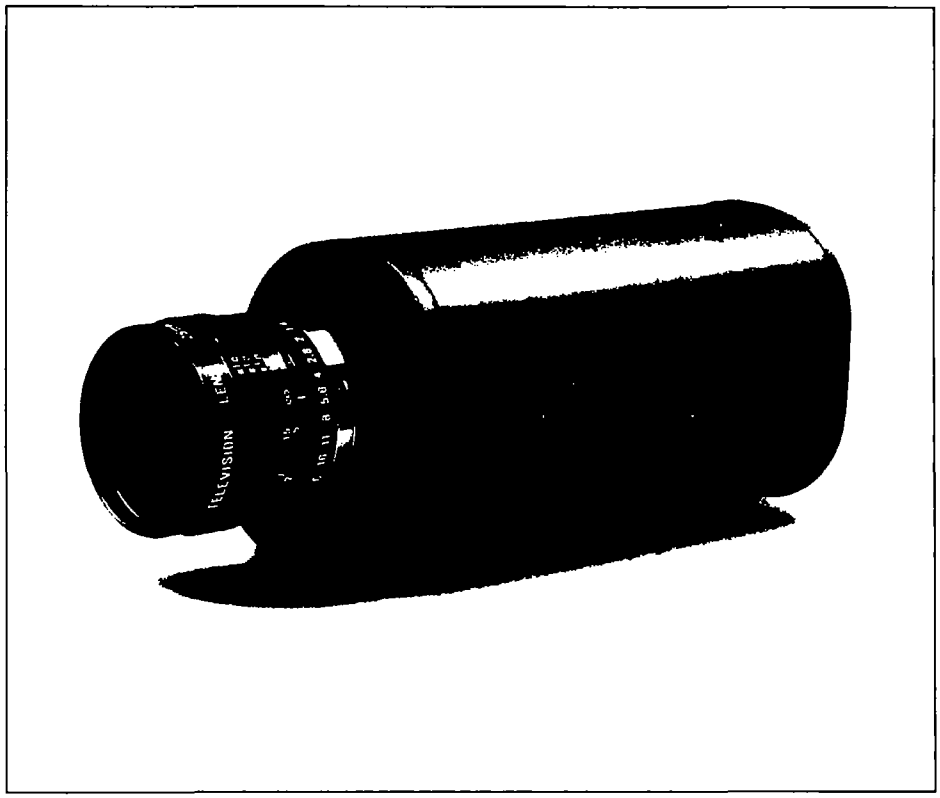
6310 SERIES

High Resolution
High Sensitivity

Cohu's 6310 Series Monochrome CCD cameras are high performance cameras which employ a unique high resolution frame transfer imager to provide an economical alternative to comparably priced cameras with much lower resolution and sensitivity. They provide high resolution pictures without geometric distortion, lag, or image retention, and sensitivity comparable to that of standard silicon target image tube cameras. These performance features, along with rugged design and low maintenance, make 6310 Series cameras an excellent value for a wide range of security/surveillance applications.

Weighing just 15 ounces, 6310 Series cameras feature 20 dB Automatic Gain Control (AGC) to provide high sensitivity in varying light conditions.

As with all Cohu CCD cameras, 6310 Series cameras are designed and manufactured in the U.S.A. and are backed by a two-year warranty. For assistance in selecting the proper camera for your application, please call Cohu at (619) 277-6700 and ask to speak with one of our experienced Applications Engineers.



Cohu 6310 Series Monochrome CCD Camera

FEATURES AND BENEFITS

- **High Resolution** with ½" format frame transfer image sensor with over 350,000 active picture elements
- **High Sensitivity** improves image in low light levels
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **No Lag or Image Retention** for fast, clean, precise images
- **Wide Range of Options** for flexible system integration
- **Low Power Consumption** for flexible system integration, energy savings, and minimal dissipation
- **20 dB AGC with Peak-Average Adjustment** for clear images in varying light conditions.
- **High Signal-to-Noise Ratio** provides better dynamic range
- **Auto Black** for contrast enhancement
- **Quality, State-of-the-Art Design and Construction** for total, solid-state reliability and long life
- **IR Sensitive** for use in IR applications.
- **Over 350,000 picture elements**
- **Made in U.S.A.** — direct factory support, parts availability
- **Two-Year Warranty**

APPLICATIONS

- **Security/Surveillance**
  Government Facilities
  Environmental Monitoring
  Power Plants
  Banks
  Retail Stores
  Unmanned Storage Facilities
  Parking Garages
  Office Buildings
  Correctional Facilities
- **Transportation Safety and Control**
  Bridges and Tunnels
  Mass Transit
  Airports and Train Stations
  Fare Collection Points
- **Teleconferencing**
- **Image Processing**

Designed and manufactured in U.S.A.

COHU INC
ELECTRONICS DIVISION

6310 SERIES RS-170 MONOCHROME 1/2" CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Imager
Single CCD using frame transfer method
Pickup Area
6.4 x 4.8 mm (1/2-inch format)
Active Picture Elements
739(H) x 484(V) (frame transfer)
Cell Size
8.5µm(H) x 19.5µm(V)
Resolution
Horizontal 550 TV lines
Vertical >350 TV lines
Sensitivity
2850 K faceplate illumination.
See Table 1.
Contrast Variation @ 25°C
<15%
Video Output
1.0 V p-p @75 ohms, unbalanced
Gamma
0.5 or 1.0 jumper selectable
AGC
Jumper selectable, On/Off.
Peak average adjusatble, 20 dB
Power Consumption
4.2W

Auto Black
Maintain set-up level at 7.5± 5 IRE units if picture contains at least 10% black
Signal-to-Noise Ratio
56 dB at gamma 1, AGC off
8 MHz bandwidth, unweighted
Auto Lens Drive Signal
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction.
Synchronization
EIA RS-170 crystal, 14.31818 clock output (standard)
Genlock, external sync with crystal line lock back-up (jumper selectable)
External H & V drive
Power Requirements
AC/DC 12V ±10%

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –10 to 50 °C
(14° to 122° F)
Storage: –30 to 70 °C
(–22° to 158° F)
Humidity
Up to 95% relative humidity
Vibration (less lens)
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage
Shock (less lens)
Up to 30 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6
Altitude
Sea level to equivalent of 3,000m/10,000 feet (500mm/20 inches of mercury)

MECHANICAL

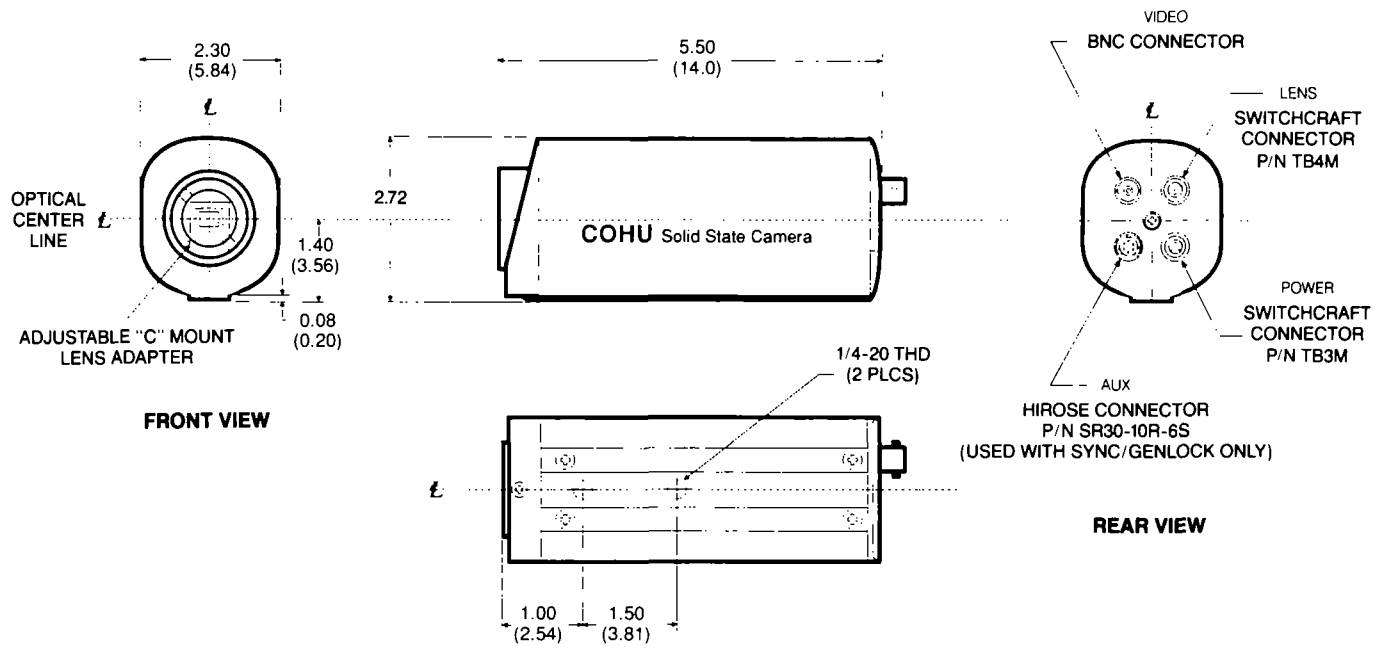
Weight (less lens)
425 grams (15 ounces)
Dimensions
Please see Figure 1.
Camera Mount
1/4 - 20 threaded holes
Lens Mount
"C" mount
Connectors
BNC connector - Video Out
Switchcraft TB4M - Lens Drive
Switchcraft TB3M - Power In
Hirose SR30-10R-6S - Auxiliary

SENSITIVITY

	With IR Filter	Without IR Filter
Full Video, AGC Off	0.40 fc (4.0 lux)	0.03 fc (0.3 lux)
90% Video, AGC On	0.036 fc (0.36 lux)	0.0027 fc (0.027 lux)
Usable Picture (30% Video, AGC On)	0.0012 fc (0.012 lux)	0.0009 fc (0.009 lux)

Table 1

DIMENSIONS

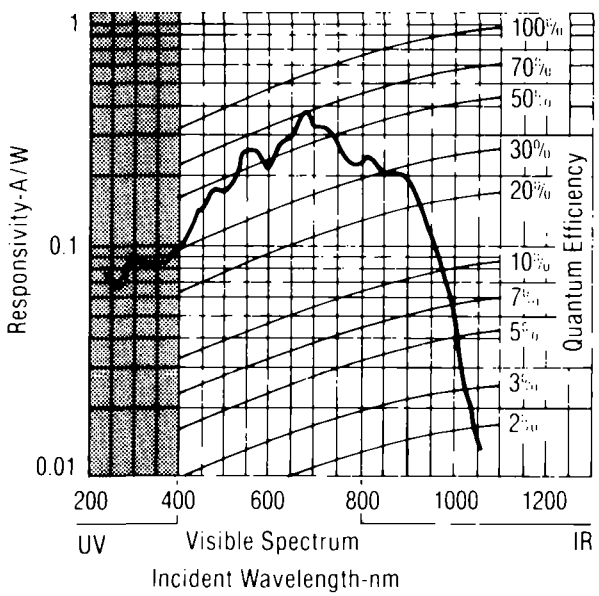


NOTE: ALL DIMENSIONS IN INCHES AND (CM).

Figure 1.

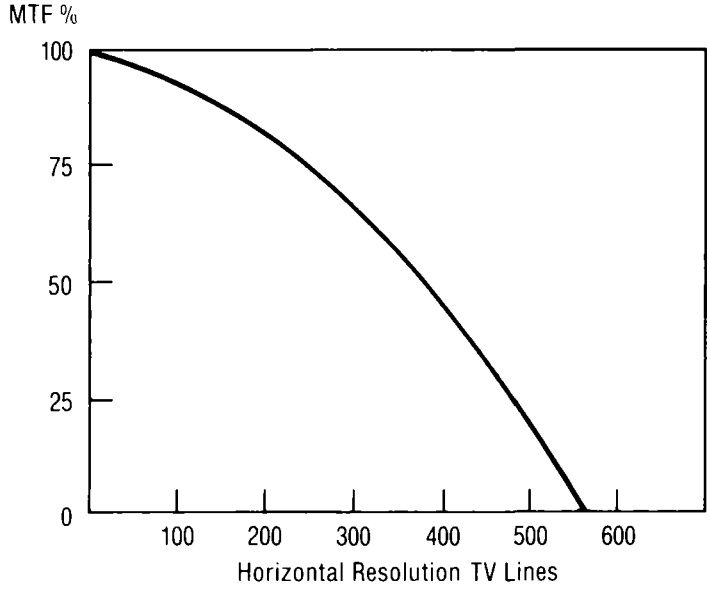
Cohu 6310 Monochrome CCD Camera

SPECTRAL RESPONSE



SHADED AREA INDICATES SPECTRAL RESPONSE WITH FACEPLATE REMOVED OR WITH A QUARTZ FACEPLATE INSTALLED. PLEASE CONSULT FACTORY FOR PRICES.

MODULATION TRANSFER FUNCTION



6310 SERIES RS-170 MONOCHROME 1/2" CCD CAMERA

ORDERING INFORMATION

631X — X X X X — XXXX

Power Options

- **2** 12V ac/dc
- **5** 115V ac, 60 Hz (with ac wall adapter)

Sync Options

- **2** Genlock (Revert to crystal)
- **3** Genlock (Revert to linelock)
- **5** RS-170 Crystal
- **7** External H & V Drive (Revert to crystal)

Optical Filter

- **0** None
- **1** IR Filter (See IR transmission curve, below.)

Option Boards

- **0** None

Video Format

- **1** RS-170

Lens Options

Manual Iris, C Mount
- ***AL04** 4.5mm, f/2.0, 2/3"
- ***AL06** 6.5mm, f/1.8, 2/3"
- ***AL08** 8mm, f/1.4, 2/3"
- **A014** 12mm, f/1.2, 1/2"
- **AL16** 16mm, f/1.4, 2/3"
- **AL26** 25mm, f/1.6, 2/3"
- **AL51** 50mm, f/2.8, 2/3"

* Wide Angle

Auto Iris, C Mount**
- **ES04** 4.2mm, f/1.8, 1/2"
- **ES05** 4.8mm, f/1.8, 2/3"
- **ES08** 8mm, f/1.4, 2/3"
- **ES13** 12mm, f/1.2, 1/2"
- **ES16** 16mm, f/1.4, 2/3"
- **EH35** 35mm, f/1.4 (2/3"

** Auto iris lens mating connectors supplied with lens. Those customers supplying their own auto iris lenses must order connector separately.

Please consult factory for other lens selections.

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OPTIONAL FEATURES

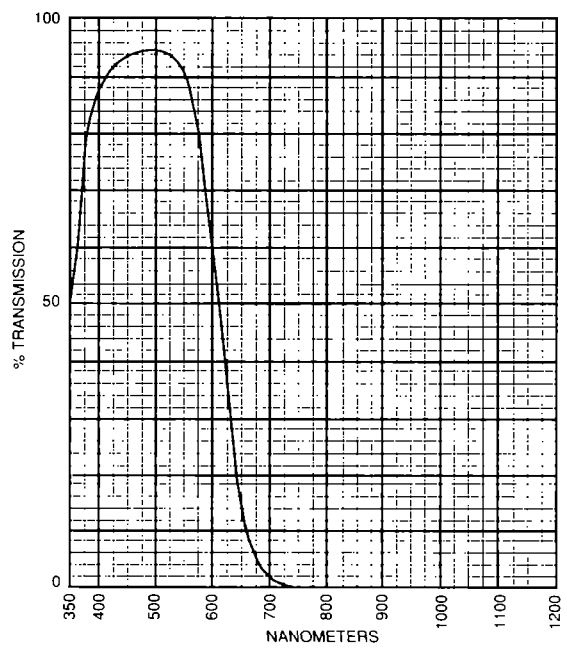
SYNC OPTIONS

The genlock board contains circuits to receive external input signals, including composite video, composite sync, and horizontal and vertical drive. These inputs are processed and supplied as reference signals to the genlock oscillator. In the absence of an externally applied signal, the camera is either crystal-locked or line locked, depending on the position of the crystal/linelock jumper. In the Linelock Mode, the camera synchronizes to an external 60 Hz reference derived from the AC power line. In the Crystal Mode, the internal crystal-controlled oscillator provides back-up. The H & V Drive Input Option allows the camera to synchronize to externally supplied horizontal- and vertical-drive signals.

IR FILTER

The 6310 Series is designed to be IR sensitive. For use in applications with undesirable IR conditions, the optional IR filter will cut off at 650 nm.

TRANSMISSION OF IR FILTER



Printed in U.S.A.
91-04-10/91-1)
October 1991

5755 Kearny Villa Road • San Diego, CA 92123 • P.O. Box 85623 • San Diego, CA 92186-5623
FAX. (619)277-0221 • Telephone: (619)277-6700 • TWX: 910-335-1244

COHU INC
ELECTRONICS DIVISION

ULTRA-HIGH-RESOLUTION MONOCHROME CCD CAMERAS

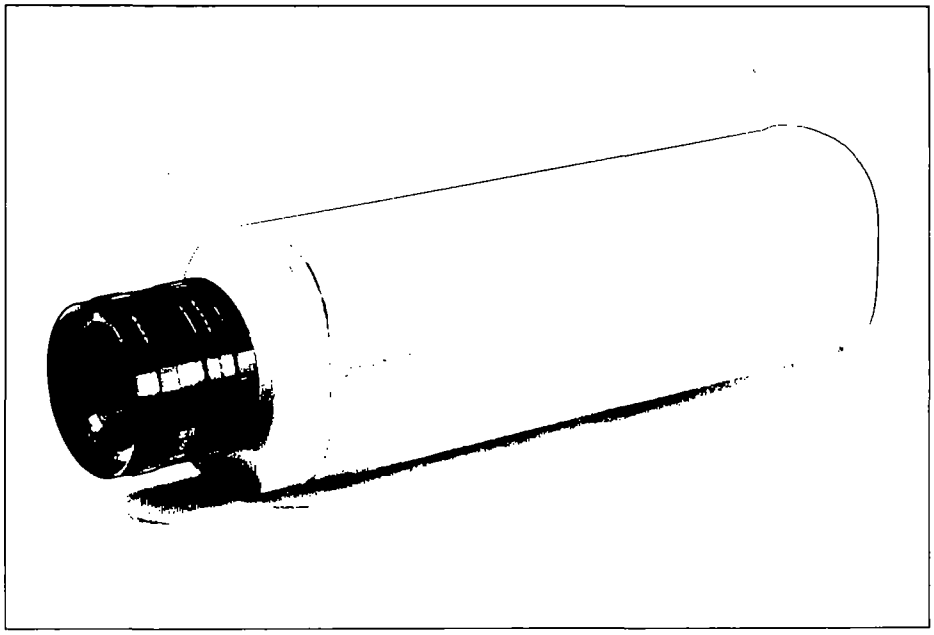
8410 & 8420 SERIES

850 TV Lines Resolution
1134 x 486 Picture Elements

The 8410 and 8420 Series are *full-frame* frame-transfer RS-170 monochrome video cameras which provide ultra-high-resolution images for a broad range of scientific, industrial, and security/surveillance applications. They employ a unique blemish-free image sensor which provides *true interlace* video output for exceptional picture quality.

Because the 8410 and 8420 Series' image sensor has two independently addressable field memories, the camera can be operated in several different modes. In addition, the frame transfer imager has contiguous pixels. A high-bandwidth video-processing circuit makes full use of the resolution of the imager, while allowing options such as Automatic Gain Control and Auto Black Control.

Independent addressing of each field memory provides flexibility for different modes of operation. In the normal mode, the camera provides true interlace with 486 lines per frame and 1134 pixels per line. After a 1/60- second exposure of the 486 active lines in the imaging area, one field of 243 lines becomes video; the other 243 lines are discarded. A subsequent 1/60-second exposure produces the additional lines to complete the frame.



Cohu 8410/8420 Series High Resolution Monochrome CCD Camera

The low-light sensitivity mode utilizes pseudo interlace by summing two adjacent lines after a 1/60-second exposure time. The alternate summing of lines provides two different fields for each frame, with a 2:1 gain in light sensitivity.

In the dual field mode, both fields are exposed simultaneously for 1/30 second and stored on-chip. This results in a frame with the higher vertical resolution associated with true interlace but without the time-dependent image offset that occurs with normal-mode operation. In this mode, higher sensitivity is achieved at the expense of greater lag.

FEATURES AND BENEFITS

- **High Resolution** — 850 horizontal TV lines for sharper images
- **Over 550,000 Active Picture Elements** — 1134 x 486 array
- **High Sensitivity** permits operation over a wide range of light levels
- **Two Independently Addressable Field Memories** allow full-frame vertical resolution in all modes of operation
- **True Interlace Operation** for true high-resolution images
- **Built-In Blooming Protection** eliminates "washed-out" images caused by bright incidental light
- **Low Power Consumption**
- **Two Year Warranty**
- **Auto Black** for contrast enhancement
- **2/3" Format Blemish-Free Frame Transfer Sensor with Contiguous Pixels**
- **Virtual Phase Sensor Technology** provides high blue response, low dark signal, uniformity and single-phase clocking
- **20 dB AGC with Peak-Average Adjustment** for clear images in varying light level applications
- **Made in U.S.A.** — rugged. reliable design, quality components, direct factory support .

APPLICATIONS

- **Scientific**
  Microscopy
  Image Processing
  Machine Vision
  Robotics
  Mapping
- **Industrial**
  Security/Surveillance
  Aerial Recognizance
  Transportation Management

Designed and Manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

8410 & 8420 SERIES ULTRA-HIGH-RESOLUTION CCD CAMERAS

SPECIFICATIONS

ELECTRICAL

Imager
Full-frame frame transfer CCD
Image Area
8.8 x 6.6 mm (2/3" format)
Active Picture Elements
1134(H) x 486(V)
Sensitivity (Full Video, AGC Off)
Normal Mode: 0.035 lux
Low-Light Mode: 0.013 lux
Dual-Field Mode: 0.013 lux
S/N Ratio
45 dB (gamma 1, gain 0 dB, aperture flat)
Horizontal Resolution
850 TV lines
Vertical Resolution
Normal Mode: 486 lines true interlace
Dual-Field Mode: 486 lines true interlace
Low-Light Mode: 350 lines pseudo interlace
Exposure
Normal Mode: 1/60 second
Low Light Mode: 1/60 second
Dual Field Mode: 1/30 second
Video Output
1.0 V p-p, 75 ohm, unbalanced
Contrast Variation
<5 %
Gamma
0.5 to 1
AGC
20 dB, peak/average adjustable
Manual Gain
20 dB variable
Auto Black
Maintain setup level at 7.5 ±5 IRE units if picture contains at least 10% black
Synchronization
Crystal lock (21.477 MHz), Genlock, line lock
Power Requirements
+15V dc, 285 mA steady state, 800 mA startup (100ms)
-15V dc, 140 mA steady state, 800 mA startup (100 ms)
5V dc, 205 mA steady state 2500mA startup (100 ms)
(For line lock, 12V ac, 60 Hz, <1 mA steady state, 1 mA startup)
115V ac, ± 10%, 60 Hz, with external power supply

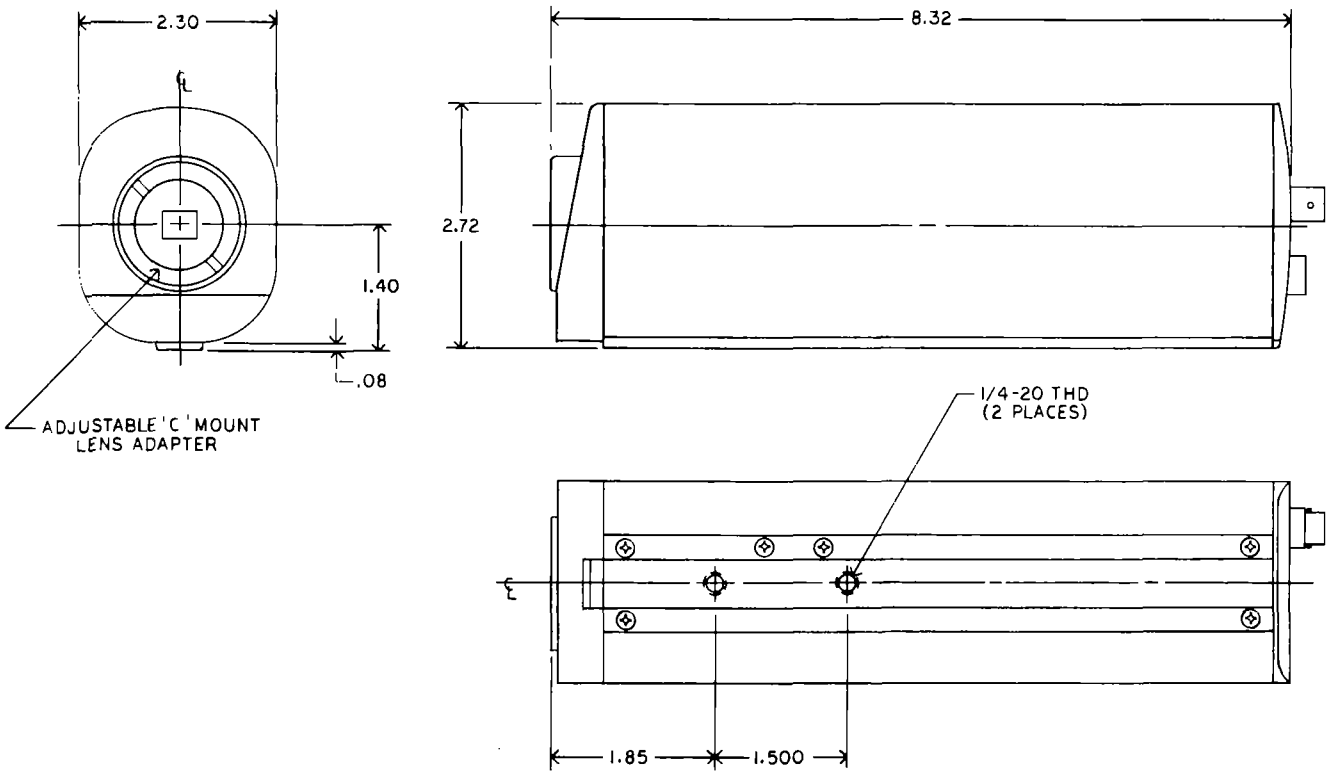
ENVIRONMENTAL

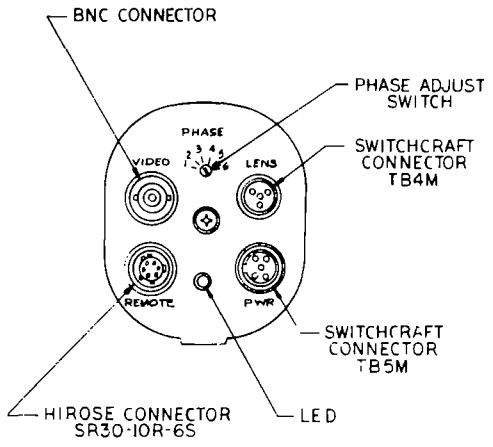
Ambient Temperature Limits
Operating: –20 to 50 °C (–4° to 122° F)
Storage: –30 to 70 °C (–22° to 157° F)
Humidity
Up to 95% relative humidity
Vibration (less lens)
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage
Shock (less lens)
Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6
Altitude
Sea level to equivalent of 3,048m/10,000 feet (508mm/20 inches of mercury)

MECHANICAL

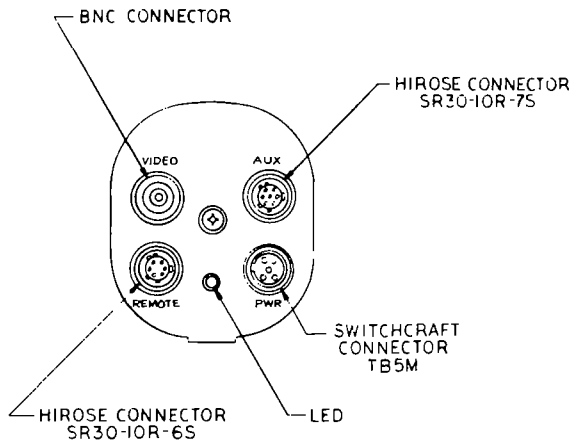
Dimensions
Please see dimensional drawings.
Weight (less lens)
Less than 48 ounces (12 V model)
Lens Mount
"C" mount adapter furnished
Connectors
BNC connector—Video Out
Switchcraft TB5M—Power In
Hirose SR30-10R-6S—Remote
Switchcraft TB4M—Lens Drive (8410 only)
Hirose SR30-10R-7S—Auxiliary Output (8420 only)

8410 & 8420 SERIES DIMENSIONS





8410 Series Industrial



8420 Series Scientific

8410 & 8420 SERIES ULTRA-HIGH-RESOLUTION CCD CAMERA

ORDERING INFORMATION

84X X — X X X / XXXX

Housing Options

1 Indoor Industrial

2 Indoor Scientific

Power Options

0 Requires external ±15V dc, +5V dc (12V ac for line lock)

5 115V ac with external power supply

Sync Options

2 Genlock (revert to crystal)

3 Genlock (revert to phase adjustable line lock)

4 Phase adjustable line lock

5 Crystal

7 External H & V Drive

Optical Filter

0 None

1 I.R. Filter (for general use)

2 I.R. Filter (for microscope use)

Video Format

10 RS-170 (EIA)

Lens Options

0000 None

Manual Iris Lenses
AL09 9mm, f/1.3 (2/3")
AL12 12.5mm, f/1.4 (1")
AL16 16mm, f/1.4 (2/3")
AL25 25mm, f/1.4 (1")
AL50 50mm, f/1.4 (1")
AL75 75mm, f/1.8 (1")

Auto Iris Lenses (for use on 8415 Series only)
ES08 8mm, f/1.4 (2/3")
ES12 12.5mm, f/1.4 (1")
ES16 16mm, f/1.4 (2/3")
ES25 25mm, f/1.4 (1")
ES50 50mm, f/1.4 (1")
ES75 75mm, f/1.8 (1")

Please consult factory for other lens selections.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

SPECIAL FEATURES

Cohu welcomes the opportunity to provide special features to better serve your particular application. Some examples of special features are: custom painting, silk screen and logo; special filters; and special lens supports and mounting configurations. Please contact Cohu concerning these or other special features.

CONNECTOR CONFIGURATIONS

LENS (8410 ONLY)

1	Lens Video
2	Chassis Ground
3	Power
4	Ground

REMOTE

1	Composite Sync Input
2	Select C (Future)
3	Vertical Reset (Future)
4	Horizontal Reset (Future)
5	Select Low-Light Mode
6	Select Dual-Field Mode
7	Ground

AUX (8420 ONLY)

1	Pixel Clock Output (-)
2	Pixel Clock Output (+)
3	Blanking (+)
4	Blanking (-)
5	Composite Sync Out (+)
6	Composite Sync Out (-)

POWER

1	-15V
2	+15V
3	60 Hz
4	+5V
5	Ground

Printed in U.S.A.
93-01 (8/93)
August 1993

5755 Kearny Villa Road • San Diego, CA 92123
FAX: (619)277-0221 • Telephone: (619)277-6700 • TWX: 910-335-1244

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NEW!

HIGH PERFORMANCE COLOR CCD CAMERA

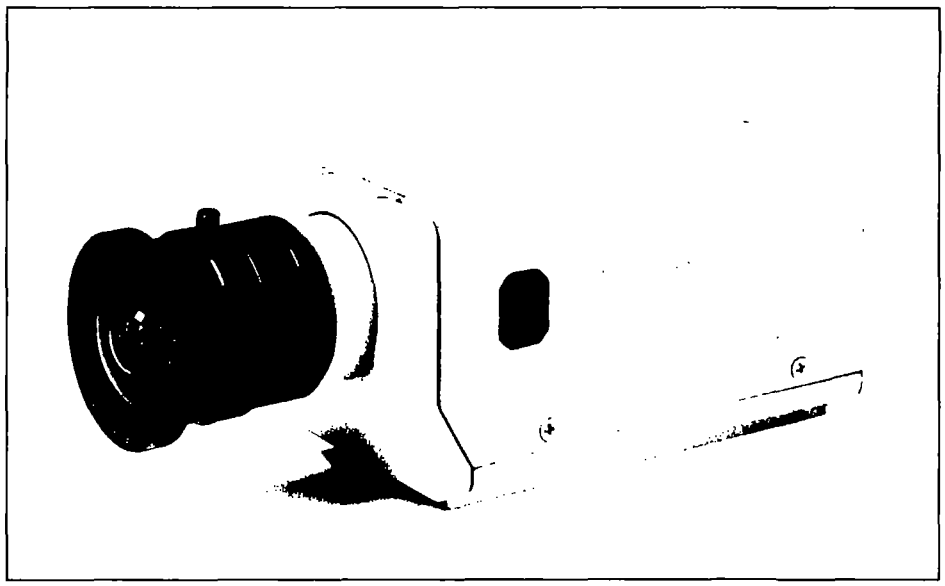
1300 SERIES

NTSC/PAL ½" On-Chip-Microlens Interline Transfer Imager

Cohu's new 1310 Series High Performance Color Cameras offers the ultimate in color vibrancy, picture clarity, and reliability. With a resolution of 460 horizontal lines (450 PAL), and a size measuring only 4" x 2" x 2", the 1300 Series combines the performance edge with a compact size for critical applications such as security, surveillance, and traffic management.

Special on-chip microlens sensor technology dramatically increases sensitivity while reducing blooming. Conveniently located adjustment pots make set up easy and fast. Gain, color balance, and externally-controlled integration setting are available on the back panel. An optional electronic iris feature is available that eliminates the need for an auto iris lens under most lighting conditions.

Designed and manufactured in the U.S.A., the 1300 Series cameras pack traditional Cohu engineering and technology excellence into a small and affordable enclosure. Cohu, Inc./Electronics Division is ISO-9001 certified.



The Cohu 1300 Series features high performance color video in an exceptionally small enclosure.

APPLICATIONS

- Surveillance
- Perimeter Security
- Access Control
- Traffic Surveillance
- Bridges and Tunnels
- Inspection and Toll Plaza
- Transportation
- Mass Transit Systems

FEATURES AND BENEFITS

- On Chip Microlens Interline Transfer Sensor provides high sensitivity and reduces blooming and transfer smear
- High Resolution - up to 460 horizontal TV lines (NTSC) for sharper images
- Small Size - only 4" x 2" x 2"
- Integration - externally controllable for low light imaging
- Standard Auto Iris - Electronic iris and DC iris optional
- Convenient Rear Panel Function Controls for precision adjustment
- High Signal-to-Noise Ratio provides clear, noise-free images
- 1000:1 Overload Capability prevents light overloads that cause blooming
- AGC for clear images in varying light conditions
- Optional crystal genlock or phase adjustable linelock synchronization
- C and CS lens mounts
- Optional top mounting accessory
- Made in U.S.A. - direct factory support
- Two Year Warranty
- Meets FCC Class B requirements

Designed and manufactured in U.S.A.

COHU

Cohu, Inc./Electronics Division

1300 HIGH PERFORMANCE COLOR CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2" format)

Active Picture Elements
NTSC: 768 (H) x 494 (V)
PAL: 752 (H) x 582 (V)

Resolution
NTSC: 460 horizontal TV lines
350 vertical TV lines
PAL: 450 horizontal TV lines
415 vertical TV lines

Sensitivity (3200K faceplate illumination)
6.5 lux at full video, AGC off
0.3 lux at 80% video, AGC on
.08 lux at 30% video, AGC on

Shutter
Internal DIP switch, 1/60 to 1/10,000, 8 steps
Electronic Shutter (Optional)
1/60 to 1/15,000 sec. auto-compensates for scene illumination

Integration
Externally controllable 1/60 to 16 sec.

Gamma
0.6

AGC
0-20 dB (on/off), selectable (local/remote)

Signal-to-Noise Ratio
46 dB (AGC off, NTSC with 4.5 MHz filter)

Video Output
Encoded NTSC and PAL, 1 V p-p @ 75 ohms, unbalanced composite,

Auto Lens Output
Controls auto iris lens

DC Iris Option
Controls aspherical lens

Color Balance
Automatic, through-the-lens type, less than 10 IRE units unbalance from 2850 to 5800 K;
Local/Remote Manual White Balance

Synchronization Options
NTSC or PAL, crystal, genlock, or phase adjust linelock

Power Requirements
12 VDC or 12 VAC

Power Consumption
7.5 W

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -20° to 50° C, -4° to 122° F
Storage: -30° to 70° C, -22° to 157° F

Humidity
Up to 95% relative, non condensing

Vibration (less lens)
Per Mil-STD-810(E), Method 514.4, Categories 1, 4, 5, 8, 9, 10

Shock (less lens)
No damage to 30 g, 11 ms duration
No crash hazard to 75 g, 11 ms duration

NEW! This camera is available in 3" and 4½" sealed and pressurized environmental enclosures. Contact your Cohu representative for full information.

MECHANICAL

Weight (less lens)
10 oz., (280 g.)

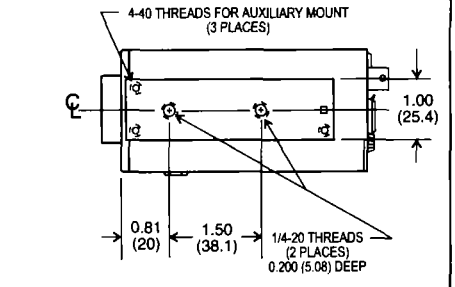
Lens Mount
C/CS standard

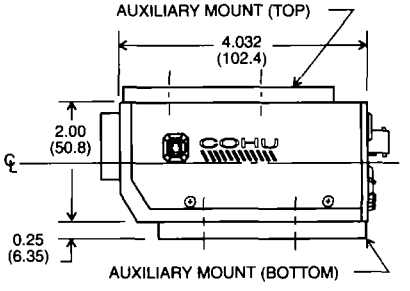
Camera Mounts
1/4-20 female, top and bottom

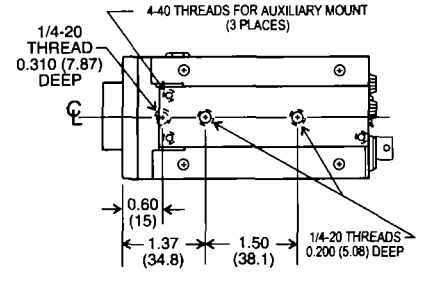
Connectors (NTSC and PAL)
Video Out: BNC
Lens Drive: 4 pin
Power In: 3 pin connector
Remote: 8 pin mini-DIN

Rear Panel Adjustments
AGC on/off/remote
Manual Gain Control
Auto/Manual/Remote White Balance select
Manual White Balance adjust

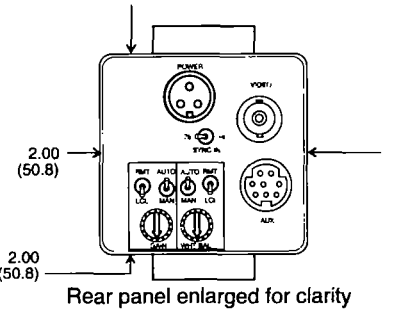
DIMENSIONS







All dimensions in inches and (mm)



Rear panel enlarged for clarity

ORDERING INFORMATION

13X	X	-X	X	00	/XXXX
Configuration	**Power Option**	**Sync**	**Iris Options**	**Unassigned**	**Lens Options**
2 - NTSC (60 Hz)	2 - 12 VDC	1 - NTSC XTAL	0 - Auto Iris		0000 None
5 - PAL (50 Hz)	7 - 12 VAC	2 - NTSC Genlock	3 - Elec. Iris NTSC		**Manual Iris/CS**
		3*- NTSC Phase Adjust LL	4 - DC Iris		A003 3.7 mm, f1.6, 1/2"
		5 - PAL XTAL	5 - Elec. Iris PAL		Contact factory for full lens selection.
		6 - PAL Genlock			

**Requires Power Option 7*

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Made in the U.S.A.

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Printed in U.S.A. 1300 Series. 2/95

Two Year Warranty!

HIGH PERFORMANCE COLOR CCD CAMERAS

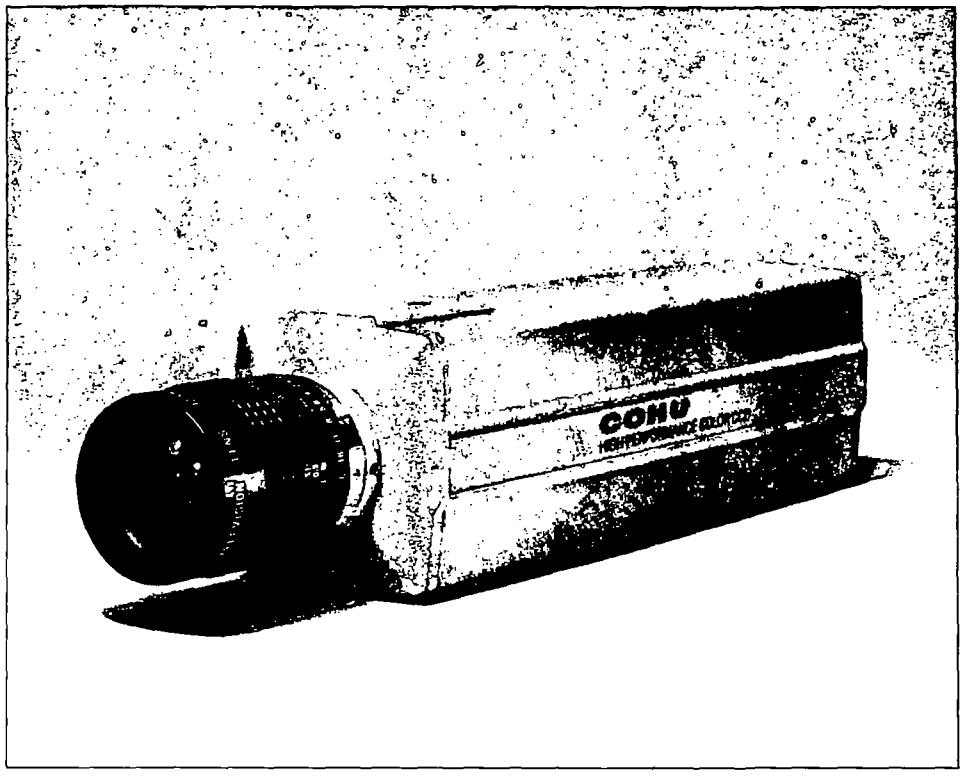
8210 & 8310 SERIES

NTSC/Y-C, PAL/Y-C, RGB Models
On-Chip-Microlens Sensor

Cohu's 8210 and 8310 Series High Performance Color CCD Cameras offer the ultimate in color vibrancy, picture clarity and reliability. They employ a half-inch interline transfer sensor with on-chip microlenses for exceptional sensitivity and minimal blooming. Y-C video outputs on NTSC and PAL models let you do high resolution recordings on Super VHS media. RGB models are also available.

8210 and 8310 Series cameras feature convenient side-panel access to electronic shutter, integration, gain, and other camera controls. And an optional electronic iris eliminates the need for an auto iris lens in most lighting conditions.

Designed and manufactured in the U.S.A., 8210 and 8310 Series High Performance Color CCD Cameras are backed by a two-year warranty. They are available with a wide range of optional features. OEM engineering requests are welcome.



Cohu High Performance Color CCD Camera

FEATURES AND BENEFITS

- **On-Chip-Microlens Interline Transfer Sensor** provides high sensitivity and reduces blooming and transfer smear.
- **High Resolution** — up to 460 horizontal TV lines (NTSC) for sharper images
- **High Sensitivity** — permits operation over a wide range of light levels
- **NTSC/Y-C and PAL/Y-C Models** provide S-VHS output for high-resolution VCR recordings.
- **Selectable Integration** for microscopy and low-light video
- **Optional Electronic Iris** automatically controls exposure, eliminating need for auto iris lens.
- **Side Panel Access to Function Controls** — for convenient, precision control
- **NTSC/Y-C and PAL/Y-C Models Feature Color Lock** for consistent color rendition in multi-camera applications
- **High Signal-to-Noise Ratio** provides better dynamic range.
- **Eight-Speed Electronic Shutter** reduces blurring of fast-moving objects
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras
- **AGC with Peak-Average Adjustment** for clear images in varying light levels
- **Choice of "C" or "CS" Lens Mounts**
- **Made in U.S.A.** — direct factory support.
- **Two Year Warranty**

APPLICATIONS

- **Security/Surveillance**
  Perimeter Security
  Traffic Safety and Control
  General Surveillance
- **Microscopy**
- **Image Processing**
  Medical and Industrial
- **Machine Vision**
  Pattern Recognition
  Non-Contact Measurement
  3-D Imaging
  Inspection
- **Robotics**

Designed and manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

8210 & 8310 HIGH PERFORMANCE COLOR CCD CAMERAS

SPECIFICATIONS

ELECTRICAL—NTSC/Y-C AND PAL/Y-C MODELS

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2" format)

Active Picture Elements
NTSC/Y-C: 768(H) x 494(V)
PAL/Y-C: 752(H) x 582(V)

Resolution
NTSC/Y-C: Horizontal 460 TV lines
Vertical 350 TV lines
PAL/Y-C: Horizontal 450 TV lines
Vertical 415 TV lines

Sensitivity
3200 K faceplate illumination.
6.5 lux at full video, AGC Off.
0.5 lux at 80% video, AGC On.

Electronic Shutter
Switch selectable, 1/60 second (off) to 1/10,000 second (8 steps)

Integration
Switch selectable, 2 to 16 fields (8 steps). Grab pulse available

Gamma
0.5

AGC
0-20 dB
Peak-average adjustable

Signal-to-Noise Ratio (AGC Off)
48 dB (NTSC with 4.5 MHz filter)
48 dB (Y output with 6 MHz filter)

Video Outputs
Encoded: NTSC and PAL
1 V p-p @75 ohms, unbalanced, composite
S Video:
Y: 1 V p-p @75 ohms, unbalanced, composite
C: 0.285 V p-p

Auto Lens Output
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction

Color Lock
Burst phase adjustment
Horizontal phase adjustment

Color Balance
Through-the-lens type
Less than 10 IRE units unbalance from 2850 to >5800 K

Synchronization
NTSC or PAL crystal, color lock standard

Power Requirements
12V ac or dc (standard)
115V ac, 60 Hz for NTSC models (optional, with wall transformer)
230V ac, 50 Hz for PAL models (optional, with wall transformer)

Power Consumption
4.5W

ELECTRICAL—RGB MODELS

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2" format)

Active Picture Elements
RGB/60: 768(H) x 494(V)
RGB/50: 752(H) x 582(V)

Resolution
RGB/60: Horizontal 450 TV lines
Vertical 350 TV lines
RGB/50: Horizontal 430 TV lines
Vertical 415 TV lines

Sensitivity
3200 K faceplate illumination.
13 lux at full video. AGC Off.
1.1 lux at 80% video, AGC On.

AGC
0-20 dB
Peak-average adjustable

Gamma
0.5 or 1.0

Electronic Shutter
Switch selectable, 1/60 second (off) to 1/10,000 second (8 steps)

Integration
Switch selectable, 2 to 16 fields (8 steps); grab pulse available

Power Requirements
12V ac or dc (standard)
115V ac, 60 Hz for NTSC models (optional, with wall transformer)
230V ac, 50 Hz for PAL models (optional, with wall transformer)

Power Consumption
4.5W

Video Outputs
RGB, per channel: 0.714 V p-p @75 ohms, unbalanced; sync on green, jumper selectable
Sync: 0.4 V p-p @75 ohms, unbalanced

Synchronization
Genlock, H & V drive

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –20 to 50 °C
(–4° to 122° F)
Storage: –30 to 70 °C
(–22° to 157° F)

Humidity
Up to 95% relative humidity

Vibration (less lens)
Sine vibration from 5 to 2,000 Hz, 5 g's peak, all 3-axis, 1/2 hr. per axis per MIL-E-5400T, para 3.2.24.5.1.2, fig. 2, curve IIIa.
Random vibration from 10 to 2,000 Hz, 11 g's rms, all 3-axis, 1/2 hr. per axis, per MIL-E-5400T, para 3.2.24.5.1.2, category 6.

Shock (less lens)
Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

MECHANICAL

Dimensions
Please see dimensional drawings.

Weight (less lens)
23 ounces (.65 kg) (12 V model)

Lens Mount
"CS" mount standard, "C" mount adapter furnished

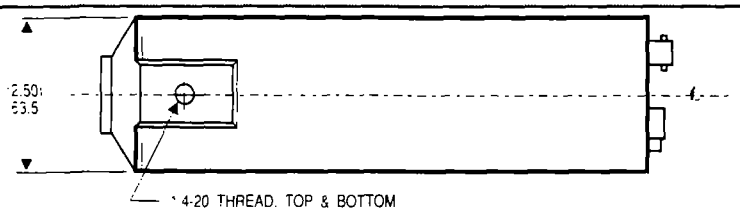
Connectors (NTSC/Y-C and PAL/Y-C Models Only)
BNC connector—Video Out
4 Circuit MINI-DIN — Y-C
3 Circuit MINI-DIN — Lens Drive
2 Circuit Terminal Strip — Power In
8 Circuit MINI-DIN — Remote

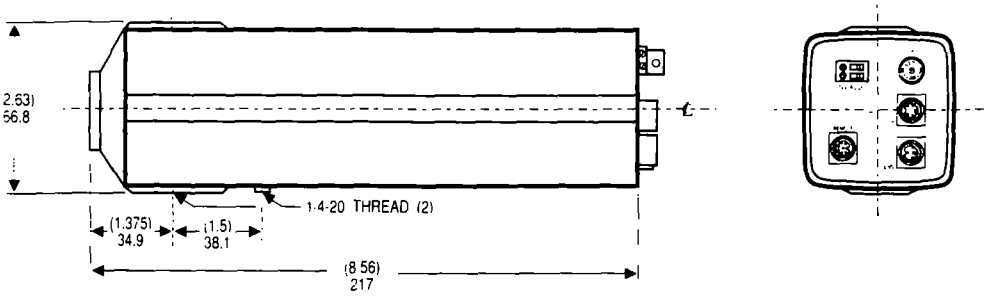
Connectors (RGB Models)
BNC connector — Video Out
8 Circuit MINI-DIN — Remote 1
7 Circuit MINI-DIN — Sync
2 Circuit Terminal Strip — Power In
9 Circuit D-Sub — RGB Out

NTSC/Y-C and PAL/Y-C Side Panel Adjustments
Shutter/Off/Integrate Selection
8-position Shutter/Integrate Switch
AGC On/Off Selection
AGC Peak/Average Adjustment
Auto/Manual/Remote White Balance Selection
White Balance Adjustment

RGB Side Panel Adjustments
Shutter/Off/Integrate Selection
8-position Shutter/Integrate Switch
AGC Peak/Average Adjustment
AGC/Manual/Remote Selection
Gain Adjustment
Vertical Phase Adjustment
Horizontal Phase Adjustment

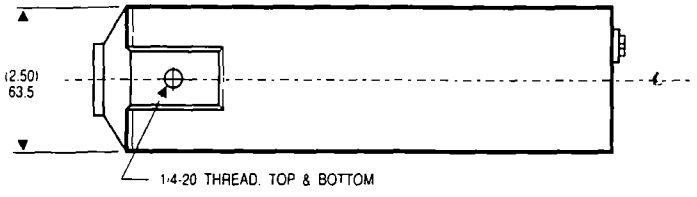
DIMENSIONS OF NTSC/Y-C AND PAL/Y-C MODELS

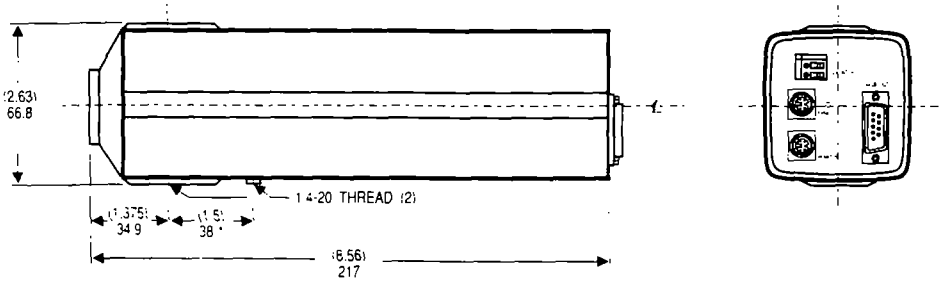




NOTE. UNLESS OTHERWISE DESIGNATED. ALL DIMENSIONS IN MM AND (INCHES)

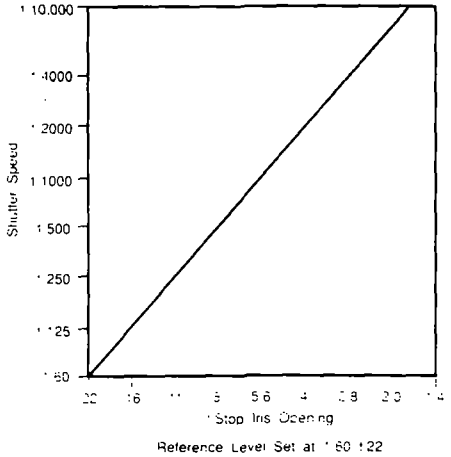
DIMENSIONS OF RGB MODELS





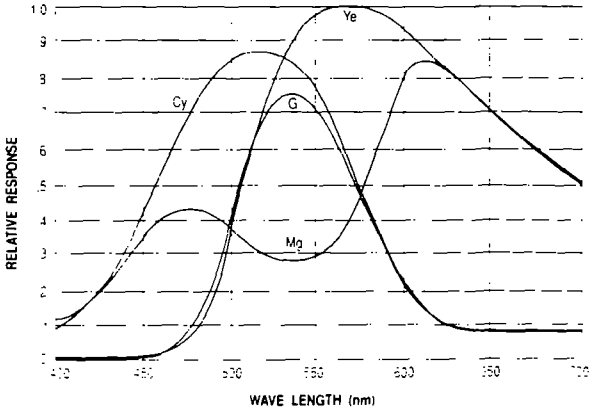
NOTE. UNLESS OTHERWISE DESIGNATED ALL DIMENSIONS IN MM AND (INCHES.

TYPICAL f/STOP VS. SHUTTER



Reference Level Set at 1/60 f22

MATRIX FILTER COLOR RESPONSES



8210 & 8310 SERIES HIGH PERFORMANCE COLOR CCD CAMERAS

ORDERING INFORMATION

8X1 X — X XXX / XXXX

Configuration

2 NTSC Format (60 Hz)

3 PAL Format (50 Hz)

Power Options

2 12V ac/dc, 50/60Hz

3 230V ac, 50 Hz, with wall transformer and connector (8310 Series only)

4 24/28 V ac/dc, 50/60 Hz

5 115V ac, 60 Hz, with wall transformer and connector (8210 Series only)

Video Format

1 NTSC/Y-C or PAL/Y-C

2 RGB/60 or RGB/50

Module Options

000 None

300 Electronic Iris*

* Electronic Iris option is designed for use with manual iris lenses only. When enabled, this option defeats electronic shutter and integration positions.

Lens Options

0000 None

Manual Iris, CS Mount
AO03 3.7mm, f1.6, 1/2"
AO06 6mm, f1.4, 1/2"
AO13 12mm, f1.4, 1/2"

Manual Iris, C Mount
AL04 4.5mm, f/2.0, 2/3"
AL06 6.5mm, f/1.8, 2/3"
AL08 8mm, f/1.4, 2/3"
AL12 12.5mm, f/1.4, 1"
AL16 16mm, f/1.4, 2/3"
AL26 25mm, f/1.6, 2/3"
AL51 50mm, f/2.8, 2/3"
AL75 75mm, f/1.8, 1"

Auto Iris, CS Mount
EH04 3.7mm, f1.6, 1/2"
EH06 6mm, f1.4, 1/2"
EH13 12mm, f1.4, 1/2"

Auto Iris, C Mount
ES05 4.8mm, f/1.8, 2/3"
ES06 6mm, f/1.2, 1/2"
ES08 8mm, f/1.4, 2/3"
ES16 16mm, f/1.4, 2/3"
ES25 25mm, f/1.4, 1"
EH35 35mm, f/1.4, 2/3"

PLEASE NOTE: Cohu welcomes the opportunity to provide special features to better serve your particular requirement. For example, custom painting, silkscreen and logo for OEM customers and special connector pin configurations can be ordered. Please contact Cohu for details.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE

NTSC, PAL CONNECTOR CONFIGURATIONS

LENS

1	Power
2	Lens Video
3	Ground

Y-C

1	Y—Ground
2	C—Ground
3	Y
4	C

REMOTE

1	Auto/Man White Balance
2	White Balance
3	Sync/Video In (color lock)
4	Shutter On/Off
5	+5
6	Ground
7	Ground
8	Grab Pulse

RGB CONNECTOR CONFIGURATIONS

REMOTE

1	Blue Level
2	Red Level
3	Sync/Horizontal In
4	Shutter On/Off
5	+5
6	Vertical In
7	Ground
8	External Gain

SYNC

1	Grab Pulse
2	Vertical Drive Out
3	Horizontal Drive Out
4	Clock Out
5	Ground

RGB

1	Ground
2	Ground
3	R
4	G
5	B
6	NC
7	Sync
8	NC
9	NC

ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

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COHU
Cohu, Inc./Electronics Division

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NEW!

HIGH PERFORMANCE COLOR CCD CAMERA

2200 SERIES

NTSC/PAL, Y-C, RGB ½" On-Chip-Microlens Interline Transfer Imager

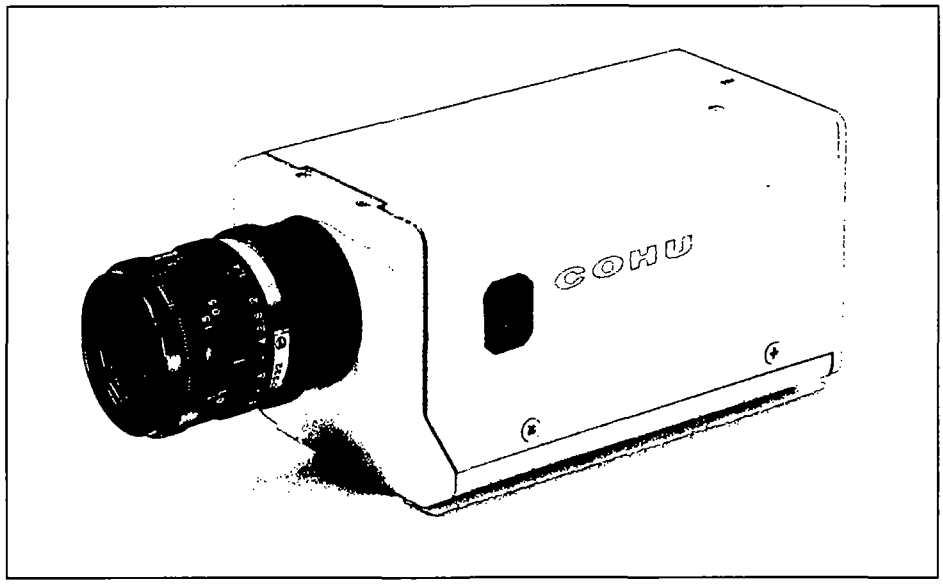
Cohu's new 2200 Series High Performance Color Cameras offers the ultimate in flexibility, features, color vibrancy, picture clarity, and reliability. With a resolution of 460 horizontal lines (450 PAL), and a size measuring only 4" x 2" x 2", the 2200 Series combines the performance edge with a compact size for industrial and scientific applications such as machine vision, medical analysis, and metrology.

The Model 2200 can offer simultaneous NTSC (or PAL), Y-C, and RGB outputs to simplify image processing and display. Special on-chip microlens sensor technology dramatically increases sensitivity while reducing blooming.

Gain, asynchronous reset, color balance, and externally-controlled integration setting are easily accessed. Optional features include RGB, genlock, electronic iris, and automatic or sample and hold white balance.

All Cohu cameras are manufactured in the U.S.A. and come with a two-year warranty and the support of experienced Applications Engineers to help make sure you achieve everything you expect from your camera.

Cohu is ISO-9001 certified.



Get a feature-rich, high performance camera in a compact, lightweight package with a Cohu 2200.

APPLICATIONS

- Machine Vision
- Medical Analysis
- Portrait Studio
- Agricultural Processing
- Microscopy (low light)
- Inspection
- Optical Measurement

FEATURES AND BENEFITS

- On Chip Microlens Interline Transfer Sensor provides high sensitivity and reduces blooming and transfer smear
- High Resolution - up to 460 horizontal TV lines for sharper images
- Small Size - only 4" x 2" x 2"
- Integration - externally controllable for low light imaging
- Asynchronous Reset
- Rear Panel Controls for precision adjustment
- High Signal-to-Noise Ratio provides clear, noise-free images
- 1000:1 Overload Capability prevents light overloads that cause blooming
- Manual Gain and Color Balance
- Optional crystal genlock
- C lens mount standard, CS optional
- Optional top or bottom mounting accessory
- Made in U.S.A. - direct factory support
- Two Year Warranty
- Meets FCC Class B and VDE Class B requirements

Designed and manufactured in U.S.A.

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2200 HIGH PERFORMANCE COLOR CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2" format)

Active Picture Elements
NTSC and RGB/60:
768 (H) x 494 (V)
PAL and RGB/50:
752 (H) x 582 (V)

Resolution

NTSC/Y-C	460 horizontal TV lines
RGB/60:	350 vertical TV lines
PAL/Y-C	450 horizontal TV lines
RGB/50:	415 vertical TV lines

Sensitivity (3200K faceplate illumination)
6.5 lux at full video, AGC off
0.3 lux at 80% video, AGC on
.08 lux at 30% video, AGC on

Shutter
Internal DIP switch, 1/60 to 1/10,000, 8 steps

Electronic Iris (Optional)
1/60 to 1/15,000 sec. auto-compensates for scene illumination

Integration
1/60 to 16 fields (active high)

Gamma
0.6

Gain AGC/Manual
0-20 dB (on/off), selectable (local/remote)

Signal-to-Noise Ratio
46 dB (AGC off @ 6.5 lux 4.5 MHz filter)

Video Output
Encoded NTSC and PAL: 1 V p-p @ 75 ohms, unbalanced composite;
S Video Y: 1 V p-p @ 75 ohm
S Video C: .285 V p-p
RGB (per channel): 0.714 V p-p @ 75 ohms, unbalanced; sync on green, 0.4 V p-p @ 75 ohms unbalanced

Auto Lens Output
Non-AGC video, DC iris drive optional

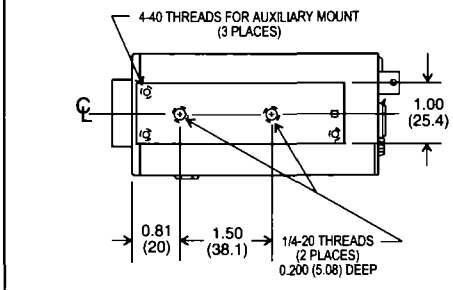
Color Balance
Automatic, through-the-lens type, less than 10 IRE units unbalanced from 2850 to 5800 K;
Local/Remote Manual White Balance

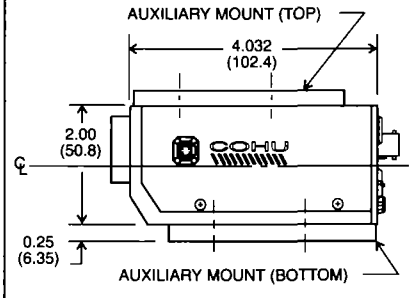
Synchronization Options
NTSC or PAL: crystal, asynchronous reset
RGB:Genlock, H&V drive (optional)

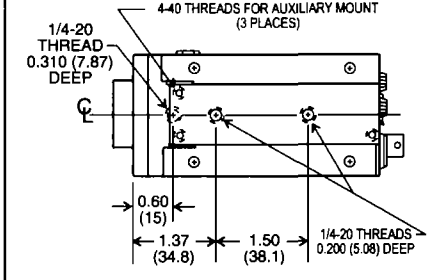
Power Requirements
12 VDC ±10%

Power Consumption
6 W

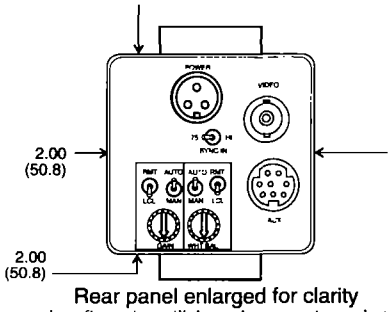
DIMENSIONS







All dimensions in inches and (mm)



Rear panel enlarged for clarity
Rear panel configuration will depend upon options selected.

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -20° to 50° C, -4° to 122° F
Storage: -30° to 70° C, -22° to 157° F

Humidity
Up to 95% relative, non condensing

Vibration (less lens)
Per Mil-STD.-810(E), Method 514.4, Categories 1, 4, 5, 8, 9, 10

Shock (less lens)
No damage to 30 g, 11 ms duration
No crash hazard to 75 g, 11 ms duration

MECHANICAL

Weight (less lens)
10 oz., (280 g.)

Lens Mount
C/CS standard

Camera Mounts
1/4-20 female, top and bottom

Connectors
Video Out: BNC; Y-C/RGB: 12 pin Aux
Lens Drive: 4 pin connector
Power In: 3 pin connector
Aux: 12 pin connector

ORDERING INFORMATION

22X	X	-X	X	X	X	/XXXX
Format	**Power Option**	**Sync**	**Iris Options**	**Color**	**Unassigned**	**Lens Options**
2 - NTSC/Y-C 5 - PAL/Y-C	2 - 12 VDC	1 - NTSC XTAL Async Reset 2 - NTSC Genlock H&V Drive 5 - PAL XTAL Async Reset 6 - PAL Genlock/H&V Drive	0 - Auto Iris 3 - Elec. Iris NTSC* 5 -Elec. Iris PAL*	0 - Manual white bal. 2 - Auto white bal. 3 - Sample & hold 4 - RGB output		0000 None Contact your Cohu representative or the factory for full lens selection.

* For manual iris lenses only.

ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

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2200 Series. Printed in U.S.A., 3/95

Microlens Sensor Technology

HIGH PERFORMANCE COLOR ENVIRONMENTAL CCD CAMERA

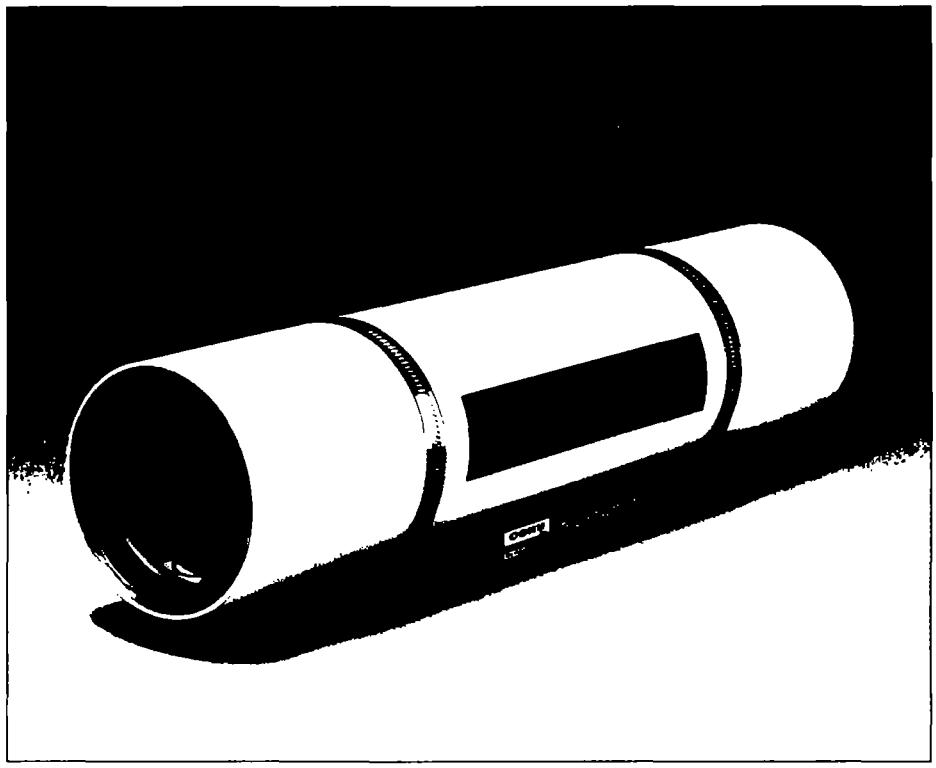
8240 SERIES

Cohu's 8240 Series is the leader in high resolution, environmentally secure CCD cameras. Special on-chip microlens sensor technology dramatically increases sensitivity while offering excellent color vibrancy, picture clarity, and reliability. The rugged, 4.5" diameter environmental housing is designed to stand up to even the harshest weather conditions.

The 8240 Series cameras provide 460 TV lines of horizontal resolution - a significant performance edge for critical applications such as security, surveillance, and traffic management.

For video applications prone to streaking problems, the microlens sensor provides a 1000:1 overload capability, which allows transmission of clear video signals, even when bright, incidental light is present in the scene.

The 8240 Series High Performance CCD cameras' sealed and pressurized environmental enclosure provides maximum protection against rain, snow, dust, humidity, chemical pollutants, extreme temperatures, and other environmental hazards.



The Cohu 8240 Series offers high performance in a rugged housing.

FEATURES AND BENEFITS

- **Superior Resolution** - 460 horizontal TV lines for sharper images
- **On-Chip Microlens Interline Transfer** dramatically increases sensitivity and virtually eliminates blooming
- **Sealed, Pressurized Environmental Housing** protects against harsh weather conditions
- **Internal Heater** allows camera to be installed in the coldest of climates
- **Selectable Integration** for low light video
- **Zero Geometric Distortion** ensures precision measurement
- **Color Lock** for consistent color rendition in multi-camera applications
- **Two Year Warranty**
- **Made In U.S.A.** for direct factory support
- **High Signal-to-Noise Ratio** provides better dynamic range

OPTIONS

- **Programmable Source ID Generator** permits incorporation of detailed messages on monitor screens
- **Fiber Optic Transmitter** for transmission of the video signal over long distances without interference or signal loss
- **Choice of Voltages**
- **Two-Digit Source ID Generator**
- **Special Engineering Revisions**

Designed and manufactured in U.S.A.

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8240 SERIES HIGH PERFORMANCE COLOR CCD CAMERAS

SPECIFICATIONS

ELECTRICAL

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2-inch format)

Active Picture Elements
768(H) x 493(V)

Resolution
Horizontal 460 TV lines
Vertical >350 TV lines

Sensitivity
3200 K faceplate illumination.
6.5 lux at full video, AGC Off.
0.5 lux at 80% video, AGC On.

Electronic Shutter*
External switch selectable, on/off.
Internal switch selectable, 1/60 second (On) to 1/10,000 second in 8 steps

Integration*
External switch selectable, on/off.
Internal switch selectable, 2 to 16 fields (8 steps).

Gamma
0.5

AGC*
0-20 dB
Internal peak-average adjustment

Signal-to-Noise Ratio (AGC Off)
48 dB (NTSC with 4.5 MHz filter)

Video Outputs
Encoded: NTSC
1 V p-p @75 ohms, unbalanced, composite
S-VHS Video (wiring requires Engineering Revision):
Y: 1 V p-p @75 ohms, unbalanced, composite
C: 0.285 V p-p

Auto Lens Operation
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction

Color Lock
Burst phase adjustment
Horizontal phase adjustment

Color Balance
Through-the-lens type
Less than 10 IRE units unbalance from 2850 to >5800 K

Synchronization
EIA RS-170 crystal, color lock standard

Power Requirements
12V ac or dc (standard), 115V ac

Power Consumption
4.5W, camera only
54.5 W, camera with heater

* Please see Standard Features section on back cover.

ENVIRONMENTAL

Ambient Temperature Limits
Operating:
-20 to 50 °C (-4° to 122° F)
-40 to 50 °C (-40° to 122° F) with optional heater
Storage:
-30 to 70 °C (-22° to 157° F)

Humidity
Up to 100% relative humidity

Vibration (less lens)
Sine vibration from 5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). Random vibration from 60 to 1000 Hz, 5 g's rms ($0.027g^2$/Hz) without damage

Shock (less lens)
Up to 15 g's, 11ms, in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

Altitude
Sea level to equivalent of 3,000m/10,000 feet (508mm/20 inches of mercury)

Air Contaminants
Withstands exposure to sand, dust, fungus, and salt atmosphere, per MIL-E-5400T, paragraph 3.2.24.7, 3.2.24.8, and 3.2.24.9

Explosion
MIL-E-5400T, paragraph 3.2.24.10

Acoustic Noise
Can withstand environments greater than 150 dB continuously for 30 minutes

EMI
FCC rules, Part 15, Subpart J, for Class A devices

Withstands exposure to sand, dust, fungus, and salt atmosphere, per MIL-E-5400T, paragraph 3.2.24.7,

MECHANICAL

Dimensions
Please see dimensional drawings.

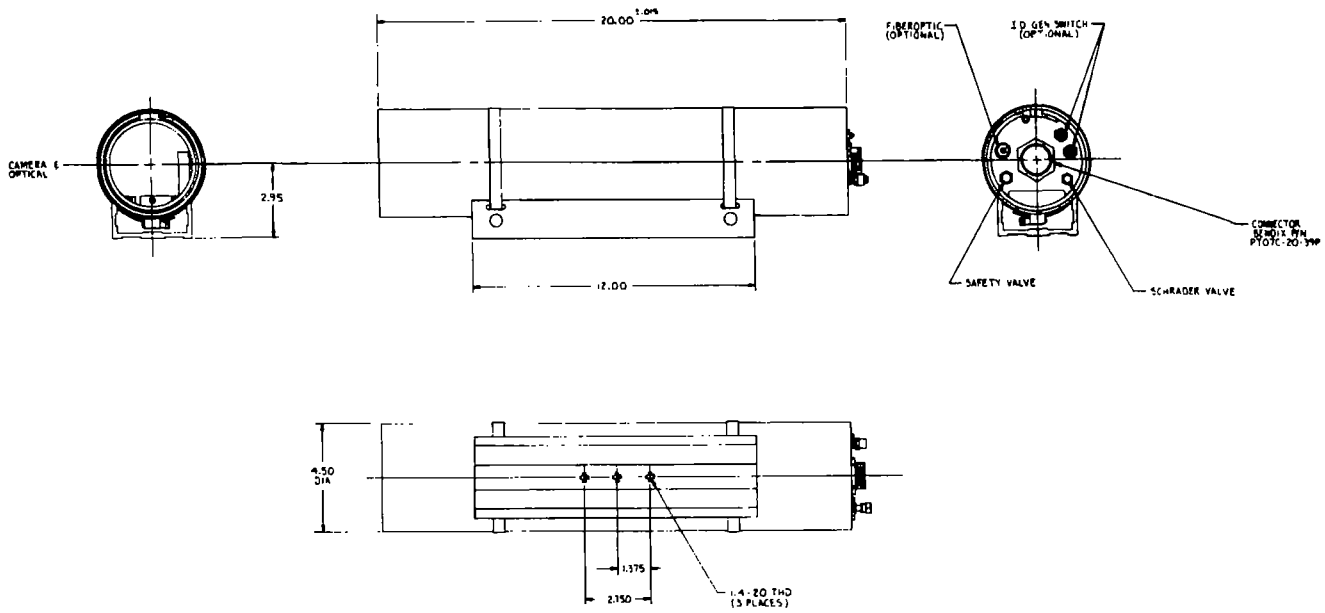
Weight (including 10:1 zoom lens)
11 pounds, 2 ounces (115V model)

Lens Mount
"CS" or "C" mount

Housing Mount
¼-20 threaded holes
Allows enclosure to be rotationally oriented in 90° increments

Purge/Relief Fitting
Schrader purge fitting
20 psi relief valve

8240 SERIES DIMENSIONS



NOTE: DIMENSIONS IN INCHES and (CM).

PIN CONFIGURATION

JI	PIN FUNCTION	JI	PIN FUNCTION
A	12/24 VAC POWER	a	PROG ID RXD -
B	REFERENCE RETURN	b	POSITION REFERENCE
C	EXT SYNC TERM.	c	AUTO/MAN IRIS SELECT
D	FOCUS POS F/B	d	12/24 VAC POWER
E	PROG ID RXD+	e	N/C
F	AUTO/MAN WHITE BAL.	f	GROUND
G	REM. SHUTTER ON/OFF	g	+5 VDC OUT
H	N/C	h	TXD -
J	VIDEO GROUND	i	TXD +
K	VIDEO OUT	j	REM WHT BAL (MAN.)
M	EXT. SYNC IN	k	N/C
N	GROUND	l	N/C
P	GROUND	m	115 VAC NEU. HEATER
R	ZOOM	n	N/C
S	FOCUS	p	N/C
T	IRIS	q	N/C
U	LENS COMMON	r	115 VAC LINE HEATER
V	115 VAC NEU. POWER		
W	115 VAC LINE POWER		
X	GROUND		
Y	POS F/B. ZOOM		
Z	GROUND		

For reference only. Always consult the maintenance manual for complete information.

PROGRAMMABLE SOURCE I.D. GENERATOR

The optional Programmable Source ID Generator is a built-in electronic circuit which allows written messages to be superimposed over images displayed on CCTV monitors. Using a computer and RS-422 serial communication, a user types messages that will then appear on the monitor. Text is made up of block letters 28 horizontal TV lines in height. The letters are white with a black outline for maximum legibility. There are two modes of operation, as follows:

1. ID Mode: Up to two lines of text (24 characters per line, including spaces) can be stored in non-volatile memory. Text can be placed at the top or bottom of the monitor screen, and can be updated from a computer or a dumb terminal, making this a real-time updatable programmable ID generator. Stored text, which typically provides information such as the location of individual cameras in multi-camera systems, will be continuously displayed until it is updated.

2. Menu Mode: In this mode, up to 12 lines of 24 characters can be entered into volatile memory without affecting data stored in the ID Mode. A computer is required to enter data in this mode.

8240 SERIES HIGH PERFORMANCE COLOR CCD CAMERAS

ORDERING INFORMATION

824X — X XXX / XXXX X

Power Options

2 12V ac, 50/60 Hz

4 24V ac, 50/60 Hz

5 115V ac, 50/60 Hz

Configuration

1 NTSC

(Note: Y-C, RGB and PAL configurations available as engineering revisions. Please consult factory.)

Module Options

000 None

010 Fiber Optic Transmitter

052 Programmable Source ID Generator

053 Programmable Source ID Generator & Fiber Optic Transmitter

Lens Options

0000 None

Auto Iris, CS Mount
EH04 3.7mm, f1.6, 1/2"
EH06 6mm, f1.4, 1/2"
EH13 12mm, f1.4, 1/2"

Auto Iris, C Mount
ES05 4.8mm, f/1.8, 2/3"
ES08 8mm, f/1.4, 2/3"
ES16 16mm, f/1.4, 2/3"
ES25 25mm, f/1.4, 1"
EH35 35mm, f/1.4, 2/3"

Zoom Lenses (1/2")
Z06R 6:1, 8—48mm, f1.0
Z10R 10:1, 8—80mm, f1.2
P06R 6:1 with presets, f1.0
P10R 10:1 with presets, f1.2

Special Options

L Low Temperature Operation

SS-425 Sunshield

For remote control and other accessories, please consult the factory.

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NOTES ON STANDARD FEATURES

Electronic Shutter/Integration: Internal switches select shutter speeds or the number of integration fields, and enable or disable the external ON/OFF control of the internally-selected shutter or integration mode. These switches are set at the factory prior to sealing and pressurizing the environmental housing. The standard factory settings disable the external ON/OFF control and provide 1/60 second shutter speed. The switches can be set differently at the factory to customer specifications, or in the field by removing the camera from the housing.

AGC Peak/Average adjustment is made via an internal control, which is set at the factory prior to sealing and pressurizing the environmental enclosure. Customer may specify different setting upon ordering.

SPECIAL FEATURES

Cohu welcomes the opportunity to provide special features to better serve your particular requirement. Some examples of special features are:

Y-C (S-VHS) Output for VCR compatibility

RGB and PAL formats

Custom painting, silkscreen, and logo

Special filters, lens supports, and mounting solutions

Special adjustment of AGC peak/average control

Customer-specified setting of Electronic Shutter or Integration mode switches

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8240 Series Rev 5/95 Printed in U.S.A.

NEW!

HIGH PERFORMANCE REMOTE-HEAD MONOCHROME CCD CAMERA

4980 SERIES

Cable Length to 100 Feet
On-Chip-Microlens Imager

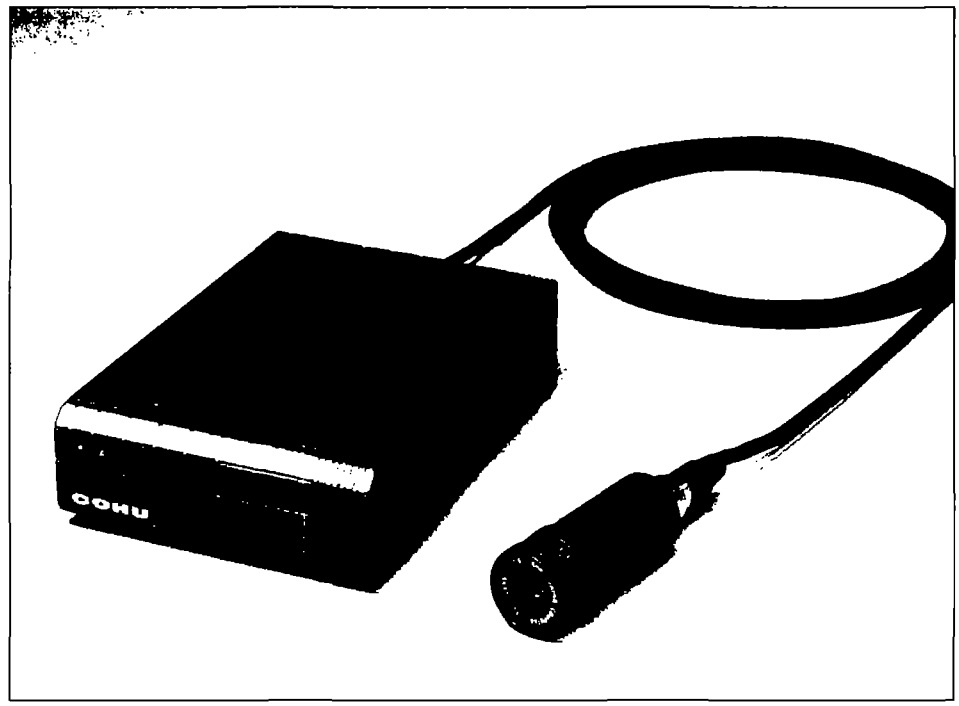
Cohu's new 4980 Series High Performance Monochrome Remote-Head CCD Cameras are the perfect solution for video applications requiring high performance in a compact package. The lightweight mini-remote head is easily incorporated into microscopes, medical instruments, and machine vision systems, and is ideal for specialized security/surveillance applications.

Available in RS-170 and CCIR models, these high resolution cameras employ a half-inch format interline transfer imager with on-chip microlenses for unparalleled sensitivity and minimal blooming. For additional sensitivity in low-light conditions, they provide 26 dB AGC and variable field/frame integration capabilities.

For video applications prone to streaking problems, the sensor provides a 1000:1 overload capability, which allows transmission of clear video signals even when bright incidental light is present in the scene.

4980 Series cameras are backed by a full two-year warranty. They're rugged, yet lightweight and compact — ideal for easy system integration. For easy access to camera controls, they have a removable trim plate on the camera control unit.

This camera is available in color models. Please request literature on Cohu's 8280 Series. We welcome requests for special products and complete CCTV systems.



The mini-remote head can be separated from the CCU by up to 100 feet of cable.

APPLICATIONS

- **Image Processing**
- **Machine Vision**
- **Microscopy**
- **Endoscopy**
- **Process Control**
- **Quality Control**
- **Image Analysis**
- **Security/Surveillance**

FEATURES AND BENEFITS

- **Compact, Lightweight Mini-Remote Head** — only 1.125" diameter means maximum flexibility for end users or OEMs
- **Variable length cable** up to 100 feet between head and CCU
- **Camera Head Connector** for complete interchangeability better definition, error-free results
- **High Resolution** — for better definition, error-free results
- **On-Chip-Microlens Interline Transfer Imager** dramatically increases sensitivity and virtually eliminates streaking and blooming.
- **Eight-Speed Electronic Shutter** reduces blurred images of fast-moving objects.
- **Choice of Synchronization Options** — Asynchronous reset, genlock, H & V drive, line lock, or crystal
- **High Signal-to-Noise Ratio** for clear, noise-free video
- **Optional Electronic Iris** automatically controls exposure.
- **Asynchronous Reset** provides random vertical reset capability for production line applications.
- **Made in U.S.A.** — direct factory support
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras.
- **No Lag or Image Retention** — provides fast, clean images
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **26 dB AGC** for increased sensitivity at low light levels
- **Optional IR Filter**
- **Field or Frame Integration** — for added sensitivity in low-light-level imaging applications
- **Choice of RS-170 & CCIR Models**
- **Two-Year Warranty**
- **Special Configurations** for OEMs and end users

Designed and Manufactured in U.S.A.

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Cohu, Inc./Electronics Division

4980 SERIES HIGH PERFORMANCE REMOTE-HEAD CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Image Area
6.4 x 4.8 mm (corresponding to 1/2" image tube)

Active Picture Elements
RS-170: 768H x 494V
CCIR: 752H x 582V

Imager Type
Interline transfer CCD with on-chip microlenses

Cell Size
RS170: 8.4 x 9.8 microns
CCIR: 8.6 x 8.3 microns

Resolution
RS170: 580 horizontal TVL, 350 vertical TVL
CCIR: 560 horizontal TVL, 450 vertical TVL

Sensitivity (faceplate) @2850 K
0.65 lux at full video, AGC off
0.02 lux at 80% video, AGC on
0.016 lux at 30% video, AGC on

Electronic Shutter
Eight steps from 1/50 or 1/60 to 1/10,000 second (1/50 or 1/60, 1/125, 1/500, 1/1,000, 1/2,000, 1/4,000, and 1/10,000 second)

Integration
Integration period controllable through external input pulse
Grab pulse output
Field (1/60 or 1/50 second) or Frame (1/30 or 1/25 second) integration selected by internal jumper

Video Output
1.0 V p-p @75 ohms, unbalanced

AGC
26 dB, variable gain

Signal-to-Noise Ratio
50 dB at gamma 1, gain 0 dB

Auto Lens
Separate lens video signal tracks AGC peak/average adjustment to eliminate AGC/auto lens interaction
Power: +15V, 35 mA maximum

Gamma
Variable 0.45 to 1.0

Synchronization
Genlock, revert to variable phase line lock with zero crossing detector
Genlock, revert to crystal
Crystal Lock
H & V Drive
Asynchronous Reset
Internal Clock Speeds
RS170: 28.6363 MHz
CCIR: 28.375 MHz

Power Requirements
12V ac or dc (standard)
115V ac (optional on RS-170 models, includes wall transformer and connector)
230V ac (optional on CCIR models, includes wall transformer and connector)
4.2 watts dc power consumption
LED Power Indicator, Green

MECHANICAL

Dimensions (less lens/cable)
Camera Head: 1.125" dia. x 2.00" length (28.57 x 50.8 mm)
CCU: 1.7"(H) x 5.0"(W) x 6.9"(D) (43.2 x 127 x 175.3 mm)

Weight
Camera Head: 4 ounces (113 grams)
CCU: 27.5 ounces (780 grams)
Cable: 1/2 ounce/ft. (45 grams/m)

Lens Mount
Adjustable "C" mount

CCU Controls
Electronic Shutter
AGC peak/average
AGC On/Off
Manual Gain
Gamma
Sharpness

CCU Connectors
Video (BNC)
Camera Head (15 pin "D" subminiature)
Power (2 circuit screw terminal)
Lens (3 pin Mini-DIN)
External Sync (8 pin DIN)
Pin 1. Ext. Vertical Trigger In
Pin 2. Ext. Sync/Horizontal Trigger In
Pin 3. Grab Pulse Out (–)
Pin 4. Ground
Pin 5. Ground
Pin 6. Vertical Reset In
Pin 7. Grab Pulse Out (+)
Pin 8. Integrate Input

ORDERING INFORMATION

498X — X X X X XXXX

Power Options
2 12V ac or dc
3 230V ac, 50 Hz, with ac wall adapter (CCIR models)
4 24VAC/VDC
5 115V ac, 60 Hz, with ac wall adapter (RS 170 models)

Sync Options
2 Genlock (revert to crystal) RS-170
3 Genlock (revert to line lock) RS-170*
4 Asynchronous Reset RS-170
5 Genlock (Revert to crystal CCIR)
6 Genlock (revert to linelock CCIR)*
7 Asynchronous reset (CCIR)

*Line lock or variable phase adjustable.

Optical Filters
0 None
1 IR Filter (Non-removable)

Options
0 Field Mode
1 Frame Integration Mode
3 Electronic Iris*

* Electronic Iris option is designed for use with manual iris lenses only. With this option, the camera operates in the field integration mode. Use of the electronic iris defeats electronic shutter positions.

Cable Length
1 10 Feet
2 25 Feet
3 50 Feet
4 100 Feet

Lens Options
Manual Iris, C Mount
***AL04** 4.5mm, f/2.0, 2/3"
***AL08** 8mm, f/1.4, 2/3"
AL16 16mm, f/1.4, 2/3"
AL25 25mm, f/1.4, 1"
AL50 50mm, f/1.4, 1"
* Wide Angle

Auto Iris, C Mount
ES04 4.2mm, f/1.6, 1/2"
ES05 4.8mm, f/1.8, 2/3"
ES08 8mm, f/1.4, 2/3"
ES12 12.5mm, f/1.4, 1"
ES16 16mm, f/1.4, 2/3"
ES25 25mm, f/1.4, 1"
EH35 35mm, f/1.4, 2/3"
ES50 50mm, f/1.4, 1"
EH75 75mm, f/1.8, 1"
Other lenses are available. Please consult factory.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -20 to 60 °C (-4° to 140° F)
Storage: -30 to 70 °C (-22° to 157° F)

Humidity
Up to 95% relative humidity

Vibration
Sine vibration from 5 to 2,000 Hz, 5 g's peak, all 3-axis, 1/2 hr. per axis per MIL-E-5400T, para 3.2.24.5.1.2, fig. 2, curve IIIa.
Random vibration from 10 to 2,000 Hz, 11 g's rms, all 3-axis, 1/2 hr. per axis, per MIL-E-5400T, para 3.2.24.5.1.2, category 6.

Shock
Up to 15 g's in any axis under nonoperating conditions

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PO Box 85623 San Diego, CA 92186-5623
Telephone: (619) 277-6700 • FAX: (619) 277-0221

COHU
Cohu, Inc./Electronics Division

HIGH PERFORMANCE REMOTE-HEAD MONOCHROME CCD CAMERA

4990 SERIES

High Sensitivity On-Chip-Microlens Imager

Cohu's new 4990 Series High Performance Monochrome Remote-Head CCD Cameras are the perfect solution for video applications requiring high performance in a compact package. The lightweight remote head is easily incorporated into microscopes, medical instruments, and machine vision systems, and is ideal for specialized security/surveillance applications.

Available in RS-170 and CCIR models, these high resolution cameras employ a half-inch format HAD interline transfer imager with on-chip microlenses for unparalleled sensitivity and minimal blooming. For additional sensitivity in low-light conditions, they provide 26 dB AGC and variable field/frame integration capabilities.

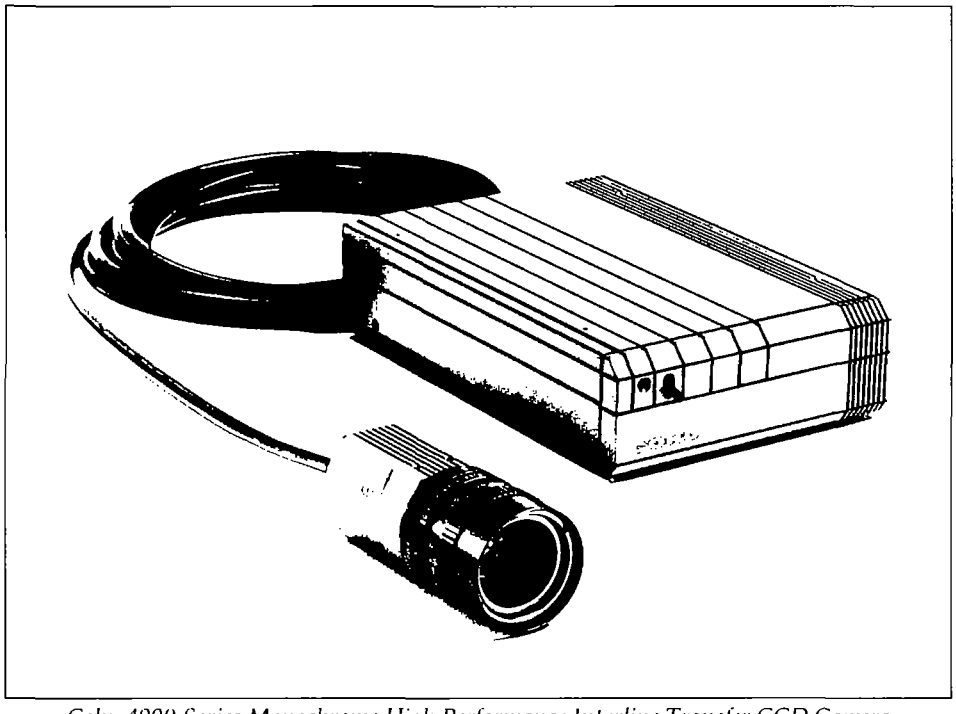
For video applications prone to streaking problems, the sensor provides a 1000:1 overload capability, which allows transmission of clear video signals even when bright incidental light is present in the scene.

4990 Series cameras are backed by a full two-year warranty. They're rugged, yet lightweight and compact — ideal for easy system integration. For easy access to camera controls, they have a removable trim plate on the camera control unit.

Cohu has been a leading U.S. manufacturer of closed circuit video cameras and systems for over 40 years. We welcome requests for special products and complete CCTV systems.

APPLICATIONS

- **Image Processing**
- **Machine Vision**
- **Microscopy**
- **Endoscopy**
- **Process Control**
- **Quality Control**
- **Image Analysis**
- **Security/Surveillance**



Cohu 4990 Series Monochrome High Performance Interline Transfer CCD Camera

FEATURES AND BENEFITS

- **Compact, Lightweight Remote Head** — maximum flexibility for end users or OEMs
- **High Resolution** — for better definition, error-free results
- **On-Chip-Microlens Interline Transfer Imager** dramatically increases sensitivity and virtually eliminates streaking and blooming.
- **Eight-Speed Electronic Shutter** reduces blurred images of fast-moving objects.
- **High Sensitivity** permits operation over a broad range of light levels.
- **Choice of Synchronization Options** for greater versatility
- **High Signal-to-Noise Ratio** for clear, noise-free video
- **Asynchronous Reset** provides random vertical reset capability for production line applications.
- **Optional Electronic Iris** automatically controls exposure
- **Made in U.S.A. —** direct factory support
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras.
- **No Lag or Image Retention —** provides fast, clean images
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **26 dB AGC** for increased sensitivity at low light levels
- **Optional IR Filter**
- **Field or Frame Integration** — for added sensitivity in low-light-level imaging applications
- **State-of-the-Art Design and Construction** for total, solid-state

Designed and Manufactured in U.S.A.

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4990 SERIES HIGH PERFORMANCE REMOTE-HEAD CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Image Area
6.4 x 4.8 mm (corresponding to ½" image tube)

Active Picture Elements
RS-170: 768H x 494V
CCIR: 752H x 582V

Imager Type
HAD interline transfer CCD with on-chip microlenses

Cell Size
RS170: 8.4 x 9.8 microns
CCIR: 8.6 x 8.3 microns

Resolution
RS170: 580 horizontal TVL, 350 vertical TVL
CCIR: 560 horizontal TVL, 450 vertical TVL

Sensitivity (faceplate) @2850 K
0.65 lux at full video, AGC off
0.05 lux at 80% video, AGC on

Electronic Shutter
Eight steps from 1/50 or 1/60 to 1/10,000 second (1/50 or 1/60, 1/125, 1/500, 1/1,000, 1/2,000, 1/4,000, and 1/10,000 second)

Integration
Integration period controllable through external input pulse
Grab pulse output
Field (1/60 or 1/50 second) or Frame (1/30 or 1/25 second) integration selected by internal jumper

Video Output
1.0 V p-p @75 ohms, unbalanced

AGC
20 dB, variable gain

Signal-to-Noise Ratio
≥56 dB at gamma 1, gain 0 dB
38 dB at gamma 1, AGC On

Auto Lens
Separate lens video signal tracks AGC peak/average adjustment to eliminate AGC/auto lens interaction
Power: +15V, 35 mA maximum

Gamma
Variable 0.45 to 1.0

Synchronization
Genlock, revert to variable phase line lock with zero crossing detector
Genlock, revert to crystal
Crystal Lock
H & V Drive
Asynchronous Reset
Internal Clock Speeds
RS170: 28.6363 MHz
CCIR: 28.375 MHz

Power Requirements
12V ac or dc (standard)
115V ac (optional on RS-170 models, includes wall transformer and connector)
230V ac (optional on CCIR models, includes wall transformer and connector)
4.2 watts dc power consumption
LED Power Indicator, Green

MECHANICAL

Dimensions (less lens)
Camera Head: 1.50" dia. x 2.00" length (38.1 x 50.8 mm)
CCU: 1.7"(H) x 5.0"(W) x 6.9"(D) (43.2 x 127 x 175.3 mm)

Weight
Camera Head (less lens and cable): 4 ounces (113 grams)
15' Remote Cable: 17 ounces (483 grams)
CCU: 27.5 ounces (780 grams)

Lens Mount
Adjustable "C" mount

CCU Controls
Electronic Shutter
AGC peak/average
AGC On/Off
Manual Gain
Gamma
Sharpness

Connectors
Video (BNC)
Power (2 circuit screw terminal)
Lens (3 pin Mini-DIN)
External Sync (8 pin DIN)
Pin 1. External Vertical Trigger In
Pin 2. External Sync/Horizontal Trigger In
Pin 3. Grab Pulse Out ( )
Pin 4. Ground
Pin 5. Ground
Pin 6. Vertical Reset In
Pin 7. Grab Pulse Out (+)
Pin 8. Integrate Input
Camera Head (15 pin "D" subminiature)

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -20 to 60 °C (-4° to 140° F)
Storage: -30 to 70 °C (-22° to 157° F)

Humidity
Up to 95% relative humidity

Vibration
Sine vibration from 5 to 2,000 Hz. 5 g's peak, all 3-axis, 1/2 hr. per axis per MIL-E-5400T, para 3.2.24.5.1.2, fig. 2, curve IIIa.
Random vibration from 10 to 2,000 Hz. 11 g's rms, all 3-axis, 1/2 hr. per axis, per MIL-E-5400T, para 3.2.24.5.1.2, category 6.

Shock
Up to 15 g's in any axis under nonoperating conditions

ORDERING INFORMATION

499X — X X X X XXXX

Power Options
2 12V ac or dc
3 230V ac, 50 Hz, with ac wall adapter (CCIR models)
5 115V ac, 60 Hz, with ac wall adapter (RS-170 models)

Sync Options
2 Genlock* (revert to crystal)
3 Genlock* (revert to phase adjustable line lock)
8 Asynchronous Reset

* Genlock can be composite sync or separate H & V drive

Optical Filters
0 None
1 IR Filter (Non-removable)

Options
0 None (Standard TV Rate)
1 Frame Integration Mode
3 Electronic Iris*

* Electronic Iris option is designed for use with manual iris lenses only. With this option, the camera operates in the field integration mode. Use of the electronic iris defeats electronic shutter positions

Video Format
1 RS-170 (EIA)
5 CCIR

Lens Options
Manual Iris, C Mount
***AL04** 4.5mm, f/2.0, 2/3"
***AL08** 8mm, f/1.4, 2/3"
AL16 16mm, f/1.4, 2/3"
AL25 25mm, f/1.4, 1"
AL50 50mm, f/1.4, 1"
* Wide Angle
Auto Iris, C Mount
ES04 4.2mm, f/1.6, 1/2"
ES05 4.8mm, f/1.8, 2/3"
ES08 8mm, f/1.4, 2/3"
ES12 12.5mm, f/1.4, 1"
ES16 16mm, f/1.4, 2/3
ES25 25mm, f/1.4, 1
EH35 35mm, f/1.4, 2/3"
ES50 50mm, f/1.4, 1"
EH75 75mm, f/1.8, 1"

Other lenses are available. Please consult factory.

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Printed in U.S.A. 92-03 (8-92) April 93

TWO-YEAR WARRANTY

REMOTE-HEAD MONOCHROME FRAME-TRANSFER CCD CAMERAS

6400 & 6700 SERIES

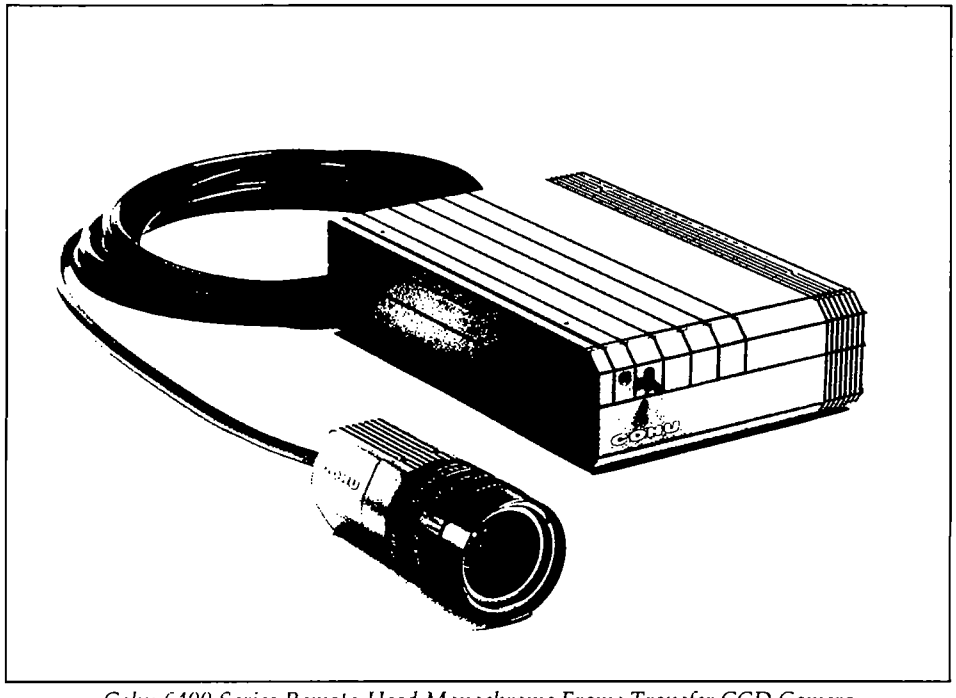
Compact, Lightweight Electronic Shutter

Cohu's Monochrome Remote-Head Frame-Transfer CCD Cameras offer all the outstanding performance characteristics of Cohu's 4800 and 4700 Series standard monochrome frame-transfer cameras, with the added benefits of a two-piece configuration, electronic shutter, and enhanced signal-to-noise characteristics. The lightweight remote camera head is ideally suited for mounting on microscopes, robots, and other equipment with size and weight limitations.

Both the 6400 Series RS-170 and the 6700 Series CCIR cameras provide high resolution and high sensitivity. The blemish-free CCD sensor provides pixel-to-pixel contrast variation of less than 5%, with zero geometric distortion and no lag or image retention.

Connected to the camera control unit by an integral 15-foot cable, the remote camera head weighs only 113 grams, and measures only 38mm in diameter and 51mm in length.

As with all Cohu CCD cameras, the 6400 and 6700 Series cameras are designed and manufactured in U.S.A., and are backed by a full two-year warranty.



Cohu 6400 Series Remote-Head Monochrome Frame Transfer CCD Camera

APPLICATIONS

- **Microscopy**
- **Machine Vision**
- **Medical Imaging**
- **Process Control**
- **Quality Control**
- **Image Analysis**
- **Security/Surveillance**

FEATURES AND BENEFITS

- **Compact, Lightweight Remote Head** — maximum flexibility for end users or OEMs
- **High Resolution** — for better definition, error-free results
- **Two-Speed Electronic Shutter** reduces blurred images of fast-moving objects.
- **High Sensitivity** permits operation over a broad range of light levels.
- **Genlock, H & V Drive, Pixel Clock Outputs** for machine vision interface
- **High Signal-to-Noise Ratio** for better dynamic range.
- **Auto Black** for contrast enhancement
- **100% Blemish-Free Frame-Transfer Image Sensor** — no dead pixels.
- **Made in U.S.A.** — direct factory support
- **No Lag or Image Retention** — provides fast, clean images
- **Zero Geometric Distortion** for consistent corner-to-corner linearity
- **Selectable AGC Ranges** for better control under varying light conditions
- **Optional IR Filter**
- **State-of-the-Art Design and Construction** for high performance, reliability and long life
- **Choice of RS-170 & CCIR Models**
- **Two-Year Warranty**
- **15' Remote Cable** facilitates system design and installation.
- **Special Configurations** for OEMs and end users

Designed and Manufactured in U.S.A.

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6400 & 6700 SERIES REMOTE-HEAD FRAME-TRANSFER CCD CAMERAS

SPECIFICATIONS

ELECTRICAL

Imager Type
Single CCD using frame-transfer method

Image Area
6.4 x 4.8 mm (corresponding to ½" image tube)

Active Picture Elements
RS-170: 755H x 242V
CCIR: 699H x 288V

Cell Size
RS170: 8.5(H) x 19.5 (V) microns
CCIR: 9.2(H) x 16.8(V) microns

Resolution
RS170: 550 horizontal TV lines, 350 vertical TV lines
CCIR: 525 horizontal TV lines, 415 vertical TV lines

Sensitivity (faceplate) @2850 K
0.25 lux at full video, AGC off
0.009 lux at 80% video, AGC on

Contrast Variation
<5% overall at gamma 1, gain 0 dB

Electronic Shutter
Switch selectable, $\frac{1}{1,000}$ second, $\frac{1}{2,000}$ second, and Off

Video Output
1.0 V p-p @75 ohms, unbalanced

AGC
Switch selectable, Off/Low Gain/High Gain
Peak-average adjustable
Low Gain: 0 - 6 dB
High Gain: 0 - 20 dB

Auto Black
Maintain set-up level at 7.5 ±5 IRE units if picture contains at least 10% black

Signal-to-Noise Ratio
≥56 dB at gamma 1, gain 0 dB
38 dB at gamma 1, AGC On

Auto Lens
Separate lens video signal tracks AGC peak/average adjustment to eliminate AGC/auto lens interaction
Power: +9V, 100 mA maximum

Gamma
0.5 or 1.0 jumper selectable

Synchronization
Genlock, revert to crystal
Genlock, revert to phase adjustable line lock
External H & V Drive
Internal Clock Speeds
RS170: 14.31818 MHz
CCIR: 14.375 MHz

Power Requirements
4.5 watts dc (without lens)

MECHANICAL

Dimensions (less lens)
Camera Head: 1.50" dia. x 2.00" length (38.1 x 50.8 mm)
Cable: 15 feet (4.57 meters)
CCU: 1.7"(H) x 5.0"(W) x 7.3"(D) (43.7 x 127 x 189 mm)

Weight
Camera Head (less lens and cable): 4 ounces (113 grams)
Remote Cable: 17 ounces (483 grams)
CCU: 29 ounces (822 grams)

Lens Mount
Adjustable "C" mount, 16mm format

Connectors
BNC connector — Video Out
Switchcraft TB4M — Lens Drive
Switchcraft TB3M — Power In
Hirose SR30-10R-7S — Auxiliary

ENVIRONMENTAL

Ambient Temperature Limits
Operating: -10 to 50°C (14 to 122°F)
Storage: -30 to 70 °C (-22 to 157°F)

Humidity
Up to 95% relative humidity

Vibration
5 to 60 Hz with 0.082 inch total excusion (15 g's @ 60 Hz). From 60 to 1,000 Hz, 5 g's rms random vibration without damage.

Shock (less lens)
Remote head: Up to 30 g's.
CCU: Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

Altitude
Sea level to the equivalent of 3,000 meters or 10,000 feet (508mm/20 inches of mercury)

ORDERING INFORMATION

6X	1X	—	X	XXX	/ XXXX
Video Format	Power Options		Sync Options	Optical Filters	Lens Options
4 RS-170 (EIA) **7** CCIR	**2** 12V ac or dc **3** 230V ac, 50 Hz, with ac wall adapter (CCIR models) **5** 115V ac, 60 Hz, with ac wall adapter (RS-170 models)		**2** Genlock (revert to crystal) **3** Genlock (revert to phase adjustable line lock) **7** External H & V Drive (revert to crystal)	**000** None **100** IR Filter (non-removable)	**Manual Iris, C Mount** ***AL04** 4.5mm, f/2.0, 2/3" ***AL08** 8mm, f/1.4, 2/3" **AL09** 9mm, f/1.4, 2/3" **AL16** 16mm, f/1.4, 2/3" **AL26** 25mm, f/1.6, 2/3" **AL51** 50mm, f/1.8, 2/3" * Wide Angle **Auto Iris, C Mount** **ES04** 4.2mm, f/1.6, 1/2" **ES06** 6mm, f/1.2, 1/2" **ES08** 8mm, f/1.4, 2/3" **ES13** 12mm, f/1.2, 1/2" **ES16** 16mm, f/1.4, 2/3" **ES25** 25mm, f/1.4, 1" **EH35** 35mm, f/1.4, 2/3" NOTE: Auto iris lenses require auto iris cable assembly 8352-1, to be ordered separately.

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6400 Series 5/95 Printed in U.S.A.

Microlens Sensor Technology

HIGH PERFORMANCE COLOR MINI-REMOTE-HEAD CCD CAMERAS

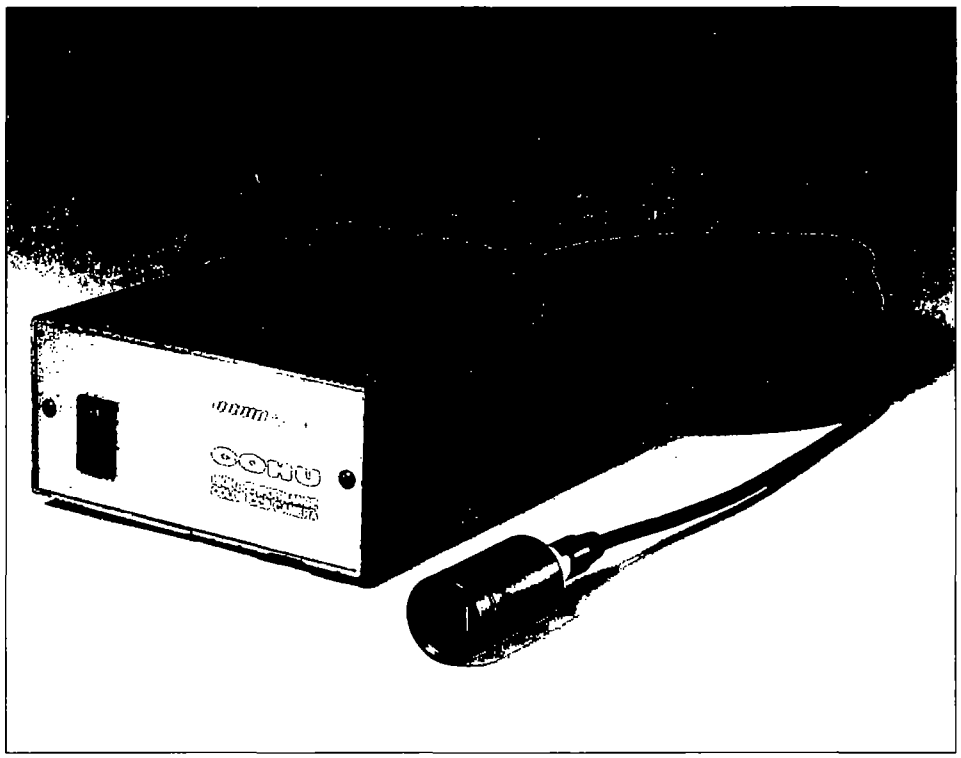
8280 & 8380 SERIES

Cable Lengths to 100 Feet
Reduced Head Size

Cohu's new 8280 and 8380 Series High Performance Color Mini-Remote-Head CCD Cameras are the perfect solution for remote-head camera applications requiring extended cable lengths and reduced head size. The mini-remote camera head connects to the camera control unit with a fully detachable cable, which can be ordered in lengths of 10, 25, 50, or 100 feet. The lightweight remote head is easily incorporated into microscopes, medical imaging systems, and machine vision systems.

Available in NTSC/Y-C, PAL/Y-C, and RGB models, these high resolution cameras use on-chip microlens technology, which dramatically increases sensitivity by placing an individual lens on each pixel of the sensor.

Designed and manufactured in the U.S.A., 8280 and 8380 Series High Performance Color Mini-Remote-Head CCD Cameras are backed by a two-year warranty.



Cohu High Performance Color Mini-Remote-Head CCD Camera with 50' Cable (less lens)

FEATURES AND BENEFITS

- **Compact, Lightweight Mini-Remote Head** — 1.125" diameter facilitates camera operation and integration
- **Selectable Cable Lengths** — up to 100 feet
- **On-Chip Microlens Sensor** enhances sensitivity and dynamic range, reduces vertical smear
- **High Resolution** — 460 horizontal TV lines for sharper images
- **High Sensitivity** — permits operation over a wide range of light levels
- **Convenient External Adjustments** for shutter speed, integration period, AGC, white balance controls
- **Two Year Warranty**
- **Eight-Speed Electronic Shutter** reduces blurring of fast-moving objects or provides electronic iris capability
- **Selectable Integration Periods with Grab Pulse** — for low light level microscopy applications.
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras
- **AGC with Peak-Average Adjustment** for clear images in varying light level applications
- **Made in U.S.A.** — direct factory support, quality design and construction.

APPLICATIONS

- **Microscopy**
- **Image Processing**
  Medical and Industrial
- **Machine Vision**
  Pattern Recognition
  Non-Contact Measurement
  3-D Imaging
  Inspection
- **Robotics**
- **Computer Graphics**
- **Remote Sensing**
- **Mapping**
- **Teleradiology**
- **Quality Control**
- **Teleconferencing**
- **Security/Surveillance**

Designed and manufactured in U.S.A.

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8280 & 8380 SERIES MINI-REMOTE-HEAD COLOR CCD CAMERAS

SPECIFICATIONS

ELECTRICAL — NTSC and PAL Models

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2" format)

Active Picture Elements
NTSC/Y-C: 768(H) x 493(V)
PAL/Y-C: 752(H) x 582(V)

Resolution
NTSC/Y-C: Horizontal 460 TV lines
Vertical 350 TV lines
PAL/Y-C: Horizontal 450 TV lines
Vertical 415 TV lines

Sensitivity
3200 K faceplate illumination.
6.5 lux at full video, AGC Off.
0.5 lux at 80% video, AGC On.

Electronic Shutter
Switch selectable, 1/60 second (off) to 1/10,000 second (8 steps)

Integration
Switch selectable, 2 to 16 fields (8 steps). Grab pulse available

Gamma
0.6

AGC
0-20 dB
Peak-average adjustable

Signal-to-Noise Ratio (AGC Off)
48 dB (NTSC with 4.5 MHz filter)
45 dB (PAL with 5 MHz filter)

Video Outputs
Encoded: NTSC and PAL
1 V p-p @75 ohms, unbalanced, composite
S Video:
Y: 1 V p-p @75 ohms, unbalanced, composite
C: 0.285 V p-p

Auto Lens Output
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction

Color Lock
Burst phase adjustment
Horizontal phase adjustment

Color Balance
Through-the-lens type
Less than 10 IRE units unbalance from 2850 to >5800 K

Synchronization
NTSC or PAL crystal, color lock standard

Power Requirements
12V ac or dc (standard)
115V ac, 60 Hz for NTSC models (optional, with wall transformer)
230V ac, 50 Hz for PAL models (optional, with wall transformer)

Power Consumption
4.5W

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –20 to 50 °C
(–4° to 122° F)
Storage: –30 to 70 °C
(–22° to 157° F)

Humidity
Up to 95% relative humidity, non-condensing

Vibration (less lens)
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage

Shock (less lens)
Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

Altitude
Sea level to equivalent of 3,000m/10,000 feet (508mm/20 inches of mercury)

MECHANICAL

Dimensions (less lens/cable)
Camera Head: 1.125" dia. x 2.41" length (38.1 x 60 mm)
CCU: 2.63" (H) x 5.75" (W) x 7.75"(D)
(65 mm x 148 mm x 200mm)

Weight
Camera Control Unit (12 V model): 36 ounces (1000 grams)
Camera Head (less lens and cable): 1.75 ounces (49 grams)
10' Remote Cable: 7.5 ounces (205 grams)

Lens Mount
"CS" mount standard, "C" mount adapter furnished

Connectors (NTSC and PAL Models)
BNC connector—Video Out
4 Circuit MINI-DIN — Y-C
3 Circuit MINI-DIN — Lens Drive
2 Circuit Terminal Strip — Power In
15 Circuit "D" — Camera Head
8 Circuit MINI-DIN — Remote
Pin 1: Auto/Man White Balance
Pin 2: White Balance
Pin 3: Sync/Video In
Pin 4: Shutter On/Off
Pin 5: +5
Pin 6: Ground
Pin 7: Ground
Pin 8: Grab Pulse

ORDERING INFORMATION

8X8 X — X XX X / XXXX

Video Format
2 NTSC/Y-C
3 PAL/Y-C*

Power Options
2 12V ac/dc
3 230V ac, 50 Hz. with wall transformer (8380 Series only)
4 24V ac/dc, 28V dc
5 115V ac, 60 Hz with wall transformer (8280 Series only)

Configuration
1 NTSC or PAL
2 RGB*

Board Options
00 None
30 Electronic Iris**

** For use with manual iris lenses only. When enabled, this option disables the electronic shutter and integration positions.

Cable Options
1 10 feet
2 25 feet
3 50 feet
4 100 feet

Lens Options
Manual Iris, CS Mount
AO03 3.7mm, f1.6, 1/2"
AO06 6mm, f1.4, 1/2"
AO13 12mm, f1.4, 1/2"

Manual Iris, C Mount
AL04 4.5mm, f/2.0, 2/3"
AL06 6.5mm, f/1.8, 2/3"
AL08 8mm, f/1.4, 2/3"
AL12 12.5mm, f/1.4, 1"
AL16 16mm, f/1.4, 2/3"
AL26 25mm, f/1.6, 2/3"
AL51 50mm, f/2.8, 2/3"
AL75 75mm, f/1.8, 1"

Please consult factory for additional lens selections.

*Contact factory prior to placing order.

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8280/8380 Series Printed in USA 3/95

NEW! On-Chip Microlens Sensor

HIGH PERFORMANCE COLOR REMOTE-HEAD CCD CAMERAS

8290 & 8390 SERIES

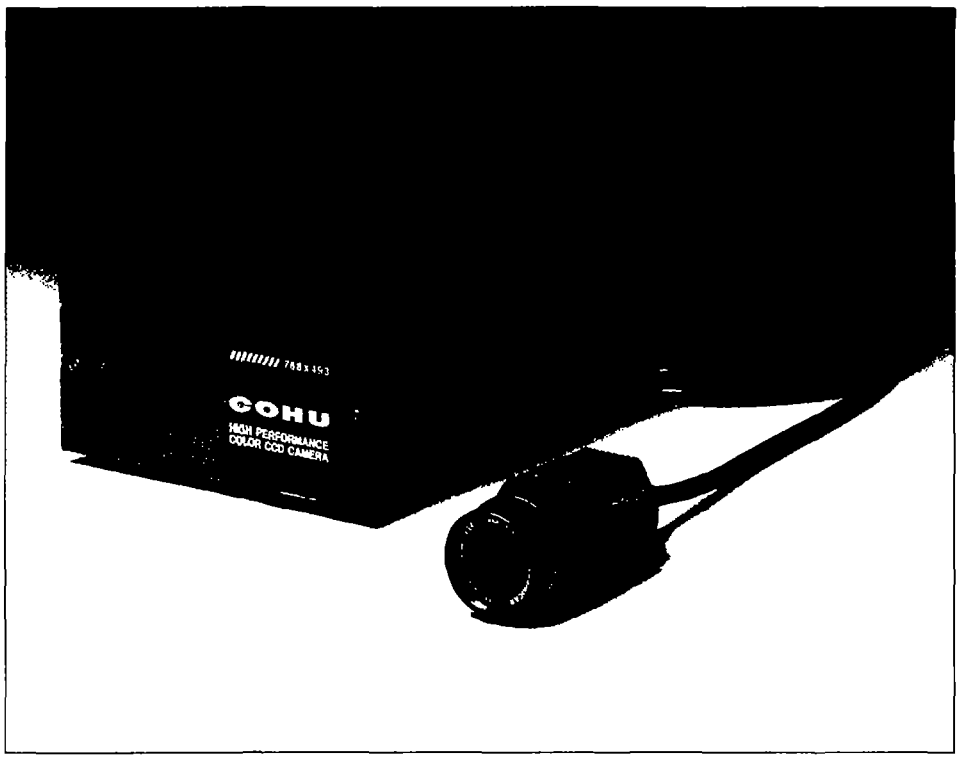
NTSC/Y-C, PAL/Y-C, or RGB On-Chip Microlens Sensor

Cohu's new 8290 and 8390 Series High Performcance Color Remote-Head CCD Cameras are the perfect solution for applications requiring high performance in a compact package. The lightweight remote head is easily incorporated into microscopes and machine vision systems, and is ideal for specialized security/surveillance applications.

Available in NTSC/Y-C, PAL/Y-C, and RGB models, these high resolution cameras use on-chip microlens HAD sensor technology, which enhances dynamic range and sensitivity while reducing vertical smear.

An easily removable trim plate on the camera control unit provides convenient access to electronic shutter timing, integration, AGC, and white balance controls.

Designed and manufactured in the U.S.A., 8290 and 8390 Series High Performance Color Remote-Head CCD Cameras are backed by a two-year warranty. OEM engineering requests are welcomed.



Cohu High Performance Color Remote-Head CCD Camera

FEATURES AND BENEFITS

- **Compact, Lightweight Remote Head** — for easy installation and operation
- **On-Chip Microlens Sensor** enhances sensitivity and dynamic range, reduces vertical smear
- **High Resolution** — 460 horizontal TV lines for sharper images
- **High Sensitivity** — permits operation over a wide range of light levels
- **Convenient External Adjustments** for control of shutter speed, integration period, AGC, and other critical parameters
- **Zero Geometric Distortion** ensures precision measurement.
- **Two Year Warranty**
- **Choice of Video Formats** — including Y-C and RGB outputs for specialized applications
- **Eight-Speed Electronic Shutter** reduces blurring of fast-moving objects
- **Selectable Integration Periods with Grab Pulse** — for low light level microscopy applications.
- **1000:1 Overload Capability** permits incidental light overloads up to ten times that of other CCD cameras
- **AGC with Peak-Average Adjustment** for clear images in varying light level applications
- **Made in U.S.A.** — direct factory support, quality design and construction.

APPLICATIONS

- **Microscopy**
- **Image Processing**
  Medical and Industrial
- **Machine Vision**
  Pattern Recognition
  Non-Contact Measurement
  3-D Imaging
  Inspection
- **Robotics**
- **Computer Graphics**
- **Remote Sensing**
- **Mapping**
- **Teleradiology**
- **Quality Control**
- **Teleconferencing**
- **Security/Surveillance**

Designed and manufactured in U.S.A.

COHU
Cohu, Inc./Electronics Division

8290 AND 8390 SERIES REMOTE-HEAD COLOR CCD CAMERAS

SPECIFICATIONS

ELECTRICAL — NTSC AND PAL MODELS

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2" format)

Active Picture Elements
NTSC/Y-C: 768(H) x 493(V)
PAL/Y-C: 752(H) x 582(V)

Resolution
NTSC/Y-C: Horizontal 460 TV lines
Vertical 350 TV lines
PAL/Y-C: Horizontal 460 TV lines
Vertical 415 TV lines

Sensitivity
3200 K faceplate illumination.
6.5 lux at full video, AGC Off.
0.55 lux at 80% video, AGC On.

Electronic Shutter
Switch selectable, 1/60 second (off) to 1/10,000 second (8 steps)

Integration
Switch selectable, 2 to 16 fields (8 steps). Grab pulse available

Gamma
0.5

AGC
0-20 dB
Peak-average adjustable

Signal-to-Noise Ratio (AGC Off)
48 dB (NTSC with 4.5 MHz filter)
45 dB (PAL with 5 MHz filter)

Video Outputs
Encoded: NTSC and PAL
1 V p-p @75 ohms, unbalanced, composite
S Video:
Y: 1 V p-p @75 ohms, unbalanced, composite
C: 0.285 V p-p

Auto Lens Output
Peak-average characteristic tracks AGC adjustment to eliminate AGC/auto lens interaction

Color Lock
Burst phase adjustment
Horizontal phase adjustment

Color Balance
Through-the-lens type
Less than 10 IRE units unbalance from 2850 to >5800 K

Synchronization
NTSC or PAL crystal, color lock standard

Power Requirements
12V ac or dc (standard)
115V ac, 60 Hz for NTSC models (optional, with wall transformer)
230V ac, 50 Hz for PAL models (optional, with wall transformer)

Power Consumption
4.5W

ELECTRICAL — RGB MODELS

Imager
Single interline transfer CCD with matrix filter (cyan, yellow, magenta, green)

Image Area
6.4 x 4.8 mm (1/2-inch format)

Active Picture Elements
RGB/60: 768(H) x 493(V)
RGB/50: 752(H) x 582(V)

Resolution
RGB/60: Horizontal 460 TV lines
Vertical 350 TV lines
RGB/50: Horizontal 460 TV lines
Vertical 415 TV lines

Sensitivity
3200 K faceplate illumination.
6.5 lux at full video, AGC Off.
0.55 lux at 80% video, AGC On.

AGC
0-20 dB
Peak-average adjustable

Gamma
0.5 or 1.0

Electronic Shutter
Switch selectable, 1/60 second (off) to 1/10,000 second (8 steps)

Integration
Switch selectable, 2 to 16 fields (8 steps); grab pulse available

Power Requirements
12V ac or dc (standard)
115V ac 60 Hz (optional, with wall transformer)
230V ac 50 Hz (optional, with wall transformer)

Power Consumption
4.5W

Video Outputs
RGB, per channel: 0.714 V p-p @75 ohms, unbalanced; sync on green, jumper selectable
Sync: 0.4 V p-p @75 ohms, unbalanced

Synchronization
Genlock, H & V drive

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –20 to 50 °C
(–4° to 122° F)
Storage: –30 to 70 °C
(–22° to 157° F)

Humidity
Up to 95% relative humidity, non-condensing

Vibration (less lens)
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage

Shock (less lens)
Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6

Altitude
Sea level to equivalent of 3,000m/10,000 feet (508mm/20 inches of mercury)

MECHANICAL

Dimensions
Please see dimensional drawings.

Weight
Camera Control Unit (12 V model): 36 ounces (1000 grams)
Camera Head (less lens and cable): 4 ounces (113 grams)
15' Remote Cable: 17 ounces (483 grams)

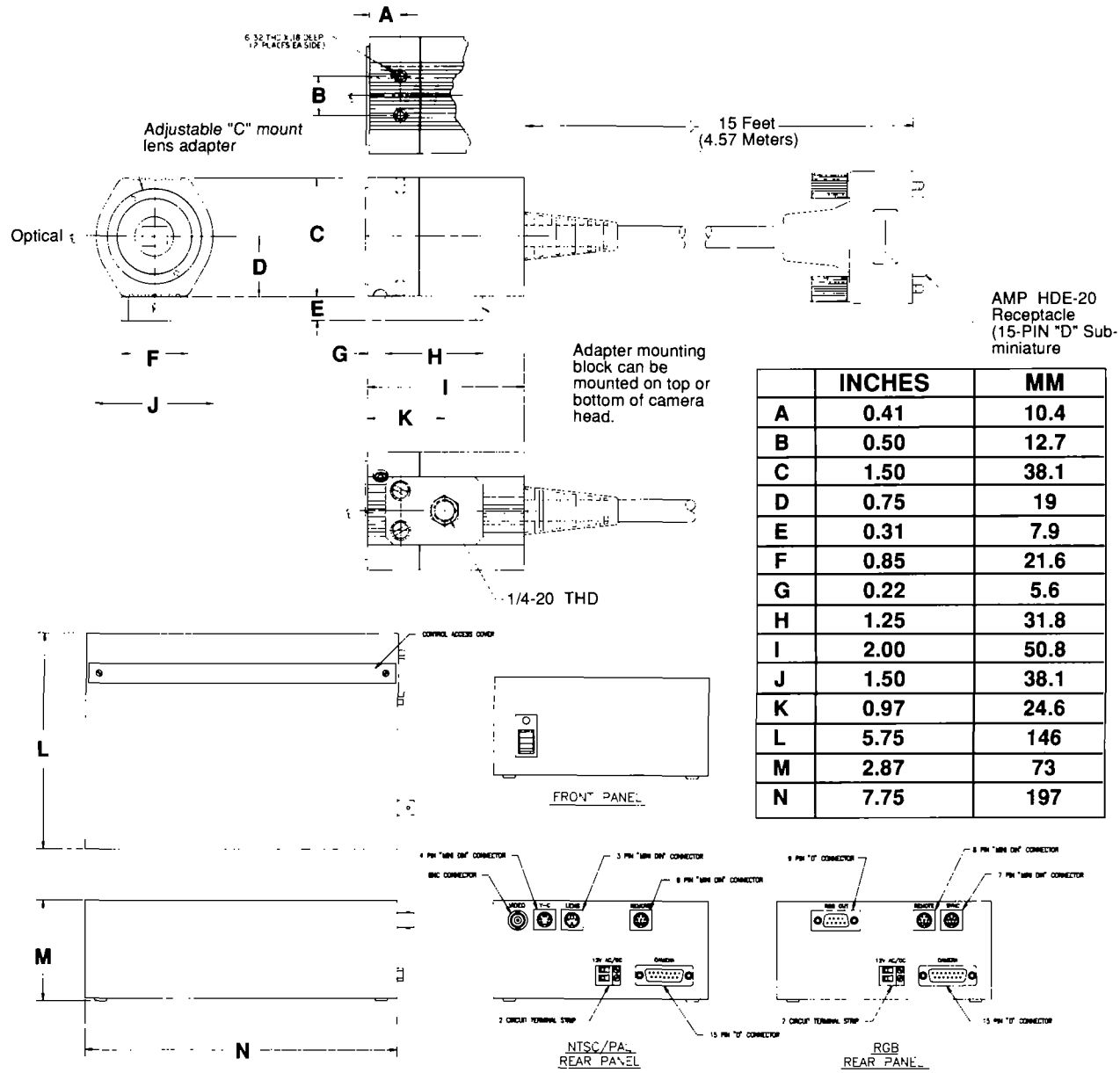
Lens Mount
Adjustable "C" mount

Connectors
Please see dimensional drawings

Top Panel Adjustments
Shutter/Off/Integrate
8-Position Shutter/Integrate Switch
AGC On/Off *
AGC Peak/Average Adjustment
Auto/Manual/Remote White Balance Switch *
White Balance Adjustment*
Horizontal Phase/Color Lock*
SC Phase Switch*
SC Phase Adjustment*
AGC/Manual/Remote**
Gain**
Vertical Phase Adjustment**
Horizontal Phase Adjustment**

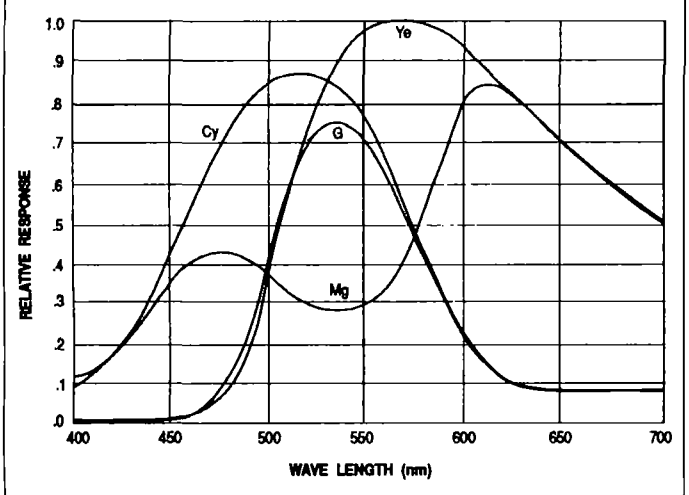
* NTSC/Y-C and PAL/Y-C Models Only
** RGB Models Only

DIMENSIONS

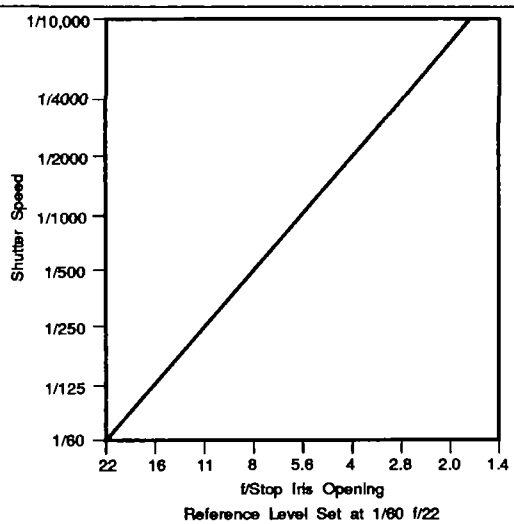


	INCHES	MM
A	0.41	10.4
B	0.50	12.7
C	1.50	38.1
D	0.75	19
E	0.31	7.9
F	0.85	21.6
G	0.22	5.6
H	1.25	31.8
I	2.00	50.8
J	1.50	38.1
K	0.97	24.6
L	5.75	146
M	2.87	73
N	7.75	197

MATRIX FILTER COLOR RESPONSES



TYPICAL f/STOP VS. SHUTTER



8290 AND 8390 SERIES REMOTE-HEAD COLOR CCD CAMERAS

ORDERING INFORMATION

8X9 X — XXXX / XXXX

Format Options

2 NTSC Format (60 Hz)

3 PAL Format (50 Hz)

Power Options

2 12V ac/dc

3 230V ac, 50/60 Hz, with wall transformer, (8390 Series only)

4 24V ac/dc, 50/60 Hz

5 115V ac, 50/60 Hz, with wall transformer (8290 Series only)

Configuration Options

1000 NTSC/Y-C or PAL/Y-C

2000 RGB/60 or RGB/50

Lens Options

0000 None

Manual Iris, C Mount

AL04 4.5mm, f/2.0, 2/3"
AL06 6.5mm, f/1.8, 2/3"
AL08 8mm, f/1.4, 2/3"
A014 12mm, f/1.2, 1/2"
AL16 16mm, f/1.4, 2/3"
AL25 25mm, f/1.4, 1"
AL50 50mm, f/1.8, 1"

Auto Iris, C Mount*

ES05 4.8mm, f/1.8, 2/3"
ES08 8mm, f/1.4, 2/3"
ES16 16mm, f/1.4, 2/3"
EH35 35mm, f/1.4, 2/3"

PLEASE NOTE: Cohu welcomes the opportunity to provide special features to better serve your particular requirement. For example, custom painting, silkscreen and logo for OEM customers and special connector pin configurations can be ordered. Please contact Cohu for details.

* Customers supplying their own auto iris lenses must order lens connector separately. Please consult factory.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

NTSC & PAL CONNECTOR CONFIGURATIONS

LENS

1	Power
2	Lens Video
3	Ground

Y-C

1	Y—Ground
2	C- Ground
3	Y
4	C

REMOTE

1	Auto/Man
2	White Balance
3	Sync/Video In
4	Shutter On/Off
5	+5
6	Ground
7	Ground
8	Grab Pulse

RGB CONNECTOR CONFIGURATIONS

REMOTE 1

1	Blue Level
2	Red Level
3	Sync/Horizontal In
4	Shutter On/Off
5	+5
6	Vertical In
7	Ground
8	External Gain

SYNC

1	Grab Pulse
2	V Drive Out
3	H Drive Out
4	Clock Out
5	Ground

RGB

1	Ground
2	Ground
3	R
4	G
5	B
6	NC
7	Sync
8	NC
9	NC

NOTE: The RGB connector layout is directly compatible with Targa®, Vista®, and other image capture boards.

ADVANCED SOLID STATE TECHNOLOGY Made in the U.S.A.

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COHU
Cohu, Inc./Electronics Division

8290/8390 Series Printed in USA 4/94

2-YEAR WARRANTY!

REMOTE-HEAD COLOR CCD CAMERA

6800 SERIES

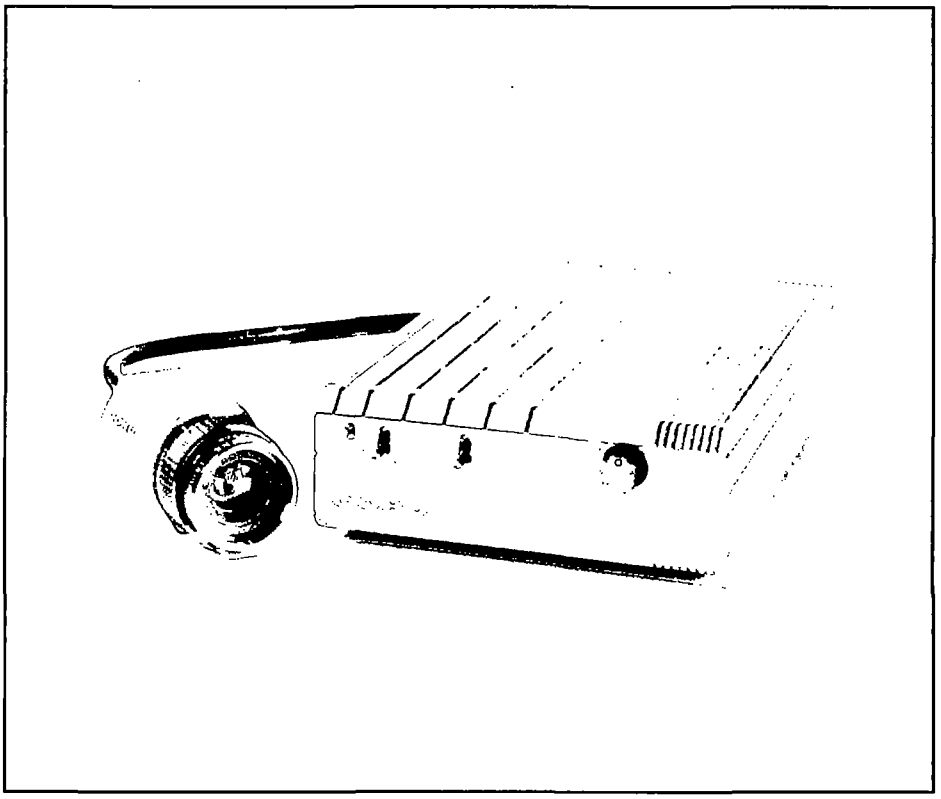
RGB, NTSC, and Y-C Outputs, High S/N, Electronic Shutter

Cohu's new 6800 Series Remote-Head Monochrome CCD Camera offers excellent performance characteristics in a compact, two-piece configuration. The small, lightweight remote imager and choice of RGB, Y-C, or NTSC outputs offer optimum capability to both OEM design engineers and end users across a broad range of scientific and industrial applications.

The 6800 Series Remote-Head CCD Camera features state-of-the-art frame transfer technology with an RGB stripe filter for reliable, high-sensitivity true color video. Cohu's unique, 1/2-inch format blemish-free image sensor provides over 357,000 picture elements for greater resolution. The high signal-to-noise ratio ensures excellent dynamic range, while the two-speed electronic shutter greatly reduces problems associated with blurred images of fast moving objects.

The compact, rugged 6800 Series consists of the remote camera head with integral 15-foot control cable, and the camera control unit. The remote head weighs a mere 4 ounces, and measures only 1.5 inches in diameter and two inches in length with standard C-mount adapter.

As with all Cohu CCD cameras, the new 6800 Series is designed and manufactured in the U.S.A., and comes with a two-year warranty.



Cohu 6800 Series Remote-Head Solid-State Color CCD Camera

FEATURES AND BENEFITS

- **Small, Lightweight Remote Imager** ensures maximum flexibility in system design and installation.
- **Electronic Shutter** reduces blurring of fast-moving objects.
- **Separate RGB, NTSC, and Y-C outputs** to support a wide range of applications. For S-VHS recording applications, Y-C outputs permit a minimum of 300 TV lines horizontal resolution.
- **Horizontal and Vertical Aperture Correction** for sharper pictures.
- **100% Blemish-Free Sensor** - no dead pixels.
- **High Resolution** with 1/2-inch format sensor
- **High, 50 dB Signal-to-Noise Ratio** provides better dynamic range.
- **Color Lock** provides consistent color rendition in multi-camera applications.
- **15' Remote Cable** facilitates system design and installation.
- **Auto/Manual White Balance** enhances color control.
- **Selectable AGC Ranges** for better control under varying light conditions.

APPLICATIONS

- **Image Processing**
- **Microscopy**
- **Borescopes**
- **Machine Vision**
  Pattern Recognition
  Non-contact measurement
  Inspection
- **Medical Imaging**
- **Robotics**
- **Security/Surveillance**

Designed and manufactured in U.S.A.

COHU INC
ELECTRONICS DIVISION

6800 SERIES REMOTE-HEAD COLOR CCD CAMERA

SPECIFICATIONS

ELECTRICAL

Imager
Single CCD using frame transfer method
Image Area
6.4 x 4.8 mm (1/2-inch format)
Active Picture Elements
739 x 484 (frame transfer)
Cell Size
8.5µm(H) x 19.75µm(V)
Resolution (RGB or NTSC)
Horizontal >300 TV lines
Vertical >350 TV lines
Sensitivity
Please see Table 1, below.
Contrast Variation
<5% overall at gamma 1, gain 0 dB
Video Output Levels (Note 1)
NTSC:
1.0 V p-p @75 ohms, unbalanced, composite
Y-C:
Y: 1.0V p-p @75 ohms, unbalanced, composite
C: .258 V p-p @ 75 ohms
Component (RGB):
R: 0.714 V p-p @75 ohms, unbalanced
G: 0.714 V p-p @75 ohms, unbalanced
B: 0.714 V p-p @75 ohms, unbalanced
Sync: .4V p-p @75 ohms, unbalanced
Gamma
0.5 or 1.0 jumper selectable
Aperture Correction
Jumper selectable in or out
Signal to Noise Ratio
50 dB at gamma 1, AGC Off, encoded output
Color Lock
Burst phase adjustment
Horizontal phase adjustment
Color Balance
Through-the-lens type.
Less than 10 IRE units unbalance from 2850 to 6400 K
Electronic Shutter
Switch selectable, 1/1000 second, 1/2000 second, or Off
AGC
Switch selectable,
Off/Low Gain, High Gain
Low Gain: 0 - 12 dB
High Gain: 8 - 20 dB
Auto Lens Output
Peak/Average ratio tracks AGC adjustment
Synchronization
RS-170 crystal, 14.31818 MHz clock output, with color lock standard
Remote
White Balance
Auto/Manual White Balance
Shutter On/Off
Sync/Horizontal Trigger In
Vertical Trigger In
Master Clock Output 14.31818 MHz
Power Requirements
AC 115V ±10%, 60 Hz
Fuse protected
12V ac/dc, 60 Hz
Power Consumption
4.2W

NOTE: 1. Simultaneous output of all video signals is provided. Up to four outputs may be terminated at one time.

ENVIRONMENTAL

Ambient Temperature Limits
Operating: –10 to 50 °C
(14° to 122° F)
Storage: –30 to 70 °C
(–22° to 157° F)
Humidity
Up to 95% relative humidity
Vibration
5 to 60 Hz with 0.082 inch total excursion (15 g's @ 60 Hz). From 60 to 1000 Hz, 5 g's rms random vibration without damage
Shock (less lens)
Up to 15 g's in any axis under nonoperating conditions, MIL-E-5400T, paragraph 3.2.24.6
Remote Head: Up to 30 g's.
Altitude
Sea level to equivalent of 3,048m/10,000 feet (508mm/20 inches of mercury)

MECHANICAL

Camera Control Unit
Dimensions: See Figure 1.
Weight: 29 ounces
Camera Head
Dimensions: See Figure 1.
Weight: 4 ounces
Cable Length: 15 feet
Lens Mount
"C" mount, 16mm format
Connectors
BNC Connector - Video Out
Switchcraft TB3M - Power In
3 Pin Mini-Din - Lens Drive
4 Pin Mini-Din - Y-C output (Industry Standard Configuration)
7 Pin Mini-Din - R-G-B-Sync Output
8 Pin Mini-Din - Remote

SENSITIVITY, 3200 K ILLUMINATION

	Faceplate Illumination	Minimum Scene Illumination, f/1.4 lens
AGC Off, 100% video	1.7 fc (17 lux)	17 fc (170 lux)
Lo AGC, 12 dB, 70% video	0.35 fc (3.5 lux)	3.5 fc (35 lux)
Hi AGC, 20 dB, 70% video	0.1 fc (1 lux)	1.0 fc (10 lux)
Useable picture, 35% video	0.05 fc (0.5 lux)	0.5 fc (5 lux)

Table 1

DIMENSIONS

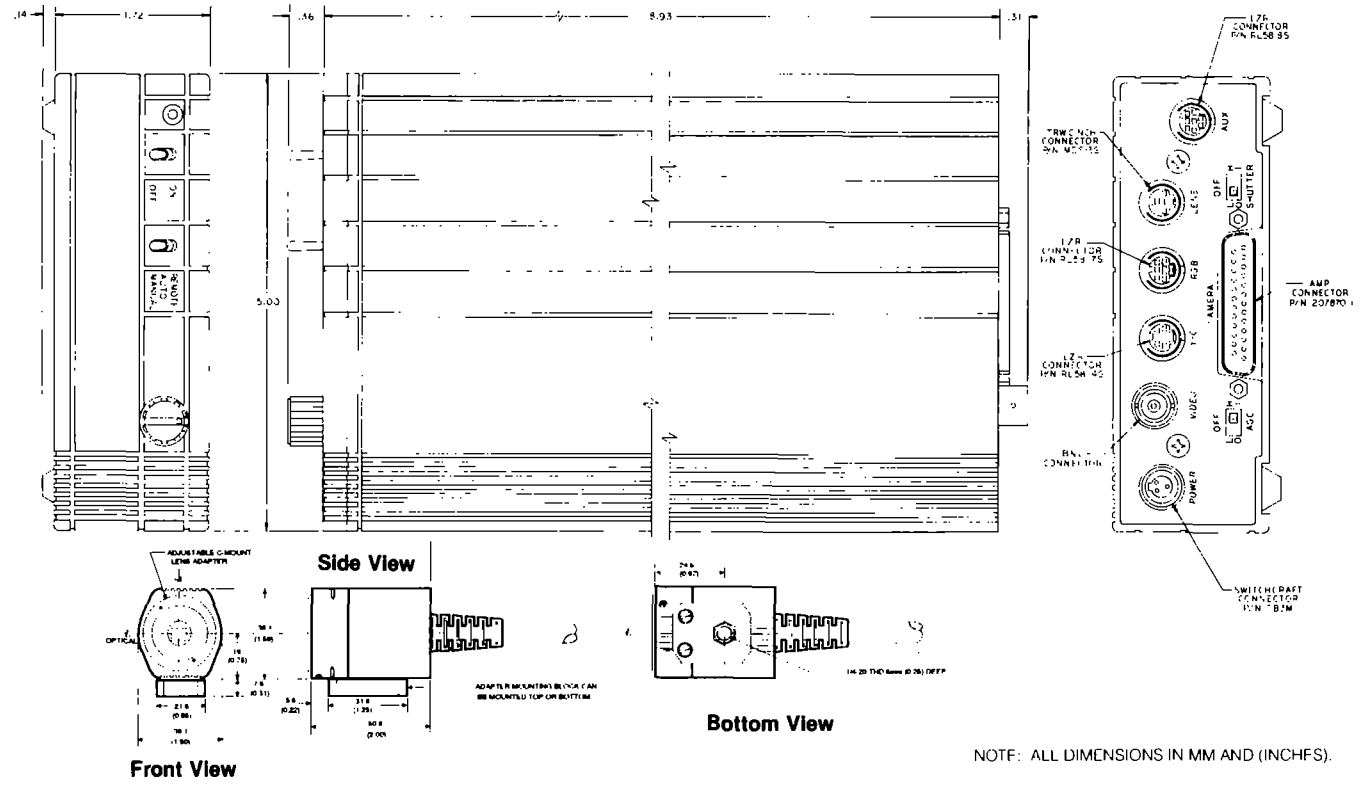


Figure 1

CONNECTOR CONFIGURATIONS

(BNC - Encoded Video)

LENS
3-Pin Mini-Din

1	Power
2	Lens
3	Ground

Y - C
4- Pin Mini-Din

1	Y - Ground
2	C - Ground
3	Y
4	C

RGB
7-Pin Mini-Din

1	Ground
2	Ground
3	SYNC
4	Blue
5	Green
6	Ground
7	Red

REMOTE
8-Pin Mini-Din

1	Auto/Manual
2	White Balance
3	SYNC/ H.Trigger In
4	Shutter ON/OFF
5	+5
6	Vertical Trigger In
7	Ground
8	Clock Out

6800 SERIES REMOTE-HEAD COLOR CCD CAMERA

ORDERING INFORMATION

681X – 2100 / XXXX

Power Options

2 12 VAC/DC, 60 Hz
5 115 VAC, 60 Hz

Standard Configuration

Lens Options

0000 None

Manual Iris Lenses
AL04 4.5mm, f/2.0 (2/3")
AL06 6.5mm, f/1.8 (2/3")
AL08 8mm, f/1.4 (2/3")
AL09 9mm, f/1.4 (2/3")
AL12 12mm, f/1.4 (1")
AL16 16mm, f/1.4 (2/3")
AL26 25mm, f/1.6 (2/3")
AL51 50mm, f/2.8 (2/3")
AL75 75mm, f/1.8 (1")

Auto Iris Lenses
ES05 4.8mm, f/1.8 (2/3")
ES06 6mm, f/1.2 (1/2")
ES08 8mm, f/1.4 (2/3")
ES13 12mm, f/1.2 (1/2")
ES16 16mm, f/1.4 (2/3")
ES28 28mm, f/1.2 (1/2")
ES35 35mm, f/1.4 (2/3")
ES50 50mm, f/1.4 (1")
ES75 75mm, f/1.8 (1")

NOTE: Auto iris lenses require auto iris cable assembly 8307-8, to be ordered separately.

Please consult factory for other lens selections.

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

SPECIAL FEATURES

Cohu welcomes the opportunity to provide special features to better serve your particular requirement. For example, the remote camera head can be sealed to allow immersion in liquids for sterilization or other purposes. Other special features include custom painting, silk screen and logo for OEM customers and special connector pin configurations. Please contact Cohu for other special features.

Printed in U.S.A.
89-02 (7/90) July 1990

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COHU INC
ELECTRONICS DIVISION

NEW! With Surge Protection!

MICROPROCESSOR CAMERA CONTROL SYSTEM

MPC SERIES

For Color or Monochrome CCTV Systems

The Microprocessor Camera Control (MPC) System has been designed and manufactured by Cohu to reduce the cost of CCTV system installations and improve command and control for security/surveillance operations.

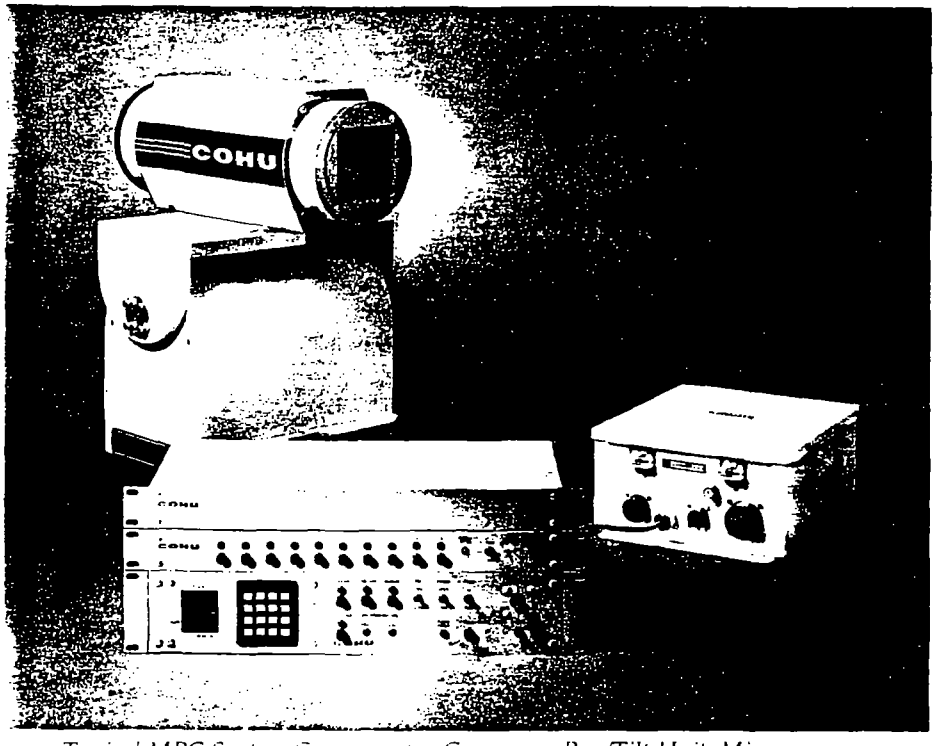
The MPC can reduce total equipment and installation costs by up to 20% for systems that exceed 1,000 feet in distance (cameras to monitors). For systems that reach 5,000 feet, the savings are 50% or more compared to traditional multi-conductor cable systems. This is accomplished by installing lower-cost individual video and control cables and by eliminating separate control units.

The MPC makes use of state-of-the-art technology, adaptable to fit most users' custom needs. A standard mini-system of one-camera site control is expandable to 223 camera sites, 32 monitors, and 32 multi-operator Master and Remote stations. Larger system configurations are available upon request.

The MPC utilizes a microprocessor-based CPU, and controls the following: Camera and Monitor selection, lens operation (iris, focus, and zoom functions), and all pan/tilt commands. Digital control signals are transmitted from the MPC by one or more of three formats: RS-422 serial-data balanced line, RS-232 serial line, or DTMF signals over a twisted pair. The MPC transmitter is compatible with existing systems where receivers utilize one of these transmission formats.

The MPC incorporates the latest in proven surge protection to protect power and data lines against voltage surges caused by lightning and other sources.

Options available to the user are the Preset Option and the Camera Video Switching Option. The Preset Option controls up to 10 preset positions for each camera. The camera video switching Option allows manual switching or random camera sequencing of up to 16 cameras per monitor for as long as 60 seconds per camera. In addition to these, autoscan, color, and bright light limiter control options are also available. For additional information on expansion capabilities, options, and accessories, consult the Cohu Applications Engineering Group in San Diego or your local Cohu representative.



Typical MPC System Components: Camera on Pan/Tilt Unit, Microprocessor Control Unit, Preset Panel, CPU Receiver Box, RS422 Distribution Unit

FEATURES

- Controls up to 223 camera sites
- Expand to 31 remote operator stations
- Compatible with RS-422, RS-232, DTMF
- Operator control of pan/tilt, lens functions
- Digitized control signals
- Operator programmable
- Distances up to 5 miles (8 km) with shielded twisted pair
- Power and data line surge protection

OPTIONS

- Preset control for up to 10 positions
- Autoscan, color and bright light limiter controls
- Video switching/sequencing
- RS-422 balanced-line service
- Multiple RS-232 ports

Designed and manufactured in U.S.A

COHU INC
ELECTRONICS DIVISION

MPC — MICROPROCESSOR CAMERA CONTROL SYSTEM

THE MPC SYSTEM

The Conu microprocessor control (MPC) system provides the latest technology in a computer controlled system. Programming and operating the MPC system is simple and requires no special training.

The MPC control system includes master control panels, remote control panels, preset control panels, control receivers, and RS-422 distribution units. Commands to the control receivers at the camera site are via a single twisted pair cable (shielded if preferred) using RS-422 digital data or optional DTMF or by other communication channels if RS-232. All of the units in the system may be connected in a "daisy chain," or by the use of an RS-422 distribution unit, in a "star" pattern with up to ten legs.

Cameras, monitors and limited camera selection access can be assigned to a specific MPC station with our unique systems approach.

The standard control priority is first call to priority. When the camera site is in use, a busy indicator is illuminated on the numeric display readout.

THE MPC MASTER CONTROL PANEL

The MPC master control panel performs as the system CPU.

The functions performed include: 1) polling remote control panels for command/camera selection input. 2) routing operator commands to correct control receiver. 3) controlling video switchers. 4) implementing commands received via RS-232. 5) implementing control priority. 6) setting system parameters such as the RS-422 baud rate. 7) non-volatile storage of camera sequence and camera selection data. 8) selection of data transfer (RS-422 2-way, RS-422 1-way, or DTMF) for each camera site. 9) implementing functions unique to a particular system (such as priority lockout or camera/monitor access assignment) that may be defined to implement non-standard requirements on a system by system basis. 10) RS-232 (single or dual), and 11) DTMF control.

Other system options may be tailored as appropriate for any user system.

THE MPC CONTROL PANEL

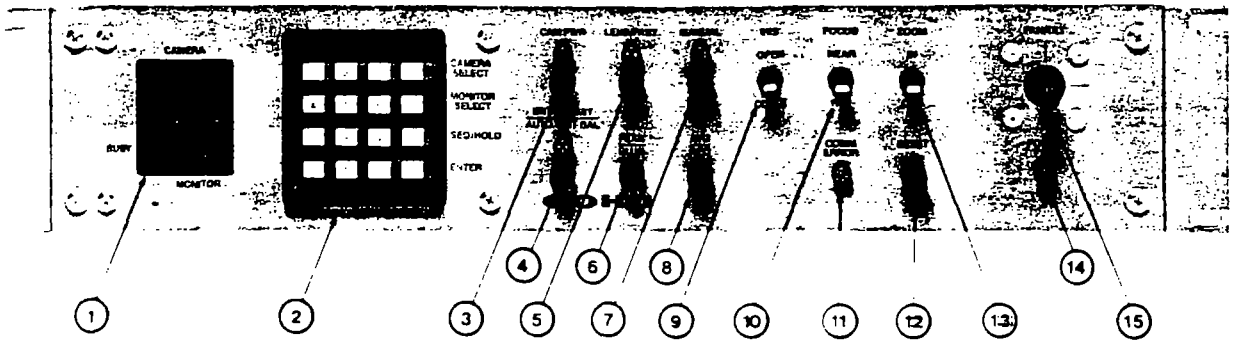
The MPC master control panel and MPC remote control panels serve as operator control units. The MPC control panel is designed for fast, efficient use with little operator training. The layout and clearly designated functions provide the operator quick command and control.

A digital keypad is used to enter monitor/camera selection, sequence programming, sequence/hold commands, and system parameter programming (master only). A numeric display indicates the camera and monitor selection. The busy LED indicator illuminates if the camera is already under control by another operator.

A joystick is used for pan/tilt control, toggle switches for zoom, focus and iris, and push button switches and LED status indicators for camera power, lens speed, and automatic/manual iris select.

Up to three auxiliary push buttons and LED indicators are also available as options for control of bright light limit on/off, peak/avg adjust, auto color balance on/off, manual white balance, or other user defined controls.

COMMAND/CONTROL FOR SELECTED CAMERA SITE



1. **NUMERIC DISPLAY**
   CAMERA
   Indicates camera site selected
   BUSY
   Indicates camera site in use
   MONITOR
   Indicates which monitor the selected camera out is being directed to
2. **PUSHBUTTON KEYPAD**
   Provides selection of:
   CAMERA SELECT KEY
   Activates camera selection function
   MONITOR SELECT KEY
   Activates monitor select function
   ENTER KEY
   Completes the selection function
   SEQ/HOLD KEY
   Starts and stops sequence
   C KEY
   Clears the selection function
   0 - 9 KEYS
   Numeric input for selection function
3. **CAMERA POWER**
   Selects power on/off. Lamp indicates power on.
4. **BRIGHT LIGHT LIMITER/ AUTO WHITE BALANCE**
   B&W—turns bright light limiter on/off. Lamp indicates bright light limiter on.
   Color—select auto or manual white balance. Lamp indicates auto.
5. **LENS/FAST**
   Select lens speed for focus and zoom functions. Lamp on indicates fast mode.
6. **PEAK/BLUE**
   B&W—adjusts peak average toward peak.
   Color—adjusts more blue in manual white balance.
7. **MANUAL**
   Select automatic, manual iris selection. Lamp on indicates manual control mode.
8. **AVERAGE/RED**
   B&W—adjusts peak average toward average
   Color—adjusts more red in manual white balance
9. **IRIS OPEN-CLOSE**
   Opens and closes lens iris when MANUAL mode is activated
10. **FOCUS NEAR-FAR**
    Controls lens focus
11. **COMM ERR LAMP**
    Communication error—indicates communication failure with camera control receiver.
12. **RESET SWITCH**
    Restarts the microprocessor
13. **ZOOM IN-OUT**
    IN brings subject closer on monitor, OUT moves it farther away.
14. **POWER LAMP**
    Green indicates the control panel has power. (On-Off switch is on rear panel.
15. **PAN/TILT JOYSTICK**
    Moving joystick to any position through a full 360° activates the panning (right-left) and/or tilting (up-down)

MPC CONTROL RECEIVER

The MPC control receiver receives command data from the MPC master control panel and decodes the command data, performs error checking, and acts on valid data to drive the pan/tilt unit (if applicable) and camera controls.

MPC PRESET CONTROL PANEL

The preset control panel installed near the MPC control panel provides push buttons for operator call-up and programming of presets. LEDs display status of preset positions.

MPC RS-422 DISTRIBUTION UNIT

The RS-422 distribution unit provides for ten twisted pair connections for MPC system data communication to control receivers and remote control panels if a single daisy chain is not convenient.

SPECIFICATIONS

ELECTRICAL

Input Voltage
(a) 105-130V ac 50/60 Hz
(b) 210-260V ac 50/60 Hz

Input Power
Control Panel: 20 Watts
Receiver: 25 Watts exclusive of camera, heater and pan/tilt power
Preset Panel: 0.025 Watts (from control panel)
RS-422 Dist. Unit: 15 Watts

Surge Protection
Power Line: 20 cycle, 60A current, 2500 amps
Data Line: 100 amps for 1 ms half value pulse width

ENVIRONMENTAL

Ambient Temperature Limits
Operating:
Control Panel
0 to 50 C (32 to 122 F)
Receiver
-40 to 60 C (-40 to 140 F)
Preset Panel
-10 to 50 C (14 to 122 F)
RS-422 Dist. Unit
-20 to 60 C (-4 to 140 F)
Storage:
Control Panel and Receiver
-40 to 85 C (-40 to 185 F)
Preset Panel
-30 to 70 C (-22 to 157 F)
RS-422 Dist. Unit
-54 to 70 C (-65 to 157 F)

Ambient Air Pressure
Sea level to equivalent of 10,000 feet (3,000m)

Humidity
Control Panel: 95% relative
Receiver: 100% relative

Vibration
5 to 30 Hz with 0.03 inches total excursion. From 30 to 1,000 Hz with peak random vibrations of 5 g's without damage or degradation

Shock
15 g's in any axis under non-operating conditions. MIL-E-5400T paragraph 3.2.24.6

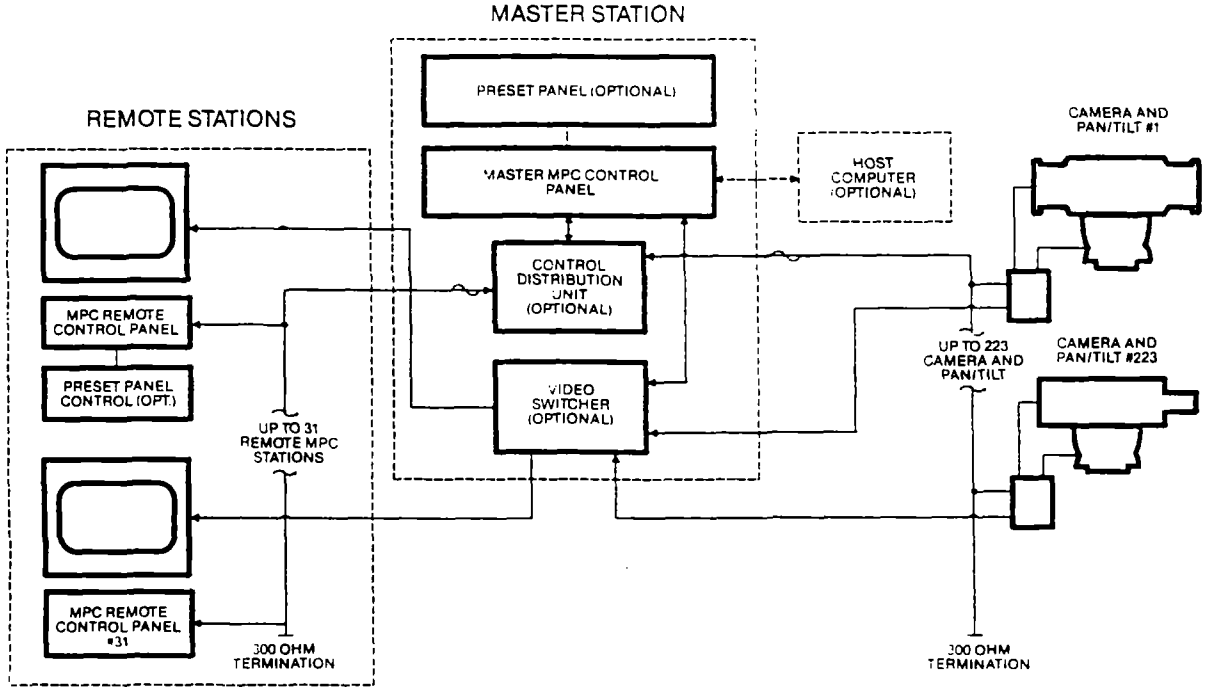
MECHANICAL

Dimensions
Control Panel:
3.5"H x 12.5"D x 19.0"W
(8.9cm x 26.7cm x 48.3cm)
Receiver:
5.4"H x 10.0"D x 13.5"W
(13.3cm x 25.4cm x 34.3cm)
Preset Panel:
1.72"H x 8.25"D x 19.0"W
(4.4cm x 21.0cm x 48.3cm)
RS-422 Dist. Unit:
1.72"H x 8.25"D x 19.0"W
(4.4cm x 20.8cm x 48.3cm)

Weight
Control Panel: 10.4 lbs. (4.7 kgs)
Receiver: 17.3 lbs (8.1 kgs)
Preset Panel: 2.3 lbs (1.02 kg)
Rs422 Distribution Unit: 4.2 lbs (1.9 kg)

Enclosure
Control Panel, Preset Panel, RS-422 Dist. Unit: 19" (48.3cm) rack mount
Receiver: NEMA-4 weatherproof box

TYPICAL MPC SYSTEM



MPC — MICROPROCESSOR CAMERA CONTROL SYSTEM

ORDERING INFORMATION

CONTROL PANEL

MPC - X - X XX / XX/---/XX

System	Panel Configuration	Input Power	Front Panel Options (*)	System Options (As required)
MPC	**M** Master **R** Remote	**0** None **1** 115 VAC, 50/60 Hz **2** 230 VAC, 50/60 Hz	**00** Basic MPC (0) **01** Bright Light Limiter (1) **02** BLL/Peak/Avg (3) **03** Auto Scan (1) **04** White Balance (3) **05** BLL/Peak/Avg/White Balance (3)	**51** Preset ° **52** RS-232, Single° **53** RS-232, Dual° **54** Video Switcher, Parallel° **56** DTMF°

* Number of positions required for options — 3 Positions Max
° Master or Remote
† Master Only

Note: Multiple Options require slash (/) between numbers

CONTROL RECEIVER

MPC-D - X X X / XX

System	Input Power	Camera Power	Pan/Tilt Power	Options (As required)
MPC-D	**1** 115 VAC, 60 Hz **2** 230 VAC, 50/60 Hz	**1** 115 VAC **2** 230 VAC **4** 12 VAC **5** 12 VDC **6** 24 VAC **7** 24 VDC	**0** None **1** 115 VAC **2** 230 VAC **3** 115 VDC **6** 24 VAC	**56** DTMF

AUXILIARY EQUIPMENT & CABLES

MPC - XX - XXX

System	Configuration	Auxiliary Equipment	Cables
MPC	**AE** Auxiliary Equipment **CA** Cable	**000** None **001** Preset Panel **102** RS-422 Distribution Unit (115 VAC, 60 Hz) **202** RS-422 Distribution Unit (230 VAC, 50/60 Hz)	**234** Master Control Panel to RS-422 Distributor Unit **236** Control Receiver to Camera **237** Control Receiver to Vicon Pan/Tilt **238** Control Receiver to Pelco Pan/Tilt (with-PP opt.) **239** RS-232 Type (Null Modem) **240** Master Control Panel to Remote Control Panel Remote Control Panel to Remote Control Panel **241** Control Panel to Preset Panel **242** Remote Control Panel to RS-422 Distribution Unit **243** Control Receiver to RS-422 Distribution Unit **244** Master Control Panel to Control Receiver **245** Control Receiver to Pelco Pan/Tilt (without-PP opt.)

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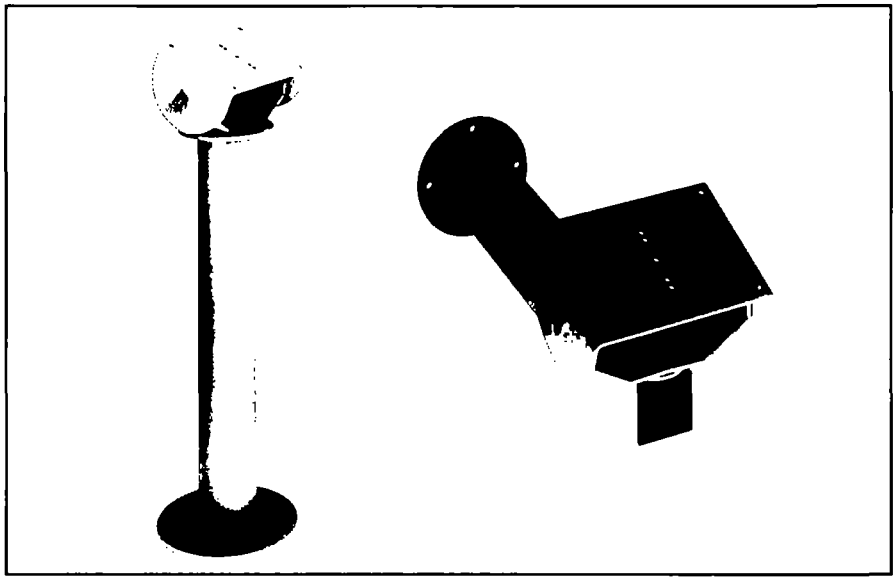
COHU INC
ELECTRONICS DIVISION

MOUNTS AND ACCESSORIES

Cohu offers a selection of light-, medium-, and heavy-duty mountings for CCTV cameras and monitors. Indoor and outdoor versions are available to suit the environment of the intended application. Each unit has been designed for dependability and long life.

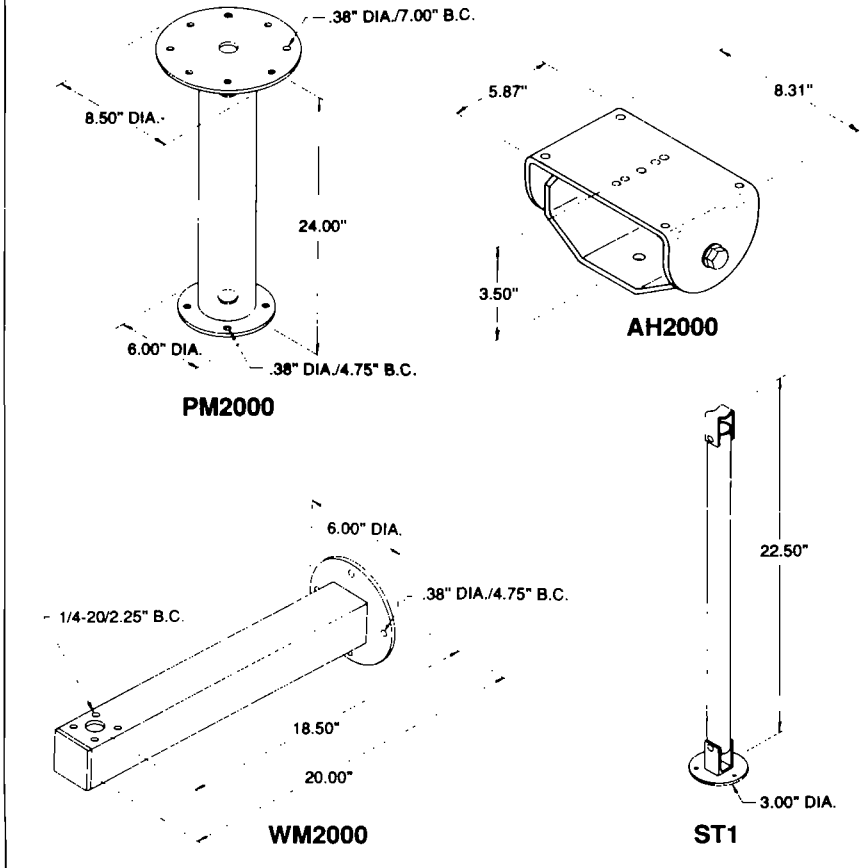
Where an adjustable head is required, be sure to include its separate model number when ordering the basic mount.

If you need assistance in determining the proper accessories for your particular CCTV installation, please call your Cohu representative, or call the factory and ask to speak with one of our experienced applications engineers.



Model PM2000 Pedestal Mount and WM2000 Wall Mount With Model AH2000 Manually Adjustable Pan/Tilt Head Adapter

PM2000, WM2000, AH2000, and ST1 DIMENSIONS



SPECIFICATIONS

WM2000 WALL MOUNT

The WM2000 is a universal wall arm mount designed for wall mounting medium- to heavy-duty pan/tilts or heavy- duty camera enclosures. The WM2000 will support loads of up to 75 lbs. When used with an optional ST1 support strut, maximum load capacity is increased to 150 lbs.

PM2000 PEDESTAL MOUNT

The PM2000 is a universal pedestal mount designed for use with all medium- and heavy-duty pan/tilts. Its aluminum construction ensures load capacity up to 125 lbs. ST1 struts can be used to increase horizontal stability in windy areas. The PM2010 is the same as the PM2000 except it is 10" high.

AH2000 HEAD ADAPTER

The AH2000 adjustable head adapter is designed for use with WM2000 and PM2000 mounts. It provides 360° horizontal movement. For certain installation applications, the AH2000 can be used alone.

INDOOR/OUTDOOR MOUNTS AND ACCESSORIES

PEDESTAL AND WALL MOUNTS

CM1700 LIGHT-DUTY MOUNT

The CM1700 is a light-duty low-cost universal mount primarily designed for ceiling or pedestal mounting. It can also be used as a wall mount. The CM1700 features an easily adjustable ball/swivel head for camera positioning and is finished in black anodized and beige enamel. Its 6.75" stem supports up to 10 lbs.

CM1400/PM14 WALL MOUNT

Designed for interior use in banks, offices and similar installations, the CM1400/PM14 will easily accommodate light-duty cameras and other equipment up to 20 lbs. This economical mount measures 9.75" from the base to its mounting point, and is made of die-cast aluminum. The CM1400 features an easily adjustable ball/swivel head which allows unlimited pan rotation and 90° tilt down angle. The PM14 is identical to the CM1400 except that it has an adapter plate in place of the ball/swivel head.

EM1400 WALL MOUNT

This light duty wall mount is designed for use with light- to medium-weight cameras and camera enclosures up to 20 lbs. It features a 9.71" die-cast aluminum arm with an adjustable head which allows mechanical positioning of the camera or enclosure.

EM22 and MM22 ENCLOSURE MOUNTS

For loads up to 40 lbs., the EM22 Wall Mount and the MM22 Pedestal/Ceiling Mount are economical solutions. Both mounts have fully adjustable swivel heads and are made of sturdy cast aluminum. The EM22 measures 16.50" from base to mounting point; the MM22 measures 6.86" in height.

MOUNTING ACCESSORIES

PAN/TILT ADAPTER PLATES

The PA2000 is the adapter plate for medium-duty pan/tilts and scanners and the PA2010 will adapt to all heavy-duty pan/tilts. Both are for use with the WM2000 Universal Wall Mount.

POLE MOUNT ADAPTERS

The PA100 Series Pole Mount Adapters permit the use of a standard wall mount when installation of CCTV equipment is required on a pole. Lightweight and easily installed, the rugged one-piece aluminum construction provides a strong, stable mounting surface for the accessory equipment. The Model PA100 is designed for use with CM1400, EM22, and EM1400 mounts. Minimum pole diameter is 1.5". Model PA102 is for use with WM2000 mounts, and requires a pole with a 3" minimum diameter. The SPA102 Pole Mount Adapter is for use with the ST1 Support Strut in installations requiring additional support; minimum pole diameter is 3 inches.

PARAPET MOUNT ADAPTER

Model PP100 Parapet Mount Adapter eliminates the expense and hazards of installing and servicing CCTV equipment mounted on parapets. Supporting up to 175 lbs., the PP100 fastens to the inside of the parapet and is rotatable a full 360° so the equipment can be installed and serviced in safety from the rooftop. It can be installed on any parapet wall at least 18" high, and is compatible with most wall mounts.

CORNER MOUNT ADAPTERS

Model CM100 Corner Mount Adapters are compatible with WM2000 Wall Mounts. In installations requiring the addition of an ST1 Support Strut, a Model SCM100 Corner Mount Strut Adapter must also be used.

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ADVANCED VIDEO TECHNOLOGY Made in the U.S.A.

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Cohu, Inc./Electronics Division

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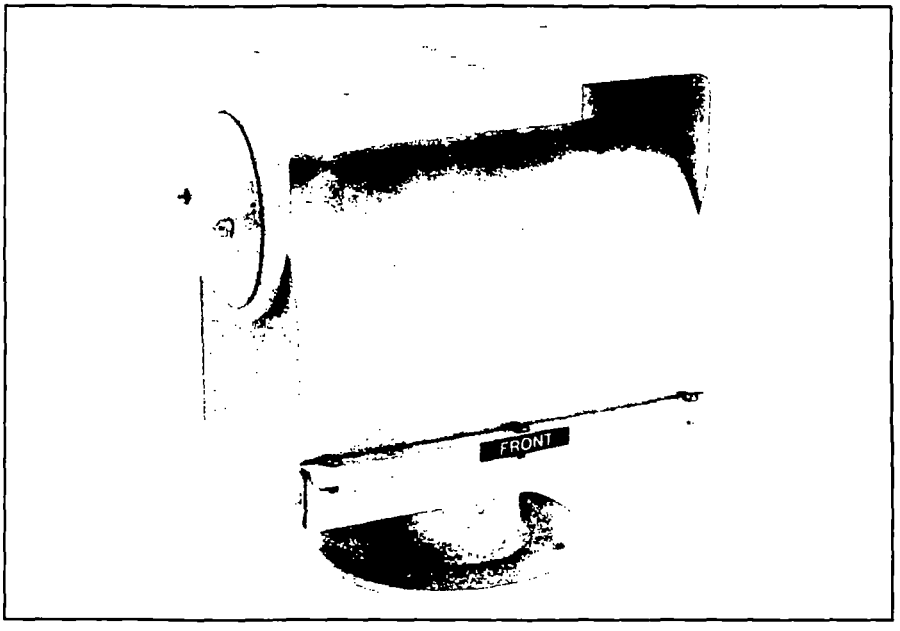
CCTV REMOTE POSITIONING DEVICES

PAN AND TILT UNITS

Cohu offers a selection of pan and tilt units for a wide array of applications and environmental conditions. Outdoor units are built to withstand harsh conditions such as rain, snow, and extreme temperatures. Some indoor applications may require environmental pan and tilt units due to extreme conditions.

In selecting the proper unit for your application, the most important consideration is weight. Be sure to include the total weight of the camera/lens package. Also, be sure to factor in high winds and other conditions that might put additional strain on the unit.

For assistance in determining the correct equipment for your application, please call your Cohu representative, or call the factory and ask to speak with one of our experienced applications engineers.



Model PT550P Medium Duty Outdoor Pan and Tilt Unit

PT175-24P LIGHT DUTY

- **Indoor/Outdoor Operation**
- **Inverted Operation**
- **External Limit Adjustment**
- **Pan**
  0—355° movement in horizontal plane at 9°/second ±1° (No-load condition)
- **Tilt**
  ±90° movement in vertical plane at 3°/sec. ±0.5° (No-load condition)
- **Maximum Load**
  20 lbs. at 5" from tilt table surface to center of gravity
- **Gearing**
  Chain and sprocket pan drive; worm gear tilt drive
- **Input Voltage**
  24V ac, 50/60 Hz
- **Power Requirements**
  Running: 0.47 amp, 30.8 VA
  Starting: 1.81 amps, 43.5 VA
- **Construction**
  Aluminum casting and plate, all internal parts corrosion protected
- **Temperature**
  -10°F to 140°F (-23°C to 60°C)
- **Weight**
  18 lbs (8.1 kg)

PT270P MINI PAN/TILT

- **For Indoor Operation**
- **Inverted Operation**
- **External Limit Adjustment**
- **Pan**
  0—355° movement in horizontal plane at 9°/second ±1° (No-load condition)
- **Tilt**
  ±90° movement in vertical plane at 3°/sec. ±0.5° (No-load condition)
- **Maximum Load**
  15 lbs. at 5" from tilt table surface to center of gravity
- **Gearing**
  Chain and sprocket final drive
- **Input Voltage**
  115V ac, 50/60 Hz or 24V ac, 50/60 Hz (Model PT270-24P)
- **Power Requirements**
  24V units: 0.74 amp (running)
  115V units: 0.13 amp (running)
- **Construction**
  Aluminum plate, all internal parts corrosion protected
- **Temperature**
  -10°F to 140°F (-23°C to 60°C)
- **Weight**
  9 lbs (4 kg)

PT550P MEDIUM DUTY

- **For Outdoor Operation**
- **Easy Serviceability**
- **Inverted Operation**
- **Dynamic Braking for Instantaneous Stopping**
- **Adjustable Worm Gear Final Drive to Prevent Drift and Minimize Backlash**
- **Pan**
  0--355° movement in horizontal plane at 6°/second ±1° (No-load condition)
- **Tilt**
  ±90° movement in vertical plane at 3°/sec ±0.5° (No-load condition)
- **Maximum Load**
  40 lbs. at 5" from tilt table surface to center of gravity
- **Input Voltage**
  115V dc
- **Power Requirements**
  0.88 amp, 102 VA maximum
- **Construction**
  Aluminum plate, all internal parts corrosion protected
- **Temperature**
  -10°F to 140°F (-23°C to 60°C)
- **Weight**
  22 lbs (9.9 kg)
- **Preset Position Option**

Designed and manufactured in the U.S.A.

COHU INC
ELECTRONICS DIVISION

PAN AND TILT UNITS

SPECIFICATIONS

PT570P MEDIUM DUTY

- **For Outdoor Operation**
- **Easy Serviceability**
- **Inverted Operation**
- **External Limit Adjustment**
- **Adjustable Worm Gear Final Drive to Prevent Drift and Minimize Backlash**
- **Pan**
  0—355° movement in horizontal plane at 6°/second ±1° (No-load condition)
- **Tilt**
  ±90° movement in vertical plane at 3°/sec. ±0.5° (No load)
- **Maximum Load**
  40 lbs. at 5" from tilt table surface to center of gravity
- **Input Voltage**
  115V ac, 50/60 Hz or 24V ac, 50/60 Hz (Model PT570-24P)
- **Power Requirements**
  24V units: 1.8 amps running, 2.70 amps maximum
  115V units: 0.36 amps running
- **Construction**
  Aluminum plate, all internal parts corrosion protected
- **Temperature**
  -10°F to 140°F (-23°C to 60°C)
- **Weight**
  22 lbs (9.9 kg)
- **Preset Position Option**

PT1250P HEAVY DUTY

- **Indoor/Outdoor Operation**
- **Easy Serviceability**
- **Rugged Construction**
- **Explosion-Proof Models**
- **External Limit Adjustment**
- **Adjustable Worm Gear Final Drive to Prevent Drift and Minimize Backlash**
- **Pan**
  0—355° movement in horizontal plane at 6°/second ±1° (No-load condition)
- **Tilt**
  ±90° movement in vertical plane at 3°/sec. ±0.5° (No load)
- **Maximum Load**
  100 lbs. at 5" from tilt table surface to center of gravity
- **Input Voltage**
  115V ac, 50/60 Hz; 220V ac option for Explosion-Proof Models); 115V dc (Model PT1250DC)
- **Power Requirements**
  Standard 115V ac models: 0.70 amps running, 1.20 amps
  Explosion-Proof Models: 1.0 amp running, 1.48 amps maximum
  115V dc models: 0.66 amps running, 1.0 amp maximum
- **Construction**
  Aluminum casting and plate, all internal parts corrosion protected
- **Temperature**
  -10°F to 140°F (-23°C to 60°C)
- **Weight**
  55 lbs (25 kg)
- **Preset Position Option**

PT2000L EXTRA HEAVY DUTY

- **Outdoor Operation**
- **Dynamic Braking for Instantaneous Stopping**
- **Rugged Construction**
- **External Limit Adjustment**
- **Adjustable Worm Gear Final Drive to Prevent Drift and Minimize Backlash**
- **Pan**
  0—355° movement in horizontal plane at 6°/second ±1° (No-load condition)
- **Tilt**
  ±90° movement in vertical plane at 6°/sec. ±0.5° (No load)
- **Maximum Load**
  150 lbs. at 5" from tilt table surface to center of gravity
- **Input Voltage**
  115V dc
- **Power Requirements**
  Running: 2.4 amps, 276 VA
  Starting: 3.6 amps, 414 VA
- **Construction**
  Aluminum casting and plate, all internal parts corrosion protected
- **Temperature**
  -10°F to 140°F (-23°C to 60°C)
- **Weight**
  110 lbs (50 kg)
- **Preset Position Option**

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PRESET POSITION OPTION

The Preset Position Option is a position feedback modification which allows pan and tilt to be automatically positioned to various preset positions. This feature requires the use of a Cohu MPC Microprocessor Control System or related equipment.

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91-02 (4/91)
April, 1991

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COHU INC
ELECTRONICS DIVISION

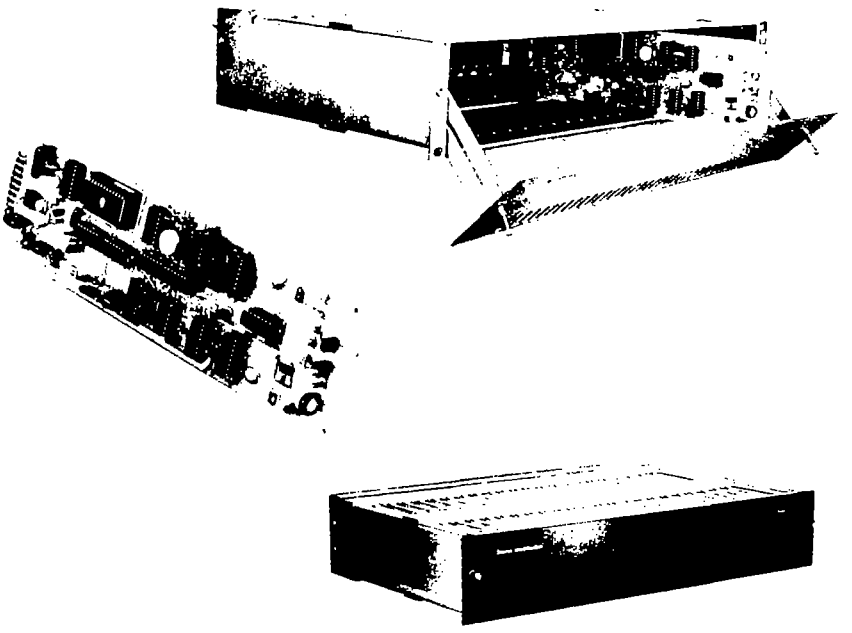
ALPHANUMERIC DISPLAY SYSTEM

SID-100 & UDC-111

Cohu's Model SID-100 Source ID Generator is designed to provide positive identification of the source of the video signal displayed on a monitor screen. The more cameras utilized in a closed-circuit television system, the more desirable it is to be certain you know which camera view is being observed. Typical applications include security/surveillance, airport ground traffic control, penal institutions, mass transit facilities, and other complex monitoring operations.

A 16-character alphanumeric display is produced by each SID-100 Source ID Generator and superimposed on the appropriate video image. Each character is 28 TV lines high and is derived from a standard 5x7 dot matrix. The particular display information is programmed into an erasable EPROM using a PROM programmer. This information is inserted into the video signal by raising the appropriate portions of the signal to whiter-than-white voltage levels without overdriving the monitor. Vertical position of the display is determined by jumper selection and horizontal position is determined by the potentiometer. Once installed, the programmed ID is automatically displayed with its associated video signal.

EPROMs are installed in the appropriate SID-100 Source ID Generator boards which are, in turn, installed into an 18-board capacity Model UDC-111 rackmountable display chassis. EPROMs may be erased with an ultra-violet light EPROM eraser. Programming of EPROMs is available from Cohu. In addition, Cohu can provide, as a special ER feature, a PROM programmer and PC-compatible software to enable user programming.



Shown clockwise from top: The Cohu SID-100 Source ID Generator and UDC-111 chassis; the UDC-111 chassis; and the SID-100 module.

ELECTRICAL

Each Source ID Generator board separates the composite sync from the video input for use in providing timing for its digital logic and memory circuits. Display information is inserted into the video output without distorting any other signalcharacteristics. Any Source ID Generator board may be removed without disturbing the video signal. The SID-100 is compatible with all closed-circuit television systems utilizing either EIA standard RS-170 or CCIR specifications.

MECHANICAL

Up to 18 individual SID-100 boards may be installed in a Cohu Model UDC-111 rackmountable chassis, which fits in a standard 19" rack with a 3.5" panel height. Video is cabled to and from the chassis through 36 BNC connectors located on the back panel.

FEATURES

- **Video source identification at a glance**
- **16-character white alphanumeric display**
- **Field programmable**
- **Display location on monitor screen, jumper selectable**
- **Capatible with EIA RS-170 and CCIR specifications**
- **Up to 18 separate Source ID Generator boards in a single 19" rackmount chassis**

Designed and manufactured in U.S.A.

COHU INC
ELECTRONICS DIVISION

SID-100 & UDC-111 — ALPHANUMERIC DISPLAY SYSTEM

SPECIFICATIONS

ELECTRICAL

Input Power
115 VAC/20 W (18 modules installed)
Input Signal Level
-4 dB; nominal 1.0 V p-p composite video, EIA RS-170 (CCIR special order only)
Characters
Alphanumeric; 28 lines high; white
Number of Characters
16 per module, including blanks

MECHANICAL

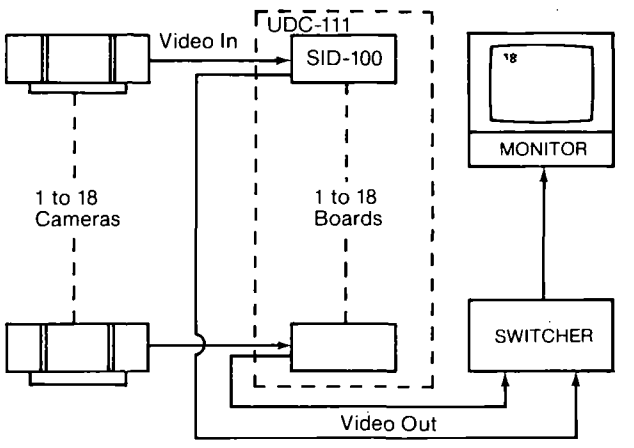
Chassis Dimensions
19.0" x 13.0" x 3.5"
(48.26 cm x 33.02 cm x 8.89 cm)
Chassis Connectors
36 BNC Type Connectors
Number of ID Generator Modules per Chassis
Up to 18, maximum

ENVIRONMENTAL

Ambient Temperature Limits
Operating: 0° to 50°C (32° to 122°F)
Storage: -40° to 85°C (-40° to 185°F)
Ambient Air Pressure
Sea level to equivalent of 10,000 feet (3,048 m) above sea level (24.4 cm of mercury)
Humidity
95% relative humidity (without condensation)
Shock
15 g's in any axis under non-operating conditions, MIL-E-5400R, para. 3.2.24.6.

ORDERING INFORMATION

MODEL NUMBER	DESCRIPTION
SID-100	Source ID Generator Module (specify EPROM programmed or unprogrammed)
UDC-111	Display Chassis, with power supply



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85-47 (1/91) January 1991

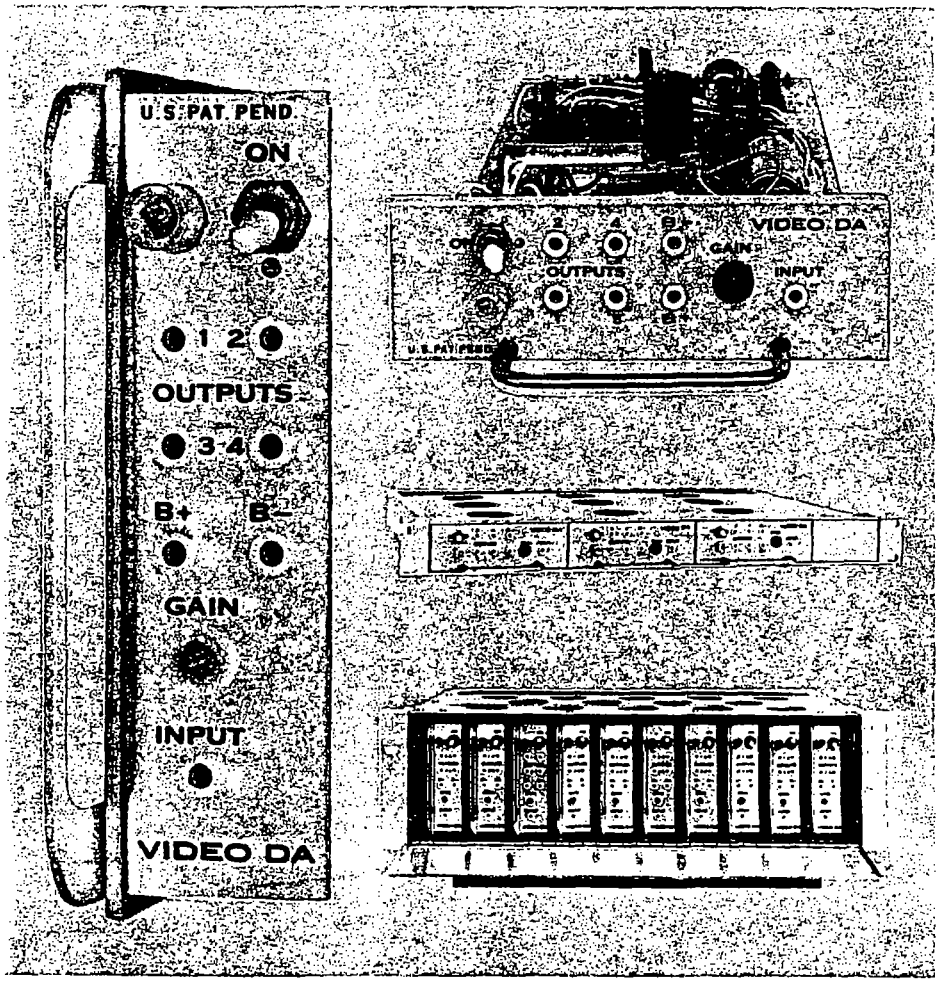
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COHU INC
ELECTRONICS DIVISION

VIDEO DISTRIBUTION AMPLIFIERS

9800 SERIES

The Cohu 9800 Series Video Disbtribution Amplifier is a solid-state, side-band video amplifier that amplifies and distributes video signals from one input to four output channels. The input may be composite or noncomposite, monochrome or color video. Each amplifier has an integral power supply; AC on-off switch and indicator; front panel test points for input, output and power supply; and a video gain adjustment on the front panel. Individual connector panels, one for each amplifier, fasten to the rear of the enclosure and have six BNC or UHF connectors, one connector for each output and two for the bridging (loop-thru) input.



FEATURES

- Modular Construction With Total Solid-State Active Circuitry
- Choice of Vertical or Horizontal Configuration
- Fits Standard 19-inch Rack or Cabinet
- Integral Power Supply on Each Module

9800 SERIES — VIDEO DISTRIBUTION AMPLIFIERS

SPECIFICATIONS

ELECTRICAL

Type of Input
Video, composite or noncomposite (monochrome or color)
Input Level
Composite: 1V p-p or 1.4V p-p (nominal)
Noncomposite: 0.7V p-p or 1V p-p (nominal)
Number of Inputs
One
Input Characteristics
Bridging greater than 50K ohms at 1 KHz. (Provision for loop-through of 75-ohm line. Less than 2 nanoseconds delay.)
Reflection Coefficient
Less than 2%
Output Level
Composite: 1V p-p or 1.4V p-p (nominal)
Noncomposite: 0.7V p-p or 1V p-p (nominal)
Number of Outputs
Four
Output Impedance
75-ohm source-terminated
Isolation Between Outputs
Greater than 35 dB at 3.58 MHz
Isolation Between Amplifiers
Greater than 60 dB to 10 MHz, greater than 50 dB to 20 MHz
Video Gain
20 MHz ± 0.25 dB (can be adjusted for 30 MHz ± 1 dB)
Differential Gain
Less than 0.2% at 10%, 50% and 90% APL (average picture level)
Differential Phase
Less than 0.2° at 10%, 50% and 90% APL
Tilt
Less than 1% (to all-white picture)
Noise
Less than 0.5mV rms, 20 Hz to 20 MHz
Delay Time
15 nanoseconds at 3.58 MHz

ENVIRONMENTAL

Power Requirements
105–125V, 50–60 Hz, 3W max. per PDA , 4W max. per VDA or 5W max. per SDA
Operating Temperature
-20°C to +50°C
Humidity
To 95%

MECHANICAL

Dimensions
Amplifiers: 1¼"W × 4½"H × 10½"D
Vertical-Chassis: 19"W × 5¼"H × 16"D
Horizontal-Chassis: 19"W × 1¾"H × 16"D
Weight
Amplifiers: 1 lb. 6 oz. net, 3 lb. shipping max
Vertical-Chassis: 12 lbs. net, 25 lbs. shipping
Horizontal-Chassis: 5 lbs. net, 10 lbs. shipping

ORDERING INFORMATION

VIDEO DA MODEL NO.		
	ENCLOSURE	
9850-000	Vertical Chassis	Holds 10 DAs
9860-000	Horizontal Chassis	Holds 3 DAs
	DISTRIBUTION AMPLIFIERS	
9800-152	For Horizontal Chassis	With BNC connector assembly. 1 input (with loop-thru) and 4 outputs
9800-352		With UHF connector assembly, 1 input (with loop-thru) and 4 outputs
9800-151	For Vertical Chassis	With BNC connector assembly, 1 input (with loop-thru) and 4 outputs
9800-351		With UHF connector assembly, 1 input (with loop-thru) and 4 outputs

Two types of enclosures are available for mounting in a standard 19-inch rack or cabinet. The vertical chassis accommodates up to ten vertically plugged-in amplifiers and the horizontal chassis holds up to three amplifiers. The line cord and fuse are attached to the rear of the chassis and power distribution to all amplifiers is via interconnection board. The vertical chassis requires 5¼" of rack space and the horizontal chassis requires 1¾" of space.

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COHU INC
ELECTRONICS DIVISION

VIDEO CABLE EQUALIZER

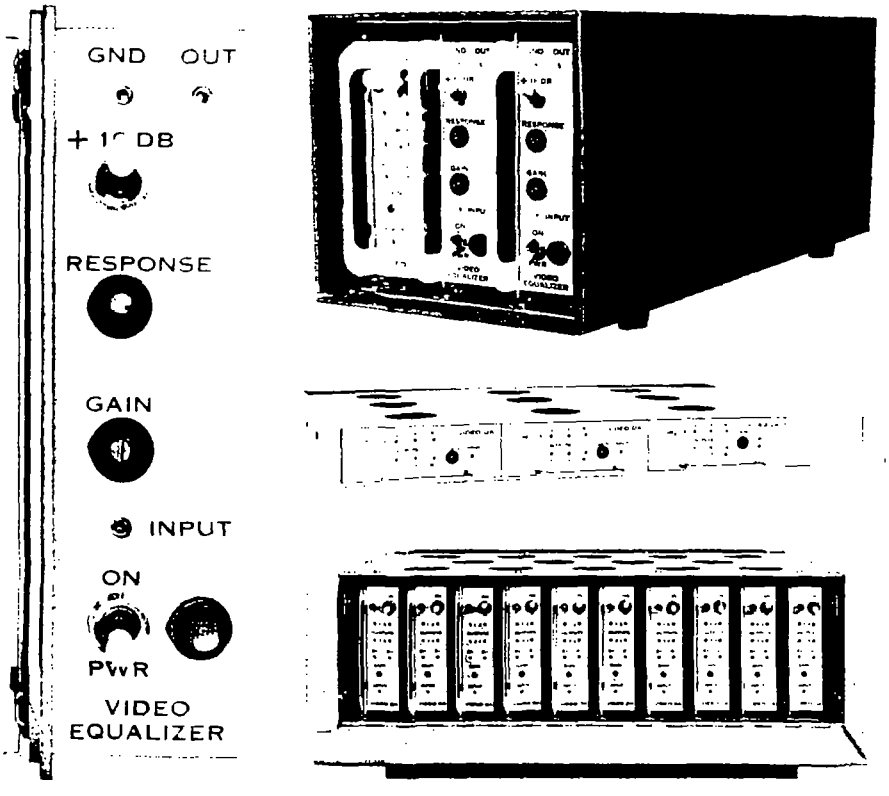
9800 SERIES

The Cohu 9800 Series Video Cable Equalizer compensates for high frequency losses due to long runs. Equalization is sufficient for up to 6000 feet of RG-11/U foam dielectric cable. Longer distances can be equalized by using polyfoam dielectric cables having even lower losses.

The equalizer is a self-contained, plug-in module, having its own integral regulated power supply. All circuitry is contained on an etched, glass epoxy circuit board. All components, test points and adjustments are prominently marked.

Equalization to 30 dB at 10 MHz is provided by three convenient front panel controls, variable RESPONSE control, a variable GAIN control, and a fixed +15 dB toggle switch. Equalization of 0 to 15 dB is made using the RESPONSE control. Equalization above 15 dB requires activating the +15 dB toggle switch and using the variable RESPONSE control. Activating the +15 dB toggle switch introduces a fixed 15 dB of equalization to which the variable RESPONSE control will add the necessary signal for up to a total of 30 dB equalization at 10 MHz. Should low frequency gain compensation be necessary, the variable GAIN control will provide from -4 dB to +6 dB adjustment, which shifts the entire equalization curve, low frequency to high frequency.

The Cohu 9800 Series Equalizer, when used at the receiving end of a cable, provides excellent results with both color and monochrome video signals. The equalizer will accept either a 75-ohm unbalanced or 124-ohm balanced input, producing an equalized 75-ohm unbalanced output. Differential input provides rejection of hum caused by ground loops. The equalizer may also be used at the transmitting end with similar excellent performance.



Shown clockwise from left: The Cohu 9800 series Video Cable Equalizer, Portable Cabinet, Horizontal Frame and Vertical Frame.

FEATURES

- **Up to 30 dB Equalization at 10 MHz**
- **Total Solid State Active Circuitry**
- **Dependable Operation Over a Wide Environmental Range**
- **Exceptional Low Hum and Noise Level**
- **Front Panel Variable Equalization Adjustments**
- **Integral, Regulated Power Supply on Each Module**

9800 SERIES — VIDEO CABLE EQUALIZER

SPECIFICATIONS

ELECTRICAL

Video Inputs
One 75-ohm coaxial input, grounded or differential alternate, one 124-ohm balanced input

Video Output
1V p-p maximum, 75-ohm source-terminated

Compensation at 10 MHz
30 dB total, 0 to 15 dB adjustable, 15 dB fixed

Frequency Response (Amplifier plus Cable)
Gain increase shall be proportional to the square root of the frequency to within ±0.5 dB, ±0.1 dB per MHz up to 10 MHz

Tilt
None (direct coupling)

Amplifier Voltage Gain
Adjustable from -4 dB to +6 dB

Common Mode Rejection
55 dB at 50 to 60 Hz up to 3 volts peak-to-peak

Differential Gain
2% maximum, 10%, 50%, 90% APL

Differential Phase
±1° maximum, 10%, 50%, 90% APL

Hum and Noise
50 dB RMS below 0.7V p-p

Power Requirements
100/130, 200/260VAC, 50-60 Hz, 10W max

Connectors
Input 75-ohm UHF, 124-ohm twin UHF; Output 75-ohm BNC

ENVIRONMENTAL

Operating Temperature
-20° to +60°C (-4° to +140°F)

Humidity
To 90%, noncondensing

Shock Limits
15 g's on any axis under non-operating conditions per MIL-E-5400R, para. 3.2.24.6

Vibration Limits
0.03 inches total excursion from 5 to 30 Hz and peak random vibration of 5 g's from 30 to 1,000 Hz

MECHANICAL

Dimensions
Equalizer: 1.1"W × 4.4"H × 10.75"D (2.79 × 11.17 × 20.30 cm)
Vertical Frame: 19.9"W × 5.25"H × 14.1"D (48.26 × 13.33 × 35.82 cm)
Horizontal Frame: 19.0"W × 1.74"H × 13.8"D (48.26 × 4.44 × 35.05 cm)
Portable Cabinet: 5.6"W × 5.4"H × 13.5"D (14.22 × 13.71 × 34.29 cm)

Weight
Vertical Frame: 12 lbs. net, 25 lbs. shipping
Horizontal Frame: 5 lbs. net, 10 lbs. shipping
Equalizer Module: 1.5 lbs.
Cabinet: 2 lbs.

ENCLOSURES

The Cohu Video Cable Equalizer Module may be mounted in any of three enclosures. A 10 module vertical frame, a 3 module horizontal frame or a 3 module self-contained portable cabinet. The 10 module vertical or 3 module horizontal frame will mount into a standard 19-inch rack.

MODEL NUMBERS

ENCLOSURE DESCRIPTION	MODEL NUMBER
10 Module Vertical Frame	9850-000
3 Module Horizontal Frame	9860-000
3 Module Portable Cabinet	9870-000
VIDEO CABLE EQUALIZER	**AMPLIFIERS**
Vertical Amplifier	9800-855
Horizontal Amplifier	9800-856

COHU RESERVES THE RIGHT TO CHANGE SPECIFICATIONS WITHOUT NOTICE.

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5755 Kearny Villa Road • P.O. Box 85623 • San Diego, CA 92138-5623
Telephone: (619) 277-6700 TWX: 910-335-1244

COHU
ELECTRONICS DIVISION

HIGH RESOLUTION CCTV MONITORS

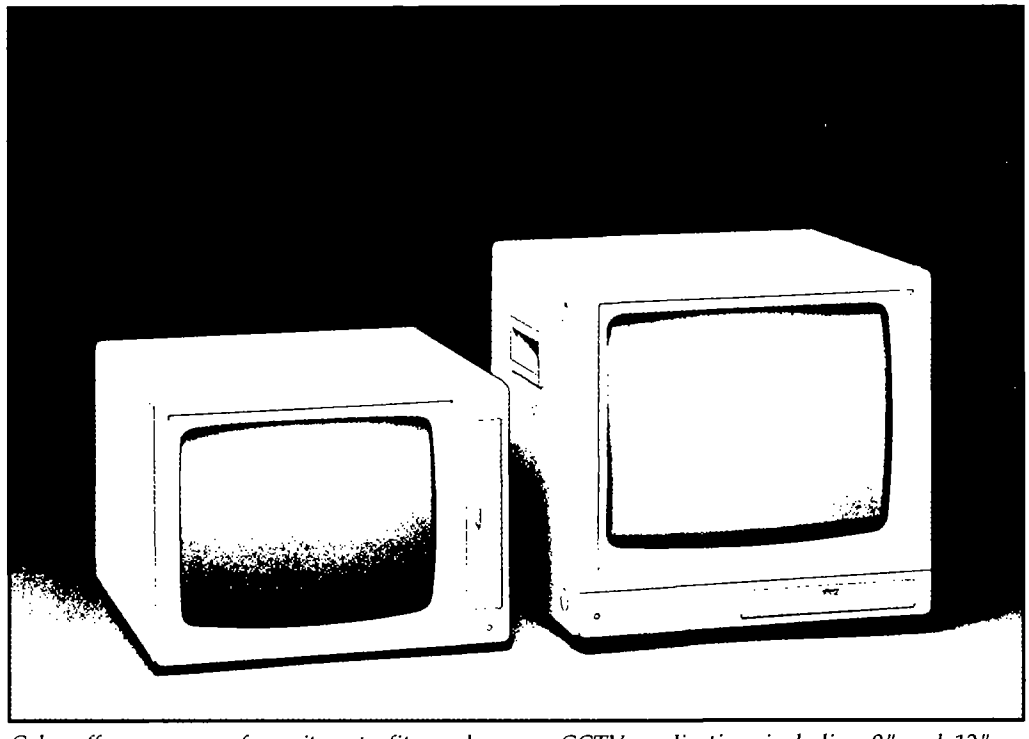
9600C SERIES

Monochrome Monitors

Cohu 9600C Series monochrome monitors are high quality, high performance raster scan displays built to international performance standards. They give stable and reliable performance for virtually every surveillance, industrial, medical, or educational CCTV application. They are extremely rugged, with exceptional geometry, and an average MTBF of 60,000 hours.

Cohu 9600C monitors are offered in 9", 12", 15", 17", and 23" (diagonal) models with P4 white phosphor anti-glare flaceplate standard and feature a minimum center resolution of 1000 TV lines.

A full selection of rack, ceiling, and wall mounts is available.



Cohu offers a range of monitors to fit nearly every CCTV application, including 9" and 12" models, shown.

STANDARD FEATURES

- **Variable scanning** to ensure signal reliability
- **High resolution** linear grey scale (16 discernible levels of black and white)
- **Rugged** metal case construction
- **Easy access** front panel controls
- **BNC connectors** for loop through of multiple monitors
- **UL, FCC, and CSA listed** for 120 V models
- **4:3 aspect ratio**
- **Switchable picture size** from 105% to approx. 85%
- **Composite Input** compatible with any EIA standard RS-170 input (0.5 - 2 V p-p)
- **Differential Input Amplifier** provides increased common mode rejection better than 40 dB up to 6 V p-p
- **Switchable Power Supply** for 110/220/240 V operation; 50/60 Hz 525/60 NTSC and 625/50 CCIR scan operations

MOUNTING ACCESSORIES

9609C/RBL or RBR
Rack mounting kit for 9609 monitors to fit standard EIA equipment rack. Holds one 9609C or two side by side with the blank panel removed. Color: brown. Dimensions: 18.97" (482 mm) W x 8.75" (222 mm) H.

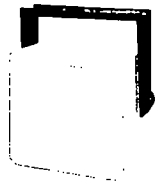


9617C/R
Rack mounting kit for one 9617C monitor, with access door at bottom. Color: brown. Dimensions: 18.97" (482 mm) W x 15.74" (400 mm) H.



9615C/R
Rack mounting kit for one 9615C monitor. Model 1915/R places access door at right (shown). Color: Brown. Dimensions: 18.97" (482 mm) W x 12.20" (310 mm) H.





9617C/YC or 9623C/YC
Ceiling mount for suspended 9617C and 9623C monitors. Fits standard 1.5" steel pipe and fittings (not included). Comes complete with mounting studs and allows monitor to tilt to desired angle. Color: black.

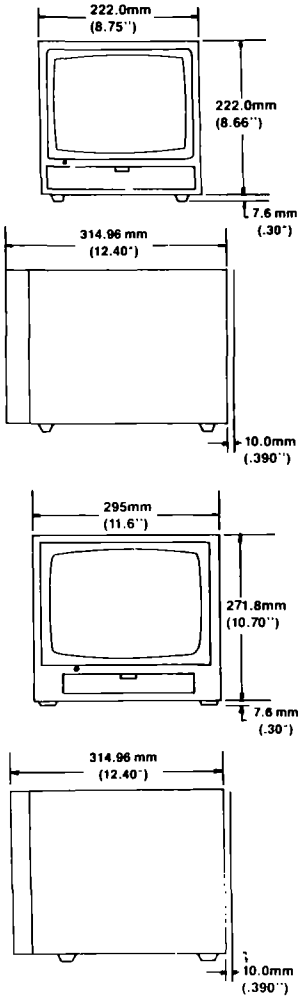


9617C/YW or 9623C/YW
Wall mount bracket for use with 9617C and 9623C monitors. Color: black.

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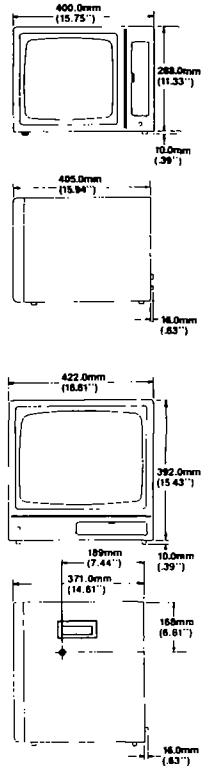
9" AND 12" HIGH RESOLUTION MONOCHROME MONITORS

Maximum Resolution
1050 TV lines at 31.5 KHz
1024 pixels at 36 KHz
Bandwidth
30 MHz -3 dB @ 25 V
Horizontal Frequency
15.5 - 40.0 KHz
Vertical Frequency
40-90 Hz
Power
90-264 VAC, 50/60 Hz
User Controls
On/Off
Horizontal Centering
Vertical Centering
Brightness
Contrast
Vertical Linearity
Vertical Size
Horizontal Size
Focus
Sub-brightness
Interfaces
1. One BNC input, 75 ohm terminated
2. Two BNC inputs, with loopthrough, A/B switchable from front panel.
Weight
9": 12 lb. (5.45 kg)
12": 19 lb. (8.64 kg)
Dimensions
As illustrated



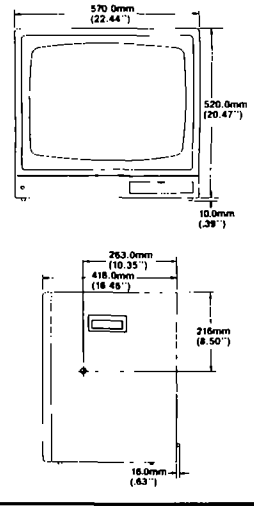
15" AND 17" HIGH RESOLUTION MONOCHROME MONITORS

Maximum Resolution
1000 TV lines at center
800 TV lines at corner
Bandwidth
30 MHz
Horizontal Frequency
15.5 - 16 KHz
Vertical Frequency
50-70 Hz
Power
90-270 VAC, 50/60 Hz
User Controls
On/Off
Horizontal Centering
Vertical Centering
Brightness
Contrast
Vertical Size
VTR Switch
A/B Switch
Interfaces
A/B BNC inputs, with loopthrough, auto terminating
Weight
15": 10.8 lb. (14 kg)
17": 37.5 lb. (17 kg)
Dimensions
As illustrated



23" HIGH RESOLUTION MONOCHROME MONITORS

Maximum Resolution
1000 TV lines at center
Bandwidth
30 MHz
Horizontal Frequency
15 - 40 KHz
Vertical Frequency
45-90 Hz
Power
90-270 VAC, 50/60 Hz
User Controls
Same as above
Interfaces
A/B BNC inputs, with loopthrough, auto terminating
Weight
66 lb. (30 kg)
Dimensions
As illustrated

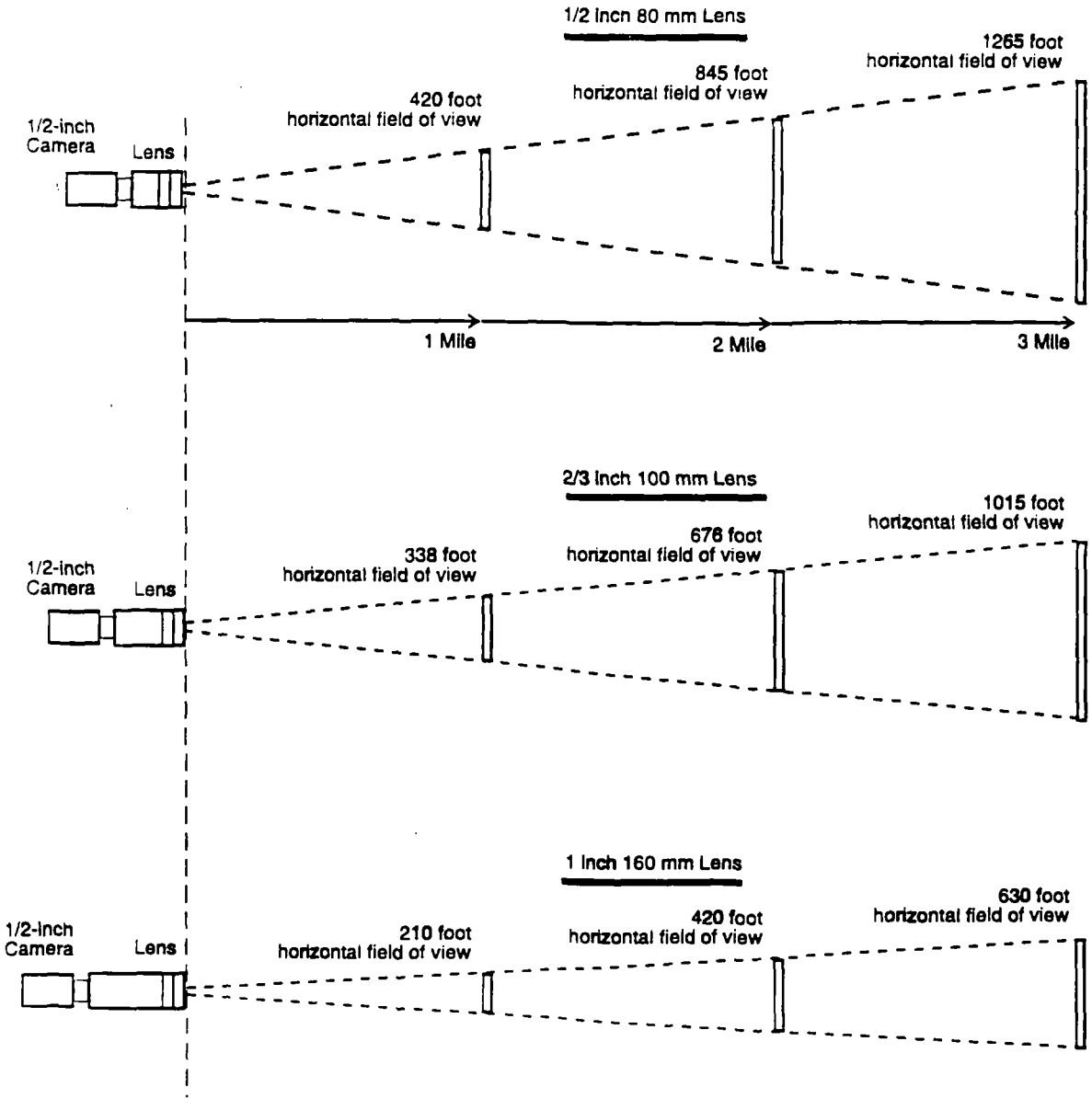


ORDERING INFORMATION

96	XXC /		X	
9600 C Series	09	9" Tube	C	Mounted in standard cabinet
	12	12" Tube	R	19" rack mount assembly
	15	15" Tube	2R	Dual rack mount for 9" monitor
	17	17" Tube	RBL	Rackmount with blank left panel
	23	23" Tube	RBR	Rackmount with blank right panel
			YC	Yoke mount for ceiling installation (17" and 23" only)
			YW	Yoke mount for wall installation (17" and 23" only)

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Horizontal fields of view. using three different lenses. at three distances.

Security System Sees Color In The Dark

SUMMARY: There are many video systems that see in the dark. Here's a low-cost system that does it in color.

By Glen Southworth

• THE COMBINATION of a single-chip color TV camera, timer, and solid state memory have made possible a 1,000-to-one improvement in the ability to see color images at very low light levels.

Applying a technique long used in astronomy, that of making time exposures through the use of special television camera tubes, a new generation of CCTV cameras have made low-cost video systems with exceptional sensitivity practical.

The secret is in allowing the light entering the camera lens to build up a charge on the camera sensor over an extended period of time, as opposed to continually scanning and destroying the charge image at a rate of 30 times per second, as is the case in normal operation. By delaying the scanning process for a number of frames, the sensor charge will continue to build up and deliver a dramatic increase in sensitivity.

This process is very similar to making time exposures with photographic film, and has much the same limitations in that the subject viewed by either type of camera must be stationary and that care must be taken to avoid overexposure.

A major difference, however, is that, in the case of the television system, the time-exposure readout consists of a single field or frame of video with the need for a means of capturing and displaying the brief image produced.

A frame counter can be incorporated into a high-quality solid state video memory and be used to control the interval during which the camera sensor remains unscanned. At the end of a preset time, the sensor readout signal is released and the resulting single field or frame of video is scanned out. At the same time scanning commences, a high-speed analog-to-digital converter digitizes the image from the camera. From there it is stored in a Colorado Video Model 440 memory for continuous viewing.

An example of the effectiveness of such a system is shown in the nighttime photograph, which is an off-the-screen shot (which accounts for the scanning lines and the soft-appearing resolution) of a time exposure captured by a single-chip COHU model 8215 color camera. Obviously, if the video camera had been a two- or three-chip low-light camera, the picture would have been even better. The system described here, however, can be put together for less than $5,000.

The exposure time was set at 34 seconds with a lens opening of f1.8. The scene was shot at approximately 10:15 PM on a cloudy evening, with the only unnatural illumination being a small light bulb about 120 feet to the right of Santa.

A striking aspect of this video system arrangement is the ability to reproduce vivid color images under conditions where a human observer would see only a dim black and white picture. This technique also allows detection of faint fluorescence in biological specimens, rocks, or other materials when illuminated by ultraviolet light. This takes the camera's greatly improved sensitivity almost into infrared capabilities.

CONTACT: InfoCard #80. Glen Southworth, Colorado Video, Box 928, Boulder, CO 80306; (303) 530-9580; Fax: (303) 530-9569.



Screen shot of a nighttime photograph captured by a single-chip COHU color camera at 10:15 at night, with the only light being a small bulb placed approximately 120 feet away from Santa.

A striking aspect of this video system arrangement is the ability to reproduce vivid color images under conditions where a human observer would see only a dim black and white picture.

DEVELOPMENT OF A LOW-COST, MODULAR, WIRELESS COLOR TELEVISION SYSTEM FOR NUCLEAR RADIATION ENVIRONMENT

Nabin C. Panda
Cohu, Inc./Electronics Division
San Diego, CA USA

ABSTRACT

The system developed is an enhancement of an existing video system for process control and observation. It was developed to work within a nuclear radiation environment to identify locations and volumes of accumulated in-cell solids and to inspect the interior and exterior of the process vessel. It also performs remote integrity assessments of tanks and pipes routings that are required by regulatory agencies. System highlights are: operation in a highly radioactive environment; microwave transmission of video and control signals: low cost: low maintenance, and: modular design to enable future enhancements. Microwave transmission resolves the complications of a wired system while increasing reliability and safety. The video image is transmitted via microwave out of the cell to TV monitors at consoles in non-radiation zones.

INTRODUCTION

This remote TV inspection system has been developed as an enhancement to an earlier modular unit serving the same general purpose.

The previous systems were designed and shipped by Cohu, Inc./Electronics Division and Broadcast Microwave Services (BMS), and are

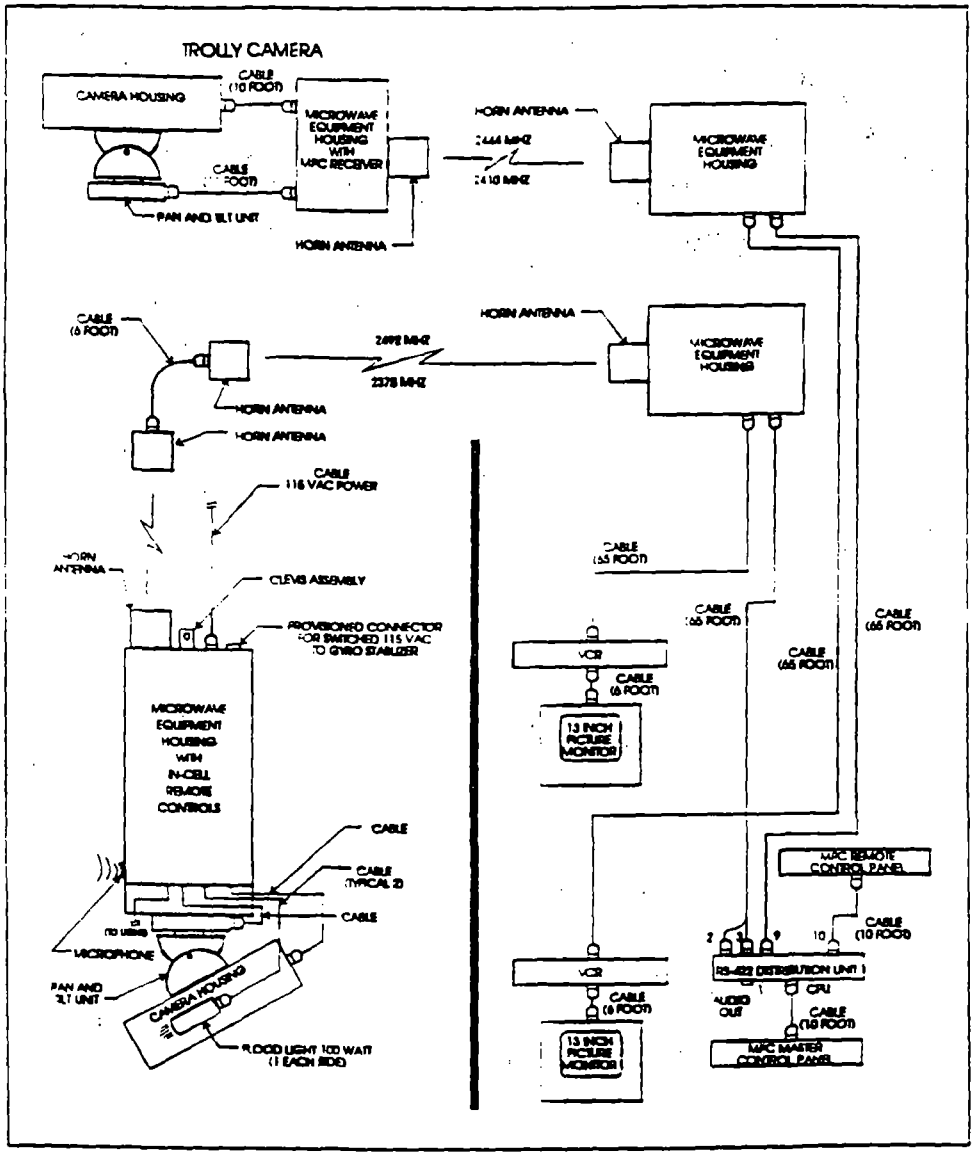


Figure 1

primarily used as a process observation tool for identifying locations and volume of accumulated in-cell solids. Due to the modular design of the basic unit, new modules are interfaced to the basic unit to add additional capability for the process vessel interior/exterior inspection tasks. The new accessory module will allow insertion of the camera into 3" (75 mm) (ID) vertical process nozzles. The accessory is a 20' (6 m) stainless steel tube, consisting of four hinged sections, with a tilting TV camera and light assembly at the end of the tube. The accessory's flexible hinged sections will allow it to pass through congested piping arrangements before reaching the process vessel nozzle. The accessory will be attached to

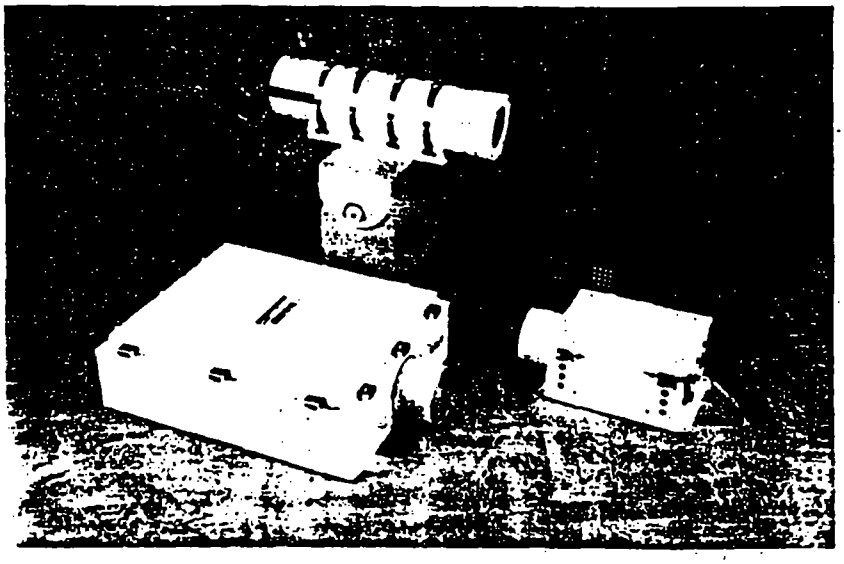


Figure 2

the original pan/tilt assembly with the tilt function disabled. The tilting of the camera head at the end of the tube is accomplished by a tilt motor mechanism at the camera end and is capable of tilting the camera head section ±95° from vertical.

Assembled from standard and modified standard components, the system creates a previously unavailable microwave-linked remote-control TV inspection system. **Figure 1** shows the three major equipment groups of the original system without the accessory. At the top-side operator's location are the control panel, TV monitor, and video receiver unit with its microwave horn antenna. It receives video from and also sends control telemetry to the in-cell unit. These signals are relayed through the passive horn antenna assembly. The in-cell unit hangs from a cable. The pan/tilt unit is bottom mounted, allowing the camera and light a full range of movement for observation.

The accessory described above is attached to the pan/tilt mechanism of the in-cell unit. **Figures 5 through 9** show the accessory for the process interior/exterior vessel inspection.

Remotely controlled functions are pan, tilt, zoom, camera on/off, light on/off, auto/manual white balance, and an auxiliary function for control of a film-camera shutter. The reserve capacity of the system allows for other functions to be controlled, too.

MODULAR DESIGN

The system is packaged largely from modules selected from standard catalog equipment. Primary components are a Cohu Color CCD Camera and microwave equipment supplied by the sister division of Cohu Inc., Broadcast Microwave Services (BMS).

Other components include various standard lens combinations packaged inside radiation shielded housings, a remotely controlled pan/tilt unit, a standard microwave transmitter/receiver, and other signal processing equipment for the telemetry control and video signals.

The accessory module consists of a 20' (6 m) long, four-section, stainless steel hinged assembly, measuring 1.5" (38 mm) outer diameter (OD), with a tilting housing at the end. On this housing is mounted a 2.5" (64 mm) OD remote head camera and lights.

Figure 2 shows the major components of the original video inspection system: microprocessor control panel, in-cell unit, and top-side unit. **Figure 3** shows the accessory module interface to the original in-cell camera. **Figures 4 through 6** show the complete vessel interior camera with tilting camera and light head.

WIRELESS TRANSMISSION

Microwave transmission solves the complications inherent in a wired system while also increasing reliability and safety in the hazardous environment. Video images generated by the remote color TV camera are transmitted by microwave to TV monitors in non-radiation zone consoles and office spaces.

The in-cell unit includes a video transmitter, a telemetry receiver, horn antenna, diplex coupler, power supply, and interconnecting cables. All components mount in a standard environmentally sealed aluminum enclosure modified to meet system requirements.

The top-side video receiving unit consists of a video receiver, diplexer, FSK modem, telemetry transmitter, horn antenna, and 115 V ac to 28 V dc power supply mounted in a sealed enclosure.

Signals are relayed via back-to-back microwave horn antennas that target the radio frequency signals.

RADIOACTIVE ENVIRONMENT

The camera unit is designed to operate in a radiation field of 2×10^8 rad cumulative dose (with occasional exposure to 200 rad/hr to 1,000 rad/hour). To provide radiation shielding, the camera head and lens are housed in a sealed aluminum housing containing lead-shielding. The housing is constructed from 6061-T6 aluminum tubing with 4.5 inch (114 mm) outside diameter and 0.25 inch (6.4 mm) wall thickness. It has a 0.23 inch (5.8 mm) optical-quality glass window.

Inside the housing, the camera head is shielded by 0.25 inch (6.4 mm) of lead. Special radiation tolerant materials are used for various gaskets and seals in the environmental housing.

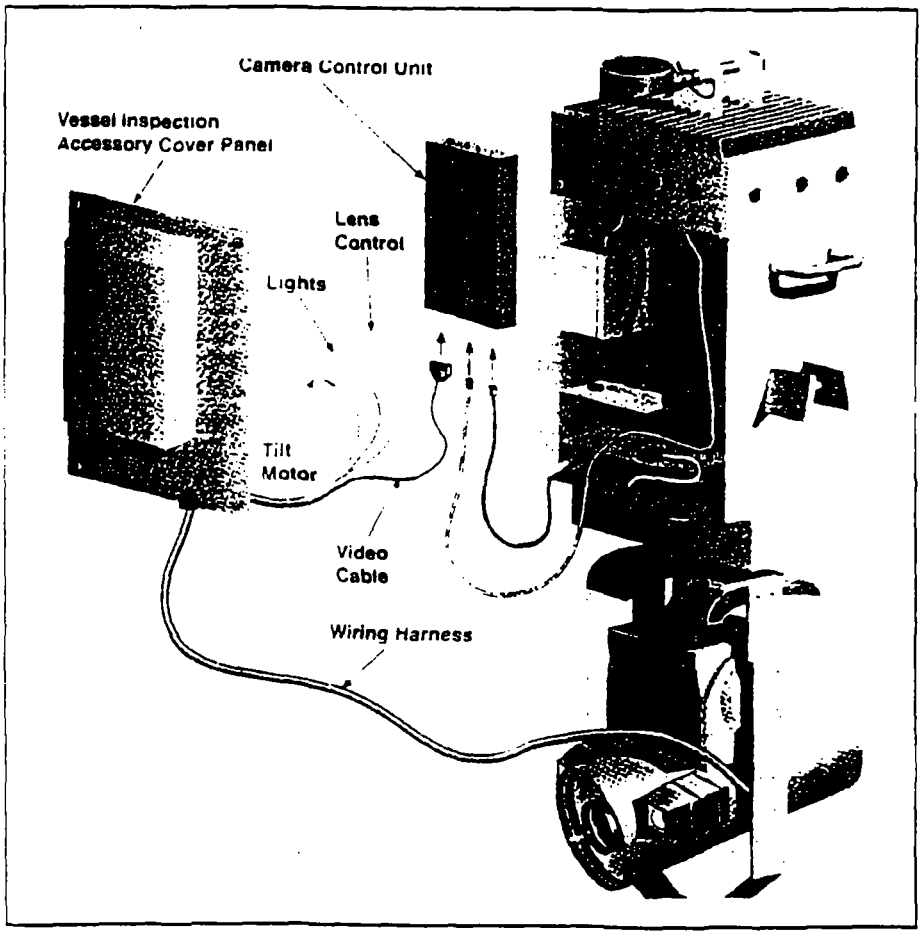


Figure 3

ACCESSORY MODULE FOR VESSEL INTERIOR INSPECTION CAMERA SYSTEM (VIICS)

The following is a description of the accessory module for the Vessel Interior Inspection Camera System (VIICS) **Figures 3 through 6.** With minor modification to the original in-cell inspection camera system, the VIICS will attach and detach easily and provide video of the process vessel interior and exterior.

Vessel Inspection Accessory Cover Panel Assembly: The vessel inspection accessory cover panel assembly (figure3) contains the new camera control unit (CCU). The cover panel is compatible

with the original in-cell inspection camera when is desirable to detach the accessory and use only the in-cell camera.

Vessel Interior Inspection Camera System (VIICS): The VIICS Assembly is attached to the original in-cell inspection camera system pan/tilt unit (**figure 3**). The VIICS assembly is folded into position (**figure 4**) for storage after disconnecting from the original in-cell inspection camera system pan/tilt unit. The VIICS accessory camera head is shown in **figures 5 & 6**.

The VIICS camera head assembly is a Cohu model 8280, consisting of a color video camera and auto iris lens, lead shielded housing, two (2) nuclear-grade sealed halogen lights, radiation resistant window glass, and necessary cables and connectors.

The housing end has a rounded centering aide to facilitate easy passage through congested piping arrangements. The centering aide is designed such that it will be at the bottom of the video display and will remain at the bottom during all tilt evolution. The lights provide a minimum of 50% video at a distance of 10' (3 m) with no thermal complications.

The original system to which the above accessory is attached consists of these components: Cohu 6800 series two-piece solid-state color camera; Cohu Micro Processor Control (MPC) master control unit; 6061-T6 aluminum housing for remote unit; 12 V dc power supply; 15 V ac 13-inch color monitor; 15 V ac pan/tilt unit; 150 W, 20 lumens/watt environmentally sealed light and mating assembly; sealed and lead-shielded housing for remote camera head; Zoom lenses and auto iris lenses; Housing for external crane cab unit enclosing telemetry transmitter, video receiver, horn antenna, diplexer, 115 V ac to 28

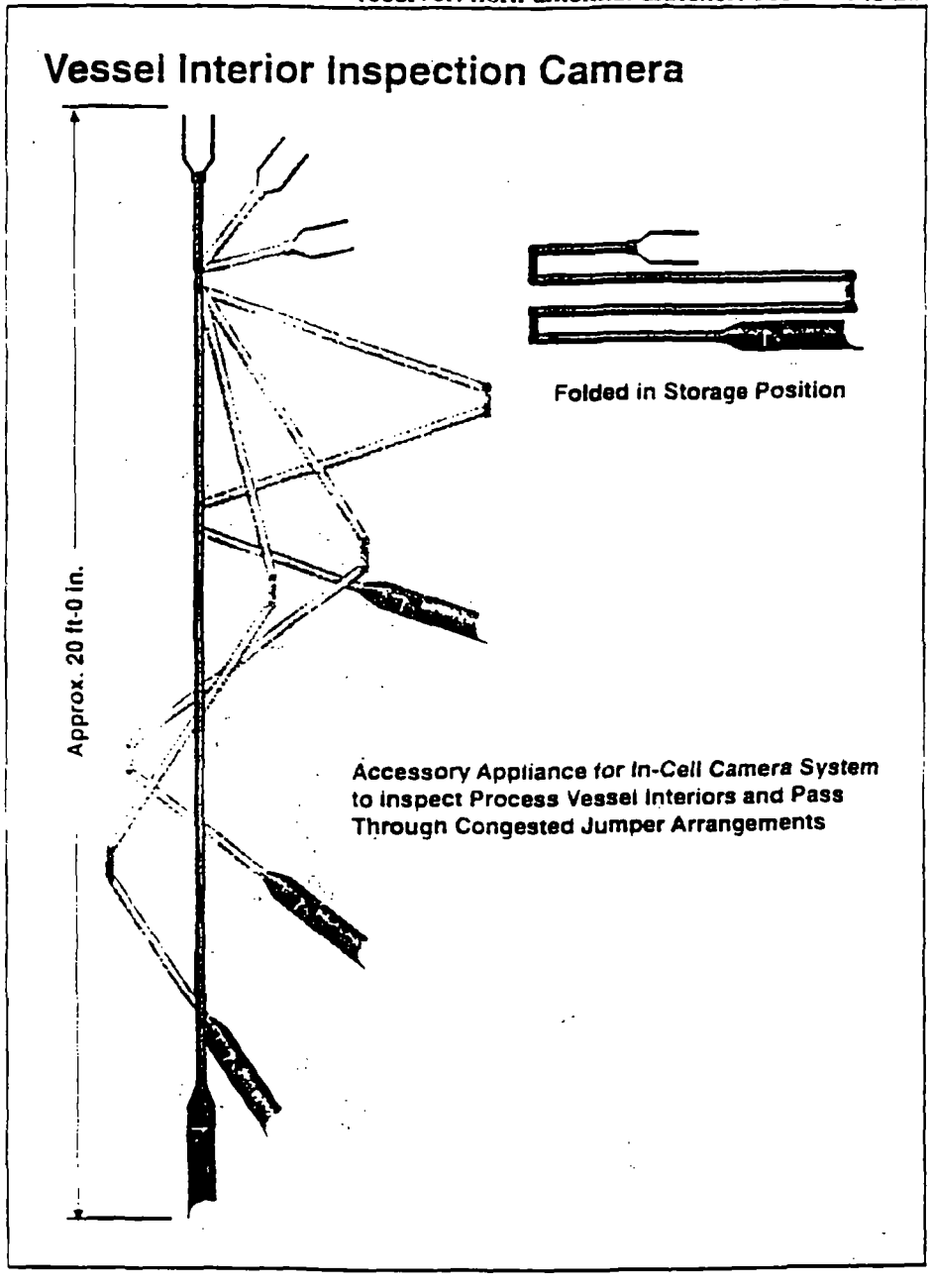


Figure 4

V dc power supply, and FSK modem: Environmentally sealed aluminum enclosure for in-cell video transmitting unit enclosing video transmitter, telemetry receiver, diplexer, pan/tilt board, 115 V ac to 28 V dc power supply, camera control, and MPC power supply; Video receiver 2450 MHz, BMS model BMR-50; Horn Antenna, BMS model BMA-10H; Telemetry transmitter, BMS model TBT-50-TL; Video Transmitter, BMS model TBT-50-VS; Telemetry Receiver, BMS model BMR-50-TL; BMS FSK Modem; Diplex Coupler, BMS model TDS-100; 115 V ac to 28 V dc power supply; Custom modified interconnection cables for video, RF and power.

REMOTE HEAD COLOR CAMERA

The Cohu compact, rugged 6800 Series camera consists of the remote camera head with integral 15-foot (4.6 m) control cable and the camera control unit (CCU). The CCU was mounted separately in a sealed enclosure with the power supply and microwave components of the system. The assembly containing the camera head and lens can be replaced without the necessity for any adjustments. This offers an easy method of changing to a different type lens when required.

PAN/TILT UNIT

The mini pan/tilt mechanism is a standard product that was specifically modified to accommodate the lighter, smaller new-generation cameras. The camera head housing and supplemental light mount next to each other on the pan/tilt unit moving platform.

SUPPLEMENTAL LIGHT

The supplemental light is an off-the-shelf unit designed for applications such as inspection, workbench illumination, and TV lighting. The light has a broad uniform color-balanced beam pattern ideal for color TV and photographic applications.

HORN ANTENNA

The Horn antenna is a standard BMS model BMA-10H. This is a circularly-polarized horn constructed with micro strip techniques.

The gain of the horn is a nominal 10 dB at 2 GHz with 30 degree beam width. With reflector attached to the horn, gain is 16 dB with 20 degree of beam width. Isolation between feeds is 25 dB, minimum.

TELEMETRY TRANSMITTER

The BMS model TBT-50 telemetry transmitter is a portable remote controlled transmitter available with operation at any frequency between 2 and 2.5 GHz. Power output is selectable from 2 to 12 watts. For this system the selected power output is 5 watts.

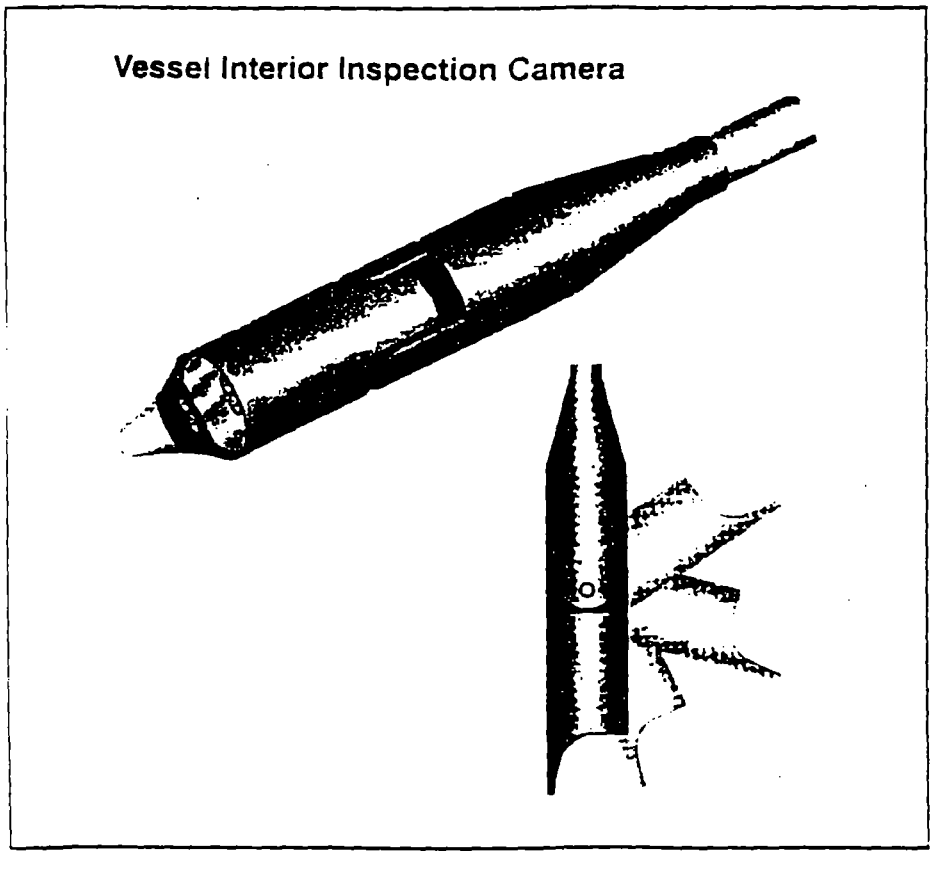


Figure 5

TELEMETRY RECEIVER

This BMS model BMR-50 is a standard-product single-channel receiver designed to receive and demodulate television broadcast signals at any designated operating frequency between 2 and 2.5 GHz. The receiver provides a standard video signal output and two independent audio outputs. An internal frequency-lock light indicates on-frequency conditions.

CONCLUSION

Although the system was developed for a specific application at Westinghouse Hanford in a high radiation environment, its adaptability for other uses at nuclear plants with similar requirements easily could be achieved. The low-cost modular design using off-the-shelf components provides relative ease in modifying the system.

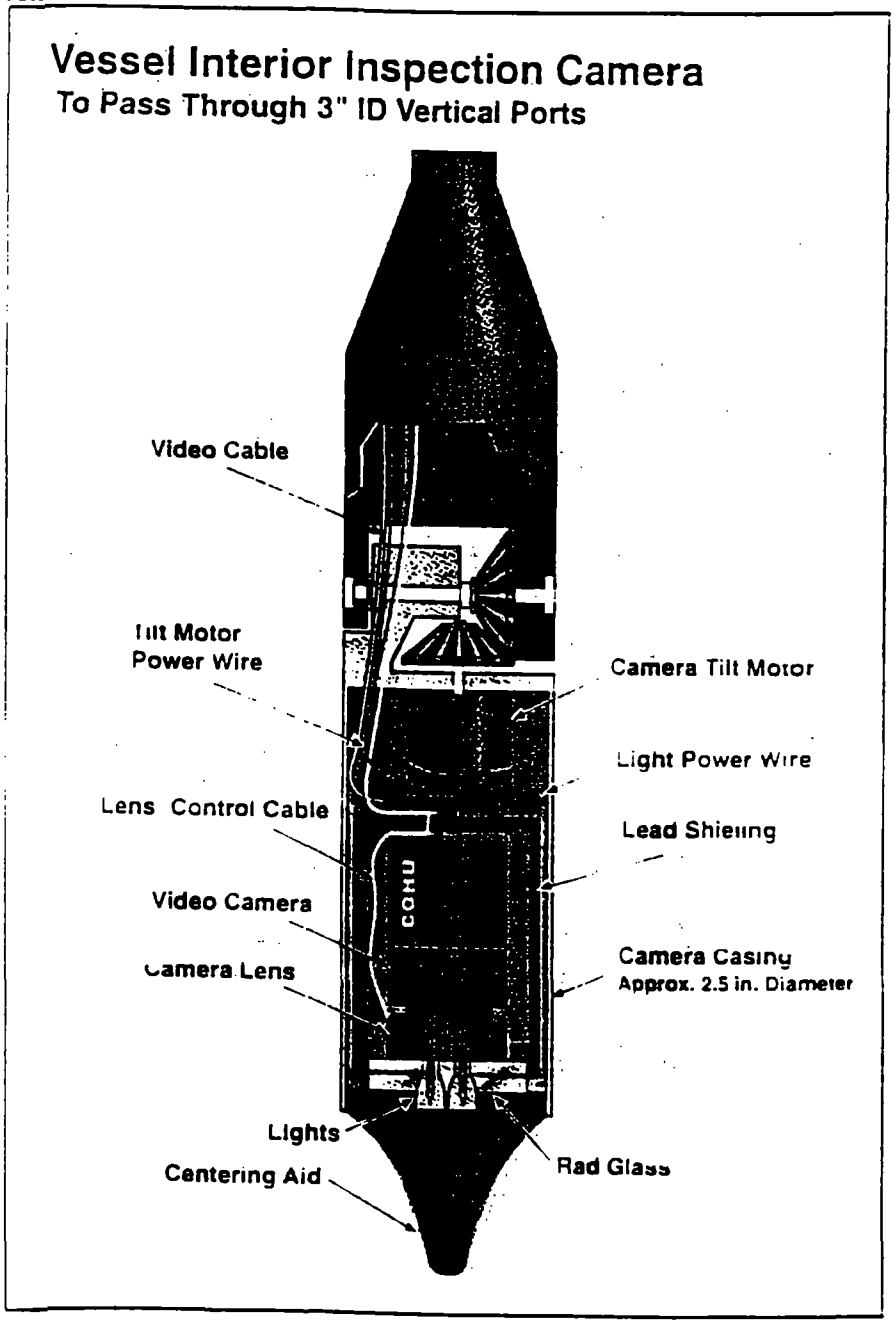


Figure 6

APPRECIATION

The author wishes to thank Westinghouse-Hanford for allowing the use of system details for this paper. The author is grateful to the following persons of Cohu Inc., Electronics Division, for their help in coordinating, editing, reviewing, and preparing the final draft for this paper: Gary Holmes of Publications; Jim Walrod and Eric Hilsen of Engineering; and Ronn Rohe of Marketing.

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1. Westinghouse Document No. WHC-S-043, REV. 2.1990.
2. Cohu Inc./Electronics Division. Broadcast Microwave Systems (BMS) Division. Standard parts Catalog.

Video Sensors: Picking a Solid-State Sensor Technology Depends on the Application

Joe Barrett
Cohu, Inc., Electronics Div.

Understanding the technology and capability of image sensors and video cameras allows identifying appropriate device solutions for measurement applications. This article examines CCD video camera technologies (frame, interline, progressive scan and charge-injection device) from an operational viewpoint.

The application of video in measurement solutions increases yearly. Understanding the features and benefits associated with video cameras allows a user to select the best technology to achieve the desired result.

Charge-coupled devices (CCDs) are two-dimensional fixed-geometry area arrays of photosites. Array sizes that are available for production-line applications (vs. scientific measurement) typically have 244, 485 and 1000 vertical lines of resolution. Each line has a specific number (typically 510, 768 or 1000) of pixels (picture elements). The greater the pixel count in each line, the higher the horizontal resolution.

Photons striking the silicon pixel generate a charge. This voltage level is referred to as a charge packet. The difference between sensor technologies is the method of construction and the path by which charge packets are transferred from the active array of the sensor chip to the camera circuits.

Frame transfer

A frame-transfer sensor may contain a field or a full frame of pixels on the active imaging area. A second array, called the storage register, also contains either a field or full frame of pixels. As photons strike the active array, a charge potential of electrons is built up in the pixel well. Clocking transfer pulses move the charge packets from the active register to the storage register (Figure 1). The time required to transfer the image from the active array to the storage register is dependent upon array size and clock speed.

A disadvantage of this transfer technique occurs when bright highlights are present. As each line of pixels moves through a bright point, the value of that pixel is altered. In an extreme case, streaking appears as a white vertical line.

The advantage of frame-transfer technology is near-100-percent fill factor: the ratio of active array area to total array area. In addition, these sensors incorporate a thicker surface substrate on each pixel, allowing their spectral response to extend into the near-infrared region (1100 nm).

Laser applications requiring a wide range of spectral response from 400 to 1100 nm are appropriate for this technology.

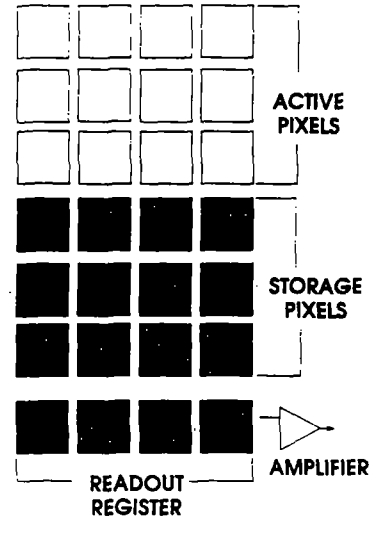


Figure 1. Frame transfer.

Progressive scan

In this technology, the lines of video on the sensor are read sequentially, rather than alternately,

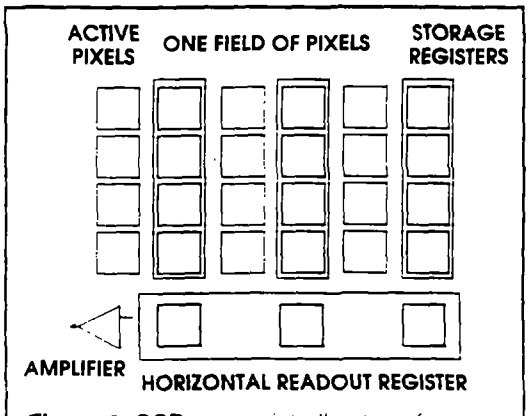


Figure 2. CCD sensor interline transfer.

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as in interlaced cameras. The problem with interlaced cameras is that an object that is moving through the field of view will change positions between field 1 and field 2 relative to its speed of travel during the 16-ms time period. This movement can produce a blurred image.

Progressive-scan cameras such as those using the Eastman Kodak KAI-0370 Interline sensor can solve the problem. However, few monitors are available to directly view progressive scan, and progressive-scan output has not been standardized, so additional consideration is necessary when selecting hardware.

This is a high-cost solution (about $1400), which is appropriate in machine-vision applications requiring a full frame of vertical resolution per integration period.

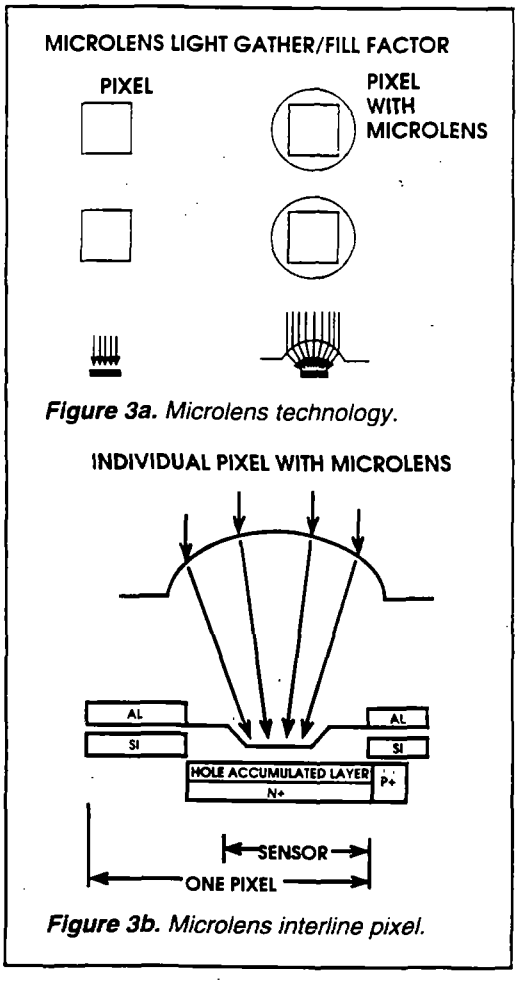


Figure 3a. Microlens technology.

Figure 3b. Microlens interline pixel.

Interline transfer

The interline-transfer sensor's active pixel area and storage register are both contained within the active imaging area (Figure 2), and the active array of this device contains a full frame of pixels (494). Each column of active pixels is separated by a column of storage elements that can store one field. This configuration reduces size and cost in manufacturing the sensor but limits the ability to acquire full-frame vertical resolution, so a strobe or electro-optical/mechanical shutter is necessary for high-speed production lines.

Interline technology offers several advantages. The transfer of charge packets from active image pixels to the storage register happens in a fraction (6.5 µs) of the time required by frame transfer, reducing the probability of highlight smearing. In addition, an effective antiblooming gate inhibits charges spilling over to adjacent pixels.

The disadvantages of this technology are that its spectral response peaks at 550 nm and falls off sharply before reaching the near-infrared region, and its fill factor is only about 35 percent. Placing microlenses above each pixel to focus the light onto the active portion of the sensor raises the fill factor to 70 percent or more (Figure 3). This increases the light accumulating on the sensor by a factor of two.

This low-cost solution (about $800) is ideal for fluorescence microscopy and applications requiring extended integration (multiple frames) for additional sensitivity, or for asynchronous capture of random events.

Charge-injection devices

The development of charge-injection devices (CIDs) focused on two features that were not available with CCDs: addressable pixels and nondestructive readout. The CID imager allows users to select individual pixels by accessing row and column electrodes (Figure 4).

Nondestructive read is achieved when the charge potential is shifted between the electrodes of two capacitors of a single pixel. The difference between the two potentials is representative of the stored signal charge. The sensed potential is converted to a voltage for readout, not shifted to a transfer register.

The user or image-processing algorithm then makes a decision: Either use this value and clear the pixel to prepare for a fresh integration period, or resume collection on top of the previous charge.

This unique feature provides the means to image very bright objects and dim areas within the same scene by reading the highlights before they saturate and allowing additional integration time for dim areas.

This device also has a near-100-percent fill factor and responsiveness out to near-infrared (1100 nm

Machine vision inspection of glass bottles, where bright light can cause bright reflections, is an ideal use of the antiblooming feature of this technology.

The future

Sensor engineering, manufacturing and quality continuously improve. Smaller-format imagers are fast becoming the norm. Smaller size allows higher yields and lower cost, with additional on-board gain and microlens technology compensating for the smaller pixel size. □

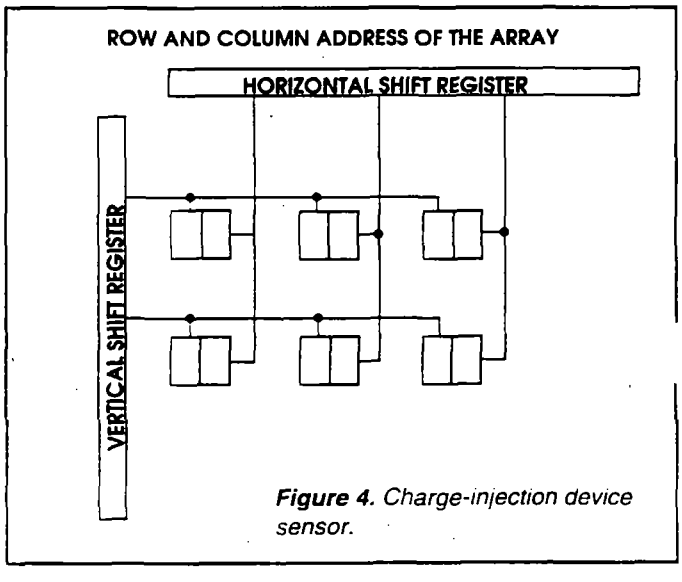


Figure 4. Charge-injection device sensor.

Selecting the Correct Video Camera for Test and Measurement Applications

Joe Barrett

ABSTRACT--Understanding the technology and capability of image sensors and video cameras allows identifying appropriate device solutions for measurement applications. This paper examines CCD video camera technologies (Frame, Interline, Progressive Scan, Charge injection Device) from an operational view point. Video timing (RS-170) and camera features (resolution, sensitivity, shuttering, integration, asynchronous reset) are presented in a non-engineering format.

The application of video in measurement solutions increases yearly. Understanding the features and benefits associated with video cameras allows a user to select the best echnology to achieve the desired result.

The goal of this paper is to deliver specific information on camera technologies that allows making an informed decision on integrating the camera into a vision system. Provided is a basic understanding of television and video cameras for optical measurement applications, including information on costs, design features, and benefits associated with using a video camera as a measurement tool. Advantages/disadvantages of the different technology options will be addressed. Information is presented in an operational/applications format rather than a design/engineering research format.

Topics covered include: television timing, technology of image sensors, including CCD and CID devices, operation of Frame Transfer, Interline Transfer, Progressive Scan and Addressable Arrays; Resolution, Modulation Transfer Function/Aliasing; Signal-to-Noise Ratio and Sensitivity (thermal noise); and Explanation of Basic Camera Variables — Gamma, Black Level, Gain, Sharpness, Integration, and Shuttering. Digital video and emerging camera technologies will close the discussion.

BACKGROUND

CCD image sensors were developed in the early 1970's by Bell Laboratories. The technology has progressively improved, resulting in higher yields, better performance, and lower cost. During the mid 1980's solid state technology surpassed video tubes as the primary means of acquiring video images. Chip size has progressively down-scaled in format from 2/3" to 1/2", and recently 1/3". Better manufacturing methods and innovative

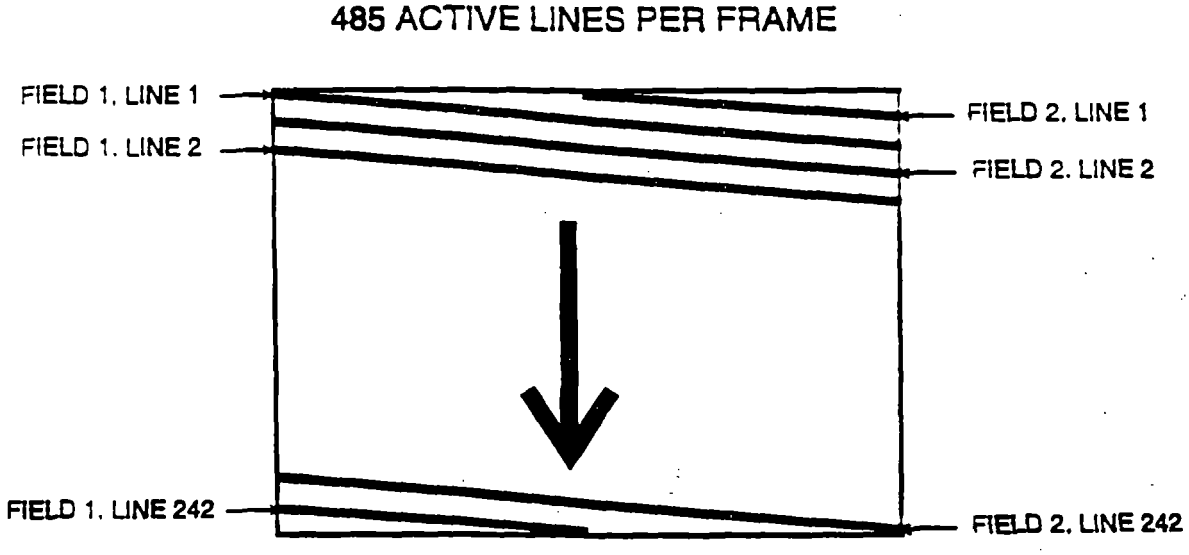


FIGURE 1. MONITOR RASTER

designs are preserving the sensitivity and resolution, as well as improving signal-to-noise ratio.

The basic video system requires an illumination source, scene or object to view, and a lens or point source of light. The sensor will convert photons of light to electrons, the camera electronics develop a signal that is output to a monitor for viewing, or image processing system for analysis.

The television timing format was defined by the EIA (Electronics Industries Association) for the purpose of standardization during the 1950's. This work resulted in television specification RS-170, defining the United States standard (525 line format). Certain technology limitations (transformer flyback time) during those years required greater separation between lines of video information. It takes 33.3ms to create a single frame of video; 20% of this time is consumed with synchronization pulses. If the standard were to be created using today's technology this percentage would be greatly reduce. So why do we chose this format for measurement? The answer lies in the availability of inexpensive hardware, off-the-shelf practical solutions, and adequate performance in image processing measurement applications.

BASIC TELEVISION

Standard television timing (RS-170) was optimized for viewing on a monitor by the human eye. The construction of the image onto the monitor is an interesting and important step in understanding video timing.

The television image is developed on the monitor by scanning an electron beam across the face of a monitor phosphor screen. The beam moves from left to right tracing one line at a time. Each beam trace slopes slightly downward from left to right as it paints a line (figure 1). 262½ lines of video will be completed when the beam reaches the bottom of the screen. The beam is reset to the top and proceeds to trace another 262½ lines in between the previous ones. (If 262½ lines are contained in each field, why are only 242½ shown on the monitor? The remaining 20 lines are consumed with synchronization pulses and do not contain visual information.) This is called 2:1 interlaced video. Field 1 is composed of lines 1, 2, 3, ...262½. Field 2 contains lines 1, 2, 3, ... 262½. Two fields are required to produce a single frame of information (262½ x 2 = 525 lines). The CCTV industry consensus is to refer to field 1 as the odd field, and field 2 as the even field. This is indexed to the last line in the field. Since field one ends in a half-line it is referred to as the odd field.

Phosphors have a specific decay time from excitation to discharge. This fact, plus the desire to reduce the "flicker effect" (appearance of a monitor flashing), deemed the 2:1 interlace as advantageous. 2:1 interlace was selected because it was the most cost effective method that produced a flicker free image. Another option, progressively scanning all 525 lines in 1/60s would have required twice the bandwidth. The 2:1 interlace solution presents a picture each 1/60s. This greatly reduces the flash effect when compared to updating each picture one 1/30s. This advantage for the human eye is not a benefit in the image processing

BEGINNING OF FIELD 2, END OF FIELD 1

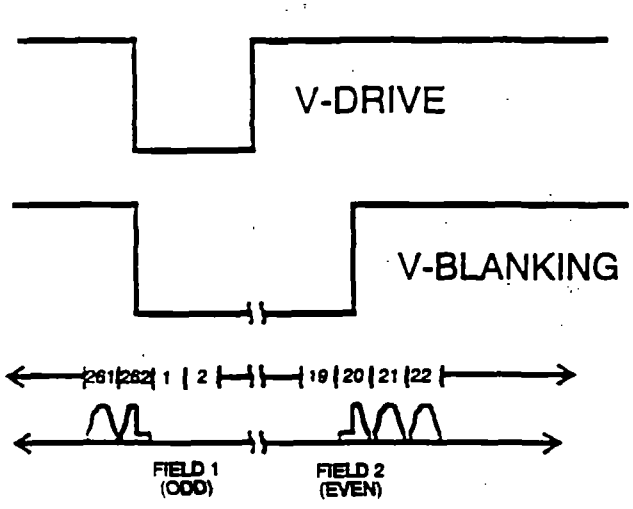


FIGURE 2. VERTICAL INTERVAL, BEGINNING FIELD 2

BEGINNING OF FIELD 1, END OF FIELD 2

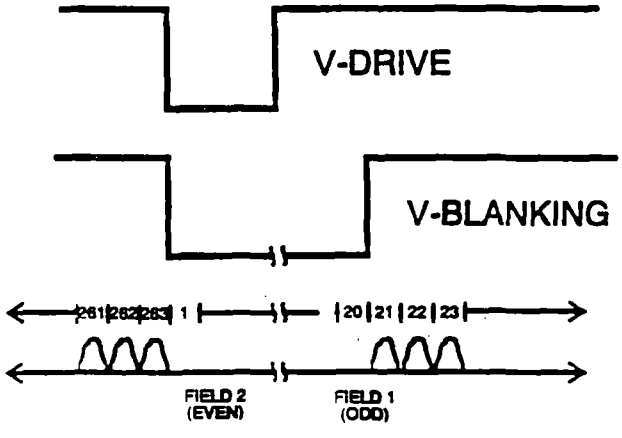


FIGURE 3. VERTICAL INTERVAL, BEGINNING FIELD 1

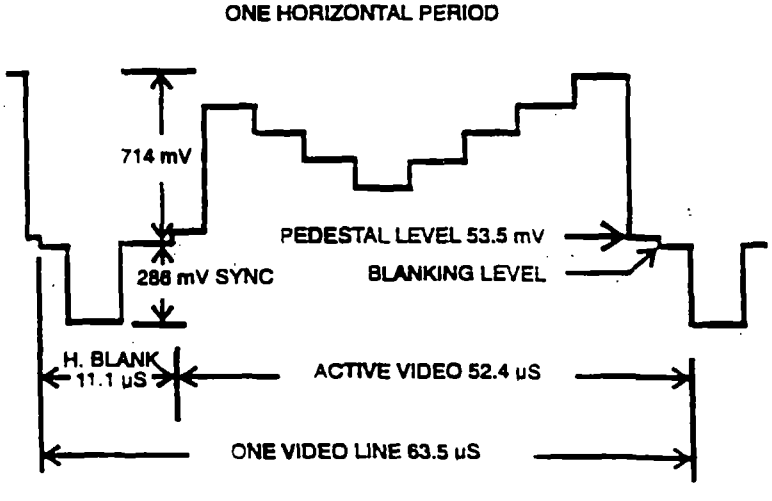


FIGURE 4. VIDEO LINE

environment where each image capture (one field) yields only fifty percent of the vertical information. A field is presented each 1/60s and it takes two fields (one frame) to acquire full vertical resolution. The imaging system's throughput is lowered by a constraint of this standard. Choosing to operate with only one field means the vertical resolution is cut in half (262½ lines), however, if 50% vertical resolution is sufficient, a benefit exists by processing at twice the rate.

TIMING SIGNALS

Video cameras use timing signals at both horizontal (line) and vertical (field) rates. Each vertical interval (1/60s) contains one field of information. Field 1 begins with a line and ends with a half-line (figure 2). Field 2 begins with a half-line and ends with a full line (figure 3). The half lines complete the picture on the top and bottom of the monitor. When referring to the line numbering system, two conditions prevail. If referring to monitor or image processor video, the first line of active video is called line 1. When discussing camera video, line 1 represents the beginning of the vertical interval, and the first line of active video starts at line 21. Twenty lines from each field are consumed by synchronization pulses. A full frame of video — 525 lines — contains 40 lines of synchronization signals. This leaves 485 active lines with video information. Standard 525-line monitors are designed to display these lines on the raster. Higher frame rates (875, 1023, 1125) require special cameras and multi-sync monitors.

Vertical drive is the signal that separates individual fields and is the monitor's indication to return the beam to the top of the raster. Vertical blanking separates active lines of video from one field to the next and is used by the monitor to blank (turn-off) the electron beam during non-video time.

HORIZONTAL RATE (LINE RATE)

The duration of one video line (1 H period) is 63.5μs (525 lines occur in 33.3ms, thus 33.3ms divided by 525 = 63.5μs). Each line is composed of synchronization and active video information (figure 4). 17.5 percent (11.1μs) of the line is blanked. This horizontal blanking signal separates the active video of adjacent lines and is used by the monitor to blank the beam during retrace. Horizontal drive separates each line, and in the monitor is the signal that begins retrace. Active video time is equal to the horizontal period (63.5μs) minus horizontal blanking (11.1μs), or 52.4μs.

RS-170 VIDEO TIMING

Composite video is the combination of horizontal and vertical synchronization signals and active video information. This is normally provided as an output over a single 75-ohm coaxial cable. The synchronization information allows the receiving device to decode/display the information.

RS-170 timing specifications:

Frame = 33.3ms	525 H Lines	1/30s

Field	= 16.6ms	262.5 H Lines 1/60s
V Blanking	= 1.24ms	20 H Lines
V Drive	= 666μs	10.5 H Lines
H Line	= 63.5μs	15.750 Hz
Active video	= 52.4μs	
H Blanking	= 11.1μs	
H Drive	= 6.35μs	

VIDEO FORMAT

Outputs are frequently specified in IRE (Institute of Radio Engineers) units. 140 IRE units is equivalent to a 1 Vp-p composite video signal. This is further sub-divided — 100 IRE (714mV) above blanking for active video and 40 IRE (286mV) below blanking for synchronization. A pedestal level is established above blanking at 53.5mV. This establishes a black reference and prevents video information from sinking below blanking. Increases in amplitude represent progressively lighter shades of gray until white is achieved at 714mV.

To determine actual video output in millivolts when given IRE units:

$$\text{mV of Video} = \frac{714\text{mV}}{100\text{ IRE}} \times \text{IRE Units}$$

Camera manufacturers sometimes specify video output with automatic gain control (AGC) in IRE units (i.e., 80% video with 12dB of AGC).

This equates to: $80\text{ IRE} \times \frac{714\text{mV}}{100\text{ IRE}} = 571\text{mV}$

CCD IMAGE SENSORS

CCD's are two-dimensional fixed geometry area arrays of photosites. The array contains 485 vertical lines, each line having a specific number of pixels (picture elements). The greater the pixel count in each line, the higher the horizontal resolution. The pixels convert light to an electrical charge. Photons striking the silicon pixel generate a charge proportional to the amount of light present during the integration period. This voltage level is referred to as a charge packet. The difference between sensor technologies is determined by the method of construction and the path by which the charge packets are transferred from the active array of the sensor chip to the camera circuits. The efficiency with which charge packets of electrons can be transferred from pixel of origin to the output without loss makes this technology an excellent measurement device.

Clocking of the charge packets contained within the pixels is at a rate sufficient to read a line (52.4μs) of pixel information while maintaining RS-170 timing. The greater the number of pixels per line the higher the clock speed. Moving the charge packets out of the

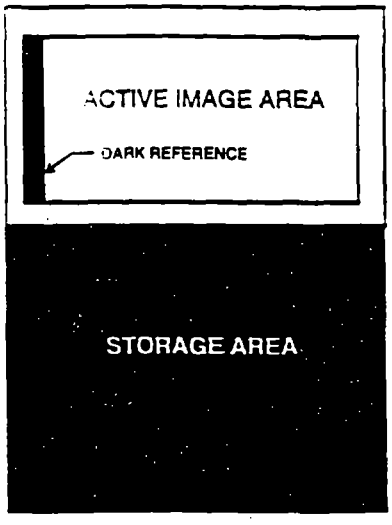


FIGURE 5. CCD SENSOR
FRAME TRANSFER

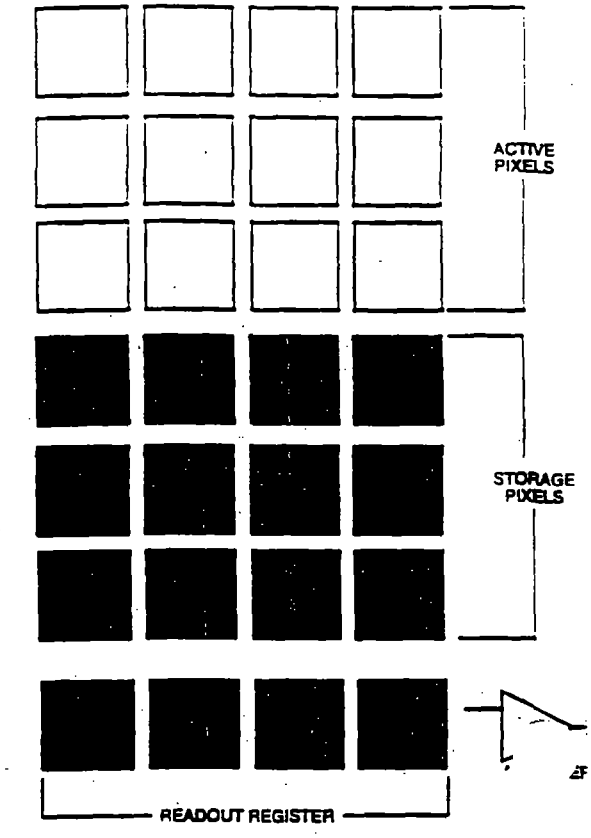


FIGURE 6. FRAME TRANSFER

sensor generates lines of analog information that are read serially one line at a time. The camera circuits will merge the video information with synchronization signals.

DARK SIGNAL

One of the noise characteristics is Dark Signal, which is produced by the image sensor independent of light input. It is a function of all semiconductor devices. Thermal energy causes a release of electron-hole pairs. The Dark Signal is one of the factors limiting the low end of sensitivity and maximum signal-to-noise ratio. Dark signal is random in distribution across the surface of the array and is a function of design and manufacturing tolerances. Typically, Dark Signal doubles for each 9°C increase in temperature. When integrated over time, or subjected to heat, the Dark Signal will increase and become an artifact of the output, observable as fixed pattern noise. The performance of the CCD can be enhanced by thermo-electrically cooling the sensor.

FRAME TRANSFER

RCA pioneered the development of the Frame Transfer CCD in the early 1980's. A Frame Transfer sensor contains two arrays of pixels (figure 5), one for active imaging, and a second to store the field previously collected during the 16ms integration period. Both arrays contain the same number of pixels. The storage register is covered with an opaque material to prevent stray light from changing the contents of any individual pixel during storage or readout. The name "Frame Transfer" seems to suggest that this technology provides complete frames (525 lines) each transfer or integration period. This in not true in most cases. The capacity of most frame transfer sensor storage registers is only one field (243 lines). If a storage register can hold the full 485 lines from the frame, then two fields integrated over an identical period of time can be imaged onto the sensor, stored, and readout.

Operation. As photons strike the silicon, a charge potential of electrons is built up in the pixel well. After 16mSec (one field) of integration, a series of clocking transfer pulses move the charge packets from the active register to the storage register (figure 6). During the vertical interval the active array is used as a shift register, moving each row of stored charges vertically one line at a time from the active area into the storage register. Each line moves down sequentially until the entire field (244 lines of pixels) is contained in the storage register. The time required for this transfer is approximately 180μs (for Texas Instruments TC-241 sensor).

A disadvantage of this transfer technique occurs when bright highlights are present. If a pin-point highlight source is impinging on a single pixel location or cluster of pixels, then as each line of pixels moves through the bright point, the value of that pixel will be altered. In an extreme case, streaking appears as a white vertical line on the monitor. Possible solutions are to inhibit imaging during transfer time with a mechanical shutter, or controlled lighting of the target.

When one field is in the storage register, the next field is being integrated onto the

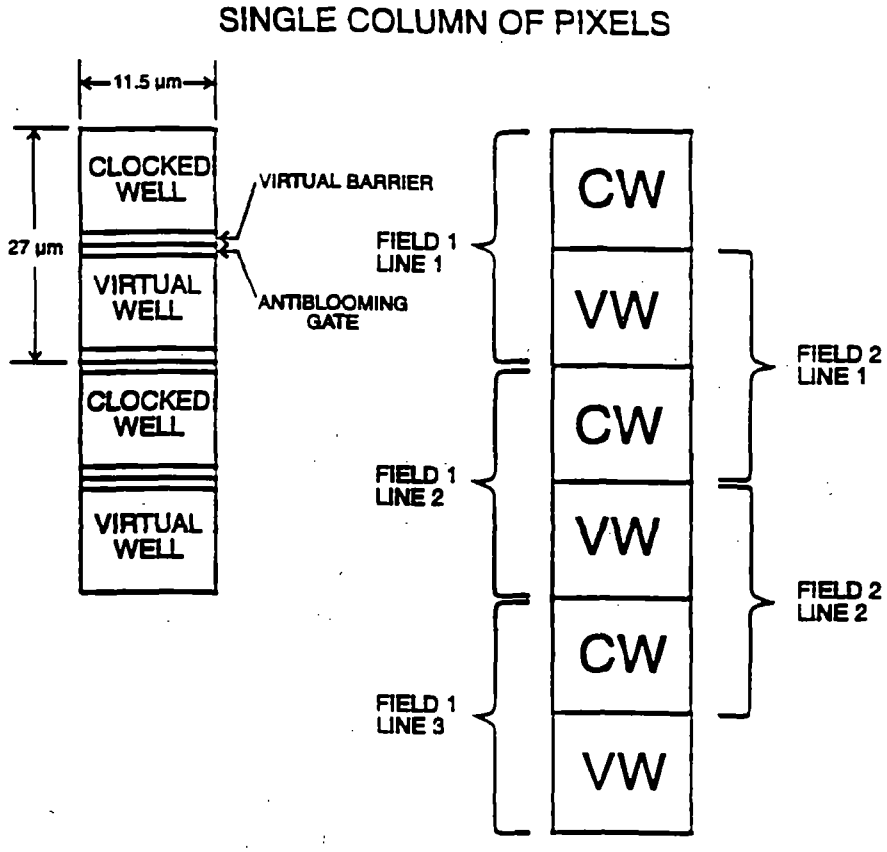


FIGURE 7. FRAME TRANSFER PSEUDO-INTERLACE

active array. The video information in the storage register is clocked into the horizontal readout register one line at a time. The readout rate for 768(H) pixel sensor is 14 Mhz.

The Texas Instruments Frame Transfer chip contains 244 pixels in the vertical direction. This is equivalent to one field. Providing full-frame resolution necessitates an interesting solution called pseudo-interlace. A proprietary technology called Virtual Phase was developed by Texas Instruments to increase the vertical resolution. Each pixel is composed of a Virtual Well and a Clocked Well (figure 7). This divides the pixels in half vertically. Changing the bias voltage to the pixels shifts the centroid by one-half pixel vertically during alternate fields, thus it is possible to increase the vertical resolution. A fifty percent overlap exists vertically between the two fields.

Advantages. Frame Transfer technology exhibits contiguous pixels (near 100% fill factor). Fill factor is the ratio of active area to total area on the surface of the sensor. Each pixel attaches to its neighbor vertically to facilitate the transfer process. Horizontally, thin channel stops separate each pixel to reduce bleed over. Large pixel size increases sensitivity.

The spectral response extends into the near IR region (1100nm). Frame Transfer sensors incorporate a thicker surface substrate on each pixel. The longer wavelengths of light penetrate deeper into the silicon and are still within the well of the pixel generating electrons proportional to the photon input.

The camera can be operated in the non-interlaced mode. The same pixels (no shift) are used for each field. The sensor exhibits 50% less noise under these conditions. Measurement repeatability is then directly tied to the same pixels.

Texas Instruments TC-241.
Picture Elements: 780(H) x 244(V)
Active Picture Elements: 754(H) x 488(V)
Pixel Size: 11.5μm(H) x 27μm(V)
Dynamic Range: 60dB
Dark Signal: 20mV @ 45°C
Typical Frame Transfer Camera Cost: $1,500

PROGRESSIVE SCAN

This technology does not operate to the RS-170 standard of 2 interlaced fields combined to form a single frame. Instead the lines of video on the sensor are read progressively (sequentially), i.e., 1, 2, 3, 4, ... 525.

Full vertical resolution during the same period of integration is advantageous. Interlaced cameras have a separation of 16ms between the two fields. Processing at higher speeds or viewing objects in motion, standard RS-170 cameras deliver 1/2 vertical resolution (one field). An object that is moving through the field of view will change positions between field 1 and field 2 relative to its speed of travel during the 16ms time period. RS-170 2:1

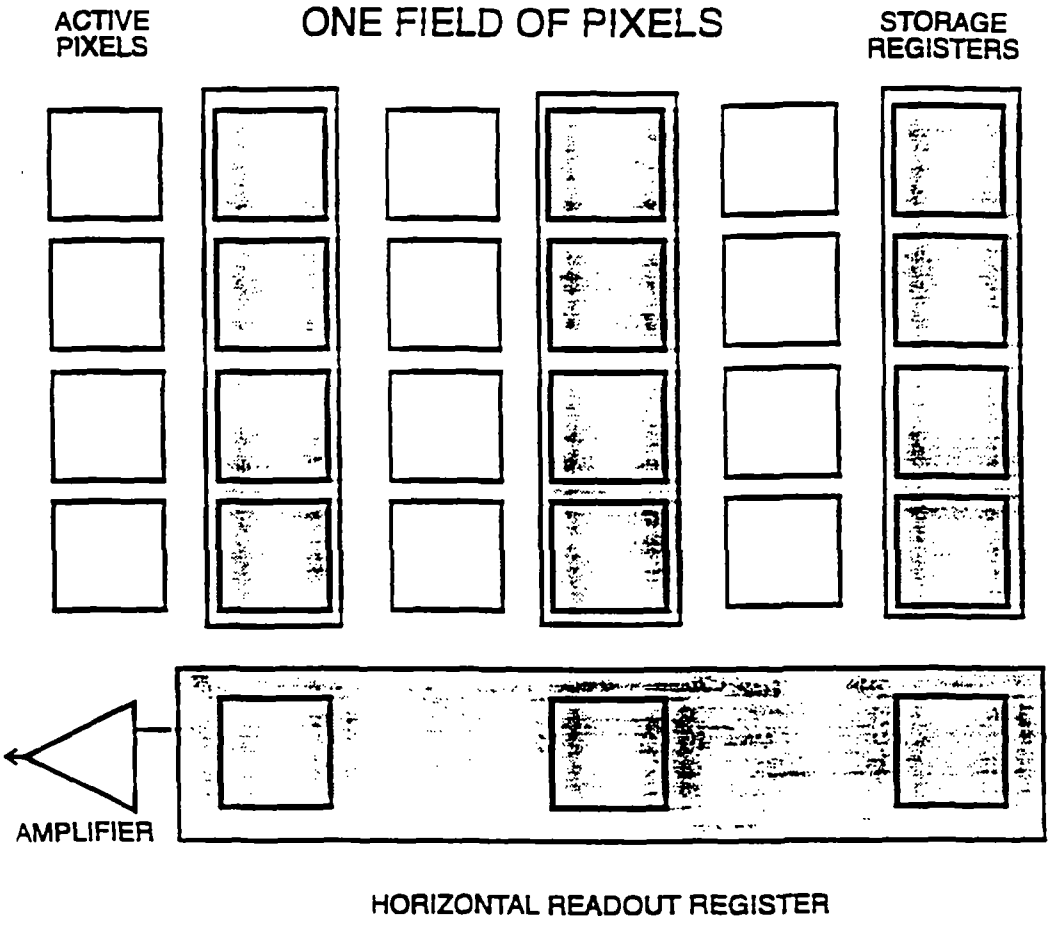


FIGURE 8. CCD SENSOR
INTERLINE TRANSFER

interlace will produce a blurred image.

Progressive Scan cameras are suited to answer this application. Presently, few monitors are available to directly view Progressive Scan. Some frame grabber (image processing) equipment accept the sequential image and can convert it to interlaced if viewing on a standard monitor is required. The progressive scan output has not been standardized so additional consideration is necessary when selecting hardware.

Kodak KAI-0370 Interline.
Picture elements: 780 (H) x 489 (V)
Active picture elements: 768 (H) x 484 (V)
Pixel size: 11.6μm (h) x 13.6μm (V)
Well depth: 60,000 electrons = saturation 600mV
Dynamic Range: 60dB
Dark Signal: 1mV @ 40°C
Typical Progressive Scan Camera Cost: $1,400

INTERLINE TRANSFER CCD

The Interline Transfer sensor presents a different approach to pixel design, transfer, and readout of the video information. The sensors active pixel area and storage resister are both contained within the active imaging area (figure 8). Active imaging pixels are not used as transfer pixels as was the case with Frame Transfer technology. The active array of this device contains a full frame of pixels (494). When viewing the imager, each column of pixels is separated by a column of storage elements that are covered with an opaque material. The storage elements have the capacity to store one field. After completion of the 16ms integration time, the charge packets from each pixel are transferred to the storage register. While the next field is gathering charge, the charge packets in the storage register are clocked to a horizontal output register one line at a time.

A sensor configured with a full frame of active pixels in the light sensitive area and only a field of capacity in the storage array reduces size and cost. It also limits the flexibility to acquire full vertical resolution where both fields are captured during identical integration periods.

The storage register is integral to the active image area. Thus the photon sensitive area of each pixel is smaller in size (relative to Frame Transfer). Less light is accumulated and a greater possibility of aliasing exists if a detail of information in the field of view falls upon the opaque area. The percentage of fill (active image area to total image area) is approximately 35%. The spectral response peaks in the photopic area at 550mn and falls-off sharply before reaching the near IR region.

Advantages. Several advantages are offered with Interline technology. The transfer of charge packets from the active image pixels to the storage register happens in a fraction (5ns) of the time required by Frame Transfer. Thus the probability of highlight smearing is reduced. An effective anti-blooming gate inhibits charges spilling over to adjacent pixels

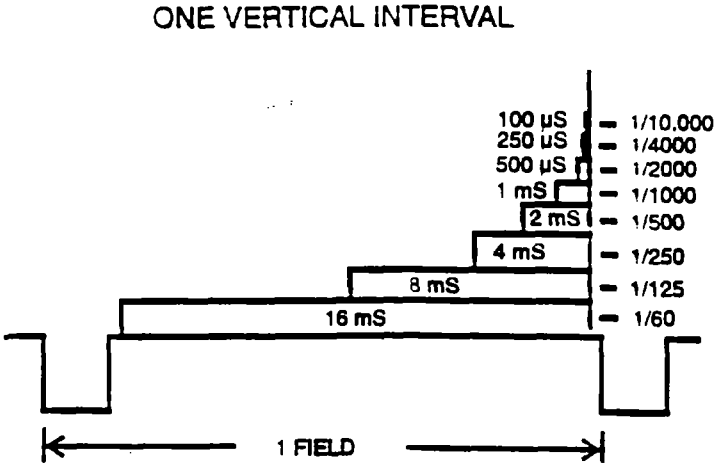


FIGURE 9. INTERLINE CCD SHUTTERING

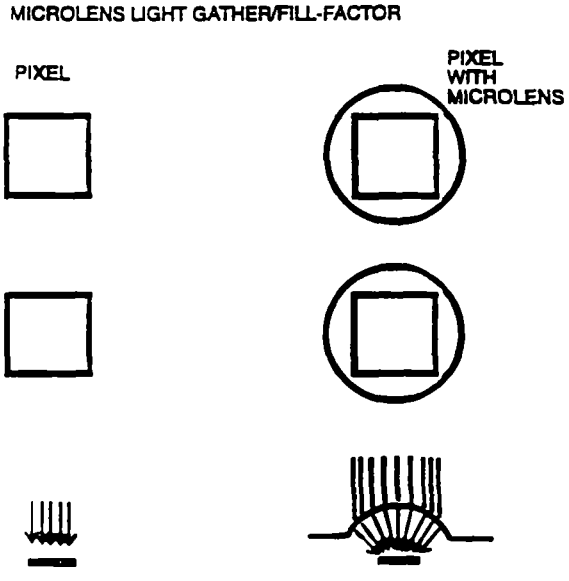


FIGURE 10A. MICROLENS TECHNOLOGY

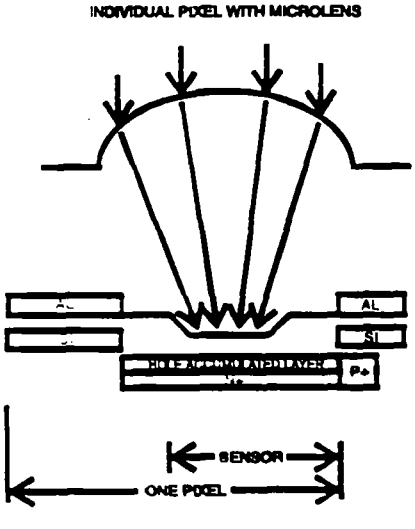


FIGURE 10B. MICROLENS INTERLINE PIXEL

(perceived as blooming). Individual pixels have a lower dark signal and a greater ability to gate away excess charge build-up into the substrate, providing wider dynamic range.

The Sony IXC038 Interline design is shutterable at the pixel level. The Frame Transfer device required 180μs to clear the array. Interline clears the contents of each pixel once every 63μs (during horizontal blanking). The actual clear time is only a few nanoseconds. During shuttering the active array is cleared each horizontal period until the time remaining in the field equals desired integration time (figure 9), then shuttering ceases, and normal charge accumulation begins.

The shutter mode steps in increments. Each change cuts the light in half as the integration period is halved. Shuttering is accomplished across its full range in 8 steps (1/60s to 1/10,000s). Modifying the camera to externally control the shutter circuit with a TTL pulse provides discrete steps at 242 levels, effectively stepping one line at a time.

A disadvantage of shuttering is the inability to obtain full frame (vertical) resolution. If two fields can be integrated during the same period, effectively stored, and then readout, true full frame resolution is achieved. Since the transfer register is designed to hold and readout only one field at a time, the information contained in the second field remains on the active array and is clocked into the substrate drain during the horizontal blanking period at the beginning of the next field. Clearing of the pixels happens across the entire array, not for selected fields. The inherent characteristics built into the sensor chip structure are the driving factors toward what features are available in cameras.

The interline chip can be asynchronously reset. A reset pulse input will initiate the vertical interval and clearing of the array nine lines (571μs) later. If the illumination to the sensor is controlled and/or a strobe is used, it is possible to quickly capture and readout a field of information. Asynchronously resetting the sensor and strobing in coincidence with reset, or before the transfer time (9 lines later), provides a quick capture time to readout (571 μs to 16.6ms). The first field begins readout 571μs after reset and completes 16.6ms after reset. The second field, still on the active array, follows the first and begins reading out. This operation takes 16.6ms. Acquiring RS-170 full-frame (vertical) resolution requires 33.3ms.

An alternative to asynchronous operation is start-stop mode. By configuring the camera to shutter each H period, pixel charge accumulation will be dumped every 63.5μs (H period) until an external control pulse is received. This pulse commands the shutter to cease, and begins active integration. The duration of integration is equal to the pulse width plus 9 H lines. At the conclusion of the input pulse, transfer takes place 9 H later. Field 1 will have integrated for the input pulse width "x" plus 571μs. Field 2 has integrated for "x" plus 571μs plus 16.6ms. The reason field 2 has integrated for an additional vertical interval resides in the limitation of the storage register to hold only one field at a time. In this mode shutter is inhibited for one field after reset to avoid destroying the second field.

A recent development is the addition of micro-lenses placed above each pixel to focus the light onto the active portion of the sensor (figure 10a). Typical Interline sensors have a

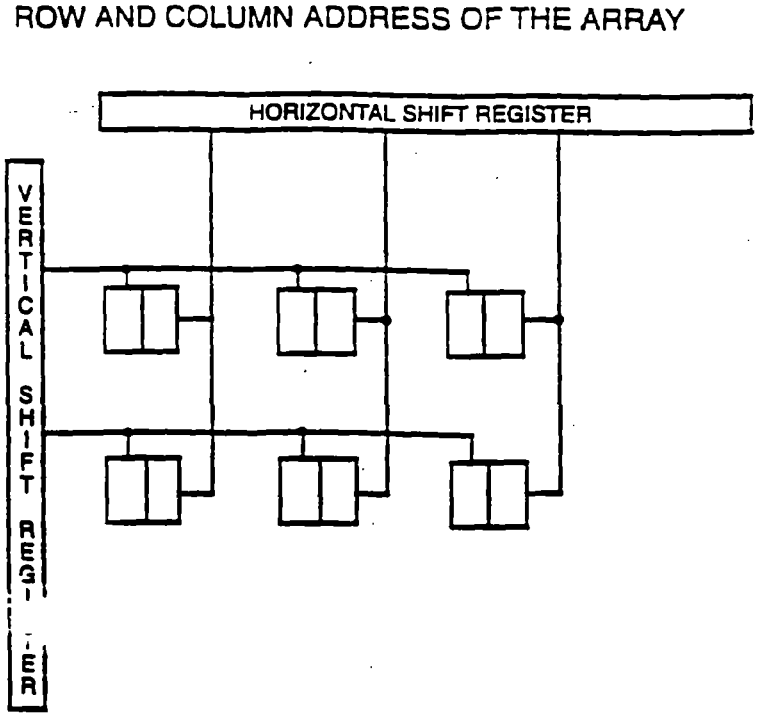


FIGURE 11. CHARGE INJECTION DEVICE SENSOR (CID SENSOR)

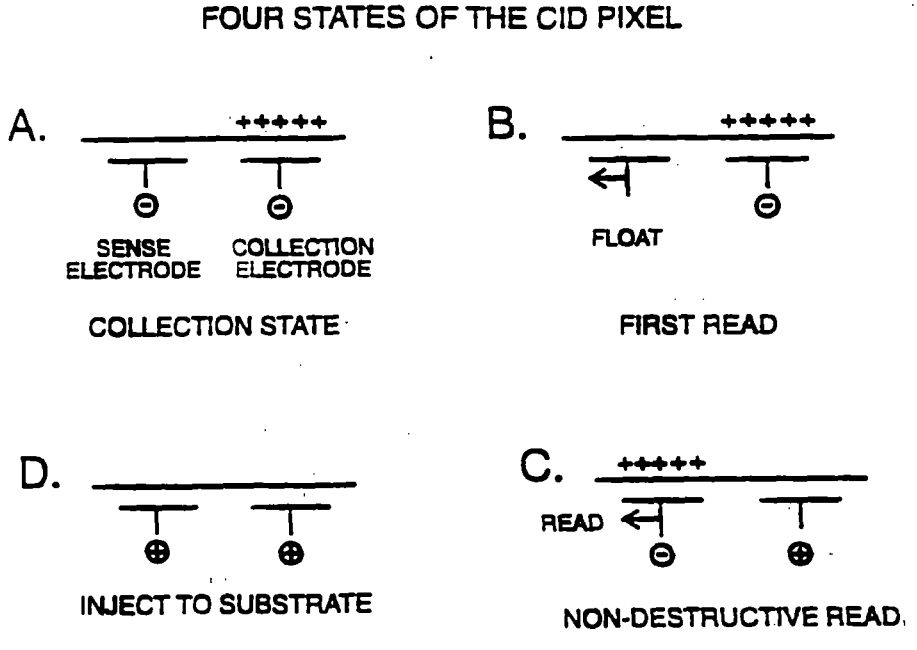


FIGURE 12. CID SENSOR PIXEL MODES

fill factor of 35%. These focusing micro-lenses increase light gathering ability and reduce aliasing (figure 10b). Depending on the quality of the lens and precise placement, fill factor is raised to 70% or more, and the light falling on the sensor is increased by a factor of two (6dB, 1-f stop).

Low Dark Signal and wide dynamic range make this technology a good candidate for integration. Integration is extending the time that photons strike the pixels to longer than the standard 16.6ms. This mode requires the target to be stationary, or the image will be blurred. The longer the integration time the greater the charge build-up on the pixels, and increasing the ability to image in low light. Sensitivity increases by a factor of two when the field integration period is doubled (i.e., 2, 4, 8, 16 fields). Pixel non-uniformities will be exaggerated as integration time increases. A fixed pattern noise will eventually appear at the output. It shows on the monitor as a "starfield" pattern (like looking through a telescope at the stars). The amount of noise will be partially dependent on ambient temperature. Cooling the sensor extends integration without this artifact. Imaging still objects provides sensitivities equal to or greater than intensified cameras with this CCD technology.

Sony ICX-038.
Total Pixels: 811(H) x 508(V)
Active Pixels: 768(H) x 494(V)
Cell Size: 8.4μm(H) x 9.8μm(V)
1/2" format 8.4(H) x 768 = 6.4mm 494(V) x 9.8 = 4.8mm
Dark Signal 2mV @ 60 ° C
Dynamic Range: 80dB
Typical Interline Transfer Camera Cost: $800

CID-CHARGE INJECTION DEVICE

CID imagers were developed in the early 1970's by General Electric for Aerospace applications. The development focused on two features that were not available with standard CCD's: addressable pixels and non-destructive readout.

The CID imager allows the user to select individual pixels by accessing row and column electrodes (a simple X-Y address; figure 11). The pixel value can be read non-destructively because the charge is not shifted out. These two unique features separate the CID imager from other sensor technologies.

Non-destructive read is achieved when the charge potential is shifted between the electrodes of two capacitors of a single pixel. The difference between the two potentials is representative of the stored signal charge. The sensed potential is converted to a voltage for readout as opposed to shifting a charge packet into a transfer register.

Photons striking the silicon of the collection electrode will accumulate holes during the integration period (figure 12a). To determine the amount of charge accumulated the pixel is "read." The sense electrode is allowed to float, the collection electrode is supplied a negative, then the potential is read (12b). Next a negative potential is supplied to the sense

electrode and a positive potential to the collection electrode (12c). The accumulated charge packet of holes will shift to the sense electrode where another read is performed. The difference in the two potentials represents the voltage equivalent of the amount of light striking the pixel during the integration time.

The user or image processing algorithm makes a decision: either use this value and clear (12d) the pixel to prepare for a fresh integration period, or resume collection on top of the previous charge (12a). Clearing a pixel is accomplished by supplying a positive potential to both electrodes forcing the holes into the substrate (12d).

This unique feature provides the means to image very bright objects and dim areas within the same scene by reading the highlights before they saturate and allowing additional integration time for dim areas. CID chip technology has deeper pixel wells than Frame or Interline Transfer (typically 300,000 vs. 80,000 electrons, respectively), thus providing wider dynamic range. The sensitivity of CID's is about half that of Frame or Interline devices.

Advantages. Near 100% fill factor, the entire active image area is sensitive to light. No separate storage register is required. There are no opaque areas on the imager. The isolation of each individual pixel and lack of transfer/storage registers provides greater resistance to blooming and smearing. Since the user controls the readout, the following reads are possible: progressive, partial area, or individual pixels. This can increase the information output rate if less than a full frame is desired. The fewer lines of readout desired the faster the update rate (non RS-170).

Asynchronous reset provides capture of fast events by operating the camera in the Charge Inject mode (not allowing a charge to build on the pixels). Switching to "collect" upon receipt of an input control pulse starts integration time. Objects entering the field of view randomly can be captured in the center of the frame. The external trigger can activate a strobe and/or transition the camera into collect mode.

CIDTEC 2710 RS-170.
Sensor Picture Elements: 776H x 512V
Active Picture Elements: 755H x 484V
Pixel size: 12.0μm x 12.7μm
Format: 2/3"
Typical CID Camera Cost: $2,900

IMAGE FORMAT

The size of the sensor's active imaging area is defined as image format. The most widely available and economic sensors are 2/3", 1/2", and 1/3" RS-170 devices. CCTV sensors have an aspect ratio of 4 x 3, meaning that the ratio of horizontal width to vertical height is four to three, respectively.

Sensor engineering, manufacturing, and quality continuously improve. The smaller format imagers are fast becoming the norm. Smaller size allows higher yields and lower

COMBINATION OF CAMERA AND MONITOR GAMMA = 1.0

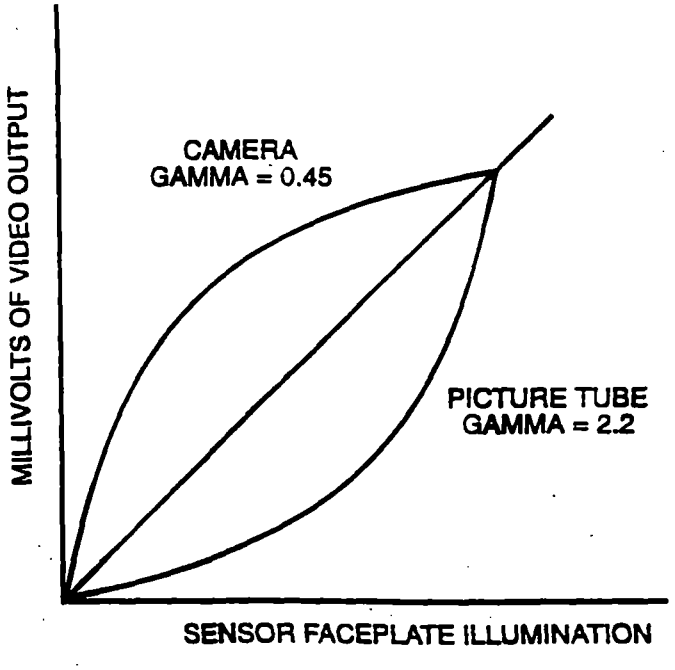


FIGURE 13. GAMMA CORRECTION

cost. Recent camera entries into the market with 1/2" and 1/3" imagers present equal resolution and comparable sensitivity at less cost. One might think that sensitivity must be lower due to the smaller pixel size. While it is true that less area means fewer photons, sensor manufacturers have compensated by adding additional gain on the sensor chip and incorporating micro-lens technology. When replacing existing cameras or seeking new solutions it is very likely that a smaller format sensor will be selected due to availability and price. Changing from a larger format to smaller and maintaining the same optics have the effect of magnifying the image.

The image format approach to identifying the size of the active image area began with tubes. The diameter was chosen as the specific identification criteria, typical tubes have diameters of 1", or 2/3". This designation was carried forward and applied to sensor chips. The following dimensions represent the aspect ratio of the three most common RS-170 image sensors:

2/3" sensor 6.6mm(V) x 8.8mm(H) x 11mm Diagonal
1/2" sensor 4.8mm(V) x 6.4mm(H) x 8mm Diagonal
1/3" sensor 3.6mm(V) x 4.8mm(H) x 6mm Diagonal

MECHANICAL INTERFACE

Standard CCTV cameras are equipped with C-Mounts (specific thread and pitch) for attachment of CCTV lenses. Lenses are available from a variety of manufacturers with the thread type defined as C-Mount. Microscopes with trinocular ports also have C adapters. Recently, CS-mount lenses have been introduced in tandem with camera manufacturers' new 1/2" and 1/3" format sensors. The difference between C and CS is the back focal distance. Back Focal is the distance between the center of the rear lens element and the sensor image plane. C lenses require a back focal length of 17.5mm; CS lenses only require 12.5mm, meaning that the CS type lens is mounted closer to the image array. This allows for using smaller and fewer optical elements, which in turn results in smaller mechanical size and lower cost. Optically the quality of better CS lenses is equal to C lenses. Apertures are proportionally smaller and the lens uses fewer elements. Light transmission is equal to, or better than C type.

GAMMA

Gamma correction is a result of non-linear phosphor coating on picture tubes. Picture tubes consistently compress black signals and stretch whites. Gamma defines the slope of the curve representing the difference between linear input and actual output. The sensor is a linear output device. If the camera is viewing a scene that changes linearly from left to right (with left representing black and right representing white), the display of this information on the monitor will appear as a slope of a curve that is shallow in the dark region and steep in the white areas (figure 13). For a given increase in illumination, a corresponding linear increase in millivolts is generated at the output of the sensor. The picture tube (monitor) will not accurately represent this information. During the infancy (1950's) of television it was decided to incorporate gamma correction into the camera since at that time far fewer cameras existed than monitors. Today gamma correction still resides in the camera.

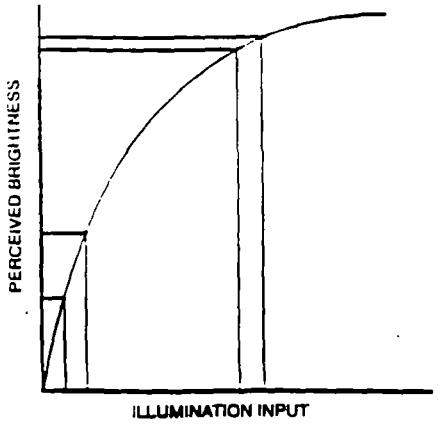


FIGURE 14. LOGARITHMIC RESPONSE HUMAN EYE

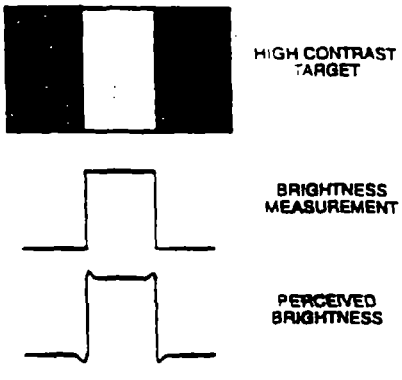


FIGURE 15. HUMAN EYE EDGE DETECTION

When desiring to view the output of a camera directly on a monitor, a gamma of 0.45 is selected. This will stretch the black and compress the whites. Since monitor picture tubes have a gamma factor of approximately 2.2, applying the camera correction of 0.45 yields a linear ratio (2.2 x 0.45 = 1).

Measurement applications, inputs to frame grabbers, and image processing require the camera be operated in a gamma of 1.0, providing a linear output.

HUMAN EYE RESPONSE

The response of the human eye to illumination is also not linear. It is actually a logarithmic response, where the steepness of the curve is greatest in the darker regions (figure 14). The curve flattens out in the white region. This makes incremental changes of the same magnitude easy to identify in the black area and difficult in the white region. By darkening images, we increase our ability to discern contrast changes.

Another anomaly of the human visual system is the apparent sharpening of edges. An edge enhancement mechanism is built into our human imaging system. Viewing black and white rectangles placed horizontally in a row, the white areas appear to be whiter just prior to the transition to black (figure 15). Equally, it would appear as if the black areas become a little blacker just before transition to white.

Camera circuits can be altered to provide a similar sharpening of edges. Most cameras include a filtering operation to smooth pixel-to-pixel transitions. Changing the filter's parameters creates sharpness at the expense of adding ringing (Oscillations).

RESOLUTION

The ability of a sensor to reproduce the detail of a viewed image is called resolution. Vertical line resolution is 485 for a 525-line raster. This is the total number of active video lines. When reading the image on a monitor using the EIA test chart or another wedge pattern, historical experimental research has lead to a kell factor of 0.7 times the active lines equal to vertical resolution on the monitor. Thus vertical resolution displayed on a monitor is 350TVL (485 x 0.7) for RS-170 525-line systems.

A limitation to reproducing an image spatially is stated as the Nyquist Sampling Theory. To clearly resolve a given frequency, the sample rate must be a minimum of two times the frequency being sampled. Aliasing occurs if the sample rate is less than twice the original signal frequency to be imaged.

Modulation Transfer Function. Modulation transfer function represents the contrast between black and white information at differing resolutions. When the camera is viewing a black and white target with a converging wedge pattern, the lower resolution detail will be presented as having a much higher modulation (figure 16). Higher resolution details appear as only slight changes in gray level at the limiting resolution of the sensor. Camera circuit rise time and bandwidth limitation create this condition.

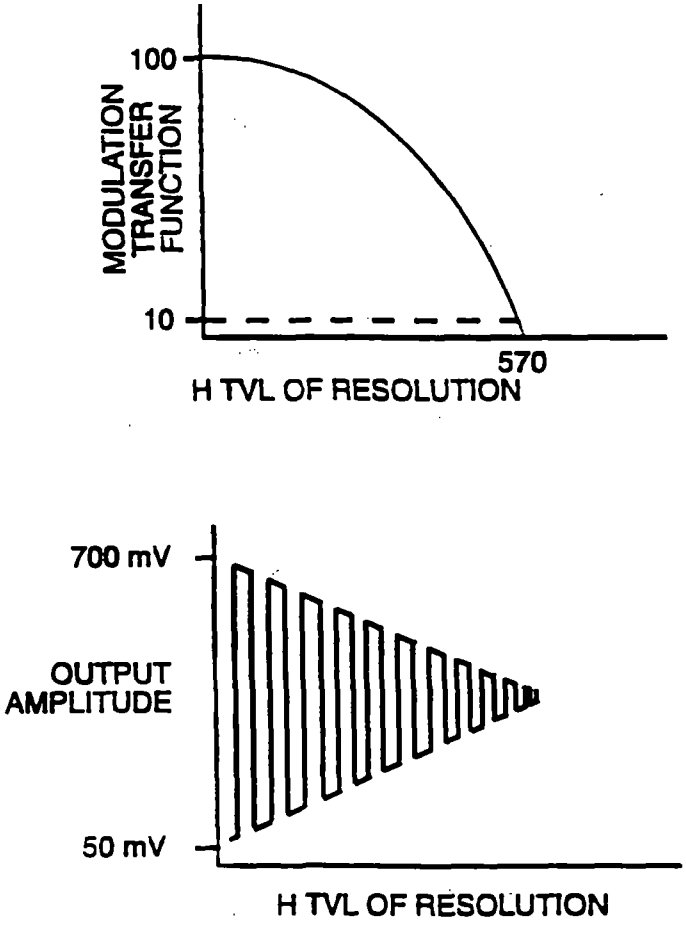


FIGURE 16. MODULATION TRANSFER FUNCTION (MTF)

Horizontal Resolution. Horizontal resolution is the number of black and white lines that are discernible across a video line equal to the height of the raster. Each line is counted, as opposed to line pairs which are used in photography and image intensifiers.

To find pixel resolution:

$$\text{Number of Pixels} \times \frac{3H}{4W} = \text{Resolution per picture height}$$

To find line pairs per millimeter:

$$\text{Lp/mm} = \frac{HTVL}{2} \times \frac{4}{3} \times \frac{1}{PW}$$

H= height
W= Width
HTVL= horizontal TV lines
PW= picture width

Resolution can also be directly read off a monitor when the camera is focused onto an EIA resolution test pattern. Attention needs to be paid to the variables associated with the system to ensure the result is not limited by another system component (e.g., monitor, lens).

The greater the horizontal detail or number of pixels, the faster the clock speed required if RS-170 timing is maintained and higher resolution is desired. The total number of horizontal pixels clocked out during the active video time (52μs) for a 768-element sensor equates to a pixel clock frequency of 14Mhz.

$$\frac{52\mu s}{768 \text{ Pixels}} = 67\text{ns/pixel} \qquad \frac{1}{67\text{ns}} = 14\text{Mhz}$$

Higher resolution cameras (1134 H-pixels) operating at the RS-170 line rate increase the pixel clock frequency:

$$\frac{52\mu s}{1134 \text{ Pixels}} = 45.8\text{ns/pixel} \qquad \frac{1}{45.8\text{ns}} = 21\text{Mhz}$$

ANALOG TO DIGITAL

An RS-170 signal input to an A-D converter is sampled or chopped into segments, each one representing a specific location on the original sensor array. A phase locked loop is used by the frame grabbing device to arrive at a close approximation of pixel spatial location. Some pixel jitter or uncertainty is inherent in this process. Using the camera pixel clock achieves a better result. Each sample or pixel is given a brightness value based on the

number of bits, where 8-bit depth equals 256 shades of gray.

The Nyquist sampling theorem again applies. To fully represent the rate of brightness change in the original image we must sample at a rate at least two times the highest spatial frequency. This ensures a re-creation of the detail.

Aliasing is the erroneous representation of high frequency information from the original image. Aliasing occurs when scene details have a spatial frequency greater than half the sampling frequency. If under sampling is happening, the result is transference of the high frequency information to a lower frequency which appears as a moiré pattern.

APPLICATIONS OF VIDEO CAMERAS

Laser Profiling, Interferometry, Tracking, Medical, Scientific, Inspection, Microscopy, Semiconductor processing.

FUTURE POSSIBILITIES FOR VIDEO CAMERAS

Active Pixel Sensors, down-scaling format, image processing in the camera, alternative formats, HDTV, Digital output, camera on a chip.

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Atlanta has decreased the amount of crime happening on their transit system with the help of security cameras.

Riding Atlanta's Rails in Safety

SUMMARY: Atlanta's commuter rails use video surveillance to help with customer service.

By Andy Maslowski

• RIDERS OF THE MARTA rail transit network in Atlanta have at least one extra level of safety, thanks to a surveillance camera system installed at its stations.

"Back in the mid-1970s, in the original design concept, it was decided that a camera system would be installed in the rail transit system," recalls MARTA police chief Gene Wilson. Since then, the Metropolitan Atlanta Rapid Transit Authority has put in more than 360 surveillance cameras, adding them as new stations are brought on line.

"On occasion, the cameras will help us with crime problems, but their primary function is as an aid to customer service," he says.

Cameras have been placed inside the paid areas of the stations, offering essentially full coverage. Each rail station has between 12 and 14 cameras, and these are monitored from one of five "zone centers."

Each zone center has about 95 monitors, and the operator who runs the cameras can start recording whenever he sees something unusual, or if he gets a request to do so from a "help phone," a handicap door access, a fare gate, or any other location he's alerted to.

Service is Our Business

The main advantage of the camera system is customer service. As Wilson explains, "Many times it has proven itself helpful in controlling crowds on a waiting platform. If we see a potential problem building, we'll send a transit police officer to the spot. Once there, the officer will make sure the people don't get too close to the rail or the tracks."

Police officers and emergency crews are dispatched to a scene because of the cameras. In some cases, the cameras spot workers who need help. But the cameras also serve as an effective deterrent to crime. This is true for serious crimes as well as for catching those who try to avoid paying their tokens at the fare gate.



The MARTA has put in more than 360 surveillance cameras.

The MARTA police force includes some 220 sworn officers, and this must also be factored in as a meaningful crime deterrent for the rail system.

The Best Equipment For the Job

The MARTA cameras are not recording all the time, but if the camera operators at the zone centers see something unusual, they hit the record button immediately. "We've looked at putting in an enhanced system, one that records continuously, but I don't know if we'll ever do that," Wilson says.

During the past decade, the MARTA system has relied heavily on surveillance equipment from Cohu's Electronics Division. The first cameras installed in 1985 were 5100 series tube models, including both fixed and zoom lenses. In 1990, more stations were added, so newer 4800 series cameras were added.

According to Laura Sallee, a Cohu applications engineer, the Cohu 5100 series is the predecessor of the 4800 series CCD cameras. "The 4800 series is ideal for applications that require both high resolution and high sensitiv-



Transit police officers benefit from the added assistance video gives.

ity," she says. "These cameras are installed at thousands of sites around the world, and support a wide range of security/surveillance and electronic imaging applications."

Specifically for the MARTA setup, the 4800 series works well because of the large areas covered by camera surveillance. They're placed in both indoor and outdoor locations, and each camera is encased in a sealed pressurized environment-resistant housing. Cohu 9-inch 9600 series monitors are used in the zone centers.

Atlanta has become one of the leading transportation centers in the U.S. In 1837, when the community was originally laid out, it was named Terminus, and it was set up to be the southern end of a proposed railroad from Chattanooga, Tennessee. By the time of the Civil War, it had been renamed Atlanta, and had a population some 15,000.

Of course it had become a major railroad hub. Because of its strong growth of businesses and city facilities, the city also has attracted many major conventions, including the National Association of Broadcasters (NAB).

Providing cameras for transportation centers is not new. But the sheer size and scope of the MARTA system has presented some unique security and surveillance challenges. These challenges continue to be met with the opening of every new station, keeping the flow of rapid rail passengers moving in and around the Atlanta metro area.

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ENVIRONMENTAL CAMERAS FOR TRAFFIC SURVEILLANCE

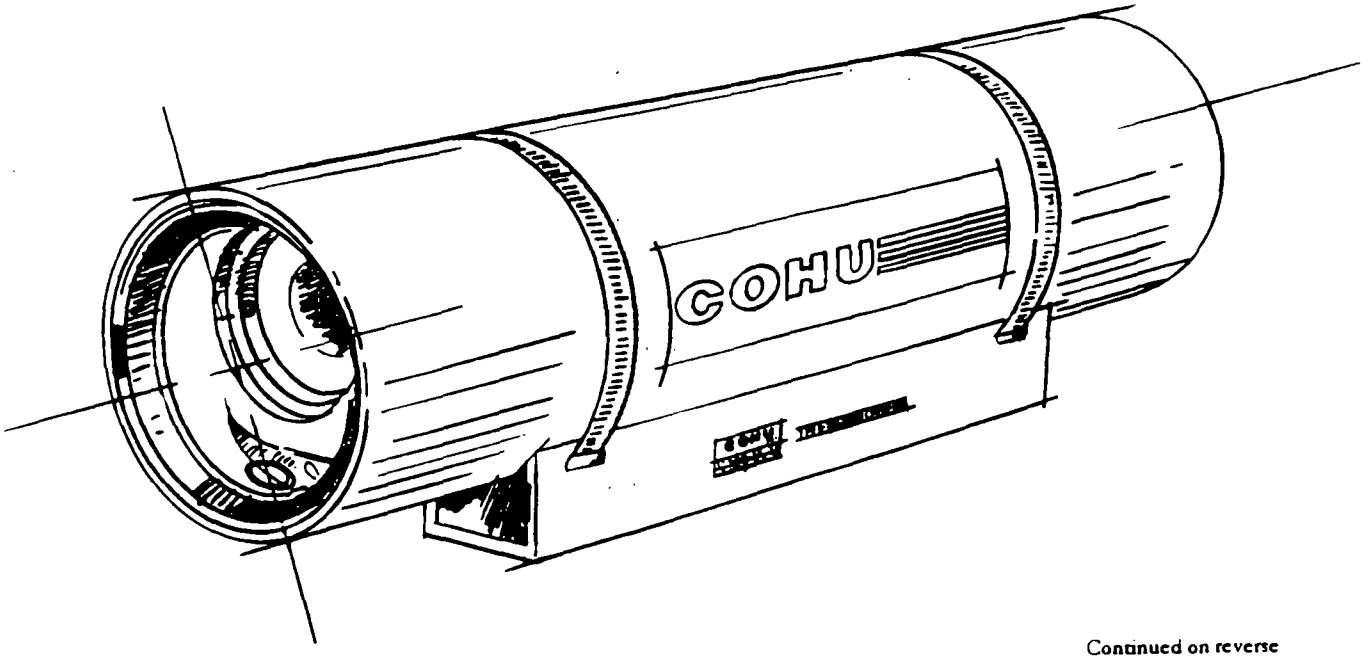
by Tim Jones
Senior Applications Engineer

Cohu Inc../Electronics Division, tends to use the "no nonsense" approach in supplying video for traffic applications.

One of the most unique features Cohu offers for the traffic industry is its variety of ruggedized camera enclosures. These rugged enclosures are sealed and pressurized, and are offered in either 3", 4.5" or 6" outside diameter. They are purged of oxygen and pressurized with 5 psi of dry nitrogen. Why take these measures? One word: reliability. This insures that the internal circuits of the camera and the lens remain free from contaminates, e.g.: humidity, salt, dust and debris normally associated with all traffic applications.

In addition to the controlled internal environment for the camera, Cohu installs desiccant bags to insure that no residual humidity is retained in the camera. The environmental enclosures can be equipped with thermostatically-controlled heaters and sunshields as a standard configuration. The lens offered in most traffic applications has an auto/manual iris that can be controlled at either the master or remote/local control receivers. Other option available include wiper washer assemblies, low pressure alarm switches, fiber optics and 24-character programmable alphanumeric generators.

The environmental housing is made of aluminum and painted with a polyurethane paint as a standard.



Continued on reverse

The sealed camera enclosure is widely used throughout traffic surveillance systems and is especially useful in areas where humidity is high. By creating a controlled environment for cameras mounted in the great outdoors, the camera has an increased life which will decrease maintenance costs. *Cameras sealed in Cohu environmental housings simply cost less to maintain and are more reliable than those without the environmental housing.* The specific maintenance costs associated with non-environmental housings are: bucket truck rental, lane closures, and actual replacement costs of camera, lens, and associated hardware.

Cohu also features a local/remote Camera Control Receiver (CCR), designed specifically for use in the traffic market. The CCR is designed for installation in a 19" rack frame, (for use in Nema or 330-type enclosures) and is featured with several useful controls.

The CCR can interface with either RS-232 or RS-422 communications and features a local/remote control switch. The CCR is equipped with dual RS-232 ports for drop and insert applications. In the remote control mode the CCR will interface with the MPC Master Control Panel via RS-422 or a PC via RS-232 located at the Traffic Operations Center (TOC). In the local mode, the CCR can operate the camera pan/tilt from the site for maintenance, repair and local control when an incident occurs. This eliminates the need for two way radio communications to the TOC. The CCR includes a BNC video output on the front panel to allow a local operator to view a monitor while performing tests, as well as a rear BNC connection for standard system operation. In addition to the standard camera pan/tilt functions, the CCR can be easily modified for use with a variety of communication modems and specific system configurations to meet the particular needs of the customer. Additionally, fiber optics transceivers for communications and video can be added.

The MPC Master Control Panel will interface via RS-422 over shielded twisted pair to the CCR and will interface with a PC or various other equipment via RS-232. The MPC Master can control most brands of matrix switchers and will interface with several different graphic user interface modules. In a standard configuration the MPC Master Control Panel provides the communication "Back Bone" for up to 223 separate camera sites and 32 remote stations.

These are just a few of the many reasons Cohu has maintained a high standard of quality throughout the more than four decades of operation.

For more information call the Traffic Experts at Cohu or your nearest Cohu sales representative.

Image Sensors, the Input Device for Machine Vision Applications

Joe Barrett
OEM Products Manager
Cohu Inc., Electronics Division

ABSTRACT--Understanding the technology and capability of image sensors and video cameras allows identifying appropriate imager solutions for measurement applications. This paper examines area array CCD (RS-170) video camera technologies (Frame, Interline) from an operational viewpoint. Camera features (field vs. frame resolution, shuttering, integration, asynchronous reset) are presented in a non-engineering format.

INTRODUCTION

The application of video in measurement solutions increases yearly. Understanding the features and benefits associated with video cameras allows a user to select the best technology to achieve the desired result.

The goal of this paper is to deliver specific information on camera technologies that allows making an informed decision on integrating the camera into a vision system. Provided is a basic understanding of video cameras for Machine Vision measurement applications. Advantages/disadvantages of the different technology options will be addressed. Information is presented in an operational/applications perspective rather than a design/engineering format.

Topics covered include: Technology of area array image sensors, including operation of (Texas Instruments) Frame Transfer, and (Sony) Interline Transfer devices. Field/Frame Resolution, Integration, Asynchronous Reset, and Shuttering as applied to the differing sensor technologies.

BACKGROUND

CCD image sensors were developed in the early 1970's by Bell Laboratories. The technology has progressively improved, resulting in higher yields, better performance, and lower cost. During the mid 1980's solid state technology surpassed tubes as the primary means of acquiring video images for most applications. Better manufacturing methods and innovative designs are enhancing sensitivity, resolution, and improving signal-to-noise ratio.

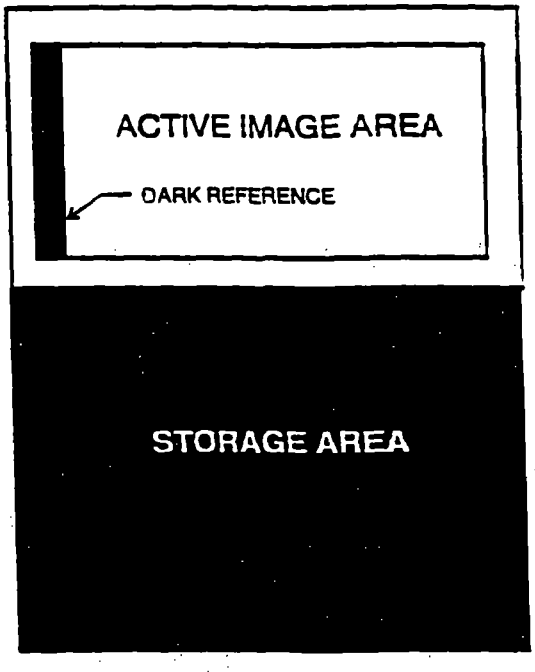


FIGURE 1. CCD SENSOR
FRAME TRANSFER

The basic video system requires an illumination source, scene or object to view, lens, video camera, and monitor/image processing equipment. The scene is focused onto the imager by the lens, the CCD image sensor will convert photons of light to electrons, camera electronics process the image and add timing signals which are output to a monitor for viewing, or image processing system for analysis.

CCD IMAGE SENSORS

Definition. CCD's are two-dimensional fixed geometry area arrays of photosites. The array contains lines (242 to 485, typical) of pixels (picture elements). Each line contains 510 to 1K pixels, the greater the pixel count in each line, the higher the horizontal resolution. The greater the number of lines the higher the vertical resolution. RS-170 video standard limits the maximum number of active video lines to 485. The total number of lines for RS-170 is 525, yet only 485 contain image information, the balance of 40 lines are consumed with synchronization signals.

Each pixel converts light to an electrical charge. Photons striking the silicon pixel generate a charge proportional to the amount of light present during the integration period (16.6ms, typical). This potential is referred to as a charge packet. Sensitivity is a function of the number of photons striking the sensor, integration time, and the efficiency of the pixel to convert photons of light to electrons. This process is analog and yields a representative analog voltage output from the imager.

The difference between sensor technologies is determined by the method of construction, and the path by which the charge packets are transferred from the active array of the sensor chip to the camera circuits. The efficiency with which charge packets of electrons can be transferred (.99995) from pixel of origin to the output without loss makes this technology an excellent measurement device.

Timing. Clocking of the charge packets contained within the pixels is at a rate sufficient to read a line (52.4μs) of pixel information while maintaining RS-170 timing. The greater the number of pixels per line the higher the clock speed. (e.g., 768 horizontal pixels; 52.4μs/768 = 68.2ns/pixel, or 14Mhz clock rate). The charge packets are clocked out of the sensor serially one pixel at a time, line by line. The camera circuits will merge the video information with synchronization signals, providing composite video (RS-170) to a monitor or frame grabber.

FRAME TRANSFER

RCA pioneered the development of the ***Frame Transfer CCD*** in the early 1980's. A Frame Transfer sensor contains two arrays of pixels (fig. 1), one for active imaging, and a second to store the field previously collected during the 16.6ms integration period. Both arrays contain the same number of pixels. The storage register is covered with an opaque material to prevent stray light from changing the contents of any individual pixel during storage or readout.

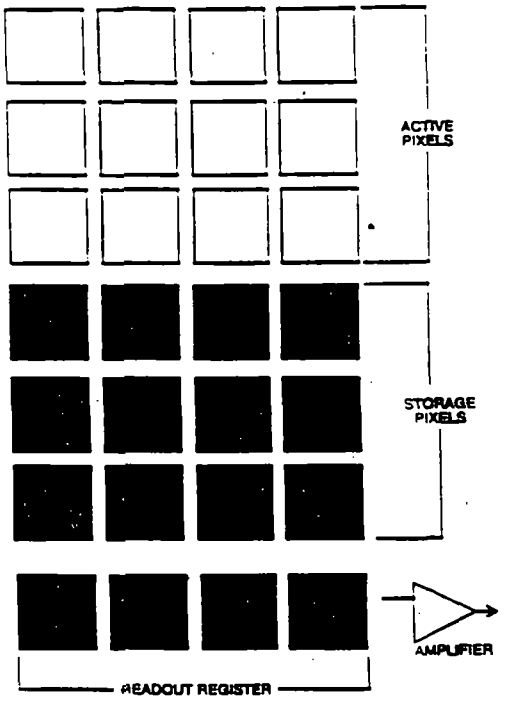


FIGURE 2. FRAME TRANSFER

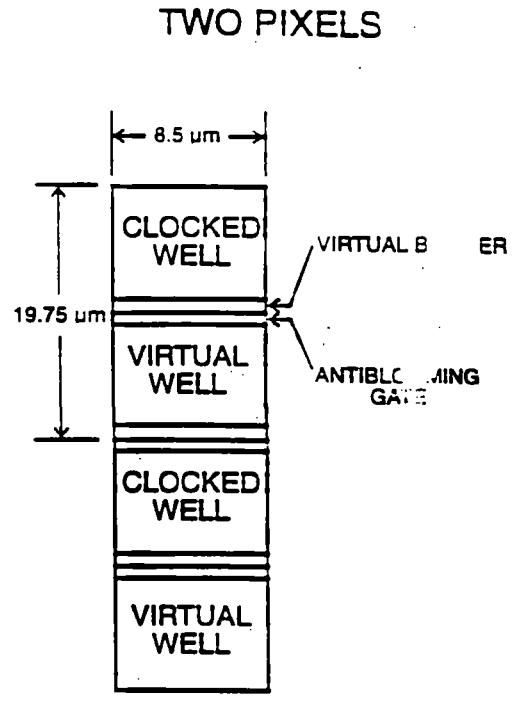


FIGURE 3. FRAME TRANSFER

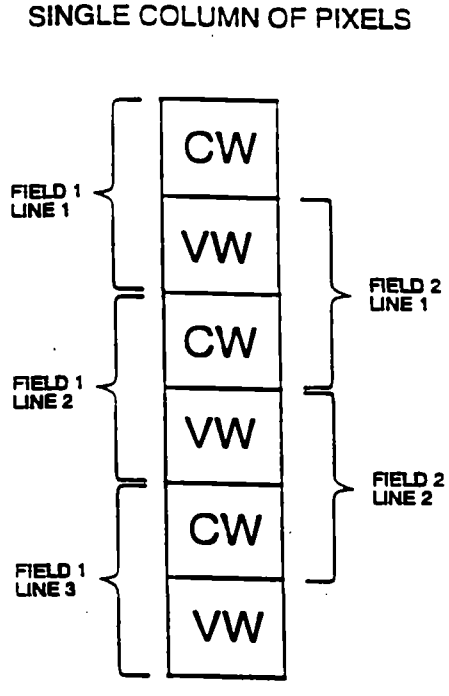


FIGURE 4. FRAME TRANSFER PSEUDO-INTERLACE

Several columns of pixels in the active image area are also covered with an opaque material. Referred to a "Dark Reference Pixels", their values are used by the camera to provide DC resoration by clamping the video line to a know level. This compensates for changes in temperature.

The name "Frame Transfer" seems to suggest that this technology provides complete frames (485 active video lines) each transfer or integration period. This in not true in many cases. The Texas Instruments TC-245[1] has only a field of video capacity on the active image array and storage register, thus full frame resolution will always contain two fields that are separated by a 16.6ms time separation. If the active image array and storage register could hold the full 485 lines of a frame, then two fields integrated over an identical period of time can be imaged onto the sensor, stored, and readout. Imagers that have the capability to transfer two fields at a time into a full frame storage register are available, yet, significantly more expensive.

Operation. As photons strike the silicon of the sensor pixels, a charge potential of electrons is accumulated in the pixel well. After 16.6ms (one field) of integration, a series of clocking pulses transfers the charge packets from the active register to the storage register (fig. 2). During the vertical interval the active array is used as a shift register, each row of charges moves vertically one line at a time from the active area into the storage register. Each line moves down sequentially until the entire field (242 lines of pixels) is contained in the storage register. The time required for this transfer is approximately 130μs (TC-245). When one image (field) is in the storage register, the next image (field) is being integrated onto the active array. The video information in the storage register is clocked to the horizontal readout register one line at a time, then moved out at the 14Mhz rate.

The Texas Instruments Frame Transfer chip contains 242 pixels in the vertical direction. This is equivalent to one field. Providing full-frame resolution necessitates an interesting solution called pseudo-interlace. A proprietary technology called Virtual Phase was developed by Texas Instruments to increase the vertical resolution without adding more rows of pixels to the array. Each pixel is composed of a Clocked Well and a Virtual Well (fig. 3). A Virtual Barrier provides separation between each pixel well to prevent bleedover. The Antiblooming Gate provides a means to discharge excess electrons, thus reducing saturation and blooming. The wells are both equally sensitive to light. The purpose behind two wells per pixel is to provide a means to divide the pixel in-half. Changing the bias voltage to the active image array shifts the center (centroid) by one-half pixel vertically (fig. 4) during alternate fields, thus it is possible to increase the vertical resolution and decrease aliasing (loss of detail due to under sampling). A fifty percent overlap exists vertically between the two fields. The positioning of a line of pixels is such that for field 1, lines 1, 2, and 3 are adjacent. The pixels used for field 2, line 1 use 50% of the pixel from field 1, line 1, and 50% of the pixel from field 1, line 2. This sequence repeats for the entire second field.

Shuttering. Photons of illumination are normally allowed to integrate on the image sensor for 16.6ms before transfer to the storage register. Shuttering decreases the integration period to either 1/1000sec (1ms), or 1/2000sec (500μs). This feature provides a stop action effect for objects in the field of view that are in motion. The shorter integration period also

FRAME TRANSFER

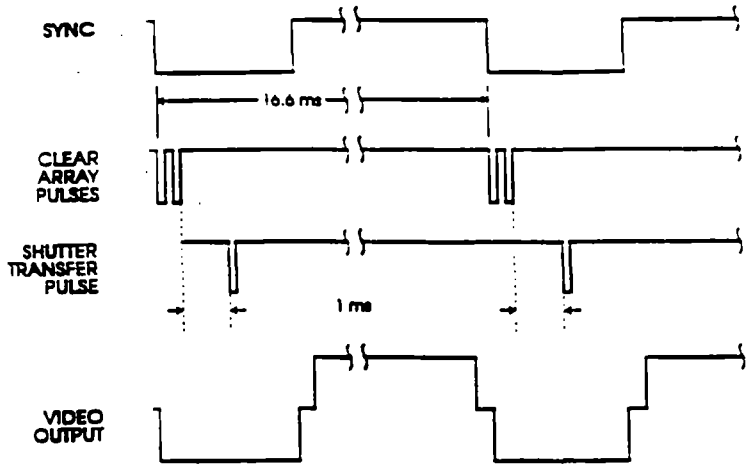
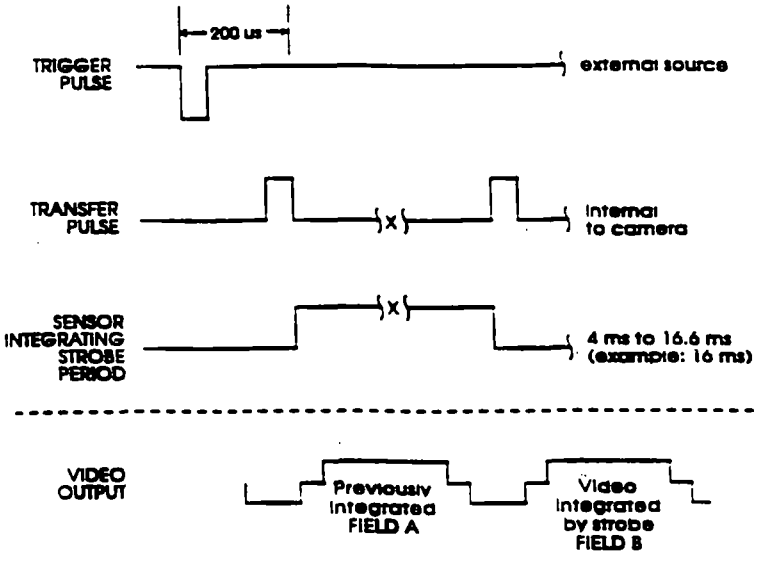


FIGURE 5. SHUTTER TIMING

FRAME TRANSFER



X = INTEGRATION PERIOD. ranges from 4 ms to 16.6 ms

Maximum triggering repetition rate = 240 hz

FIGURE 6. ASYNCHRONOUS RESET

decreases sensitivity; four f-stops for 1ms, and five f-stops for 500μs. Since each f-stop effectively cuts the electron accumulation in-half, shuttering may require additional illumination.

Timing. Achieving an electronic shuttering effect on the image sensor requires additional pulses. No mechanical device is used to stop light from reaching the sensor, thus a way must be provided to clear the sensor of undesired charge accumulation. This is accomplished with Clear Pulses (fig. 5). Two clear pulses in rapid succession initiate transfer of the image accumulated on the active array to the storage register. The first pulse shifts an undesirable image that has accumulated for the previous 15ms. The second pulse, a few microseconds later ensures the array is emptied of any residual accumulated charge. Then the sensor is allowed to integrate for the desired 1ms, or 500μs period. A transfer pulse initiates the movement of the captured video image into the storage register for readout.

Asychronous Reset[2] (option). Allows external control of the vertical interval by supplying a trigger pulse from another source to synchronize the camera to external events. Upon receipt of the trigger pulse (fig. 6); the vertical interval is initiated, and the previously accumulated charge on the active array will be transferred to the storage register within 200μs. This field of information will contain an image that integrated on the sensor immediately prior to receiving the trigger. The duration of integration on field A will be random (the trigger pulse can occur anytime during the vertical period), resulting in an unpredictable output. Thus, field A is not used. After the 200μs period, the active array is now ready to integrate the desired image by strobing the subject. Integration on the array will continue until the next vertical sync pulse (16.6ms), or next reset pulse, whichever occurs first. Then the cameras internal transfer pulse will move the information to the storage register and begin readout. If the repetition rate of the trigger pulses is increased, the vertical pixel count will decrease.

Examples:
60Hz = 242 vertical lines
120Hz = 121 vertical lines
240Hz = 61 vertical Lines

The readout from the storage register is limited to a fixed RS-170 rate, thus increasing the frequency of the trigger pulses will not allow sufficient time to read the entire field out of the storage register before the next image is clocked from the active array to the storage register.

Advantages. Frame Transfer technology exhibits contiguous pixels (near 100% fill factor). Fill factor is the ratio of active image area to total image area on the surface of the sensor. Each pixel attaches to its neighbor vertically to facilitate the transfer process. Thin channel stops (barriers) separate each column of pixels to reduce bleed over. Large pixel size increases sensitivity.

The spectral response ranges from 250nm (UV) with the faceplate removed, through the

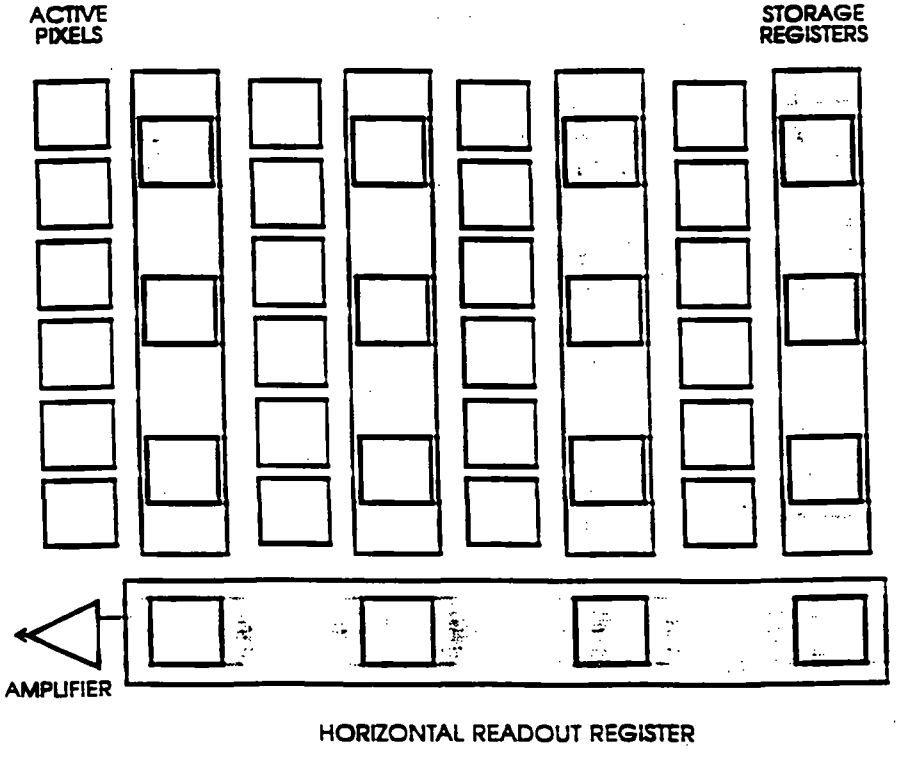


FIGURE 7. CCD SENSOR
INTERLINE TRANSFER

photopic (visible) to a peak at 800nm, and extending into the near infrared (IR) region upto 1100nm. Frame Transfer sensors incorporate a thicker surface substrate on each pixel. The infrared wavelengths of light penetrate deeper into the silicon and are still within the well of the pixel generating electrons proportional to the photon input. The same IR input to an interline device will pass completely through the thinner Interline technology without registering a signal.

This sensor can be operated in the non-interlaced mode. The same pixels (no Virtual Phase shift) are used for each field. The sensor exhibits 50% less noise, and 50% less vertical resolution in this mode. Measurement repeatability is then directly tied to the same pixels.

Disadvantage. When bright highlights are present, or a pin-point source light is impinging on a single pixel location or cluster of pixels, then as each line of pixels moves through the bright point during transfer, the value of that pixel will be altered. In an extreme case, streaking appears as a white vertical line on the monitor. Possible solutions are to inhibit imaging during transfer time with a mechanical shutter, or controlled lighting of the target.

Frame Transfer Sensor: TC-245.
Picture Elements: 768(H) x 242(V)
Active Picture Elements: 755(H) x 242(V)
Pixel Size: 8.5μm(H) x 19.75μm(V)
Dynamic Range: 50dB
1/2" Format: 8.5μ(H) x 755 = 6.4mm, 19.75μ(V) x 242 = 4.8mm
Dark Signal: 6mV @ 45°C
Typical Frame Transfer Camera Cost:
Remote Head (Cohu 6410) $2,300. Self-contained (Cohu 4810) $1,500.

INTERLINE TRANSFER CCD

An initial goal in designing the ***Interline Transfer CCD*** technology was to solve an inherent difficulty of Frame Transfer technology, streaking, which is caused by the combination of bright point-sources of light and the method of transferring the charge packets of electrons from the active array to the storage register one line at a time.

Operation. The Interline Transfer sensor presents a different approach to pixel design, transfer, and storage of the video information. The sensors active pixel area and storage resister are both contained within the active imaging area (fig. 7). Active imaging pixels are not used as transfer pixels as was the case with Frame Transfer technology. The active array of this device contains a full frame of pixels, 485 (Sony ICX-038[3]). On the imager, each column of pixels is separated by a column of storage elements that are covered with an opaque material. The storage elements have the capacity to hold only one field. Each two active vertical pixels share a single storage pixel. After completion of the 33.2ms integration time (frame mode), the charge packets from each pixel of a single field are transferred to the

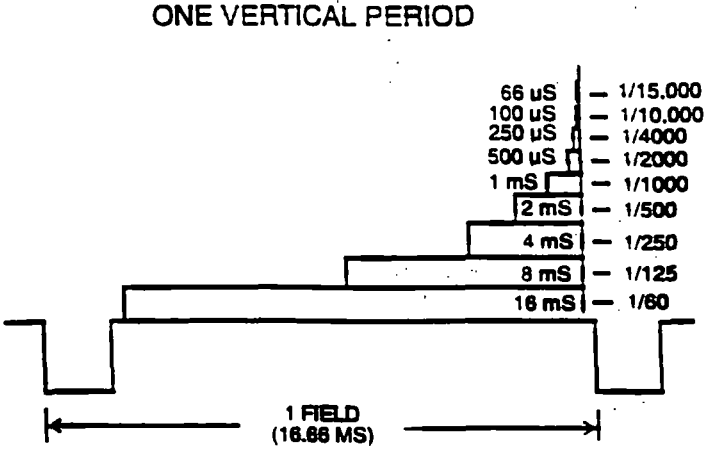


FIGURE 8. INTERLINE CCD SHUTTERING

storage register. While the next field is gathering charge, the charge packets in the storage register are clocked to a horizontal readout register one line at a time, and readout at a 28Mhz rate. The higher clock rate seems to suggest the information is moving-out faster. In fact this is not true, while the Frame Transfer unit is using a two phase clocking solution, the Interline is based on four phase clocking. Twice the clock rate as compared to Virtual Phase is required to accomplish the same task.

A sensor configured with a full frame of active pixels (485) in the light sensitive area and only a field (242) of capacity in the storage array reduces size, complexity, and cost. It also limits the ability to acquire full vertical resolution where both fields are captured during identical integration periods (possible using a strobe, or mechanical shutter).

The storage register is integral to the active image area. Thus the photon sensitive area of each pixel is smaller in size (relative to Frame Transfer). Less light is accumulated and a greater possibility of aliasing exists if a detail of information in the field of view falls upon the opaque area. The percentage of fill factor (active image area to total image area) is approximately 35%[4]. The spectral response peaks in the photopic area at 550nm and falls-off sharply (750nm) before reaching the near IR region.

Shuttering. The Sony ICX038 Interline design is shutterable at the pixel level. The Frame Transfer device required 130μs to clear the array. Interline clears the contents of each pixel in the active image array once every 63.5μs (during horizontal blanking). When shuttering, the active array is cleared each horizontal period until the time remaining in the field equals desired integration time (fig. 8), then shuttering ceases, and normal charge accumulation begins.

The shutter mode steps in increments. If the illumination is constant, each change cuts the charge accumulation by 50% as the integration period is halved. Shuttering is accomplished across its full range in 8 steps (1/60s to 1/10,000s). Modifying the camera to externally control the shutter circuit with a TTL pulse provides discrete steps at 242 levels, effectively stepping one line (H period) at a time.

A disadvantage of shuttering is the inability to obtain full frame (vertical) resolution. If two fields can be integrated during the same period, effectively stored, and then readout, true full frame resolution is achieved. Since the storage register is designed to hold only one field at a time, the information contained in the second field remains on the active array and is clocked into the substrate drain of the sensor at the beginning of the next field. Clearing the pixels happens across the entire array, not for selected fields, this is an example where inherent characteristics built into the sensor chip architecture drive the features that are available in cameras. Full vertical resolution and shuttering are mutually exclusive in this mode.

Asynchronous Reset. The interline chip can be asynchronously reset. A reset trigger input will initiate the vertical interval and transfer one field of the array 9.5 lines (614μs) later (fig. 9). If the illumination to the sensor is controlled and/or a strobe is used, it is possible to quickly capture and readout the image. Asynchronously resetting the sensor, and

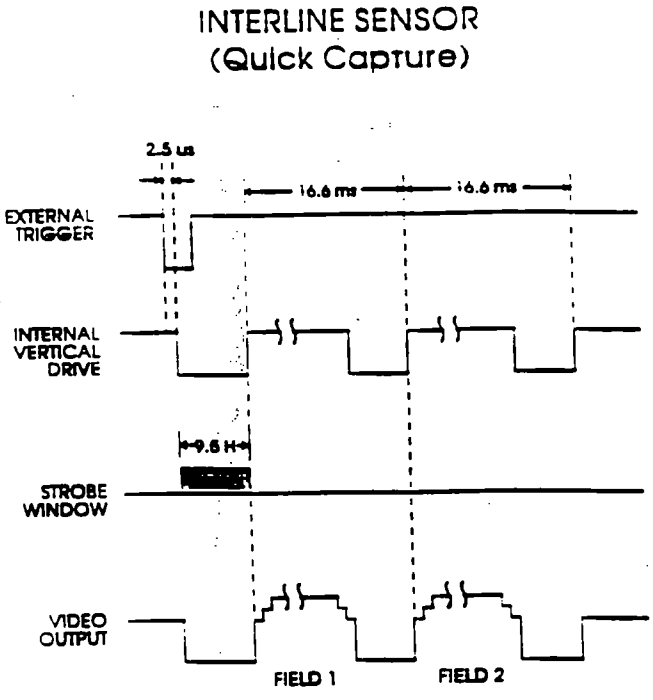


FIGURE 9. ASYNCHRONOUS RESET

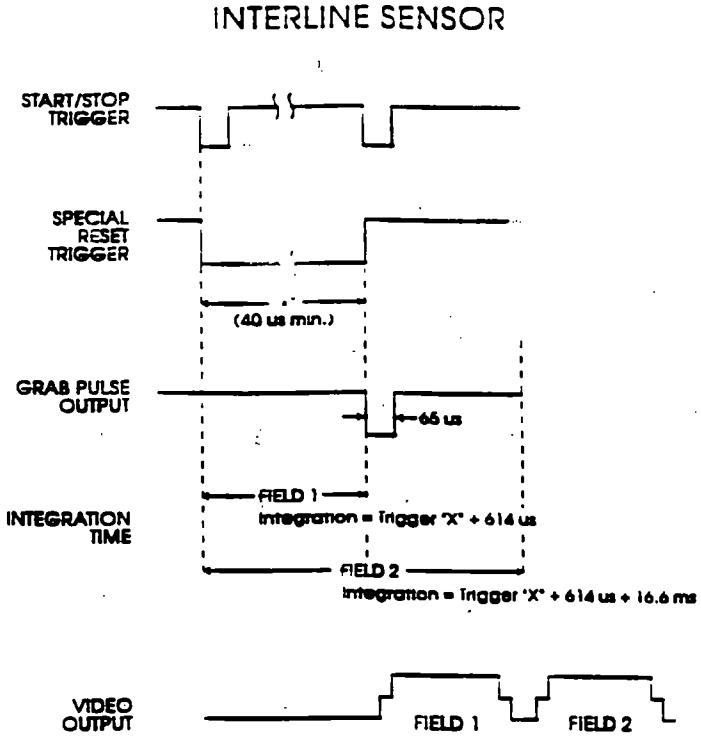


FIGURE 10. START/STOP RESET

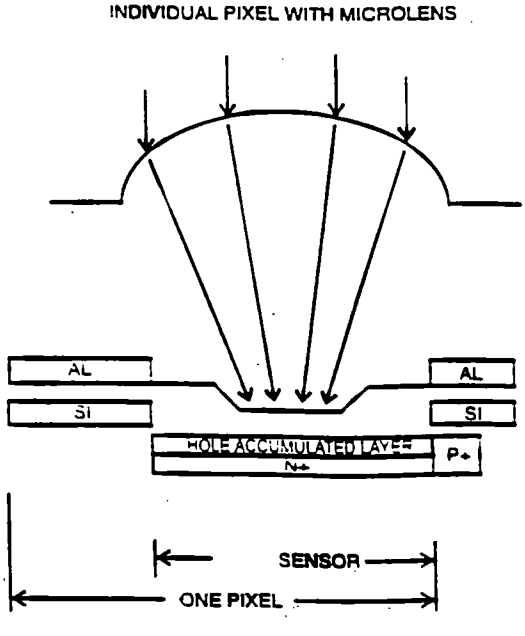


FIGURE 11. MICROLENS INTERLINE PIXEL

strobing in coincidence with reset, or before the transfer time (9.5 lines later), provides quick capture time to readout (614μs-capture to 16.6ms-readout). The first field begins readout 614μs after reset and completes 16.6ms later. The second field, still on the active array, follows the first and begins readout, this operation takes an additional 16.6ms. Acquiring RS-170 full-frame (vertical) resolution requires 33.3ms. The quality of the image is dependent upon controlling the light source such that no illumination is impinging on the imager during the time the first field is being readout and the second field is awaiting transfer.

Start/Stop. An alternative to asynchronous operation is start-stop mode. Configuring the camera to electronically shutter each H-period, pixel charge accumulation will be dumped every 63.5μs (H-period) until an external control pulse is received. This pulse commands the shutter to cease, and begins active integration (fig. 10). The duration of integration is equal to the input pulse width, plus 9.5-H (614μs) lines. Field 1 will have integrated for the input pulse width "x", plus 614μs. Field 2 has integrated for "x", plus 614μs, plus 16.6ms. The reason field 2 has integrated for an additional vertical interval resides in the limitation of the storage register to hold only one field at a time. The storage register must be readout completely (16.6ms) before a transfer is initiated and field 2 is shifted from the active image area to the storage register. In this mode electronic shuttering is inhibited for one field after reset to avoid destroying the second field.

Sensitivity. A development by Sony Imager Group is the addition of micro-lenses placed above each pixel to focus the light onto the active portion of the sensor (fig. 11). Typical Interline Sensors have a fill factor of 35%. These focusing micro-lenses increase light gathering ability and reduce aliasing. The quality of the lens and precise placement, raise the fill factor to 70% or more, the light falling on the sensor is increased by a factor of two (6dB, 1-f stop).

Integration. Low noise and wide dynamic range make this technology a good candidate for extended integration. Extended integration increases the time that photons strike the pixels beyond the standard 16.6ms. This mode requires the target to be stationary, or the image will be blurred. The longer the integration time the greater the charge accumulation on the pixels, thus increasing the ability to image in lowlight. Sensitivity increases by a factor of two when the frame integration period is doubled (e.g., 2, 4, 8, 16 frames). Pixel non-uniformities will be exaggerated as integration time increases. A fixed pattern noise will eventually appear at the output as a "starfield" pattern (like looking through a telescope at the stars). The amount of noise will be partially dependent on ambient temperature. Cooling the sensor extends integration without this artifact. Imaging still objects provides sensitivities equal to or greater than intensified cameras with this CCD technology. Full vertical resolution is possible, the difference between the integration time of the first field and second field will always be 16.6ms. The second field will remain on the active image area for an additional vertical period awaiting transfer to the storage register. This difference becomes a progressively smaller percentage as integration time increases.

Example: 4 frame integration

field A = 4 x 33.2ms = 132.8ms
field B = 4 x 33.2ms + 16.6ms = 149.4ms, 12.5% longer.

Example: 30 frame integration

field A = 30 x 33.2ms = 996ms
field B = 30 x 33.2ms + 16.6ms = 1,012ms, 1.6% longer.

Advantages. Several advantages are offered with Interline technology. The transfer of charge packets from the active image pixels to the storage register happens in a fraction (6.5μs) of the time required by Frame Transfer, this lowers the probability of highlight smearing. Effective pixel to pixel isolation inhibits charges spilling over to adjacent pixels (perceived as blooming). Individual pixels have lower noise and a greater ability to gate away excess charge accumulation into the substrate, providing wider dynamic range. Shuttering at the pixel level allows faster shutter speeds and greater flexibility for imaging high-speed operations.

Interline Transfer: ICX-038.
Total Pixels: 811(H) x 508(V)
Active Pixels: 768(H) x 494(V)
Pixel Size: 8.4μm(H) x 9.8μm(V)
Dynamic Range: 56dB
1/2" format 8.4(H) x 768 = 6.4mm, 494(V) x 9.8 = 4.8mm
Dark Signal: 2mV @ 60 ° C
Typical Interline Transfer Camera Cost:
Remote Head (Cohu 4980) $1,700. Self-contained (Cohu 4910) $800

Feature Summary for Machine Vision Cameras

	Sensitivit lux	Asynchrous Field/Frame	Shuttering Fixed	Integration Field/Frame	cost $ Bugetary
FT	0.3	Yes/No	to 1/2000	Yes/NO	$1,500
IT	0.65	Yes/Yes	to 1/10,000	Yes/Yes	$850

Key:
FT= Frame Transfer
IT= Interline Transfer

Reference

[1]TC-245 Frame Transfer Data Sheet. Texas Instruments, December 1991.

[2]Schumacher, Peter. Async Application Note. Cohu, 1990.

[3]ICX038 Interline Transfer Data Sheet. Sony Semiconductor IC Data Book 1991.

[4]Thorpe, Laurence and Duane Dahlberg. On-chip lens HyperHad Sensors for Increased CCD Sensitivity. Advanced Imaging, June 1991: 43-45

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