

# 7700-2 SERIES 1004 X 1004 PROGRESSIVE SCAN CAMERA TECHNICAL REFERENCE MANUAL

---

## CAMERA LINK

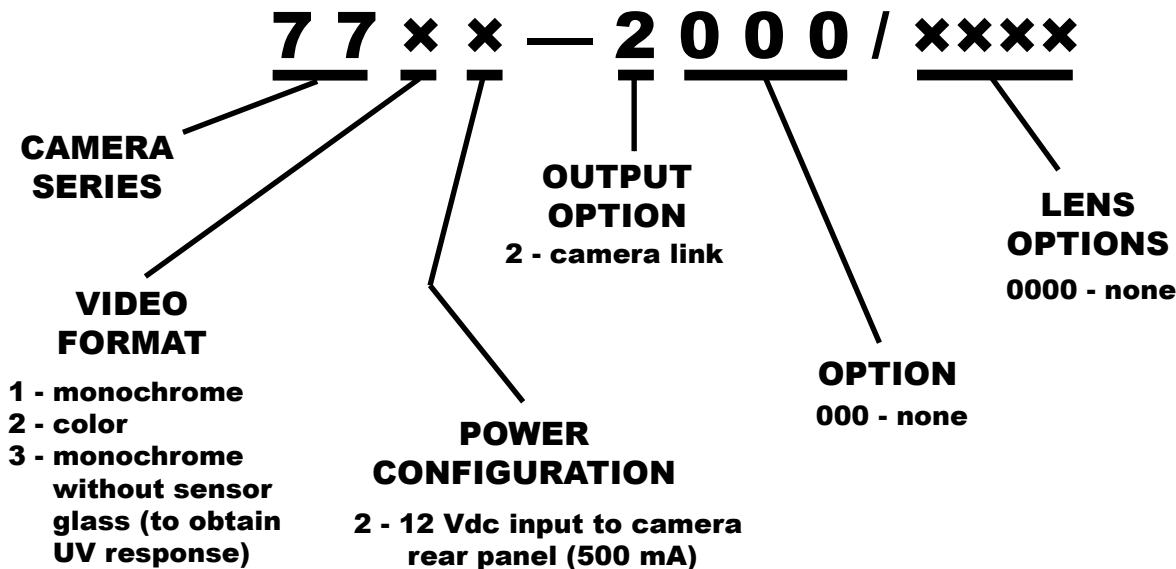


Shown with optional  
1/4-20 mounting block

**Model 7700-2 Camera**

**Table 1. Model 7700-2 Specifications**

<b>ELECTRICAL</b>	
Format	1/2-inch monochrome or color interline transfer CCD with square pixels
Pixels	1004 x 1004
Pixel Size	7.4 $\mu\text{m}$ x 7.4 $\mu\text{m}$
Total Pixels	1,008,016
Output Characteristics	10-bit depth at 30 fps (full resolution)
Sync	Internal crystal or external trigger
Shutter Control	<ul style="list-style-type: none"> <li>• Fixed shutter: exposure time preset by camera setting</li> <li>...Implicit lines: 1- 512 line interval in 10 steps</li> <li>...Explicit lines: 1 - 65,000 line interval (line interval = 33.2 <math>\mu\text{s}</math>)</li> <li>...Multiple frames: 1 - 65,000 frame intervals (frame rate = 33.3 <math>\mu\text{s}</math>)</li> <li>• Pulse width shutter (Snapshot mode only): Exposure time determined by pulse width of externally applied trigger</li> </ul>
Integration	1 to 65,000 frames (1 frame = 1/30 s) externally controlled
Sensitivity	4 lux (monochrome) with no shuttering (1/30 s) at 2450 K
Gamma	1.0 (fixed)
Gain	0 to 34 dB, externally controlled
S/N Ratio	58 dB black, 48 dB white
Spectral Response	See figure 3 and figure 4 (color antialiasing filter)
Power Input	12 $\pm$ 1.2 V dc
Power Consumption	390 mA (4.7 W)
<b>Modes of Operation</b>	
Video Mode	Free running, asynchronous
Snapshot Mode	<ul style="list-style-type: none"> <li>• Captures single image, 1/25,000 s to infinity, initiated externally by applied trigger pulse or by serial command. Exposure determined by pulse width of external trigger</li> <li>• Full resolution: 10 bit depth at 30 fps</li> <li>• Partial Readout: Define single position for start of active readout in groups of four lines</li> </ul>
Gain & Offset Control	<ul style="list-style-type: none"> <li>• Gain: Video gain amplifier setting of 320 values</li> <li>• Offset: Video black level setting of 1024 values</li> </ul>
Shutter Control	<ul style="list-style-type: none"> <li>• Fixed: Exposure time preset by camera setting</li> <li>• Variable: Software controlled 1/25,000 s to 870 s</li> </ul>
<b>MECHANICAL AND ENVIRONMENTAL</b>	
Size	See figure 6
Weight	12 ounce (340 grams) less lens
Shock	15 g's any axis, nonoperating per MIL-E-5400T
Operating Temperature	-20 to 60 $^{\circ}\text{C}$
Storage Temperature	-30 to 70 $^{\circ}\text{C}$
EMI Emissions	FCC Class A
<b>CAMERA INTERFACES</b>	
Lens Mount	CS-mount, adjustable; 5 mm externer ring adapts to C-mount lenses
Camera Link Connector	26-pin MDR
Power Connector	3-pin Switchcraft TB3M (Cohu 1310356-003)
Reset Button	Recessed rear panel (Hole for punch through of a paper clip)



**Figure 2. Model Number Interpretation Diagram**

Cameras of the 7700-2 series provide 10-bit output in Camera Link format to an external frame grabber.

Operating in progressive scan mode, they use a 1/2-inch sensor to provide 1004 × 1004 pixel resolution at 30 frames per second.

Higher frame rates can be established, but with a corresponding reduction in the number of lines available for readout.

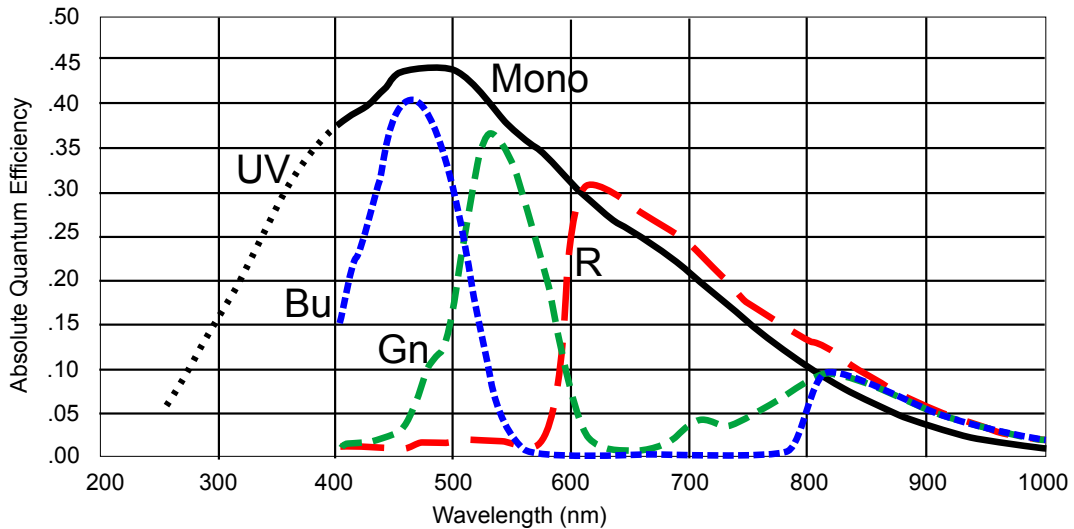
The color version (7720-2) of this camera has an antialiasing filter in front of the sensor. Sensor color filtering is the Bayer pattern. All color processing is performed by the external computer.

Operation in the UV region, (250-400nm) requires a model 7732-2000 version of the camera — which has the sensor faceplate glass removed.

Setup and control of the camera is through the rear-panel MDR connector operating via asynchronous serial communications.

Offset, gain, and other functions are adjustable through this serial interface. Preset camera configurations can be established to allow for a rapid change of duty.

Inserting a paper clip through a hole in the rear panel performs a hard reset. Also on the rear panel is a green indicator that illuminates when the 12 V dc power is applied.

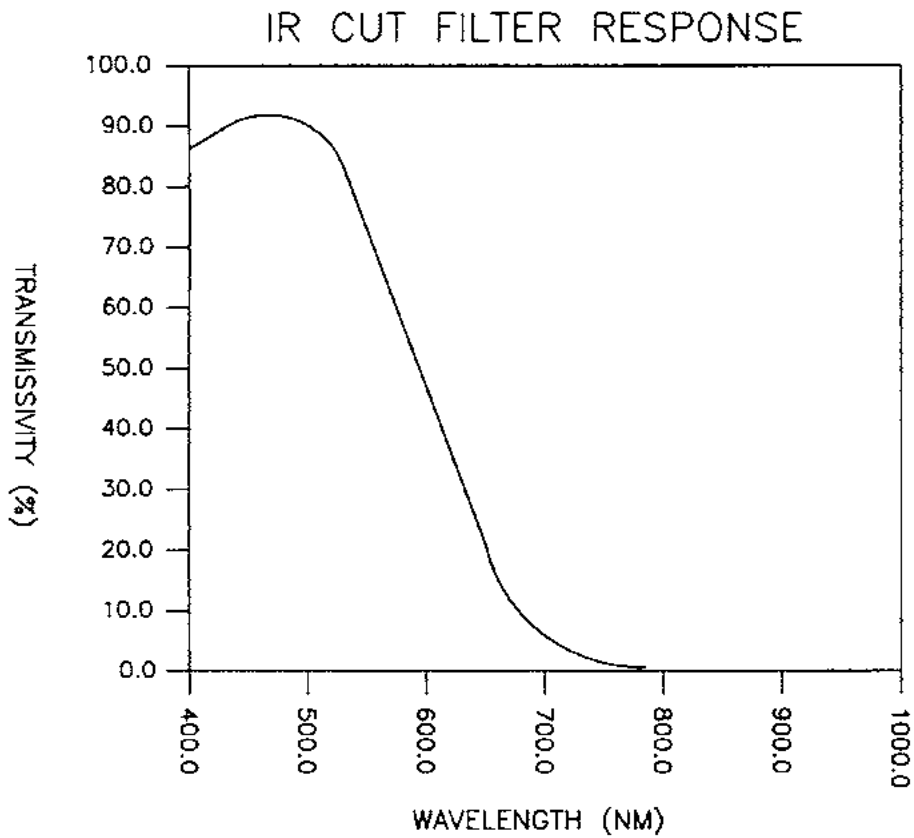


Note: Operation in the UV region requires a monochrome camera having had its sensor faceplate glass removed

**Figure 3. Sensor Response**

(Cut filter effect on overall camera response not shown in this figure)

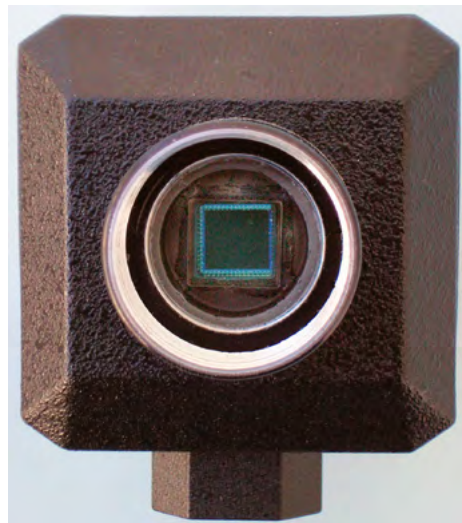
**Note: This cut filter rolls off overall response for color versions of the camera from about 500 nm out beyond 700 nm**



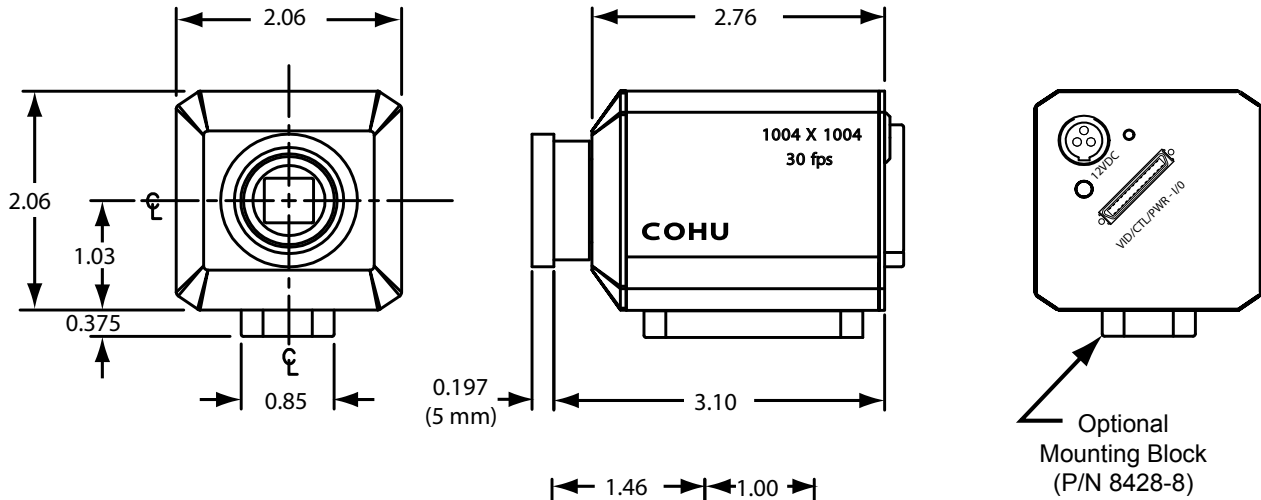
**Figure 4. Antialiasing Color Cut Filter**

<b>Table 2. Camera Mounted Items Supplied</b>	
<b>DESCRIPTION</b>	<b>PART NUMBER</b>
CS mount	8359208-001
C-mount adapter (5 mm extender ring)	2010695-001
Setscrew, nylon tipped, stainless, 4-40 x 5/32	2010258-005
<i>Note: These items typically mount on the camera when it is shipped (5 mm C-mount adapter may be loose part)</i>	

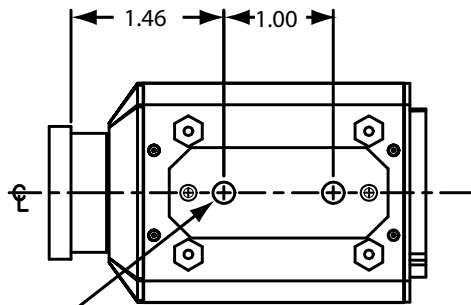
<b>Table 3. Type 8430-0 Accessory Kit</b>	
<b>DESCRIPTION</b>	<b>PART NUMBER</b>
Power Plug, 3 socket (Switchcraft TA3F)	1310356-103
Mounting Block (with two 4-40 x 5/16 pan head cross slotted screws)	8428-8
Wrench, hex key, "L" type, 0.050 across flats (for lens mount setscrew)	9710010-009
<i>Note: If this optional accessory kit has been ordered with the camera these items will be contained in a separate packet included in the shipping box</i>	



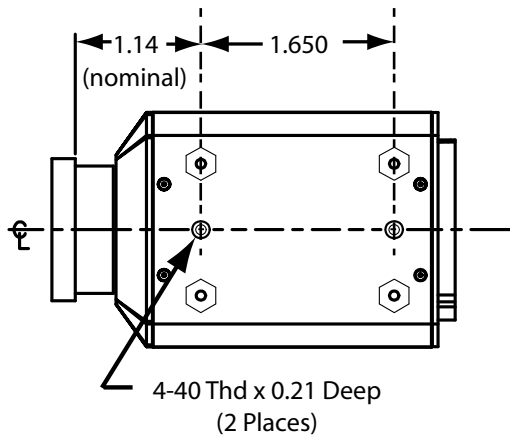
**Figure 5. Front View**



Unless otherwise noted all dimensions in inches



See alternate drawing below for mounting dimensions of camera base without the optional mounting block



**Mounting Dimensions Without Optional Mounting Base**

**Figure 6. Dimensions**

Power Connector Functions	
PIN NO.	FUNCTION
1	+12 volt
2	ground
3	(no connection)

Use minimum 500 mA supply

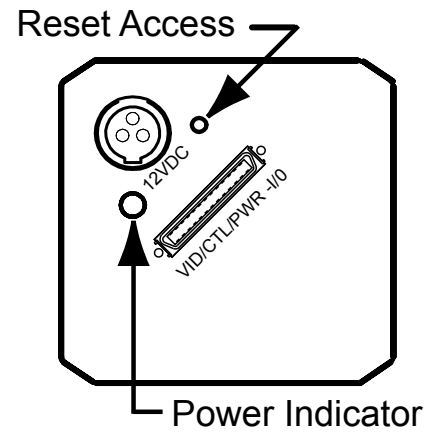
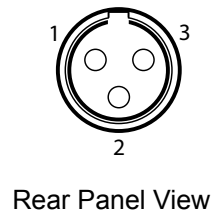
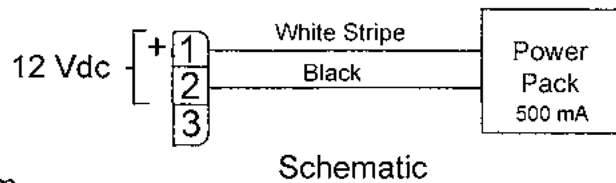
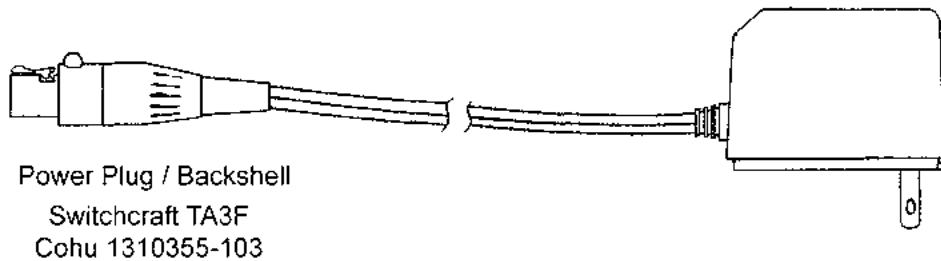


Figure 7. Power Input Features



Type 8368-4 Power Pack

Figure 8. Type 8368-4 Power Pack (12 V dc 500 mA)



**Figure 9. Bottom View  
(with mounting adapter installed)**



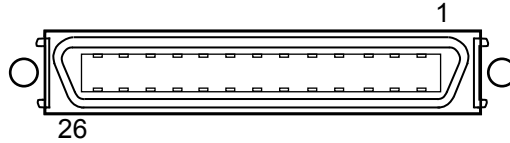
**Figure 10. Rear Panel**



<b>Table 4. Mating Rear Panel Connector Plugs</b>	
<b>DESCRIPTION</b>	<b>PART NUMBER</b>
POWER	Cohu 1310356-103 (Switchcraft TA3F) [A complete plug and backshell assembly]
CAMERA LINK	Camera link 26 pin connectors require special tooling to assemble. Thus, cables are only available pre assembled.
	Note: All cameras can use cables of the 3M company 14B26 series (table 5). However, for cameras above serial number 410368 only cables of the 14T26 series can be used (table 6).

<b>Table 5</b>	
<b>3M Camera Link Cable (B series)</b> <i>Thumbscrew type shells at each end</i>	
<b>For all serial numbers. But for s/n's above 410386 it is better to use the "T" series</b>	
<b>3M PART NUMBER</b>	<b>LENGTH (meters)</b>
14B26-SZLB-100-0LC	1
14B26-SZLB-200-0LC	2
14B26-SZLB-300-0LC	3
14B26-SZLB-450-0LC	4.5
14B26-SZLB-500-0LC	5
14B26-SZLB-700-0LC	7
14B26-SZLB-A00-0LC	10
<i>These cables available from Cohu on a special order basis (7610169-300 series)</i>	
3M Interconnections Solutions Division 6801 River Place Boulevard Austin TX 78726-9000 Phone 800-225-5373	
<b>NOTE: Cables of this "14B26" series can be used with cameras of all serial numbers</b>	

<b>Table 6</b>	
<b>3M Camera Link Cable (T series)</b> <i>Thumbscrew type shells at each end</i>	
<b>Only for serial numbers above 410368</b>	
<b>3M PART NUMBER</b>	<b>LENGTH (meters)</b>
14T26-SZLB-100-0LC	1
14T26-SZLB-200-0LC	2
*14T26-SZLB-300-0LC	3
14T26-SZLB-450-0LC	4.5
14T26-SZLB-500-0LC	5
14T26-SZLB-700-0LC	7
14T26-SZLB-A00-0LC	10
<i>*This 3-meter cable is available from Cohu stock as p/n 7610169-301 (3-meter). Other cables in the "-301" series are special order from Cohu</i>	
3M Interconnections Solutions Division 6801 River Place Boulevard Austin TX 78726-9000 Phone 800-225-5373	
<b>NOTE: This "14T26" series can be used only with cameras above serial number 410368</b>	



**Mating View of Connector on Rear Panel of Camera**

<b>Table 7. Camera Connector Pin Functions</b>		
<b>PIN</b>	<b>NAME</b>	<b>FUNCTION</b>
<b>1</b>	DGnd	digital ground
<b>2</b>	TxOut 0-	- digital video data
<b>3</b>	TxOut 1-	- digital video data
<b>4</b>	TxOut 2-	- digital video data
<b>5</b>	TxCIk-	- clock
<b>6</b>	TxOut 3-	- digital video data
<b>7</b>	Rx+	+ serial control receive
<b>8</b>	Tx-	- serial control transmit
<b>9</b>	-	(no connection)
<b>10</b>	-	(no connection)
<b>11</b>	Trig-	- snapshot trigger input start
<b>12</b>	-	(no connection)
<b>13</b>	DGnd	digital ground
<b>14</b>	DGnd	digital ground
<b>15</b>	TxOut 0+	+ digital video data
<b>16</b>	TxOut 1+	+ digital video data
<b>17</b>	TxOut 2+	+ digital video data
<b>18</b>	TxCIk +	+ clock
<b>19</b>	TxOut 3+	+ digital video data
<b>20</b>	Rx-	- serial control receive
<b>21</b>	Tx+	+ serial control transmit
<b>22</b>	-	(no connection)
<b>23</b>	-	(no connection)
<b>24</b>	Trig+	+ snapshot trigger input start
<b>25</b>	-	(no connection)
<b>26</b>	DGnd	digital Ground

<b>Table 8. 7700 Camera Link Cable Functions Cross Reference</b>			
<b>COHU CAMERA SIGNAL</b>	<b>CAMERA CONNECTOR</b>	<b>FRAME GRABBER CONNECTOR</b>	<b>CAMERA LINK SIGNAL</b>
<b>DGNDD</b>	1	1	Inner Shield
<b>DGNDD</b>	14	14	Inner Shield
<b>TXOUT0 -</b>	2	25	X0 -
<b>TXOUT0 +</b>	15	12	X0 +
<b>TXOUT1 -</b>	3	24	X1 -
<b>TXOUT1 +</b>	16	11	X1 +
<b>TXOUT2 -</b>	4	23	X2 -
<b>TXOUT2 +</b>	17	10	X2 +
<b>TXCLK -</b>	5	22	Xclk -
<b>TXCLK +</b>	18	9	Xclk +
<b>TXOUT3 -</b>	6	21	X3 -
<b>TXOUT3 +</b>	19	8	X3 +
<b>RX +</b>	7	20	SerTC +
<b>RX -</b>	20	7	SerTC -
<b>TX -</b>	8	19	SerTFG -
<b>TX +</b>	21	6	SerTFG +
—	9	18	CC1 -
—	22	5	CC1 +
—	10	17	CC2 -
—	23	4	CC2 +
<b>TRIG +</b>	11	16	CC3 -
<b>TRIG -</b>	24	3	CC3 +
<b>NC</b>	12	15	CC4 -
<b>NC</b>	25	2	CC4 +
<b>DGNDD</b>	13	13	Inner Shield
<b>DGNDD</b>	26	26	Inner Shield

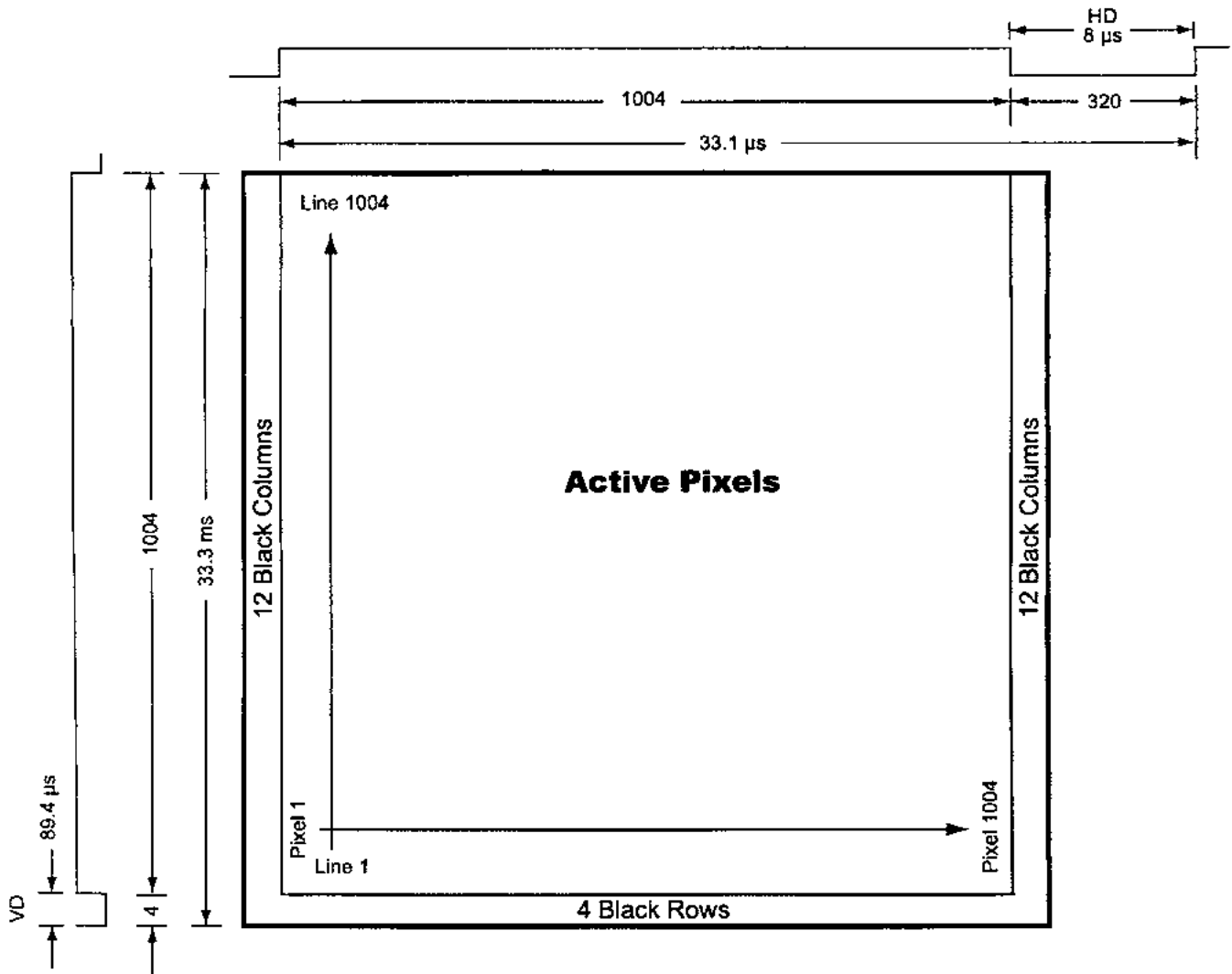
<b>Table 9. Serial Control Modes</b>	
<b>SERIAL CONTROL</b>	LVDS via Camera Link: 9600 baud rate, 8 data bits, 1 start bit, 1 stop bit, no parity, and no handshaking
<b>SERIAL INPUT COMMANDS (see table 12, Protocol, for a complete listing)</b>	
<b>SETUP COMMANDS</b>	Go to Default
	Set Mode Operational Mode: Continuous / Snapshot
	Set Exposure Mode, Implicit Lines, Explicit Lines, Frames, External
	Set Offset Level
	Set Gain Level
	Set Partial Readout (starting and stopping lines in increments of 4)
<b>OPERATION COMMANDS</b>	<b>Capture Video Frame (Snapshot and Integration Operations)</b>
	Snapshot and integration operations are basically the same but with different time intervals
	Snapshot allows image capture with high-speed shutter
	Integration allows image capture with low-speed shutter
	Each can be initiated externally by either the TRIG input signal or by command through the serial interface
	TRIG Initiated Capture. Two modes are supported when using TRIG: <ol style="list-style-type: none"> <li>1. Fixed Shutter</li> <li>2. Pulse Width Shutter</li> </ol>
	With Fixed Shutter the camera will be pre-set with the shutter value and capture will be initiated on the leading edge of TRIG
	With Pulse Width Shutter, TRIG will be received as a pulse that starts capture on the leading edge and ends capture on the trailing edge — supporting intervals from 40 $\mu$ s to infinity
<b>Serial Command Initiated Capture:</b> Commands will be supported that can initiate a snapshot or integration capture using fixed shutter values	

<b>Table 10. Operation</b>	
<b>MODE</b>	<b>DESCRIPTION</b>
Video	Continuous (free running) Snap shot
Video Rate	Full resolution - 30 fps
<b>Snap Shot Modes</b>	
External Single Trigger Fixed Trigger	Multiple Lines or Multiple Frames. Initiate capture with TRIG falling edge
External Single Trigger Pulse Width Shutter	Any shutter from 1/25,000 s to infinity; shutter start/stop times determined by TRIG pulse width
<b>Misc Controls</b>	
Gain / Offset	Individual gain and offset control through serial interface
Serial (Shipped as 9600 baud)	Serial control sets all camera modes. Once set, camera remembers state. Serial control not required for operation. (Internal jumpers select baud rate.)

<b>Table 11. Operating Modes</b>		
<b>ITEM</b>	<b>MODE</b>	<b>DESCRIPTION</b>
1	VIDEO MODE	Continuous (Full Resolution) Free Running at 30 frames per second (30 fps)
		Continuous (Partial Readout) Free Running
		Snap Shot: Captures single image when triggered
2	VIDEO RATE	Continuous: 30 fps
		Snap Shot: Maximum frame rate determined by exposure time and readout time. Faster frame rates may be achieved using Partial Readout mode at the expense of resolution
3	EXPOSURE CONTROL	High Speed Implicit Shutter: 1/60 sec to 1/25,000 sec in 10 steps
		Multiple Lines Explicit Shutter: Exposure time adjustable by number of line intervals (33.3 $\mu$ s) from line 1 to 65,000 lines
		Multiple Frames: Exposure time adjustable by number of frame intervals (33.3 ms) from 1 frame to 65,000 frames
		<b>Note: Multiple Lines exposure of 1004 = Multiple Frame exposure of 1</b>
		External Shutter: Exposure time determined by Pulse Width of an externally applied trigger pulse (Async Snap Shot mode only)
4	GAIN & OFFSET CONTROL	Gain Control: 0-30 dB. Setting values from 0 to 320 via serial command
		Offset Control: Video Black level adjustment: 0 to 1023 via serial command
5	SNAP SHOT MODES	Snap Shot imaging may be accomplished either by applying an external trigger pulse to camera or by giving the camera a serial command.
		ASYNC SNAP SHOT. Maximum Frame Rate is determined by exposure time and readout time. A new trigger may not be applied until readout of previous image is complete. Readout time = [(number of lines read out) + (number of lines dumped) / 4] x 33.2 $\mu$ s
		• Async Snap Shot (Internal Exposure Modes): Exposure is initiated by falling (leading) edge of an external trigger pulse or by serial command. Exposure time is determined by camera exposure mode (MultipleLines / MultipleFrames)
		Async Snap Shot (External Exposure Mode): Exposure is initiated by the falling (leading) edge on an external trigger pulse or by giving a Start exposure command. Exposure is ended by the rising (trailing) edge of the external trigger pulse or by giving an End exposure command.
		SYNCHRONOUS SNAP SHOT Maximum Frame Rate is determined by readout time. Trigger may be applied during the readout of previous capture frame, but previous readout must complete before end of the triggered exposure time. Readout time = 33.3 ms (Partial readout is not available in this mode). Maximum frame rate can approach 30 fps.
		• Synchronous Snap Shot (Internal Multiple Lines Mode Only): Exposure begins with the first Horizontal Drive pulse following the leading edge of an external trigger pulse or following receipt of a serial command. Exposure time is determined by camera exposure (Multiple Lines) setting. Readout begins with the next horizontal drive pulse following CCD transfer. (Minimum of 50 Line Exposure setting).
<i>Continued</i>		

<b>Table 11. Operating Modes (continued)</b>		
<b>ITEM</b>	<b>MODE</b>	<b>DESCRIPTION</b>
6	PARTIAL READOUT	(Not available in synchronous snapshot mode)
		Available in the Vertical Frame. Starting line and ending line are selectable in increments of 4 <ul style="list-style-type: none"> <li>• Full Readout: Starting at line 0, ending line 1033</li> <li>• Normal Readout Top: starting line 0, ending line (any increment of 4)</li> <li>• Normal Readout Center: starting line (any increment of 4), ending line any increment of 4 greater than the starting line.</li> <li>• Normal Readout Bottom: starting line (any increment of 4), ending line 1033</li> </ul>
7	RESET CONTROL	• Manual Reset: External reset button inside behind rear panel - accessible with paper clip through hole
		• Power-up Reset: Camera always powers up to its most recent operating mode
8	SERIAL CONTROL	Access through camera link serial interface
		• LVDS asynchronous serial communications between camera and frame grabber
		• Controls all configuration and operation functions (including factory adjustments)
		• 9600 baud rate
		• 1 start bit, 1 stop bit, no parity, no handshaking
• See camera protocol included in table 12 of this manual		
9	OUTPUTS	Access through camera link MDR connector
		• Video data: 10 bit
		• Sync outputs: Horizontal (line valid) drive, vertical (frame valid) drive
		• Clock output: Pixel clock (40 MHz, 25 ns)
10	CAMERA POWER	Access through power input: dedicated 3-pin connector
		12 ±1.2 V dc, 500 mA, input to rear panel
11	LENS	Standard CS mount lens (or C-mount with 5 mm adapter ring)
12	DEFAULT SETTINGS	Default settings are those in which the camera is shipped. There is also a default mode command which when executed will set the camera mode to the default mode listed.
		• Camera default mode is continuous, full resolution, implicit multiple line shutter (512). Gain and offset registers set to the value of the gain and offset default registers.
<i>End</i>		

**SENSOR AREA TIMING  
(Continuous Mode - Full Frame Readout)**



Each Pixel = 25 ns (40 MHz)

Each Line = 33.1 μs

Each Frame = 33.3 ms

Unit-less numbers = Number of clock cycles (pixels) (horizontal)

= Number of Lines (Vertical)

VD (Vertical Drive) timing is shown along left edge reference line position

HD (Horizontal Drive) timing is shown along top edge reference pixel position

**Figure 11. Sensor Area Timing**



**Table 12. Protocol**

Ver. 9/10/02

**1.1 General**

This document defines the serial communication protocol used to control the camera.

The communication is full duplex, asynchronous, 8 data bits, 1 start bit, 1 stop bit and no parity. Baud rate is fixed at 9600. The Camera Link interface implements the transmit and receive physical connections.

Command messages may be generated by the host computer to modify the operation of the camera. The camera acts upon the command but does not send a response. The host computer may also generate status request messages. The camera will determine present conditions and return the appropriate values in a response message

**1.2 Message Format**

Command and status request messages are sent using the format:  
The body of a message is built using the 7 bit ASCII character set.

Numeric values are passed as ASCII characters. A three digit decimal value will require three characters. If multiple data values are passed, they will be separated by a delimiter ',' with no white spaces. One or more leading '0' characters are permitted.

Only the camera address and checksum value may have the MSB set (high).

**TABLE 1: RS- 232 COMMAND AND STATUS MESSAGE FORMAT (host to camera)**

BYTE	DATA	DESCRIPTION
0	STX	Start of Text (0x02)
1	ID	Camera address (0x01 to 0xFF) (Note: 0xFF is universal)
2	'c'	Message type (camera)
3	Command Type	Command Type (In ASCII, see following sections)
4 to 4+n	Command Data	Command Data (In ASCII, see following sections)
5+n	CS	Checksum (0x80 to 0x8F)
6+n	ETX	End of message (0x03)

**1.3 Checksum Calculation**

By default, the camera will ignore the incoming checksum character, BUT it does require a dummy checksum character (Any value 80-8F hex).

In a response to a status request, the camera will generate a full valid checksum character according to the following:

The checksum calculation is best described by code fragments with an example:

```
unsigned char RXbuffer [RX_MAX]; // buffer holds all received characters, positions 0 to n+6
unsigned char RXindex; // pointer to position of a character within message
```

**Table 12. Protocol (continued)**

It is assumed that the serial receive buffer was cleared before message is sent. The receive interrupt routine stores characters in the buffer and increments the pointer. When an end of message is detected, the following data is returned:

Message	STX	ID	'c'	'C'	'0'	CS	ETX	
RXbuffer[]	0x02	0x01	0x63	0x43	0x30	0x81	0x03	0x00
RXindex	0	1	2	3	4	5	6	7 (final value)

The checksum calculations then proceeds:

```

unsigned char RXloop;           // scan position for checksum calculation
unsigned char RXchecksum;       // build the checksum value for received message

RXchecksum = RXbuffer [1];      // initialize checksum with value at position 1 (camera address)
RXloop = 2;                     // begin buffer scan at position 2 (always 'c')
while ((RXbuffer [RXloop] & 0x80) == 0) // scan message from positions 2 thru 5+n (received checksum)
    RXchecksum ^= RXbuffer [RXloop++]; // checksum xor calculation in progress
RXchecksum &= 0x0F;             // throw away upper four bits
RXchecksum |= 0x80;            // set most significant bit
if (RXchecksum != RXbuffer [RXloop]) { // compare calculated checksum to received checksum

```

#### 1.4 Control Commands (upper case)

The various camera control commands are listed below.

“FIELD” indicates an absolute data position.

“VALUE” indicates a relative data position and may use leading 0's; multiple data positions are separated from each other by a delimiter “,”.

**Note: When received, commands are stored in buffer in camera. To execute the commands requires an execution command "T0" (See 'T' Trigger)**

<u>Command Type</u>	<u>Command Data</u>
'B' user analog	Set user analog offset (black level) and gain (white level) Value 0 = '0', offset command Value 0 = '1', gain command ';' delimiter Value 1 = offset (0 to 1023) or gain (0 to 320) value

EXAMPLE 1: 'B0,512' sets user offset to 512

EXAMPLE 2: 'B1,160' sets user gain to 160

'C' Capture Mode:	Sets capture mode Value 0 = '0', continuous Value 0 = '1', snap-shot (asynchronous) Value 0 = '2', snap-shot (synchronous)
-------------------	-------------------------------------------------------------------------------------------------------------------------------------

EXAMPLE 1: 'C1' sets camera to asynchronous snap-shot mode

'D' Default:	Sets the Camera to the default mode: camera ID = 1: camera address = 1 capture mode = 0: continuous implicit shutter = 10: 512 lines of exposure frame = 0,0: all lines active offset = default: value from offset default register gain = default: value from gain default register
--------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Table 12. Protocol (continued)**

EXAMPLE 1: 'D' sets all camera parameters to factory default values

**'E' Exposure Time** Set exposure controls  
 Value 0 = '0', external control (hardware or software)  
 Value 0 = '1', multiple frames (explicit values 1 to 65000)  
 Value 0 = '2', multiple lines (implicit values 0 to 10)  
 Value 0 = '3', multiple lines (explicit values 0 to 65000)  
 ';' delimiter  
 Value 1 = number of frames or lines of exposure

NOTE 1: external control valid for asynchronous snap-shot mode only;  
 multiple frames not valid for synchronous snap-shot mode

NOTE 2: frame time is defined by the number of active lines (M) and  
 inactive lines (N) lines:  $T = 0.033 * [M + (N/4)]$

EXAMPLE 1: 'E0' sets camera to external exposure control

EXAMPLE 2: 'E1,5' sets exposure time at 5 frames

EXAMPLE 3: 'E2,10' sets exposure time at 512 lines (implicit)

EXAMPLE 4: 'E3.512' sets exposure time at 512 lines (explicit)

**TABLE 2: IMPLICIT EXPOSURE TIMES**

Implicit	H-lines	msec	seconds
0	0	0.039	1/25640
1	1	0.072	1/13888
2	2	0.105	1/9523
3	4	0.170	1/5882
4	8	0.300	1/3333
5	16	0.565	1/1770
6	32	1.100	1/909
7	64	2.150	1/465
8	128	4.250	1/235
9	256	8.400	1/119
10	512	16.800	1/60

**'F' Frame** Set partial readout start and stop positions  
 Value 0 = '0', start normal readout  
 Value 0 = '1', stop normal readout  
 ';' delimiter  
 Value 1 = start or stop normal at line 0 to 1003

NOTE 1: value 1 must be in multiples of 4 lines

NOTE 2: value 1 must be greater than value 0

NOTE 3: values > 1003 are interpreted as 0

NOTE 4: partial readout not valid for synchronous snap-shot mode

EXAMPLE 1: 'F0,256' sets start of normal readout at line 256  
 'F1,768' sets end of normal readout at line 768  
 this combination reads data from center of image

EXAMPLE 2: 'F0,256' sets start of normal readout at line 256  
 'F1,1004' sets end of normal readout at line 1004  
 this combination reads data from bottom of image

EXAMPLE 3: 'F0,0' sets start of normal readout at line 0  
 'F1,1004' sets end of normal readout at line 1004  
 this combination reads entire image

**Table 12. Protocol (continued)**

**'T' Trigger** trigger beginning or end of snap-shot exposure  
 Field 0 = '0': configuration complete, execute changes  
 Field 0 = '1': software trigger  
 ';' delimiter  
 Field 1 = '0': end of snap-shot exposure time  
 Field 1 = '1': start of snap-shot exposure time

NOTE 1: T1,0 and T1,1 not valid for continuous mode  
 NOTE 2: T1,0 valid only when external exposure enabled

EXAMPLE 1: 'T0' changes to user parameters become active  
 EXAMPLE 2: 'T1,1' begins exposure time  
 captures a snap-shot with pre-defined exposure time  
 EXAMPLE 3: 'T1,1' begins exposure time  
 'T1,0' ends exposure time  
 captures an image with external exposure time

**1.5 Status Requests (lower case)**

The camera will respond with status data as Values.

<u>Command Type</u>	<u>Status Data</u>
'b' analog status	user offset and gain values <span style="float: right;">see table</span>

<u>Data</u>	<u>Description</u>
STX	Start of text
ID	Camera address
'c'	Camera command
'b'	user Offset and Gain
Value 0	calibration Offset (refer to "B" command for values)
';	delimiter
Value 1	calibration Gain (refer to "B" command for values)
CS	Checksum
ETX	End of message

**'c' capture status** present capture mode and exposure settings

<u>Data</u>	<u>Description</u>
STX	Start of text
ID	Camera address
'c'	Camera command
'c'	capture status request
Value 0	capture mode status (refer to "C" command for values)
';	delimiter
Value 1	exposure mode status (refer to "E" command for values)
';	delimiter
Value 2	exposure mode status (refer to "E" command for values)
CS	Checksum
ETX	End of message

**Table 12. Protocol (continued)**

'f' frame status            present frame positions

Data	Description
STX	Start of text
ID	Camera address
'c'	Camera command
'f'	frame status request
Value 0	begin normal readout position
':'	delimiter
Value 1	end normal readout position
CS	Checksum
ETX	End of message

'r' read Date/Revision    Latest Date & revision of firmware

Data	Description
STX	Start of text
ID	Camera address
'c'	Camera command
'r'	Firmware date/revision #
month	month of year
'/'	slash
day	day of the month
'/'	slash
year	year – 00
'v'	version
revision	major revision number
','	period
revision	minor revision number
CS	Checksum
ETX	End of message

**SPECIAL USE FOR SYSTEM INSTALLATIONS**

'N' Camera ID            Set camera ID address  
 Value 0= camera ID 1-255  
**Note: 255 reserved for all cameras**

**Notes:**

- 1) The camera will be shipped with a set of default parameters. However, all parameters are stored in non-volatile memory and once changed will always power up to the last state.

**WARRANTY**

Please refer to the COHU website for product warranty information:  
**[www.cohu-cameras.com](http://www.cohu-cameras.com)**

Revision History		
Revision	Date	Comments
Rev C	04/28/2011	<ul style="list-style-type: none"><li>• this manual has been revised to comply with the latest engineering requirements. See ECO 030972 for the list of changes.</li></ul>