

Table 8. Camera Control Protocol (Continued)

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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 “,”.

Command Type
‘B’ User Analog

Command Data

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 46), or gain (0 to 8)

NOTE 1: The user offset value ‘x’, entered by ‘B0,x’, is added to an offset constant ‘n’, and the sum is sent to the IBIS5 sensor. The constant value ‘n’ is currently hard-coded to 60. (i.e. ‘B0,22’ results in 22 + 60 = 88 being sent to the sensor.)

NOTE 2: For backward compatibility with previous 7800 cameras (pre-IBIS5), the ‘B1’ (gain) command is scaled by 2 to allow the original (pre-IBIS5) range (0 to 8) to cover the new IBIS5 sensor range (0 to 16). This results in a reduction in the resolution of gain steps by 1/2. (i.e. B1,4 sets the user gain to 4 x 2 = 8, which is a DC Gain of 5.20). The ‘G1’ command is recommended to allow for maximum resolution gain steps.

EXAMPLE 1: ‘B0,22’ sets user offset to 22

EXAMPLE 2: ‘B1,4’ sets the actual user gain to 8

Table 8. Camera Control Protocol (Continued)

Table i. – Gain Values

<u>User Gain</u>	<u>DC Gain</u>
0	unity
1	1.37
2	1.62
3	1.96
4	2.33
5	2.76
6	3.50
7	4.25
8	5.20
9	6.25
10	7.89

'C' Capture Mode Sets capture mode
 Value 0 = '0', continuous
 Value 0 = '1', snap-shot

'D' Default Sets the camera to default factory settings:
 camera ID = 1: camera address = 1
 capture mode = 0: continuous
 implicit shutter = 15: 26.2ms exposure
 frame = all: full window
 offset = 2:
 gain = 0:
 trigger = internal:
 mode = 3: continuous

EXAMPLE 1: 'D' sets all camera parameters to factory defaults

'E' Exposure Time Set exposure controls
 Value 0 = '0', not defined
 Value 0 = '1', External Exposure
 Value 0 = '2', Implicit Exposure
 Value 0 = '3', not defined
 ',' delimiter
 Value 1 = Implicit Exposure Index (see Table ii)

NOTE 1: External Exposure is valid only in snap-shot with external trigger

EXAMPLE 1: 'C1' sets capture mode to snap-shot
 'T0' sets trigger to external
 'E1' sets exposure time to pulse width of external trigger
 EXAMPLE 2: 'E2,10' sets exposure time at 1 msec

Table 8. Camera Control Protocol (Continued)**Table ii. – Implicit Exposure Values**

<u>Index</u>	<u>msec</u>	<u>seconds</u>
0	0.100	1/10,000
1	0.100	1/10,000
2	0.100	1/10,000
3	0.100	1/10,000
4	0.100	1/10,000
5	0.100	1/10,000
6	0.100	1/10,000
7	0.100	1/10,000
8	0.200	1/5,000
9	0.500	1/2,000
10	1.000	1/1,000
11	2.000	1/500
12	4.000	1/250
13	8.000	1/125
14	16.67	1/60
15	26.2	1/38

NOTE 2: The index range is backward compatible with previous 7800 cameras, but the new maximum exposure is 26.2ms (as opposed to 33.3ms), and all index values 7 and below give 0.100ms exposure.

'F' Frame

Set partial readout by pixel and line start and stop positions

Value 0 = '0', start pixel position

Value 0 = '1', stop pixel position

Value 0 = '2', start line position

Value 0 = '3', stop line position

Value 0 = '4', make controls active

',' delimiter

Value 1 = disable sub-window (Value 0 = 4 only)

Value 1 = load parameters and enable sub-window (Value 0 = 4 only)

Value 1 = start or stop pixel position (0 to 1279)

Value 1 = start or stop line position (0 to 1023)

NOTE 1: value(1) must be greater than value(0)

NOTE 2: value(3) must be greater than value(2)

NOTE 3: values > max are interpreted as max

EXAMPLE 1: 'F0,256' sets start position at pixel 256

'F1,768' sets stop position at pixel 768

'F2,256' sets start position at line 256

'F3,768' sets stop position at line 768

'F4,1' makes present window (256,256) to (768,768)

this combination reads data from near center of image

EXAMPLE 2: 'F4,0' sets current window to maximum (1280 x 1024)

Table 8. Camera Control Protocol (Continued)

'G' User Analog	<p>Set user analog offset (black level) and gain (white level) Value 0 = '0', offset command Value 0 = '1', gain command Value 0 = '2', balance command ',' delimiter Value 1 = offset (0 to 46), gain (0 to 16), or balance (0 to 127)</p> <p>NOTE 1: See NOTE 1 for 'B' command. NOTE 2: The 'G1' (gain) command provides maximum resolution gain steps for the IBIS5 sensor. Table i lists the DC gain vs. user gain value (i.e. 'G1,4' = 2.3 DC gain).</p> <p>EXAMPLE 1: 'G0,22' sets user offset to 22 EXAMPLE 2: 'G1,4' sets user gain to 4 EXAMPLE 3: 'G2,45' sets user balance to 45</p>
'M' Mode	<p>Sets camera operating mode explicitly Field 0 = '0': Snap-Shot – External Exposure Field 0 = '1': Snap-Shot – Software Trigger Field 0 = '2': Snap-Shot – External Trigger Field 0 = '3': Continuous Mode</p> <p>NOTE 1: This is a consolidated command that incorporates features of the 'C', 'E', and 'T' commands.</p> <p>EXAMPLE 1: 'M3' sets camera mode to Continuous Mode EXAMPLE 2: 'M1' sets camera mode to Snap-Shot – Software Trigger 'E2,14' sets the implicit exposure time to 1/60 second 'T1,1' sends Software Trigger (initiates Frame cycle)</p>
'T' Trigger	<p>trigger beginning or end of snap-shot exposure Field 0 = '0': external trigger Field 0 = '1': software trigger ',' delimiter Field 1 = '0': set mux to soft and clear soft trigger Field 1 = '1': set mux to soft and set soft trigger</p> <p>NOTE 1: commands affect signal, but inactive for continuous mode NOTE 2: 'T1,0' is left for legacy compatibility. The trigger is self-clearing</p> <p>EXAMPLE 1: 'T0,1' sets mux to external source, does not affect soft trigger EXAMPLE 2: 'T1,1' sets soft mux position and sets soft trigger EXAMPLE 3: 'T1,0' sets soft mux position and clears soft trigger</p>

Table 8. Camera Control Protocol (Continued)

'W' Window	<p>Set partial readout by sub-window location and size</p> <p>Value 0 = '0', horizontal start position (x)</p> <p>Value 0 = '1', vertical start position (y)</p> <p>Value 0 = '2', width (w)</p> <p>Value 0 = '3', height (h)</p> <p>Value 0 = '4', make controls active</p> <p>' ,' delimiter</p> <p>Value 1 = disable sub-window (Value 0 = 4 only)</p> <p>Value 1 = load parameters and enable sub-window (Value 0 = 4 only)</p> <p>Value 1 = start or stop pixel position (0 to 1279)</p> <p>Value 1 = start or stop line position (0 to 1023)</p> <p>NOTE 1: (w) must be < 1279 - (x)</p> <p>NOTE 2: (h) must be < 1023 - (y)</p> <p>NOTE 3: values > max are interpreted as max</p> <p>EXAMPLE 1: 'W0,256' sets horizontal start position at pixel 256 'W1,256' sets vertical start position at pixel 256 'W2,512' sets width to 512 'W3,512' sets height to 512 'W4,1' makes present window 512 x 512 beginning at pixel (256, 256) this combination reads data from near center of image</p> <p>EXAMPLE 2: 'W4,0' sets current window to maximum (1280 x 1024)</p>
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Table 8. Camera Control Protocol (Continued)

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 see table i.

<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

NOTE 1: The value returned for Value 1 = whole part of [(actual gain value) / 2]
 (i.e. if the actual gain had been set by the 'G1' command to 5, Value 1 returned by 'b' will be 5 / 2 = 4) See 'B' and 'G' commands.

'c' capture status	present capture mode and exposure settings
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<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	trigger mux status (refer to "T" command for values—snap-shot only)
','	delimiter
Value 2	trigger mode status (refer to "T" command for values—snap-shot only)
','	delimiter
Value 3	sub-window mode status (refer to "F" command for values)
CS	Checksum
ETX	End of message

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

Table 8. Camera Control Protocol (Continued)

'f' frame status	present frame positions	
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<u>Data</u>	<u>Description</u>	
STX	Start of text	
ID	Camera address	
'c'	Camera command	
'f'	frame status request	
Value 0	begin pixel position	
' '	delimiter	
Value 1	end pixel position	
' '	delimiter	
Value 2	begin line position	
' '	delimiter	
Value 3	end line position	
CS	Checksum	
ETX	End of message	
'g' analog status	user offset, gain, and balance values	see table i.
<hr/>		
<u>Data</u>	<u>Description</u>	
STX	Start of text	
ID	Camera address	
'c'	Camera command	
'g'	user Offset and Gain	
Value 0	calibration Offset (refer to 'G' command for values)	
' '	delimiter	
Value 1	calibration Gain (refer to 'G' command for values)	
' '	delimiter	
Value 2	calibration balance	
CS	Checksum	
ETX	End of message	
'm' mode status	camera mode	
<hr/>		
<u>Data</u>	<u>Description</u>	
STX	Start of text	
ID	Camera address	
'c'	Camera command	
'm'	frame status request	
Value 0	camera mode (refer to "M" command for values)	
CS	Checksum	
ETX	End of message	

Table 8. Camera Control Protocol (Continued)

'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 (1 or 2 digits)
'.'	period
revision	minor revision number (1 or 2 digits)
CS	Checksum
ETX	End of message

's' read Serial Number Camera Serial Number

Data	Description
STX	Start of text
ID	Camera address
'c'	Camera command
's'	Firmware date/revision #
0xx	xx = most significant digits of S/N
','	delimiter
0yy	yy = middle digits of S/N
','	delimiter
0zz	zz = least significant digits of S/N
CS	Checksum
ETX	End of message

Example Text Response (for camera w/ S/N = 123456):
cs012,034,056

'w' window status present window position and size

Data	Description
STX	Start of text
ID	Camera address
'c'	Camera command
'w'	frame status request
Value 0	horizontal start position (x)
','	delimiter
Value 1	vertical start position (y)
','	delimiter
Value 2	width (w)
','	delimiter
Value 3	height (h)
CS	Checksum
ETX	End of message

Table 8. Camera Control Protocol (Continued)**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.

End of Protocol**WARRANTY**

Cohu, Inc., Electronics Division warrants equipment manufactured to be free from defects of material and workmanship. Any such defective part or parts will be repaired or replaced when confirmed by Cohu examination to have become defective within two years from the date of shipment to the original purchaser for standard CCD, CMOS and uncooled thermal cameras and one year date of shipment to the original purchaser for image intensified cameras, and all other Cohu manufactured products.

Pressurized Housings: Pressurized camera products include a lifetime pressurization warranty. Cohu will re-pressurize, at no charge, returned environmental cameras not exhibiting evidence of physical damage due to misuse. All warranty repairs will be performed at the Cohu factory or as otherwise authorized by Cohu in writing. Purchaser shall prepay transportation charges to Cohu.

Extended IR cameras: Cameras utilizing extended infrared (extended IR) sensors found to exceed acceptable white blemish specifications within one month of delivery shall be repaired or replaced without charge.

This Warranty does not extend to Cohu equipment subjected to misuse, accident, neglect, improper application, or repaired or altered other than by Cohu, or unless authorized by Cohu in writing. Cameras utilizing extended IR sensors are not warranted for use in areas of elevated levels of cosmic radiation.

Television image pickup tubes, image intensifiers, lenses, and products manufactured by companies other than Cohu are warranted by their original manufacturers. This Warranty is in lieu of all other warranties, expressed, implied, or statutory, including warranties of fitness for a particular purpose and merchantability, and this warranty sets forth the purchaser's sole remedy in connection with such warranties. Whether as a result of breach of contract or warranty, tort, (including negligence) or otherwise, Cohu shall not be liable for any penalties regardless of reason, including but not limited to collateral, consequential, incidental, or exemplary damages, including without limitation, any loss or profit or revenues, loss of use of any equipment or goods, or removal or re-installation of equipment without prior approval.

A Return Authorization (RA) number must be obtained from Cohu prior to returning any item for warranty repair or replacement.

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