



# Bobcat Cameras

**Camera Link  
GigE, GeV**

**Intelligent, Flexible, Programmable, Field  
Upgradeable...**



## Bobcat Camera Family

Model	Max. Image Resolution	Frame Rate	CCD Vendor	Optical Format	Body Size (X Y Z) mm	Power	PoCL	Availability
ICL-B0610	648 x 488	110/137	Kodak	1/3", 4:3	45 x 45 x 39	1.65 W	Yes	Q1, 2009
ICL-B0620	648 x 488	209/260	Kodak	1/3", 4:3	45 x 45 x 39	2.40 W	Yes	Q2, 2009
ICL-B1410	1392 x 1040	23/30	Sony	2/3", 4:3	45 x 45 x 39	2.05 W	Yes	Q1, 2009
ICL-B1610	1624 x 1224	16/19	Sony	1/1.8", 4:3	45 x 45 x 39	1.95 W	Yes	Q1, 2009
ICL-B2520	2458 x 2048	11/16	Sony	2/3", 4:3	45 x 45 x 39	2.40 W	Yes	Q2, 2009
ICL-B1620	1608 x 1208	33/38	Kodak	1", 4:3	45 x 45 x 45	TBD	Yes	Q2, 2009
ICL-B1920	1928 x 1084	32/38	Kodak	1", 16:9	45 x 45 x 45	TBD	Yes	Q2, 2009
ICL-B2020	2056 x 2062	15/TBD	Kodak	1.3", 1:1	TBD	TBD	TBD	Q3, 2009
ICL-B4020	4032 x 2688	5.0/TBD	Kodak	43.3 mm, 3:2	60 x 60 x 38	3.60 W	No	Q3, 2009
ICL-B4920	4904 x 3280	3.0/4.2	Kodak	43.3 mm, 3:2	60 x 60 x 38	3.60 W	No	Q3, 2009



## Bobcat Platform

Intelligent ... Flexible ... Programmable ... Upgradeable ...

- **Open Platform**

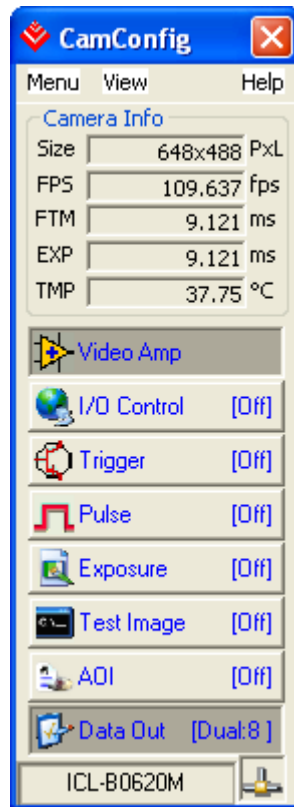
- 2/4 Million gate FPGA
- Dual clock, 14-bit internal data processing
- CameraLink output with PoCL support
- Small camera size – 45 x 45 x 39 mm
- Image processing engine

- **Highly Programmable**

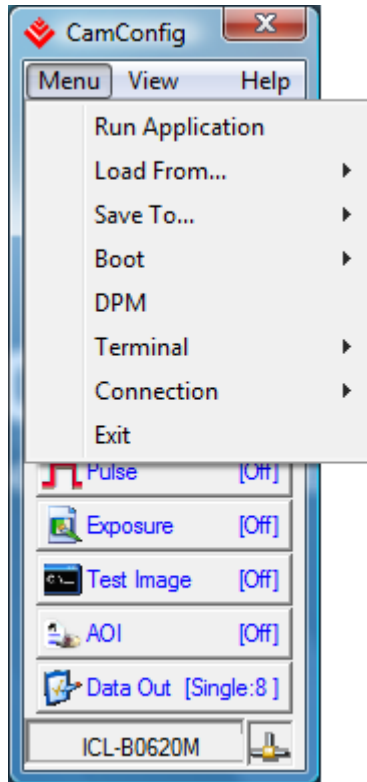
Mono and color - 8/10/12/14-bit data, (RGB) mode , Auto white balance, Normal and over-clock operation, Analog and digital gain and offset control, 1x, 2x, 3x, 4x, 8x horizontal and vertical binning, Eight (8) independent horizontal and vertical AOIs, Horizontal and vertical resolution, Line time, Frame time, Speed, Elaborate triggering (3 triggering sources, 5 triggering modes), Automatic gain, exposure and iris control, Internal/External exposure control, Internal/External H and V sync input/output, Left/right digital bit shift, Test image with image superimposition  
Built in pulse generator, Programmable I/O mapping (17 signals, 4 inputs, 3 outputs), Dynamic black level correction, Auto tap balance, FFT, LUT, DPC, HPC, Temperature monitor...

- **Field upgradeable: FW, LUT, FFC, DPM, HPM**
- **Image processing engine - soon**

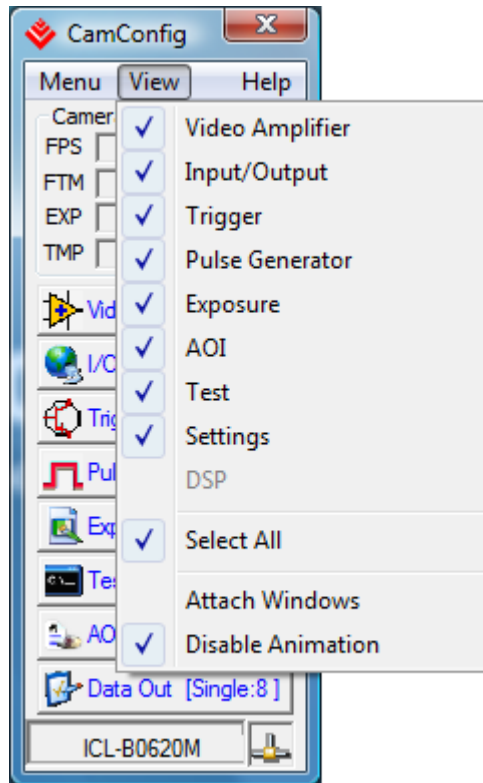




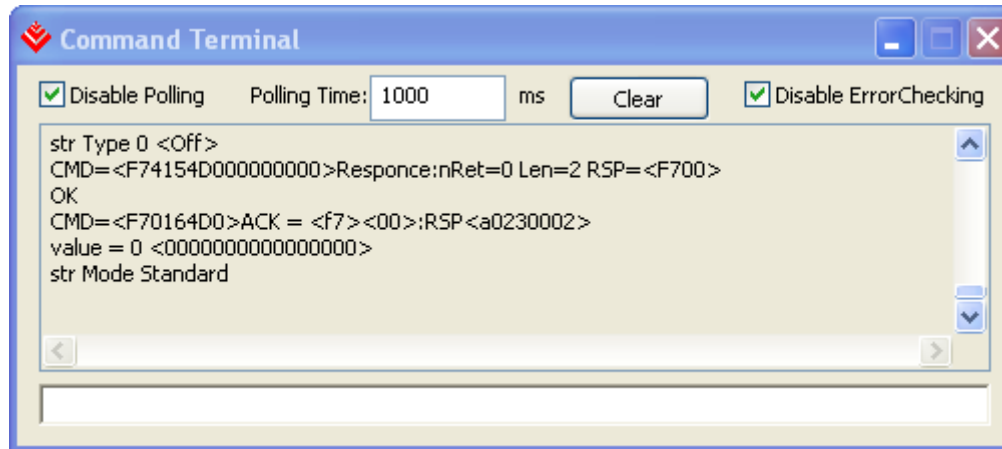
- **Simple, Small, Intuitive**
- **Easy to use**
- **Full Camera Control**
- **9 Configuration Panels**
- **Current Camera Info**
  - Image size
  - Camera speed [fps]
  - Frame Time [us, ms, s]
  - Exposure Time [us, ms, s]
  - CCD Temperature
- **Menu**
- **Help**
- **Command Terminal**
- **Download Terminal**
- **Connection Status**
  - Camera connected
  - Error Status



- **Run Application**
  - Opens Windows Explorer
- **Load From... / Save To...**
  - File
  - Factory Space (Password to “Save to factory”)
  - User Space #1
  - User Space #2
- **Boot**
  - Factory Space - Default
  - User Space #1
  - User Space #2
- **DPM**
  - Displays Defective Pixels Location
- **Terminal**
  - Command and Download
- **Connection**
  - Select Port or BAUD rate
- **Exit**
  - Closes the Application

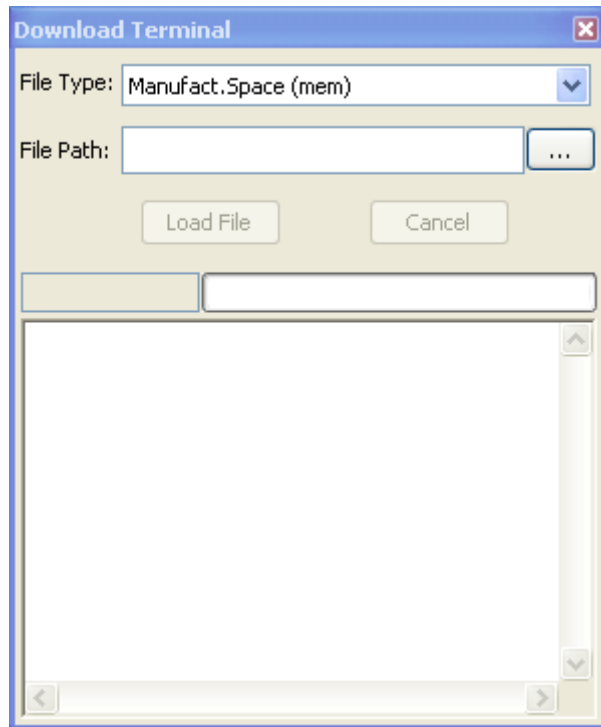


- **Selects the Windows**
  - Select the windows you need
- **Attach window**
  - Attach or detach the window
- **Disable Animation**
  - Enable or disable animation

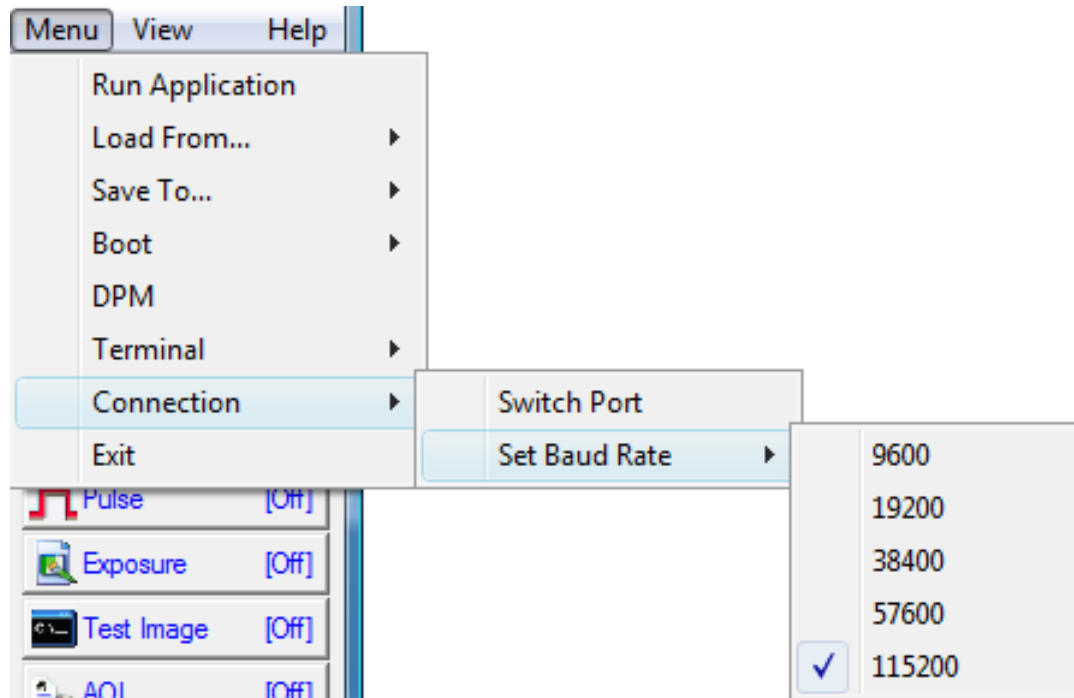


- **RS232 data transfer**
  - Register based camera
  - Displays all serial traffic
  - Command line interface for camera configuration
- **Data polling**
  - Set polling time
  - Disable polling
- **Error checking**
  - ON/OFF

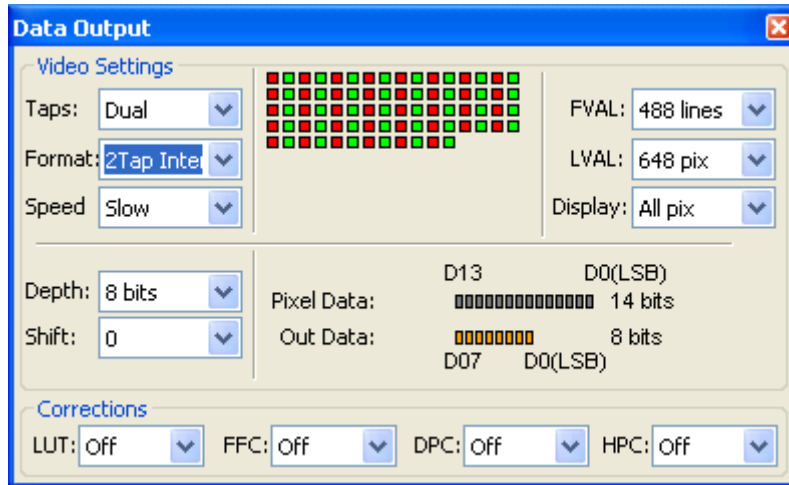
## Download Terminal



- **Uploads User Data**
  - LUT, DPM, HPM, FFC
- **Firmware upgrade**
  - Factory image
  - User image
- **Register space upgrade**
  - Factory
  - User #1, #2



- **Set Baud rate**
  - 115200 - default
- **Switch Port**
  - Selects the .dll



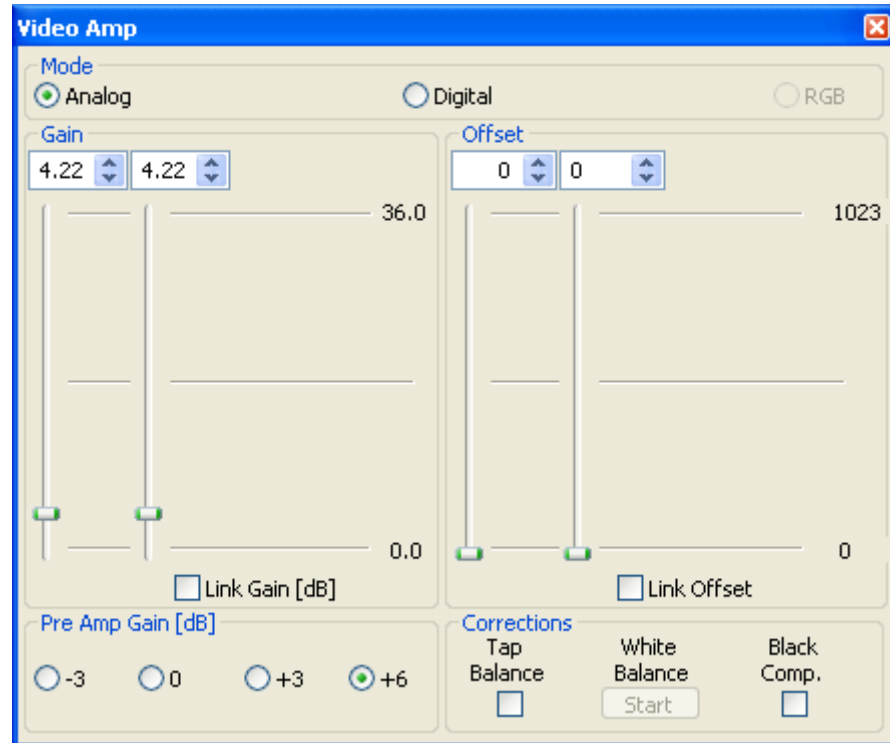
### Exercise

- Bobcat – Set FVAL, LVAL
- FG – set the image size
- Bobcat – Set Dept – 10 bit
- FG – set the bit depth
- Bobcat – Set Shift to
  - Left 2, Right 2, others
  - Open, close the Iris
- Bobcat – Select Speed
- Observe image speed
- Bobcat – set LUT to LUT 1
- Bobcat – Restore defaults

### • Video Settings

- Single or Dual
- Data Format
  - 1 tap Single
  - 1 tap RGB (soon)
  - 2 tap Interleaved
  - 2 tap Sequential
  - 1 tap Dual (soon)
  - Visual display
- Image Size
  - FVAL
  - LVAL
- Speed
  - Dual clock operation
  - Slow, Fast
- Bit Depth
  - 8, 10, 12, 14 (single only)
  - +/- 7 bits shift
  - Visual display
- Corrections
  - LUT 1, LUT 2
  - DPC, HPC
  - FFC

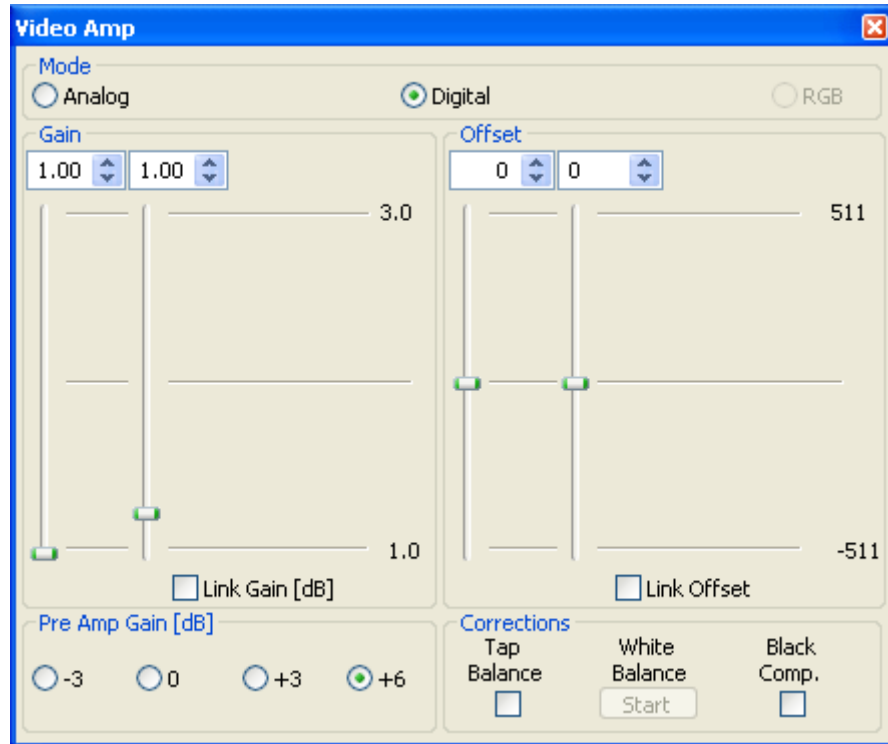
## Video Panel - Analog



- **Pre-Amp Gain**
  - 4 options (-3, 0, +3, +6) dB
- **Analog Gain**
  - Independent channel controls
  - 36 dB range, 1024 steps
  - Link gain – gain tracking mode
- **Analog Offset**
  - Independent channel controls
  - 1024 steps
  - Link offset – gain tracking mode
- **Corrections**
  - Auto tap balance
  - Black level compensation

### Exercise

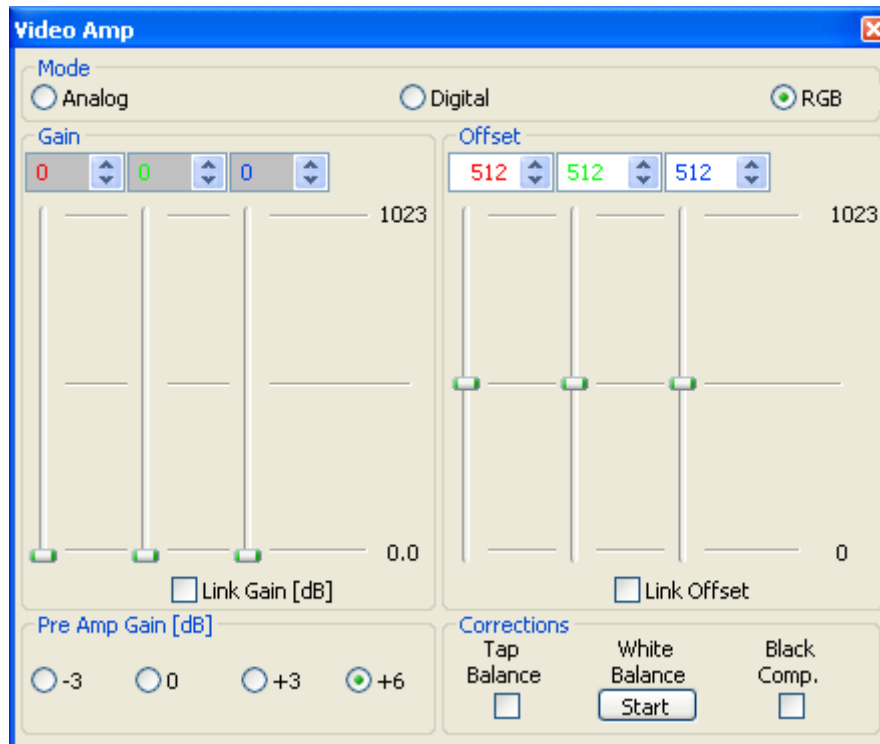
- Set analog gain to 6 db
- Set pre Amp gain to 0
- Set pre Amp gain to + 6
- Set offset to 800
- Set offset to 0



- **Digital Gain**
  - Independent channel controls
  - 1.0x to 3.0x range, 30 steps
  - Link gain – gain tracking mode
- **Digital Offset**
  - Independent channel controls
  - (-510 to + 511 ) range, 1024 steps
  - Link offset – gain tracking mode

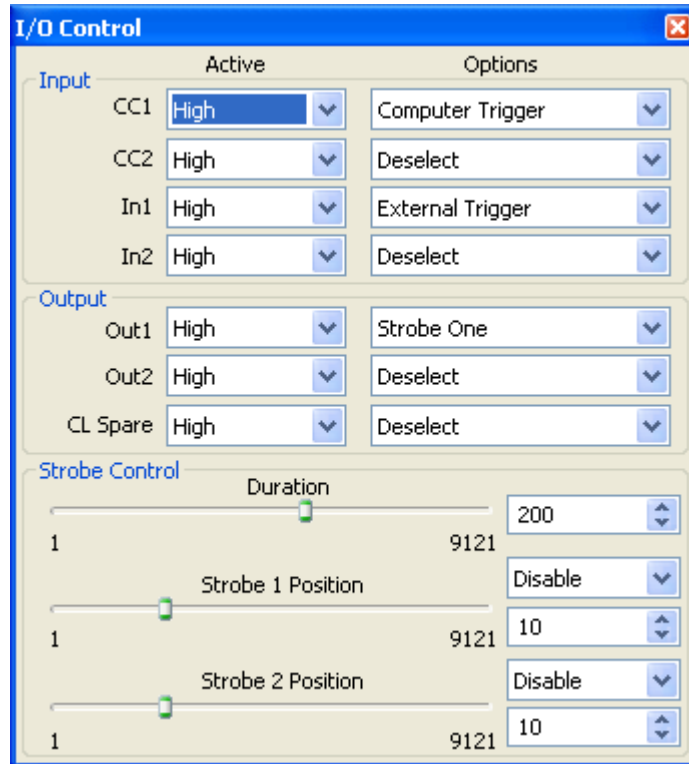
### Exercise

- Set digital gain to 1.40x
- Set digital gain to 1.00x
- Set digital offset to (- 200)
- Set digital offset to 0



### Coming Soon

- **R G B Gain**
  - Independent channel controls
  - 36 dB range, 1024 steps
  - Link gain – gain tracking mode
- **R G B Offset**
  - Independent channel controls
  - 1024 steps
  - Link offset – gain tracking mode
- **Corrections**
  - Auto white balance

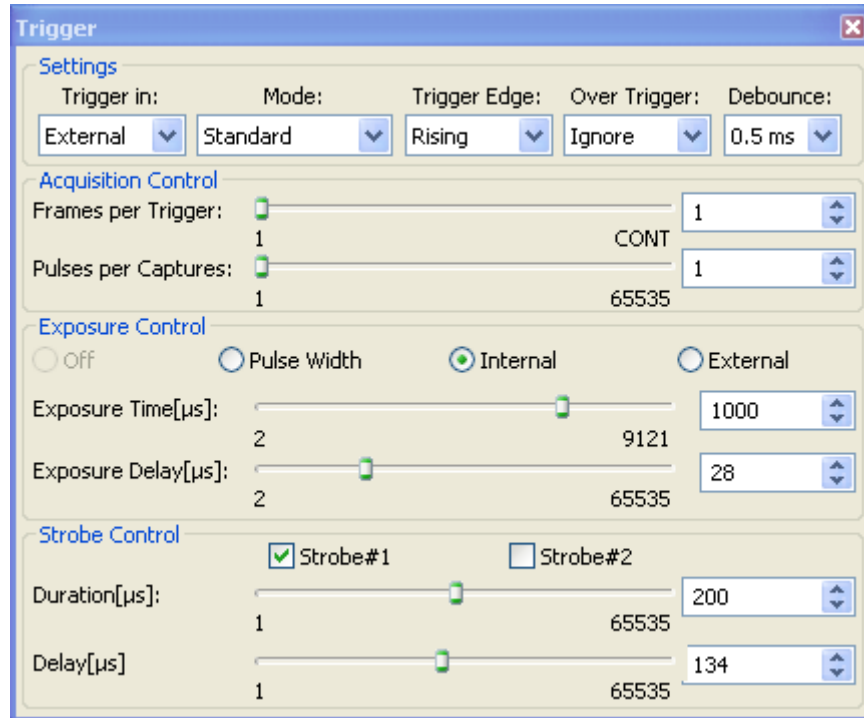


### Exercise

- Set CC1 to “Computer Trigger”
- Set In1 to “Deselect”
- Set Out1 to “Strobe Two”
  - Duration to 400 us
  - Position 1000 us
  - Odd frames

- **4 Selectable Inputs**
  - CC1, CC2, IN1, IN2
  - Active Low/High
    - Computer, External trigger
    - Exposure control
    - H – sync, V – sync
    - Deselect
- **3 Selectable Outputs**
  - Out1, Out2, CL Spare
  - Active Low/High
    - Strobe one, two
      - duration, position
    - Pulse generator
    - Camera ready
    - Exposure start, mid, end
    - Active exposure window
    - Trigger pulse, delayed
    - Odd/Even frame flag
    - H – sync, V – sync
    - Deselect
- **1 Fast SPI Output (optional)**
  - Sub-sampled Image
  - TBD

# Trigger Control - Settings



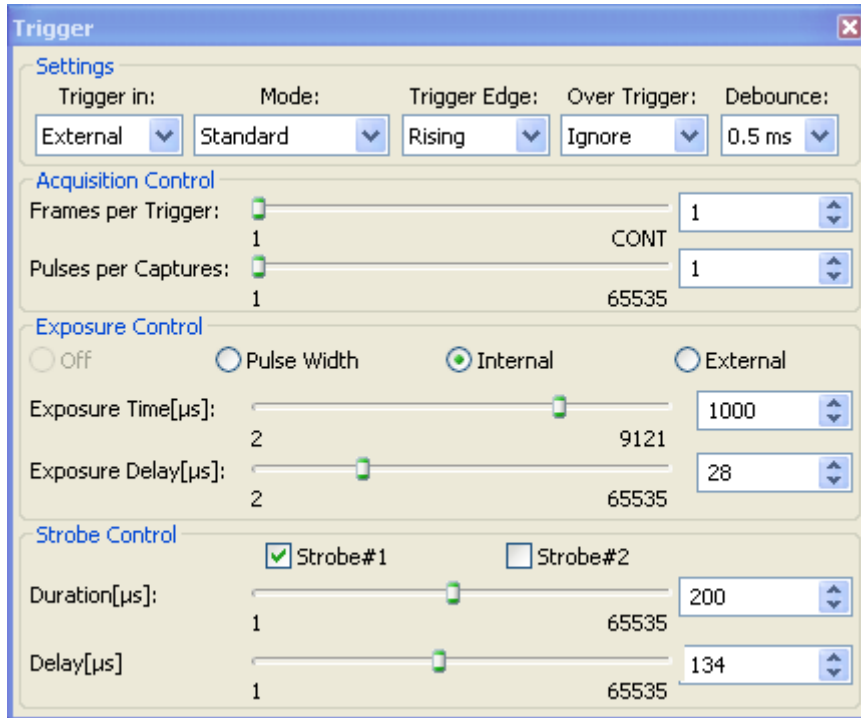
## Exercise

- Set Trigger in to “Computer Trigger”
- Standard, Rising, Ignore, 0.5 us
- Set Frames per Trigger to “1”

- **Trigger Input**
  - OFF – free running mode
  - External – hardware input
  - CC – computer input
  - Pulse Generator
- **Trigger Modes**
  - All triggering inputs
  - Standard – expose then read
  - Fast – expose while reading
  - Double – two consecutive events
  - Asynchronous
  - Multi-frame
- **Triggering Edge**
  - Rising
  - Falling
- **Over Triggering**
  - Ignore next trigger
  - Use next trigger
  - Latch next trigger
- **Trigger De-bounce**
  - Off
  - 0.5 ms, 1.0 ms, 5.0 ms



# Trigger Control - Acquisition



## Exercise

- Set Exposure Control to Internal
- Set Exposure Time to 4000 us
- Set Exposure Time to 280 us
- Set Strobe Control to Strobe #1
  - Duration to 200 us
  - Delay to 130 us

## • Acquisition Control

- Frames captured per trigger
  - 1 to 65500 discrete
  - continuous
- Pulses per capture
  - Multi-frame mode
  - 1 to 65535

## • Exposure Control

- Pulse width – trigger pulse duration
- Internal – exposure register
  - 10 us \* to 16 sec
  - 1 us increment
- External – external pulse control
- Exposure delay
  - 1 us to 65535 us
  - 1 us increment

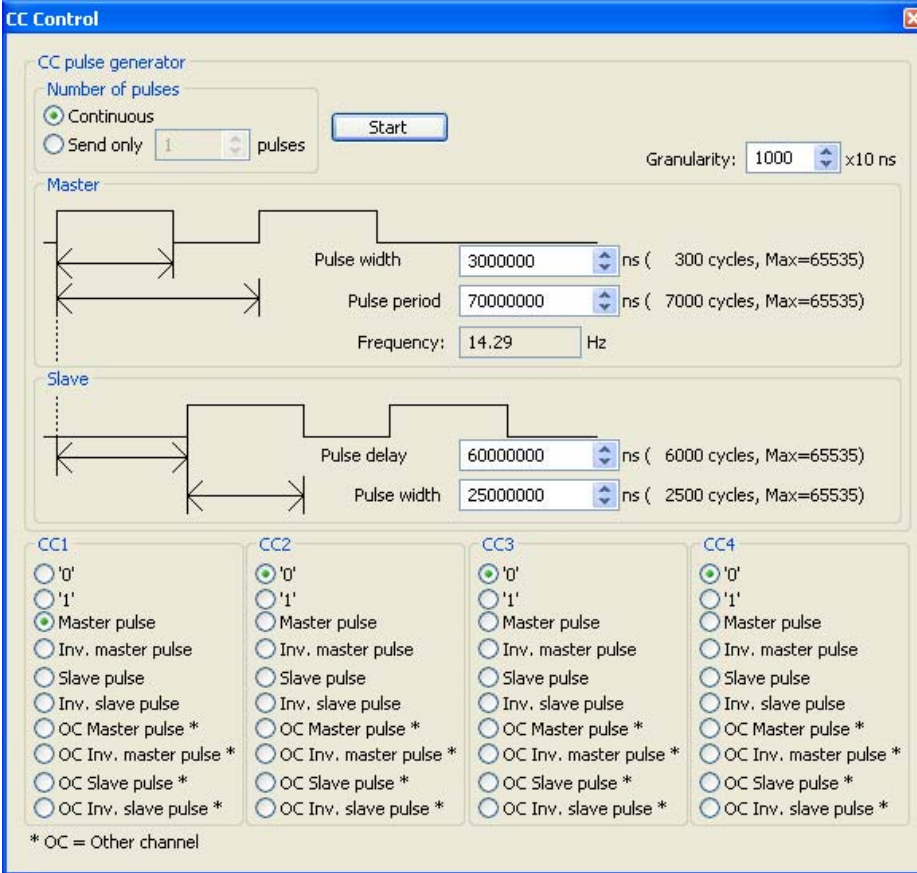
## • Strobe Control

- Strobe 1, Strobe 2
- Duration
  - 1 us to 65535 us
  - 1 us increment
- Delay
  - 1 us to 65535 us
  - 1 us increment

# Trigger Control - Exercise

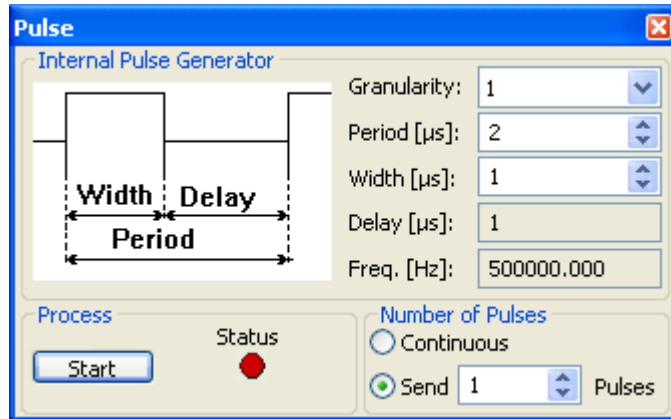
## Exercise

- FG - Set CC1 to Master Pulse
- FG - Set Pulse width to 3000 ns
- FG - Set Pulse period to 70000 ns
- FG - Set Granularity to 1000
- FG - Check Frequency – 14.29Hz
- FG - Set number of Pulses – Continuous
- FG - Press START
- Bobcat - Change Exposure control to Pulse Width
- Bobcat - Observe the image brightness change
- Bobcat - Set Trigger in to Off
- FG - Press STOP
- FG - Close CC Control panel



The screenshot shows the 'CC Control' software interface. At the top, there is a 'CC pulse generator' section with 'Number of pulses' set to 'Continuous' and a 'Start' button. Below this, the 'Master' channel is configured with a pulse width of 3000000 ns (300 cycles), a pulse period of 70000000 ns (7000 cycles), and a frequency of 14.29 Hz. The 'Slave' channel is configured with a pulse delay of 60000000 ns (6000 cycles) and a pulse width of 25000000 ns (2500 cycles). At the bottom, there are four output channels (CC1, CC2, CC3, CC4) with radio buttons for selecting pulse types: '0', '1', Master pulse, Inv. master pulse, Slave pulse, Inv. slave pulse, and OC (Other channel) variants. CC2 has '0' selected, while the others have '0' selected but are not explicitly marked as active in the same way.

## Programmable Pulse Generator



### Exercise

- Set Granularity to “1000”
- Set Period to “20000” us
- Set Width to “3000” us
- Set Pulses to “1”
- Press Start

### • Features

- Start/Stop
- Granularity
  - 1x, 10x, 100x, 1000x
- Period [us]
  - 20 bit, 1048576 steps
  - Range – 1 us to 17.46 min
- Width [us]
  - 19 bit, 524288 steps
  - Range – 1 us to 8.73 min
- Number of Pulses
  - 16 bit, 65536 discrete pulses
  - Continuous

### • Display

- Pulse frequency [Hz]
- Delay [us]
- Status (R – running / G – stop)



## External Sync - Exercise

### ❖ Exercise 1 – H sync

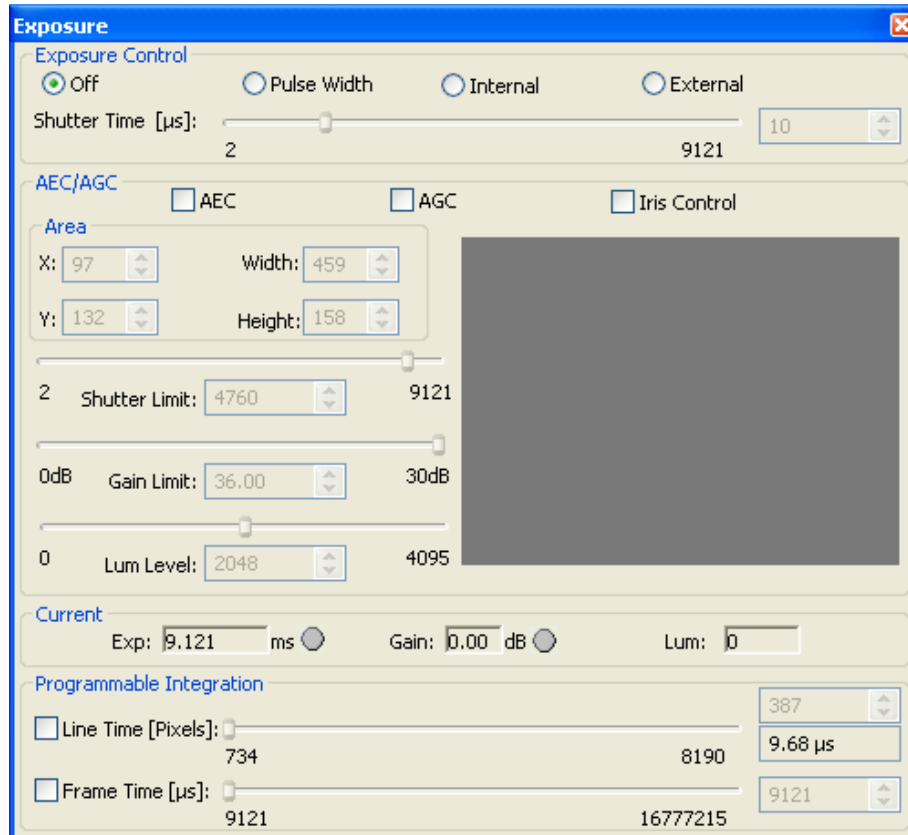
- FG - Set CC1 to Master Pulse
- FG - Set Pulse width to 50 ns
- FG - Set Pulse period to 20000 ns
- FG - Set Granularity to 1
- FG - Check Frequency – 50000 Hz
- FG - Set number of Pulses – Continuous
- FG - Press START
- Bobcat – Map H-sync to CC1
- Observe the image brightness change
- Bobcat - Set Trigger in to Off
- FG - Press STOP
- Bobcat – Map Deselect to CC1

### ❖ Exercise 2 – V sync

- FG - Set CC1 to Master Pulse
- FG - Set Pulse width to 30 ns
- FG - Set Pulse period to 20000 ns
- FG - Set Granularity to 1000
- FG - Check Frequency – 50.00 Hz
- FG - Set number of Pulses – Continuous
- FG - Press START
- Bobcat – Map V-sync to CC1
- Observe the image brightness change
- Bobcat - Map Deselect to CC1
- FG - Press STOP
- FG - Close CC Control panel



## Exposure Panel - Main



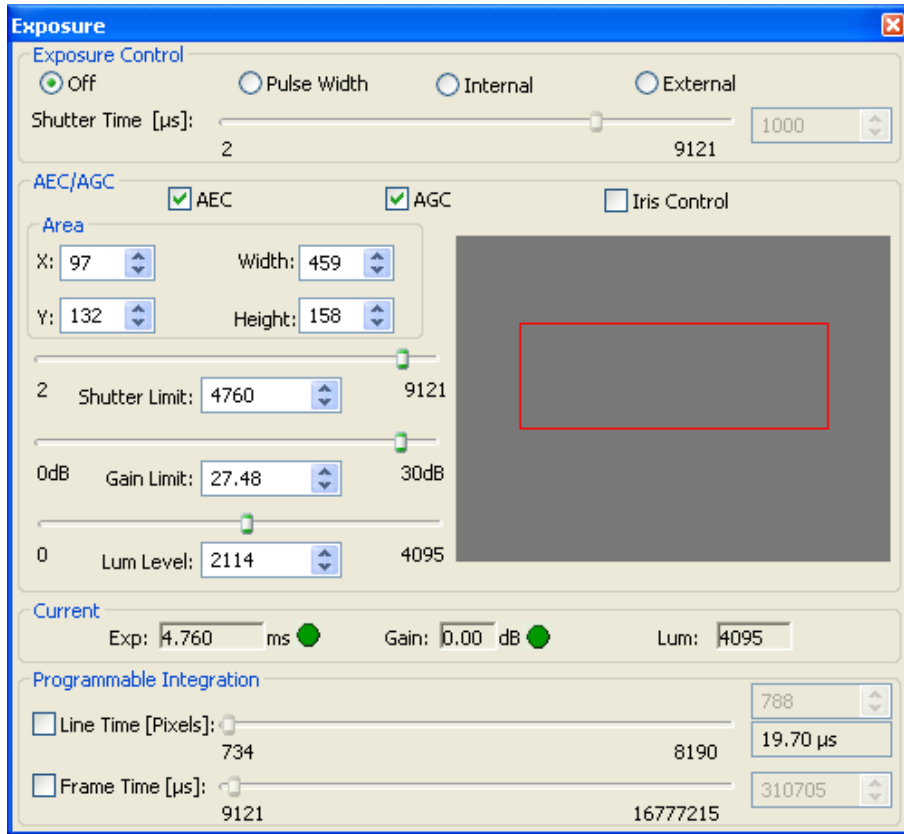
- **Exposure Control**
  - Off
  - Internal
    - 1 us resolution
    - (2 – 8 us) minimum exposure
  - External
    - External pulse (I/O mapped)
    - 2 us minimum exposure
  - Pulse Width
    - Trigger mode only
- **Programmable integration**
  - Independent Line & Frame
  - Line time
    - Clock cycles (8190 max)
  - Frame time
    - 1 us resolution
    - ~ 16 sec. Max integration

### Exercise

- Set Exposure Control to Internal and shutter time to 3000 us
- Enable Line Time and set value to 740
- Enable Frame time integration and set frame time to 12000 us
- Set Exposure Control to Off, observe the brightness change
- Disable Line Time and Frame Time



## Exposure Panel - AGC, AEC, AIC



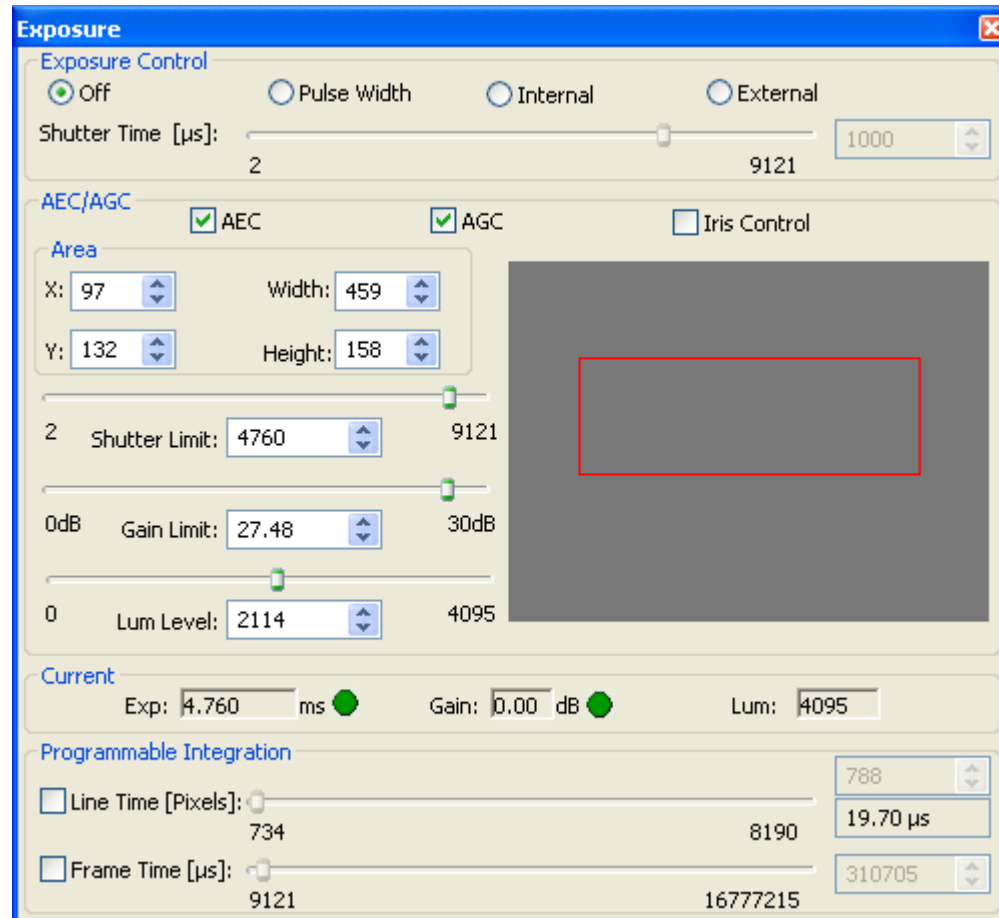
- **AEC, AGC**

- Independently selectable
- AOI for both
  - Samples only the AOI
  - Entire image changes
- AEC - Shutter Limit
  - Max - User selectable
  - Min – camera minimum
- AGC - Gain Limit
  - Max - User selectable
  - Min – 0.05 dB
- Luminance Level
  - Brightness to be maintained
  - Peak or Average
- Convergence Speed
  - AEC – 1x, 2x, 3x, 4x
  - AGC – 1x, 2x, 3x, 4x
- Display – Current values
  - Current Exposure
  - Current Gain
  - Current Luminance

- **AIC**

- Video Auto Iris lenses

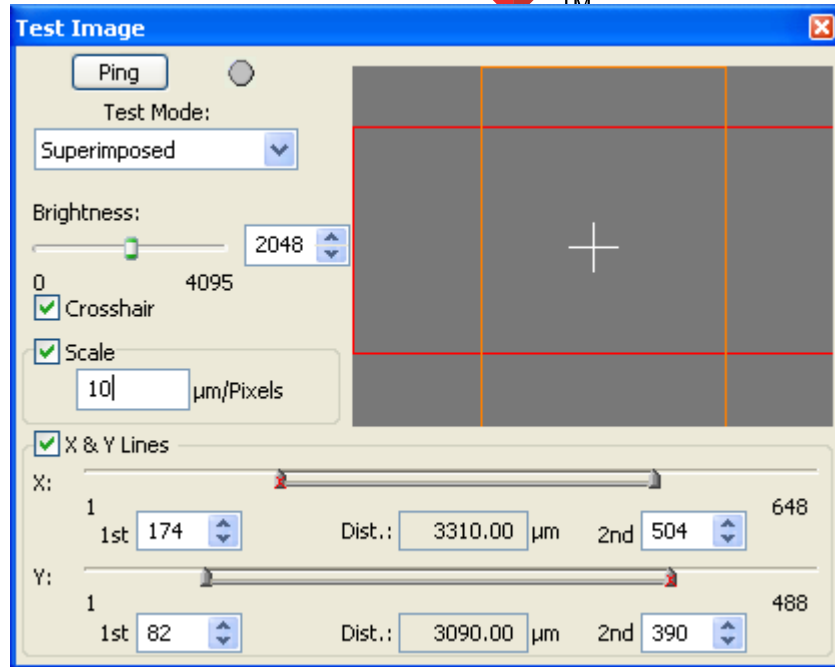
## AGC, AEC, AIC - Exercise



### Exercise

- Enable AEC and AGC
- Set Shutter Limit to 4760 us
- Set Gain Limit to 27.48 dB
- Set Lum. Level to 2114
- Set Area to
  - W = 458, X = 97
  - H = 158, Y = 132
- Open, close the Iris
- Select different AOI
- Observe image
- Observe the current values
- Disable AEC, AGC

## Test Image



### Exercise

- Set Mode to – select several
- Set Mode to Superimpose
  - Enable Crosshair
  - Set Brightness – select value
  - Enable X & Y Lines
  - Set values for X and Y
  - Enable Scale
    - Select object
  - Calibrate Scale, measure
- Set Mode to Off

### • Test Image Modes

- Black, Gray, White images
- H and V ramps
  - static or moving
- Vertical bars
- Superimpose on live image

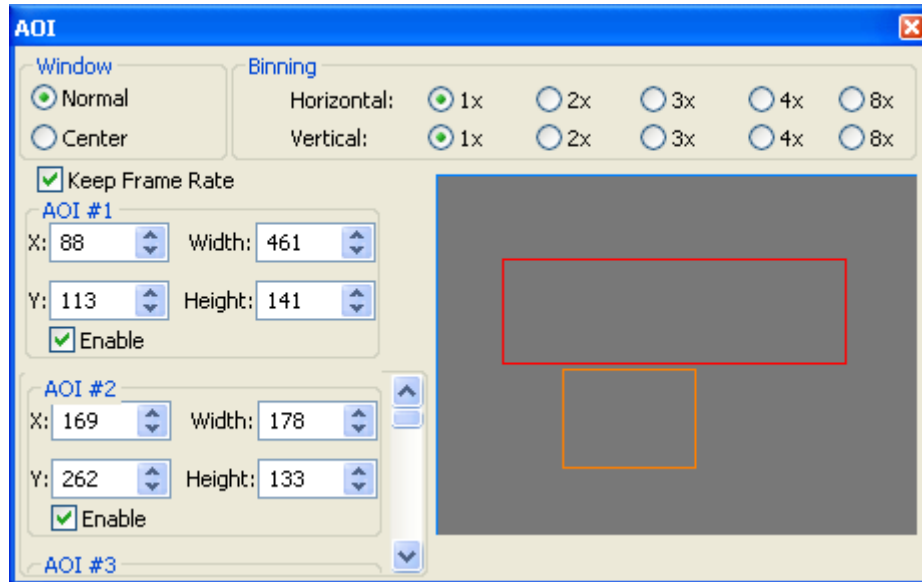
### • Ping

- Green – OK
- Red – No communication

### • Superimpose

- Crosshair (
  - 2 pixels, 2 lines
  - Optical center of the image
- X & Y lines
  - 1 pixel, 1 line
  - Displays the distance
    - Pixels
    - Units
    - User calibration

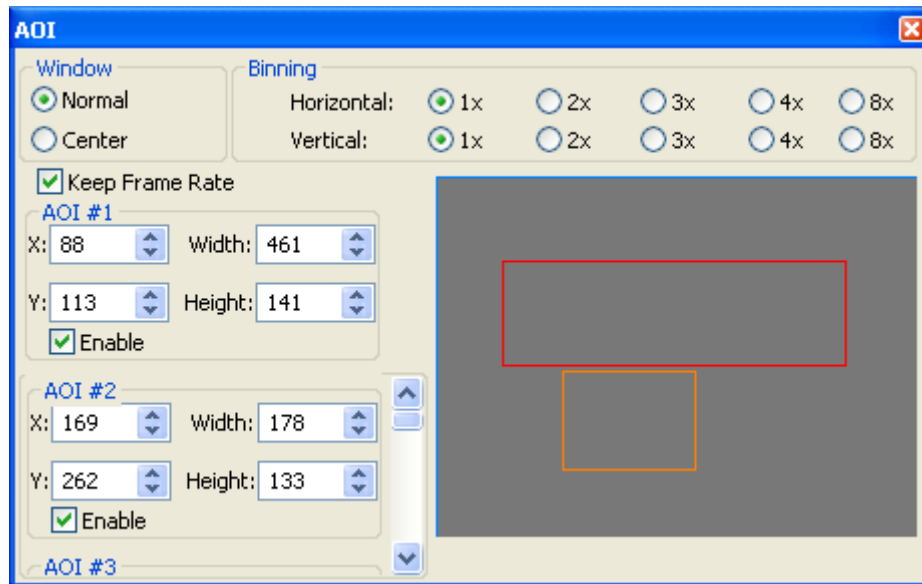
## AOI Panel - Binning



- **Window**
  - Normal
    - All cameras
  - Center
    - 0610, 0620 (228 pixels H)
    - 1410, 1610, 2520
      - Sub-sampled image
- **Binning**
  - Independent H & V
  - Horizontal – 1x, 2x, 3x, 4x, 8x
  - Vertical – 1x, 2x, 3x, 4x, 8x
  - AOI possible

### Exercise

- Bobcat – Set Window to Normal
- Bobcat – Set Binning
  - Vertical to 2x
  - Horizontal to 2x
- Bobcat – Check the image size
- FG – Set the correct image size
- Bobcat – Observe the image
- Bobcat – Set Window to Center
- Bobcat – Check the image size
- FG – Set the correct image size
- Bobcat – Set Window to Normal
- Bobcat – Set Binning
  - Vertical to 3x
  - Horizontal to 4x
- Bobcat – Check the image size
- FG – Set the correct image size
- Bobcat – Set Window to Normal
- Bobcat – Set Binning to 1x
- FG – Set the correct image size



- **Area of Interest**
  - Keep Frame rate enabled
    - Frame rate does not change
    - 8 independent AOIs
    - No overlapping restrictions
  - Keep Frame rate disabled
    - Frame rate increases
    - AOI1 is master
      - Sets the frame rate
    - AOI2 to AOI8 must be in AOI1

### Exercise

- Bobcat – Enable AOI #1
- Bobcat – Set AOI # 1
  - $W = 461, X = 88$
  - $H = 141, Y = 113$
- Bobcat – Disable Keep Fr. Rate
- FG – Set the correct image size, Ignore DVAL checked
- Bobcat – Observe the image size and speed
- Bobcat – Enable AOI #2
- Bobcat – Select AOI #2 size
- Bobcat – Disable AOI #2
- Bobcat – Enable Keep Fr. Rate
- Bobcat – Observe the image size and speed
- FG – Set the correct image size
- Bobcat – Enable AOI #2, set size
- Bobcat – Enable other AOIs
- Bobcat – Disable all AOIs



## In Camera Processing

- **Built in Image Algorithms**
  - 3 x 3 filters
  - Set of predetermined functions
  - User input
- **128 Meg Internal memory**
  - Frame averaging
  - Frame subtraction
- **Thresholding**
  - Single or Dual
  - User selectable values



## **Bobcat Competitive Advantages**

### **Flexible Platform Design**

- **Field upgradeable firmware**
- **Expandable platform**
- **Optimized mechanical design**
- **Small size, Low power**
- **Intuitive, easy-to-use Software**

### **Camera Features**

- **Highly programmable**
- **Unique Features**
- **In board Processing**
- **User Customization**

### **Education**

- **Manuals, App. Notes, Software**

### **Automated Testing**

- **Test software**