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USER'S MANUAL

PIXCI® E1, E1DB, E4, E4DB, E8, EL1, or EL1DB
Revision 1.3

24 September 2014

For use with:
PIXCI® E1 or E1DB R1, E4 or E4DB R0 through R5, EL1 R0 through R4, EL1DB R0 through R4, E8 R0 through R3

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1. Installation

Thank you for purchasing imaging products from EPIX, Inc. We are available via email, telephone, or FAX to help with installation or to answer questions about the use of our products.

The PIXCI® E1, E1DB, E4, E4DB, E8, E8DB, EL1, or EL1DB frame grabbers, for the PCI Express bus, are packed in a static dissipative bag. Prior to opening the bag, place the bag near the computer into which the frame grabber will be installed.

We recommend installing XCAP prior to installing the PIXCI® frame grabber. Please refer to the Software Installation chapter for the XCAP installation directions, then follow the frame grabber installation instructions below. Installing XCAP software, which includes the PIXCI® frame grabber drivers, prior to installing the PIXCI® frame grabber isn't required, but more convenient.

1.1. Instructions

1. Use of a static free area and a wrist strap connected to the computer or to the static free area is suggested during installation. Walking can generate static electricity. Keep your feet stationary while removing the PIXCI® frame grabber from the anti-static bag. Hold the bag and the computer at the same time, or place the bag on the computer chassis and touch the chassis to dissipate the static charge that may have been created while transporting the frame grabber to the computer.
2. Power down the computer, and remove the power from all equipment to be connected.
3. Select a vacant PCI Express slot and remove the metal bracket and screw covering the back panel slot with which it is aligned. Consult the manual for the computer if there is any doubt about which slot is a PCI Express slot.
4. Remove the PIXCI® frame grabber from the anti-static bag and insert it into the PCI Express slot. Do not use excessive force.
5. If installing a PIXCI® E4 or E4DB revision 4 or later, or if installing a PIXCI® E8 or E8DB revision 2 or later, note the switch at the bottom right corner of the frame grabber that is labeled H6. If the switch is in the up position, the frame grabber will be configured as a PIXCI® E4DB or E8DB when the computer boots up. If the switch is in the down position, the frame grabber will be configured as a PIXCI® E4 or E8 when the computer boots up. If installing a PIXCI® E4 or E4DB revision 3 and earlier, note that there is no switch; these frame grabbers are preset as either a PIXCI® E4 or a PIXCI® E4DB and can't be altered. If installing a PIXCI® E8 or E8DB revision 1 and earlier, note the switch at the top middle of the frame grabber that is labeled A3. If the switch is in the position towards the bracket, the frame grabber will be configured as a PIXCI® E8DB when the computer boots up. If the switch is in the position away from the bracket, the frame grabber will be configured as a PIXCI® E8 when the computer boots up.
6. If installing a PIXCI® E4 or E4DB revision 4, or if installing a PIXCI® E8 or E8DB revision 2, there may be two switches on the back surface of the frame grabber. If these switches are present, they control whether the PoCL (Power over Camera Link) feature is enabled on Camera Link connectors P1 and P2. If the top switch on the back surface of the frame grabber is in the position towards the bracket, the PoCL feature is disabled for the top Camera Link connector (P2). If the top switch on the back surface of the frame grabber is in the position away from the bracket, the PoCL feature is enabled for the top Camera Link connector (P2). If the bottom switch on the back surface of the frame grabber is in the position away from the bracket, the PoCL feature is disabled for the bottom Camera Link connector (P1). If the bottom switch on the back surface of the frame grabber is in the position towards the bracket, the PoCL feature is enabled for the bottom Camera Link connector (P1). At time of shipping the switches are set to disable the PoCL feature for both connectors, to prevent damage to the frame grabber which can occur in rare instances when using certain non-PoCL cameras if the PIXCI® E4 or E8 PoCL feature is enabled and if the camera and PIXCI® E4 or E8 are connected while both are powered on.
7. If installing a PIXCI® E4 or E4DB revision 5, or if installing a PIXCI® E8 or E8DB revision 3, there are two jumpers present on the front surface of the frame grabber. These jumpers control whether the PoCL (Power over Camera Link) feature is enabled on Camera Link connectors P1 and P2. If the jumper to the right of the bottom Camera Link connector (P1) is in the up position (POCL), the PoCL feature is enabled for P1. If the jumper to the right of P1 is in the down position (GND), the PoCL feature is disabled for P1. If the jumper immediately above the top Camera Link connector (P2) is in the position towards the bracket (POCL1), the PoCL feature is enabled for P2. If the jumper immediately above P2 is in the position away from the bracket (GND), the PoCL feature is disabled for P2. At the time of shipping the jumpers are set to disable the PoCL feature for both connectors.
8. Replace the screw to secure the PIXCI® frame grabber in the slot.
9. The camera should only be connected or disconnected to/from the PIXCI® frame grabber with the camera and the PC powered off to avoid hardware damage. Connect the cable(s) between the PIXCI® frame grabber, camera, and power supply, making sure that the thumbscrews on each Camera Link cable are tightened completely into the standoffs on both the frame grabber and camera. The lower connector is for Base mode Camera Link camera connections and should be connected to the Base connector on the camera. On the PIXCI® E1 and EL1 frame grabbers the upper connector is for Medium or Full Camera Link cameras and should be connected to the Medium

or Full camera connector. On the PIXCI® E4 and E8 frame grabbers the upper connector is for Medium, Full, or 80 Bit Camera Link cameras and should be connected to the Medium, Full, or 80 Bit camera connector. On the PIXCI® E1DB, E4DB, E8DB, and EL1DB frame grabbers the upper connector is used to connect to a second Base mode camera. When using a PIXCI® E1, E4, E8, or EL1 frame grabber with a Medium or Full camera, and when using a PIXCI® E4 or E8 frame grabber with an 80 Bit camera, two cables are required. These two cables must be the exact same length, manufacturer, and cable type; otherwise, small difference in signal propagation time may interfere with image capture.

10. Power up the camera(s) and computer.
11. Install (if not done previously) and run the XCAP application software, following the instructions in the Software Installation and the Getting Started with XCAP chapters. In case of problems, refer to the In Case of Trouble chapter.

1.2. Computer

The size and the number of images that can be stored in memory on the motherboard is a function of the amount of memory that can be spared by the operating system. The amount of memory requested by XCAP by default depends on the operating system. If more memory is required for image sequences, the "Driver Assistant" (via the menubar's PIXCI®, PIXCI® Open/Close) can be used to request additional frame buffer memory. Some operating systems may require up to 2 gigabytes to operate efficiently.

The PIXCI® frame grabbers can capture and store full resolution images to computer memory (RAM) on a PCI Express motherboard. The PIXCI® frame grabbers have been tested at sustained data rates of 204 megabytes per second, and burst rates of 250 megabytes per second for an x1 slot and x1 frame grabber. The PIXCI® frame grabbers have been tested at sustained data rates of 700 megabytes per second, and burst rates of 1000 megabytes per second for an x4 slot and x4 frame grabber. An x8 slot has more than enough bandwidth to accomodate the data rate of any Camera Link camera, so there are effectively no bandwidth limitations when using one Base, Medium, Full, or 80 Bit Camera Link camera, or two Base Camera Link cameras, on an x8 slot and x8 frame grabber. Wider PCI Express slots may be used for the PIXCI frame grabbers, but note that some x16 slots (e.g. motherboards using the 915 chip set) will only operate in x1 or x16 capability, resulting in slower data rates. Each PCI Expess slot on a motherboard may exhibit different performance characteristics. If the motherboard manufacturer doesn't indicate the slot which supports the highest bandwidth, try all slots.

EPIX, Inc. is an Intel approved, value added reseller and can assemble computer based imaging systems including camera(s), RAID video to disk systems, power supplies, monitors, and cables that have been tested to specific sustained data rates prior to shipment.

2. Connectors

2.1. PIXCI® E1 revision 0, E4 revision 0 through 3, EL1 revision 0 through 3, E1DB revision 0, E4DB revision 0 and 1, and EL1DB revision 0

The PIXCI® E1, E4 revision 0 through 3, EL1 revision 0 through 3, E1DB, E4DB revision 0 and 1, and EL1DB revision 0 frame grabbers have two 26 pin Camera Link connectors which are accessible through the bracket that mounts the frame grabber to the computer chassis. The PIXCI® E1, E4 revision 0 through 3, EL1 revision 0 through 3, E1DB, E4DB revision 0 and 1, and EL1DB revision 0 frame grabbers also have four 10 pin headers, as well as one optional 20 pin header, which can be found on the front surface of the frame grabber.

2.1.1. 26 Pin 3M MDR Connector P1

The 26 pin MDR connector P1 is a Camera Link Base configuration data and control connector as described in the Camera Link specification. P1 is the lower connector on the computer mounting bracket and should be used when connecting to a camera with a single Camera Link connector (Base camera). The PIXCI® E1, E4 revision 0 through 3, and EL1 revision 0 through 3 frame grabbers support cameras with two Camera Link connectors (Medium or Full cameras); when using these cameras, P1 should be connected to the camera's Base connector. On the dual base frame grabbers PIXCI® E1DB, E4DB revision 0 and 1, and EL1DB revision 0, P1 and P2 provide identical capabilities.

Signal Name	Pin Number
Inner Shield	13
Inner Shield	26
X0-	25
X0+	12
X1-	24
X1+	11
X2-	23
X2+	10
XCLK-	22
XCLK+	9
X3-	21
X3+	8
SerTC+	20
SerTC-	7
SerTFG-	19
SerTFG+	6
CC1-	18
CC1+	5
CC2-	4

CC2+	17
CC3-	16
CC3+	3
CC4-	2
CC4+	15
Inner Shield	1
Inner Shield	14

2.1.2. 26 Pin 3M MDR Connector P2

The 26 pin MDR connector P2 is the upper connector on the computer mounting bracket. On the PIXCI® E1, E4 revision 0 through 3, and EL1 revision 0 through 3, the P2 is a Camera Link Medium and Full configuration data connector as described in the Camera Link specification. On the PIXCI® E1DB, E4DB revision 0 and 1, and EL1DB revision 0, the P2 supports a base camera connection and has the same connections as P1.

Signal Name	Pin Number
Inner Shield	13
Inner Shield	26
Y0-	25
Y0+	12
Y1-	24
Y1+	11
Y2-	23
Y2+	10
YCLK-	22
YCLK+	9
Y3-	21
Y3+	8
TERM+	20
TERM-	7
Z0-	19
Z0+	6
Z1-	18
Z1+	5
Z2-	17
Z2+	4
ZCLK-	16
ZCLK+	3

Z3-	15
Z3+	2
Inner Shield	1
Inner Shield	14

2.1.3. 10 Pin Header P4 Signal List

Signal Name	IN/ OUT	Pin Number	Pin Number	IN/ OUT	Signal Name
Ground		1	2		+5 VDC (0.75 Amp max)
TRGM	I	3	4	I	TRGP
NFEN	I	5	6	I	PFEN
TRGOM	O	7	8	O	TRGOP
NIO	I/O	9	10	I/O	PIO

P4 is for input and output signals external or internal to the computer case. External signals can be connected with a cable to a 9 pin D-Subminiature connector through a second slot with a bracket to mount the D-Subminiature connector. A LVDS (low voltage differential signal) to TTL Module and 2 meter cable are available for connecting TTL trigger, frame enable, and trigger out signals to the PIXCI® frame grabber.

P4 is located in the top left of the PIXCI® frame grabber with pin 1 in the upper left position and pin 2 in the upper right position. It is to the left of Header P5.

Pin 1
: Ground.

Pin 2
: +5 volts through a 0.75 ampere resettable thermal fuse.

Pin 3
: TRGM, a negative LVDS trigger input.

Pin 4
: TRGP, a positive LVDS trigger input.

Pin 5
: NFEN, a negative LVDS frame enable input for line scan applications.

Pin 6
: PFEN, a positive LVDS frame enable input for line scan applications.

Pin 7
: TRGOM, a negative LVDS trigger output.

Pin 8
: TRGOP, a positive LVDS trigger output. The TRGOM and TRGOP signals are a strobe output that is driven from the camera control state machine. The strobe output is delayed by two state machine clocks from the exposure signal.

Pin 9
: NIO, a negative LVDS signal, which can be configured as an input or output. NIO is reserved for custom use.

Pin 10
: PIO, a positive LVDS signal, which can be configured as an input or output. PIO is reserved for custom use.

2.1.4. 10 Pin Header P5 Signal List

Header P5 is located at the top center of the frame grabber between P4 and P6. It is used for input and output signals external or internal to the computer case for the PIXCI® E1DB, E4DB revision 0 and 1, and EL1DB revision 0 frame grabbers. P5 has a similar pinout as P4, but the signals are dedicated to the second base camera connected to P2.

2.1.5. 10 Pin Header P6 Signal List

Header P6 is located at the top center of the frame grabber between P5 and P7.

Signal Name	IN/ OUT	Pin Number	Pin Number	IN/ OUT	Signal Name
Ground		1	2		+5 VDC (fused at 0.75 A)
Out 1	O	3	4		Ground
Out 2	O	5	6		Ground
In 2	I	7	8		Ground
In 1	I	9	10		Ground

Pin 1 of P6 is in the upper left position.

Pin 1
Ground.

Pin 2
+5 volts through a 0.75 ampere thermally limited regulator.

Pin 3
OUT1, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V.

Pin 4
Ground.

Pin 5
OUT2, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V.

Pin 6
Ground.

Pin 7
IN1, a +3.3V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V. IN1 is pulled up to 3.3 volts.

Pin 8
Ground.

Pin 9
IN2, a +3.3V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V. IN2 is pulled up to 3.3 volts.

Pin 10
Ground.

2.1.6. 10 Pin Header P7

Header P7 is located at the top right of the frame grabber to the right of P6. P7 is reserved for configuration of the FPGA.

2.2. PIXCI® E4 revision 4 and 5, and E4DB revision 4 and 5

The PIXCI® E4 revision 4 and 5, and E4DB revision 4 and 5, frame grabbers have two 26 pin Camera Link connectors which are accessible through the bracket that mounts the frame grabber to the computer chassis. The PIXCI® E4 revision 4 and 5, and E4DB revision 4 and 5, frame grabbers also have three 10 pin headers, as well as one optional 20 pin header, which can be found on the front surface of the frame grabber.

The PIXCI® E4 revision 4 and 5, and E4DB revision 4 and 5, frame grabbers are user-configurable in either E4 mode, which allows capture from one Base, Medium, Full, or 80 Bit Camera Link camera, or E4DB mode, which allows capture from up to two Base Camera Link cameras. There is a switch labeled H6 at the bottom right corner of the surface of the frame grabber. With the switch in the up position, upon applying power to the computer the frame grabber is configured as an E4DB and is recognized as such by software. With the switch in the down position, upon applying power to the computer the frame grabber is configured as an E4 and is recognized as such by software.

2.2.1. 26 Pin 3M MDR Connector P1

The 26 pin MDR connector P1 is a Camera Link Base configuration data and control connector as described in the Camera Link specification. P1 is the lower connector on the computer mounting bracket and should be used when connecting to a camera with a single Camera Link connector (Base camera). When E4 configuration is enabled, for cameras with two Camera Link connectors (Medium, Full, or 80 Bit cameras), P1 should be connected to the camera's Base connector. P1 supports PoCL (Power over Camera Link). When E4DB configuration is enabled, P1 and P2 provide identical capabilities.

On later releases of the PIXCI® E4 revision 4, two switches have been added to the back surface of the frame grabber. The bottom switch controls whether the PoCL feature is enabled on connector P1. With the bottom switch in the position away from the bracket, the PoCL feature is disabled for P1. With the bottom switch in the position towards the bracket, the PoCL feature is enabled for P1. At time of shipping, the PoCL feature is disabled to prevent damage to the frame grabber which can occur in rare instances when using certain non-PoCL cameras if the PIXCI® E4 PoCL feature is enabled and if the camera and PIXCI® E4 are connected while both are powered on.

On the PIXCI® E4 revision 5, the PoCL circuit has been improved to prevent the potential damage to the frame grabber referenced in the previous paragraph. However, it is desirable to disable the PoCL feature when using a non-PoCL camera so that the former ground wires, that PoCL uses for power on the Camera Link cable, are fully grounded. Two jumpers on the front surface of the frame grabber can be used to disable or enable the PoCL feature. With the jumper to the right of P1 in the up position (POCL), the PoCL feature is enabled for P1. With the jumper to the right of P1 in the down position (GND), the PoCL feature is disabled for P1. At the time of shipping the PoCL feature is disabled.

Signal Name	Pin Number
Power Return	13
Power	26
X0-	25
X0+	12
X1-	24
X1+	11
X2-	23
X2+	10
XCLK-	22

XCLK+	9
X3-	21
X3+	8
SerTC+	20
SerTC-	7
SerTFG-	19
SerTFG+	6
CC1-	18
CC1+	5
CC2-	4
CC2+	17
CC3-	16
CC3+	3
CC4-	2
CC4+	15
Power	1
Power Return	14

2.2.2. 26 Pin 3M MDR Connector P2

The 26 pin MDR connector P2 is the upper connector on the computer mounting bracket. When the frame grabber is configured in E4 mode, P2 is a Camera Link Medium, Full, and 80 Bit configuration data connector as described in the Camera Link specification. When the frame grabber is configured in E4DB mode, P2 supports a base camera connection and has the same connections as P1.

On later releases of the PIXCI® E4 revision 4, two switches have been added to the back surface of the frame grabber. The top switch controls whether the PoCL feature is enabled on connector P2. With the top switch in the position towards the bracket, the PoCL feature is disabled for P2. With the top switch in the position away from the bracket, the PoCL feature is enabled for P2. At time of shipping, the PoCL feature is disabled to prevent damage to the frame grabber which can occur in rare instances when using certain non-PoCL cameras if the PIXCI® E4 PoCL feature is enabled and if the camera and PIXCI® E4 are connected while both are powered on.

On the PIXCI® E4 revision 5, the PoCL circuit has been improved to prevent the potential damage to the frame grabber referenced in the previous paragraph. However, it is desirable to disable the PoCL feature when using a non-PoCL camera so that the former ground wires, that PoCL uses for power on the Camera Link cable, are fully grounded. Two jumpers on the front surface of the frame grabber can be used to disable or enable the PoCL feature. With the jumper immediately above P2 in the position towards the bracket (POCL1), the PoCL feature is enabled for P2. With the jumper immediately above P2 in the position away from the bracket (GND), the PoCL feature is disabled for P2. At the time of shipping the PoCL feature is disabled.

Signal Name	Pin Number
Power Return	13
Power	26
Y0-	25
Y0+	12

Y1-	24
Y1+	11
Y2-	23
Y2+	10
YCLK-	22
YCLK+	9
Y3-	21
Y3+	8
TERM+	20
TERM-	7
Z0-	19
Z0+	6
Z1-	18
Z1+	5
Z2-	17
Z2+	4
ZCLK-	16
ZCLK+	3
Z3-	15
Z3+	2
Power	1
Power Return	14

2.2.3. 10 Pin Header P3 Signal List

Signal Name	IN/ OUT	Pin Number	Pin Number	IN/ OUT	Signal Name
Ground		1	2		+3.3 VDC (0.75 Amp max)
TRG	I	3	4	O	TRG_OUT
FEN_IN	I	5	6	O	FEN_OUT
IN2	I	7	8	O	OUT1
IN1	I	9	10	O	OUT2

P3 is for signals external or internal to the computer case.

P3 is located in the top left of the PIXCI® frame grabber with pin 1 in the upper left position and pin 2 in the upper right position. It is to the left of Header P6.

Pin 1

Ground.

Pin 2
+3.3 volts.

Pin 3
TRG, a +3.3V TTL level trigger input. TRG is pulled up to 3.3 volts.

Pin 4
TRG_OUT, a +3.3V TTL level strobe output. TRG_OUT is driven from the camera control state machine. TRG_OUT is delayed by two state machine clocks from the exposure signal.

Pin 5
FEN_IN, a +3.3V TTL level frame enable input for line scan applications.

Pin 6
FEN_OUT, a +3.3V TTL level frame enable output. FENOUT is a copy of the frame enable signal from the camera.

Pin 7
IN1, a +3.3V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V. IN1 is pulled up to 3.3 volts.

Pin 8
OUT1, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V.

Pin 9
IN2, a +3.3V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V. IN2 is pulled up to 3.3 volts.

Pin 10
OUT2, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V.

2.2.4. 10 Pin Header P6 Signal List

Header P6 is located at the top of the frame grabber to the right of P3. It is used for input and output signals external or internal to the computer case when the PIXCI® frame grabber is configured as an E4DB. P6 has a similar pinout as P3, but the signals are dedicated to the second base camera connected to P2.

2.2.5. 10 Pin Header P4

Header P4 is located at the top right of the frame grabber. P4 is reserved for configuration of the FPGA.

2.3. PIXCI® E8 and E8DB

The PIXCI® E8 and E8DB frame grabbers have two 26 pin Camera Link connectors which are accessible through the bracket that mounts the frame grabber to the computer chassis. The PIXCI® E8 and E8DB frame grabbers also have three 10 pin headers, as well as one optional 20 pin header, which can be found on the front surface of the frame grabber.

The PIXCI® E8 and E8DB frame grabbers are user-configurable in either E8 mode, which allows capture from one Base, Medium, Full, or 80 Bit Camera Link camera, or E8DB mode, which allows capture from up to two Base Camera Link cameras. There is a switch labeled H6 at the bottom right corner of the surface of the frame grabber (for revision 0 and revision 1 frame grabbers, the switch is labeled A3 and is located at the top middle of the surface of the frame grabber). With the switch in the up position (position towards the bracket for revision 0 and revision 1 frame grabbers), upon applying power to the computer the frame grabber is configured as an E8DB and is recognized as such by software. With

the switch in the down position (position away from the bracket for revision 0 and revision 1 frame grabbers), upon applying power to the computer the frame grabber is configured as an E8 and is recognized as such by software.

2.3.1. 26 Pin 3M MDR Connector P1

The 26 pin MDR connector P1 is a Camera Link Base configuration data and control connector as described in the Camera Link specification. P1 is the lower connector on the computer mounting bracket and should be used when connecting to a camera with a single Camera Link connector (Base camera). When E8 configuration is enabled, for cameras with two Camera Link connectors (Medium, Full, or 80 Bit cameras), P1 should be connected to the camera's Base connector. P1 supports PoCL (Power over Camera Link). When E8DB configuration is enabled, P1 and P2 provide identical capabilities, with the exception that for revision 0 frame grabbers only P1 supports PoCL.

On later releases of the PIXCI® E8 revision 2, two switches have been added to the back surface of the frame grabber. The bottom switch controls whether the PoCL feature is enabled on connector P1. With the bottom switch in the position away from the bracket, the PoCL feature is disabled for P1. With the bottom switch in the position towards the bracket, the PoCL feature is enabled for P1. At time of shipping, the PoCL feature is disabled to prevent damage to the frame grabber which can occur in rare instances when using certain non-PoCL cameras if the PIXCI® E8 PoCL feature is enabled and if the camera and PIXCI® E8 are connected while both are powered on.

On the PIXCI® E8 revision 3, the PoCL circuit has been improved to prevent the potential damage to the frame grabber referenced in the previous paragraph. However, it is desirable to disable the PoCL feature when using a non-PoCL camera so that the former ground wires, that PoCL uses for power on the Camera Link cable, are fully grounded. Two jumpers on the front surface of the frame grabber can be used to disable or enable the PoCL feature. With the jumper to the right of P1 in the up position (POCL), the PoCL feature is enabled for P1. With the jumper to the right of P1 in the down position (GND), the PoCL feature is disabled for P1. At the time of shipping the PoCL feature is disabled.

Signal Name	Pin Number
Power Return	13
Power	26
X0-	25
X0+	12
X1-	24
X1+	11
X2-	23
X2+	10
XCLK-	22
XCLK+	9
X3-	21
X3+	8
SerTC+	20
SerTC-	7
SerTFG-	19
SerTFG+	6
CC1-	18
CC1+	5
CC2-	4

CC2+	17
CC3-	16
CC3+	3
CC4-	2
CC4+	15
Power	1
Power Return	14

2.3.2. 26 Pin 3M MDR Connector P2

The 26 pin MDR connector P2 is the upper connector on the computer mounting bracket. When the frame grabber is configured in E8 mode, P2 is a Camera Link Medium, Full, and 80 Bit configuration data connector as described in the Camera Link specification. When the frame grabber is configured in E8DB mode, P2 supports a base camera connection and has the same connections as P1, with the exception that for revision 0 frame grabbers P2 does not support PoCL.

On later releases of the PIXCI® E8, two switches have been added to the back surface of the frame grabber. The top switch controls whether the PoCL feature is enabled on connector P2. With the top switch in the position towards the bracket, the PoCL feature is disabled for P2. With the top switch in the position away from the bracket, the PoCL feature is enabled for P2. At time of shipping, the PoCL feature is disabled to prevent damage to the frame grabber which can occur in rare instances when using certain non-PoCL cameras if the PIXCI® E8 PoCL feature is enabled and if the camera and PIXCI® E8 are connected while both are powered on.

On the PIXCI® E8 revision 3, the PoCL circuit has been improved to prevent the potential damage to the frame grabber referenced in the previous paragraph. However, it is desirable to disable the PoCL feature when using a non-PoCL camera so that the former ground wires, that PoCL uses for power on the Camera Link cable, are fully grounded. Two jumpers on the front surface of the frame grabber can be used to disable or enable the PoCL feature. With the jumper immediately above P2 in the position towards the bracket (POCL1), the PoCL feature is enabled for P2. With the jumper immediately above P2 in the position away from the bracket (GND), the PoCL feature is disabled for P2. At the time of shipping the PoCL feature is disabled.

Signal Name	Pin Number
Power Return	13
Power	26
Y0-	25
Y0+	12
Y1-	24
Y1+	11
Y2-	23
Y2+	10
YCLK-	22
YCLK+	9
Y3-	21
Y3+	8
TERM+	20
TERM-	7

Z0-	19
Z0+	6
Z1-	18
Z1+	5
Z2-	17
Z2+	4
ZCLK-	16
ZCLK+	3
Z3-	15
Z3+	2
Power	1
Power Return	14

2.3.3. 10 Pin Header P3 Signal List

Signal Name	IN/ OUT	Pin Number	Pin Number	IN/ OUT	Signal Name
Ground		1	2		+3.3 VDC (0.75 Amp max)
TRG	I	3	4	O	TRG_OUT
FEN_IN	I	5	6	O	FEN_OUT
IN2	I	7	8	O	OUT1
IN1	I	9	10	O	OUT2

P3 is for signals external or internal to the computer case.

P3 is located in the top left of the PIXCI® frame grabber with pin 1 in the upper left position and pin 2 in the upper right position. It is to the left of Header P6.

Pin 1
Ground.

Pin 2
+3.3 volts.

Pin 3
TRG, a +3.3V TTL level trigger input. TRG is pulled up to 3.3 volts.

Pin 4
TRG_OUT, a +3.3V TTL level strobe output. TRG_OUT is driven from the camera control state machine. TRG_OUT is delayed by two state machine clocks from the exposure signal.

Pin 5
FEN_IN, a +3.3V TTL level frame enable input for line scan applications.

Pin 6
FEN_OUT, a +3.3V TTL level frame enable output. FENOUT is a copy of the frame enable signal from the camera.

Pin 7

IN1, a +3.3V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V. IN1 is pulled up to 3.3 volts.

Pin 8
OUT1, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V.

Pin 9
IN2, a +3.3V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V. IN2 is pulled up to 3.3 volts.

Pin 10
OUT2, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +3.3V.

2.3.4. 10 Pin Header P6 Signal List

Header P6 is located at the top of the frame grabber to the right of P3. It is used for input and output signals external or internal to the computer case when the PIXCI® frame grabber is configured as an E8DB. P6 has a similar pinout as P3, but the signals are dedicated to the second base camera connected to P2.

2.3.5. 10 Pin Header P4

Header P4 is located at the top right of the frame grabber. P4 is reserved for configuration of the FPGA.

2.4. PIXCI® EL1 revision 4 and EL1DB revision 4

The PIXCI® EL1 revision 4 and EL1DB revision 4 have two 26 pin Camera Link connectors which are accessible through the bracket that mounts the frame grabber to the computer chassis. The PIXCI® EL1 revision 4 and EL1DB revision 4 also have two 10 pin headers, as well as one optional 20 pin header, which can be found on the front surface of the frame grabber.

The PIXCI® EL1 revision 4 and EL1DB revision 4 frame grabbers are factory-configurable in either EL1 mode, which allows capture from one Base, Medium, or Full Camera Link camera, or EL1DB mode, which allows capture from up to two Base Camera Link cameras. This configuration is set at the factory and cannot be modified by the user.

2.4.1. 26 Pin 3M MDR Connector P1

The 26 pin MDR connector P1 is a Camera Link Base configuration data and control connector as described in the Camera Link specification. P1 is the lower connector on the computer mounting bracket and should be used when connecting to a camera with a single Camera Link connector (Base camera). The PIXCI® EL1 revision 4 frame grabber supports cameras with two Camera Link connectors (Medium or Full cameras); when using these cameras, P1 should be connected to the camera's Base connector. On the dual base frame grabber PIXCI® EL1DB revision 4, P1 and P2 provide identical capabilities.

Signal Name	Pin Number
Inner Shield	13
Inner Shield	26
X0-	25
X0+	12

X1-	24
X1+	11
X2-	23
X2+	10
XCLK-	22
XCLK+	9
X3-	21
X3+	8
SerTC+	20
SerTC-	7
SerTFG-	19
SerTFG+	6
CC1-	18
CC1+	5
CC2-	4
CC2+	17
CC3-	16
CC3+	3
CC4-	2
CC4+	15
Inner Shield	1
Inner Shield	14

2.4.2. 26 Pin 3M MDR Connector P2

The 26 pin MDR connector P2 is the upper connector on the computer mounting bracket. On the PIXCI® EL1 revision 4, the P2 is a Camera Link Medium and Full configuration data connector as described in the Camera Link specification. On the dual base frame grabber PIXCI® EL1DB revision 4, the P2 supports a base camera connection and has the same connections as P1.

Signal Name	Pin Number
Inner Shield	13
Inner Shield	26
Y0-	25
Y0+	12
Y1-	24
Y1+	11
Y2-	23

Y2+	10
YCLK-	22
YCLK+	9
Y3-	21
Y3+	8
TERM+	20
TERM-	7
Z0-	19
Z0+	6
Z1-	18
Z1+	5
Z2-	17
Z2+	4
ZCLK-	16
ZCLK+	3
Z3-	15
Z3+	2
Inner Shield	1
Inner Shield	14

2.4.3. 10 Pin Header P3 Signal List

Signal Name	IN/ OUT	Pin Number	Pin Number	IN/ OUT	Signal Name
Ground		1	2		+3.3 VDC (0.75 Amp max)
TRG	I	3	4	O	TRGOUT
FENIN	I	5	6	O	FENOUT
IN2	I	7	8	O	OUT1
IN1	I	9	10	O	OUT2

P3 is for signals external or internal to the computer case.

P3 is located in the top left of the PIXCI® frame grabber with pin 1 in the upper left position and pin 2 in the upper right position. It is to the left of Header P4.

Pin 1
Ground.

Pin 2
+3.3 volts.

Pin 3
TRG, a +3.3V or +5V TTL level trigger input. TRG is pulled up to 3.3 volts.

Pin 4
TRGOUT, a +3.3V TTL level strobe output. TRG_OUT is driven from the camera control state machine. TRG_OUT is delayed by two state machine clocks from the exposure signal.

Pin 5
FENIN, a +3.3V or +5V TTL level frame enable input for line scan applications.

Pin 6
FENOUT, a +3.3V TTL level frame enable output. FENOUT is a copy of the frame enable signal from the camera.

Pin 7
IN1, a +3.3V or +5V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +5V. IN1 is pulled up to 3.3 volts.

Pin 8
OUT1, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +5V.

Pin 9
IN2, a +3.3V or +5V TTL level general purpose input. It is not buffered and should be used only to receive signals from other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +5V. IN2 is pulled up to 3.3 volts.

Pin 10
OUT2, a +3.3V TTL level general purpose output. It is not buffered and should be used only to drive other devices internal to the enclosure. Care must be taken to only connect signals for which the voltage ranges from +0V to +5V.

2.4.4. 10 Pin Header P4 Signal List

Header P4 is located at the top of the frame grabber to the right of P3. It is used for input and output signals external or internal to the computer case when the PIXCI® frame grabber is configured as an EL1DB. P4 has a similar pinout as P3, but the signals are dedicated to the second base camera connected to P2.

2.4.5. 10 Pin Header P7

Header P7 is located at the bottom of the frame grabber. P7 is reserved for configuration of the FPGA.

3. Software Installation

XCAP-Plus, XCAP-Std, XCAP-Ltd, and XCAP-Lite are easy to install by following the instructions below.

3.1. For Windows 7 32/64-Bit

1. Install Files:
    a. If XCAP is provided on a compact disk (CD):
        i. If your computer is set to allow automatic execution of loaded CDs, the CD's interactive index program will be executed automatically. Otherwise, execute the index program, from a command prompt, or via the Windows "Start", "Run":

```
> Z:SETUP       (replace Z with drive letter for your CD)
```

        ii. Select "Setup PIXCI(R) Imaging Software" and "XCAP Imaging Application for Windows 10/8/7/Vista/XP/2000 32-Bit" or "XCAP Imaging Application for Windows 10/8/7/Vista/XP 64-Bit". Click "OK".
        iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is nominally C:\Program\Files\EPIX\XCAP, or C:\Program\Files(x86)\EPIX\XCAP for installation of 32-bit XCAP on 64-bit Windows, but depends on the current Windows' CSIDL settings.
    b. If XCAP is provided via the internet:
        i. Download:

```
ftp.epixinc.com/software/xcap_v38/XCAPWIN32.EXE (for 32-bit XCAP for Windows)
```

        or

```
ftp.epixinc.com/software/xcap_v38/XCAPWIN64.EXE (for 64-bit XCAP for Windows)
```

        from the EPIX, Inc. ftp site.
        ii. Execute the downloaded program, from a command prompt, or via the Windows "Start", "Run":

```
> XCAPWIN32.EXE     (for 32-bit XCAP for Windows)
```

        or

```
> XCAPWIN64.EXE     (for 64-bit XCAP for Windows)
```

        iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is nominally C:\Program\Files\EPIX\XCAP, or C:\Program\Files(x86)\EPIX\XCAP for installation of 32-bit XCAP on 64-bit Windows, but depends on the current Windows' CSIDL settings.
        iv. Delete the downloaded .EXE file from your computer's hard drive.
    c. The installation procedure creates a new program group, containing XCAP and several .TXT files. The *.TXT files contain these installation instructions, a list of distributed files, corrections or additions to this manual, or other up-to-date information. The `PCITIPS.TXT` file provides the *PCI Configuration Tips*, with tips for resolving hardware and software conflicts. The installation procedure also, optionally, creates a desktop shortcut for XCAP.
2. Install Authorization Key (for XCAP-Plus, XCAP-Std, and XCAP-Ltd):
    a. XCAP-Plus, XCAP-Std, and XCAP-Ltd, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

        The printer port authorization key is black and approximately the size and shape of a printer cable's connector (5.5×4.5×1.6 cm), but having 25-pin connectors at both ends and no cable attached. If provided, connect the authorization key to any printer port. If a printer cable was attached to the printer port, reconnect the printer cable to the back of the authorization key. The authorization key will not affect normal printer operation.

        Do not connect the printer port authorization key to a 25-pin serial (RS-232) port, or to any other interface that happens to use the same style connector; the authorization key will not function, might be permanently damaged, and the warranty will be void!

        The USB port authorization key is blue and approximately the size of the little (i.e. small) finger (6.0×1.6×0.8 cm, or 5.2×1.6×0.8 cm), having a USB standard 4-pin connector at one end. If provided, connect

the authorization key to a USB port. Operating system support for USB devices is required; XCAP does not add USB support to the operating system.

The authorization key must remain attached, to the printer port or USB port as appropriate, while XCAP is running. If the authorization key is missing, or disconnected while XCAP is running, then XCAP-Plus, XCAP-Std or XCAP-Ltd, will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

The XCAP-Plus, XCAP-Std, and XCAP-Ltd and its authorization key are supported only on Intel i386 and x86-64 platforms,

b. The *Driver Assistant* within XCAP, provides simple, interactive installation of the authorization key's driver(s).
c. Or, run the authorization key utility program provided with XCAP by "Start", "Run", from the chosen installation directory:

```
> C:\Program\Files\EPIX\XCAP\HARDLOCK\HASPDINST -install
```

d. Or, in command prompt mode, switch to the chosen installation directory:

```
> CHDIR C:\Program\Files\EPIX\XCAP\HARDLOCK
```

and execute:

```
HASPDINST  -install
```

to run the authorization key utility program.

3. Install PIXCI® Frame Grabber Driver:
   a. The PIXCI® frame grabber's driver may be installed in response to the Windows Device Manager's prompts (it will prompt once after detecting a newly installed card) and pointing the Device Manager to Drivers\Win7 for Windows 7 32-Bit or Drivers\Win7x64 for Windows 7 64-Bit within the chosen installation directory, or may be installed during XCAP's installation (such as via the `XCAPWIN32.EXE` or `XCAPWIN64.EXE` installer), or may be installed by the *Driver Assistant* feature within XCAP.

   Alternately, the PIXCI® frame grabber's driver can be installed as follows.

   b. Under Windows 7 32/64-Bit, the Windows' Device Manager must be used for initial installation of the PIXCI® driver, and your user account must have administrative privileges.

   Open the Windows Device Manager by clicking "Start", "Control Panel", "System & Security", "System", and "Device Manager". In the Device Manager look for an entry with a yellow exclamation mark that is labeled "Multimedia Controller" or "Coprocessor". Double-click on the entry and then click the "Update Driver..." button. In the "Update Driver Software" window that pops-up, select "Browse my computer for driver software"; in the "Search for driver software in this location" enter path Drivers\Win7 for Windows 7 32-Bit, or Drivers\Win7x64 for Windows 7 64-Bit, within the chosen installation directory (typically C:\XCAP or C:\Program\Files\EPIX\XCAP), and click "Next". A window asks "Would you like to install this device software?"; click "Install". A window reports "The software for this device has been successfully installed" and "The hardware you installed will not work until you restart your computer"; click "Finish" and restart Windows.

   c. Alternately, using the Windows Explorer, highlight Drivers\Win7\EPIXXCW2.INF for Windows 7 32-Bit or Drivers\Win7x64\EPIXXCW6.INF for Windows 7 64-Bit within the chosen installation directory, right-click and select "Install", and restart Windows.
4. Restart Windows.
5. XCAP is now ready to run, by clicking the optional shortcut, or by clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

The *Driver Assistant* feature within XCAP simplifies configuration of the PIXCI® frame grabber's driver and the authorization key's driver(s). Under Windows 7 32/64-Bit, such a feature must have administrator privileges. To run XCAP once with administrator privilege, right click on its shortcut or on the "XCAP for Windows" and select "Run as administrator". To always run XCAP with administrator privilege, right click on its shortcut or on the "XCAP for Windows" and select "Properties", "Shortcut", "Run as administrator", and "OK".

3.2. Windows 7 32/64-Bit Esoterica

3.2.1. Windows 7 32/64-Bit - Installation Details

Use of the Windows Device Manager and

```
EPIXXCW2.INF
EPIXXCW2.CAT
EPIXXCW2.SYS
```

for Windows 7 32-Bit, or

```
EPIXXCW6.INF
EPIXXCW6.CAT
EPIXXCW6.SYS
```

for Windows 7 64-Bit, as described above, provides automatic installation of the PIXCI® frame grabber's driver.

The following information assists in correcting problems or integration with an OEM's procedures.

1. The EPIXXCW2.SYS for Windows 7 32-Bit or EPIXXCW6.SYS for Windows 7 64-Bit is copied to the SYSTEM32\DRIVERS directory, typically:

   ```
   C:\WINDOWS\SYSTEM32\DRIVERS
   ```

2. A registry entry, such as:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW2
   ```

   for Windows 7 32-Bit, or

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW6
   ```

   for Windows 7 64-Bit is created with keys such as:

   ```
   ErrorControl  =  0x00000001
   Group         =  "Extended base"
   Start         =  0x00000001
   Type          =  0x00000001
   ```

   In addition, the entry may contain, or have added by XCAP, the key:

   ```
   PIXCI         =  "-IM <memorysize>"
   ```

   with Driver Configuration Parameters, as described below.
3. A registry entry, such as:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCW2
   ```

   for Windows 7 32-Bit or

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCW6
   ```

   for Windows 7 64-Bit is created by the Device Manager with keys such as:

   ```
   EventMessageFile = "%SystemRoot%\System32\IoLogMsg.dll"
   TypesSupported   = 0x00000007
   ```

3.2.2. Windows 7 32/64-Bit - Frame Buffer Memory Allocation

Under Windows 7 32/64-Bit, frame buffer memory must be allocated during Windows' initialization.

The requested frame buffer memory size must be specified in the Registry entry described above, using an entry named "PIXCI", such as:

```
PIXCI         =  "-IM <memorysize>"
```

replacing the "<memorysize>" with the desired memory size in kBytes. If no frame buffer memory size is specified, a default size of 32768 kBytes is used. Windows must be restarted for the new specification to take effect.

Optionally,

```
"-MB <memory_partition_size>"
```

specifies that the requested

```
"-IM <memorysize>"
```

is to be allocated in blocks or partitions of the stated size. Requesting memory partitioned into blocks may allow receiving more memory that would be available as a single block. However, (a) Each frame buffer must be completely contained within a partition, and (b) The maximum number of partitions is 256 under 32 bit operating systems, the maximum number of partitions is 256 under 64 bit operating systems. Systems with very high resolution cameras using large frame buffers should choose the partition size carefully, so as to minimize the unusable memory remaining, smaller than a frame buffer, at the end of each partition.

For the PIXCI® CL3SD and SI2, which have on-board frame buffer memory, memory reserved by the -IM parameter is needed as a DMA buffer (approximately 1 MByte) and optionally for support of time stamping of captured frames as specified by the "-MU" parameter (see PIXCI® Driver Esoterica) specifies use of frame buffer memory for that purpose. Currently, 64 bytes are needed for each frame buffer's capture status.

Windows 7 32/64-Bit limits the maximum amount of allocatable frame buffer memory, dependent upon what other devices are installed, the total computer memory size, and other factors. Under Windows 7 32-Bit, the amount of memory that Windows may grant during startup is typically limited to 1024 MByte, but not more than half of the computer memory size. Under Windows 7 64-Bit, the amount of memory that Windows may grant during startup has not yet been determined, but is probably similar to the limit for Windows Vista 64-Bit: the smaller of 6 GByte or one half of the computer memory size.

Windows may provide less frame buffer memory than was requested. If no memory could be allocated, the PIXCI® frame grabber will not be available, stating "Can't allocate frame buffer memory". Otherwise, within XCAP, the number of available frame buffers can be checked under *PIXCI®*, *PIXCI® Video Setup*, *Resolution*. As the frame buffer memory is allocated once during Windows initialization; the contents of frame buffers are retained as XCAP is closed and restarted, but lost if Windows is restarted.

3.2.3. Windows 7 32/64-Bit - Forceful Frame Buffer Memory Allocation

As described above, frame buffer memory allocated by EPIXXCW2.SYS for Windows 7 32-Bit, or EPIXXCW6.SYS for Windows 7 64-Bit, during Windows startup may be limited to a small percentage of total computer memory. Under Windows 7 32-Bit, the amount of memory that Windows may grant during startup is typically limited to 1024 MByte, but not more than half of the computer memory size. Under Windows 7 64-Bit, the amount of memory that Windows may grant during startup has not yet been determined, but is probably similar to the limit for Windows Vista 64-Bit: the smaller of 6 GByte or one half of the computer memory size. Some computer and/or Windows configurations may have lower limits.

A larger frame buffer memory can be obtained by limiting the amount of memory recognized by Windows, and then instructing EPIXXCW2.SYS for Windows 7 32-Bit, or EPIXXCW6.SYS for Windows 7 64-Bit, to explicitly use a section of memory without allocating it from Windows:

1. Use the Windows' `BCDEDIT` utility to create a copy of the "{CURRENT}" boot entry, set the new entry use limit memory usage via "truncatememory", and changing the new entry's description.

   Typical commands are:

   ```
   BCDEDIT  /enum
   ```

   to list current entries and obtain the current entry's description,

   ```
   BCDEDIT  /copy  {current}  /d  "CURRENT_ENTRY_DESCRIPTION [PIXCI=##M NT=##M"
   ```

   to create a new entry with modified description and boot prompt including a reminder of the amount of memory provided to Windows and to the PIXCI® imaging card,

   ```
   BCDEDIT /enum  /v
   ```

   to get the ID of the new entry, and:

   ```
   BCDEDIT /set <new_entry_id> truncatememory <memory_size>
   ```

   to limit the Windows memory size to <memory_size>, in bytes.

   Also using `BCDEDIT` change the timeout selection to be greater than 0:

   ```
   BCDEDIT /timeout 30
   ```

Otherwise the boot configuration options will not be shown when Windows starts.

2. Edit the registry entry:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW2
```

for Windows 7 32-Bit, or

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW6
```

for Windows 7 64-Bit. On the "PIXCI" field add:

```
-IA <image_memory_adrs_in_kByte>
-IM <size_of_image_memory_in_kByte>
-MB <image_memory_partition_size_in_kByte>
-BH <size_of_BIOS_hole_below_4GB_in_kByte>
```

In practice, all four fields are on the same line.

The -MB partition size specifies the size into which image memory is partitioned for the sake of virtual memory management: (a) Each frame buffer must be completely contained within a partition, (b) A value of 0 specifies that the entire image memory is to be handled as one partition, and (c) The maximum number of partitions is 256 under 32 bit operating systems, the maximum number of partitions is 256 under 64 bit operating systems. For most systems, a value of 8192 or 16384 is suggested; though the value need not be a power of two. Systems with very high resolution cameras using large frame buffers should choose the partition size carefully, so as to minimize the unusable memory remaining, smaller than a frame buffer, at the end of each partition.

When using more than 1 or 2 GBytes of image memory, it may be necessary to append:

```
-MU 0x01
```

to the "PIXCI" field, conserving system memory mapping resources by not mapping the image memory directly into the application program's space. It may also be necessary to append:

```
-MU 0x03
```

which additionally conserves system resources by mapping memory only on demand.

Be careful that the -IA address is equal to (or above) the specified "truncatememory" limit - including exact base2 to base10 conversions! Likewise, be certain that the -IA plus -IM values do not exceed the amount of memory available!

On a computer populated with 4 or more GBytes of memory, some of the memory directly below the 4 GByte address overlaps other hardware resources such as BIOS, memory mapped I/O, PCI configuration space, etc.[1] and is unavailable to either the operating system or for use as frame buffers. The usable frame buffer memory is therefore reduced by the amount by which the -IA address up to the -IA address plus -IM size overlap the 4 GByte address minus -BH size up to the 4 GByte address. The -BH size may be set to 0 (or not specified) if the computer has significantly less than 4 GBytes of memory.

On computers with Intel vPro Technology, computer memory between the 768 MByte and 1024 MByte addresses may be reserved; the -IA address should not be lower than the 1024 MByte address.

3. Restart Windows, using the newly added boot selection.

For example, for a computer with 1 GByte of memory, allocating 256 MByte for Windows and the remainder for frame buffer memory, use:

```
BCDEDIT /set NEW_ENTRY_ID truncatememory 268435456
```

and use:

```
PIXCI = -IA 262144 -IM 786432 -MB 8192
```

in the registry entry. Note that 262144 is 256×1024, and 786432 is (1024-256)×1024.

Note that if this memory allocation method is used, program access to image data may be slower. Thus, the video display rate (and image processing) may be slower, but the video capture rate (such as sequence capture) is not adversely affected. This method of memory allocation is primarily used for video rate acquisition of long sequences, followed by off-line analysis or saving of the sequence.

3.2.4. Windows 7 32/64-Bit - Authorization Key - Manual Installation

Use of HASPDINST.EXE, as described above, provides automatic installation of the printer port authorization key's driver, needed under Windows 7 32/64-Bit for XCAP-Plus, XCAP-Std, and XCAP-Ltd (but not needed for XCAP-Lite). The following information allows manual installation, correcting problems, or integration with an OEM's procedures for the printer port version of authorization keys.

1. The file HARDLOCK.SYS must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

```
C:\WINNT\SYSTEM32\DRIVERS
```

2. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock
```

   This key must contain values:

```
ErrorControl  =  0x00000001
Group         =  "Extended Base"
Start         =  0x00000002
Type          =  0x00000001
```

   or, if using REGEDT32, the values should appear as:

```
ErrorControl:REG_DWORD:0x1
Group:REG_SZ:ExtendedBase
Start:REG_DWORD:0x2
Type:REG_DWORD:0x1
```

3. Shut down and restart Windows for the new registry entries to take effect.
4. If the authorization key is connected to a non-standard printer port, an additional entry may be required:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock\Parameters
```

   which contains a value:

```
IoPortAddress0  = 0x????           (for REGEDIT)
IoPortAddress0:REG_DWORD:0x????    (for REGEDT32)
```

   where the "????" is replaced with the parallel port's I/O address in hexadecimal. As before, Windows must be shut down and restarted.

The

```
HASPDINST.EXE -install
HASPDINST.EXE -remove
HASPDINST.EXE -info
HASPDINST.EXE -help
```

provides for installing, uninstalling, and listing the installed modules to support authorization keys. The authorization key's vendor does not provide detailed information regarding installation of drivers for USB port authorization keys.

3.3. For Windows 8/10 32/64-Bit

1. Install Files:
   a. If XCAP is provided on a compact disk (CD):
      i. If your computer is set to allow automatic execution of loaded CDs, the CD's interactive index program will be executed automatically. Otherwise, execute the index program, from a command prompt, or via the Windows "Start", "Run":

```
> Z:SETUP       (replace Z with drive letter for your CD)
```

      ii. Select "Setup PIXCI(R) Imaging Software" and "XCAP Imaging Application for Windows 10/8/7/Vista/XP/2000 32-Bit" or "XCAP Imaging Application for Windows 10/8/7/Vista/XP 64-Bit". Click "OK".
      iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is nominally C:\Program\Files\EPIX\XCAP, or C:\Program\Files(x86)\EPIX\XCAP for installation of 32-bit XCAP on 64-bit Windows, but depends on the current Windows' CSIDL settings.
   b. If XCAP is provided via the internet:
      i. Download:

```
ftp.epixinc.com/software/xcap_v38/XCAPWIN32.EXE (for 32-bit XCAP for Windows)
```

or

```
ftp.epixinc.com/software/xcap_v38/XCAPWIN64.EXE (for 64-bit XCAP for Windows)
```

from the EPIX, Inc. ftp site.

ii. Execute the downloaded program, from a command prompt, or via the Windows "Start", "Run":

```
> XCAPWIN32.EXE     (for 32-bit XCAP for Windows)
```

or

```
> XCAPWIN64.EXE     (for 64-bit XCAP for Windows)
```

iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is nominally C:\Program\Files\EPIX\XCAP, or C:\Program\Files(x86)\EPIX\XCAP for installation of 32-bit XCAP on 64-bit Windows, but depends on the current Windows' CSIDL settings.

iv. Delete the downloaded .EXE file from your computer's hard drive.

c. The installation procedure creates a new program group, containing XCAP and several .TXT files. The *.TXT files contain these installation instructions, a list of distributed files, corrections or additions to this manual, or other up-to-date information. The `PCITIPS.TXT` file provides the *PCI Configuration Tips*, with tips for resolving hardware and software conflicts. The installation procedure also, optionally, creates a desktop shortcut for XCAP.

2. Install Authorization Key (for XCAP-Plus, XCAP-Std, and XCAP-Ltd):

a. XCAP-Plus, XCAP-Std, and XCAP-Ltd, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

The printer port authorization key is black and approximately the size and shape of a printer cable's connector (5.5×4.5×1.6 cm), but having 25-pin connectors at both ends and no cable attached. If provided, connect the authorization key to any printer port. If a printer cable was attached to the printer port, reconnect the printer cable to the back of the authorization key. The authorization key will not affect normal printer operation.

Do not connect the printer port authorization key to a 25-pin serial (RS-232) port, or to any other interface that happens to use the same style connector; the authorization key will not function, might be permanently damaged, and the warranty will be void!

The USB port authorization key is blue and approximately the size of the little (i.e. small) finger (6.0×1.6×0.8 cm, or 5.2×1.6×0.8 cm), having a USB standard 4-pin connector at one end. If provided, connect the authorization key to a USB port. Operating system support for USB devices is required; XCAP does not add USB support to the operating system.

The authorization key must remain attached, to the printer port or USB port as appropriate, while XCAP is running. If the authorization key is missing, or disconnected while XCAP is running, then XCAP-Plus, XCAP-Std or XCAP-Ltd, will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

The XCAP-Plus, XCAP-Std, and XCAP-Ltd and its authorization key are supported only on Intel i386 and x86-64 platforms,

b. The *Driver Assistant* within XCAP, provides simple, interactive installation of the authorization key's driver(s).

c. Or, run the authorization key utility program provided with XCAP by "Start", "Run", from the chosen installation directory:

```
> C:\Program\Files\EPIX\XCAP\HARDLOCK\HASPDINST -install
```

d. Or, in command prompt mode, switch to the chosen installation directory:

```
> CHDIR C:\Program\Files\EPIX\XCAP\HARDLOCK
```

and execute:

```
HASPDINST  -install
```

to run the authorization key utility program.

3. Install PIXCI® Frame Grabber Driver:

a. The PIXCI® frame grabber's driver may be installed in response to the Windows Device Manager's prompts (it will prompt once after detecting a newly installed card) and pointing the Device Manager to Drivers\Win8

for Windows 8/10 32-Bit or Drivers\Win8x64 for Windows 8/10 64-Bit within the chosen installation directory, or may be installed during XCAP's installation (such as via the `XCAPWIN32.EXE` or `XCAPWIN64.EXE` installer), or may be installed by the *Driver Assistant* feature within XCAP.

Alternately, the PIXCI® frame grabber's driver can be installed as follows.

b. Under Windows 8/10 32/64-Bit, the Windows' Device Manager must be used for initial installation of the PIXCI® driver, and your user account must have administrative privileges.

Open the Windows Device Manager by right-clicking on the lower left corner of the screen and select "Device Manager". In the Device Manager look for an entry with a yellow exclamation mark that is labeled "PCI Device" or "Multimedia Controller" or "Coprocessor" or "Unknown Device". Double-click on the entry and then click the "Update Driver..." button. In the "Update Driver Software" window that pops-up, select "Browse my computer for driver software"; in the "Search for driver software in this location" enter path Drivers\Win8 for Windows 8/10 32-Bit, or Drivers\Win8x64 for Windows 8/10 64-Bit, within the chosen installation directory (typically C:\XCAP or C:\Program\Files\EPIX\XCAP or C:\Program\Files(x86)\EPIX\XCAP), and click "Next". A window reports "Windows has successfully updated your driver software." click "Close" and restart Windows.

c. Alternately, using the Windows Explorer, highlight Drivers\Win8\EPIXXCW2.INF for Windows 8/10 32-Bit or Drivers\Win8x64\EPIXXCW6.INF for Windows 8/10 64-Bit within the chosen installation directory, right-click and select "Install", and restart Windows.

4. Restart Windows. (Note that using Windows' Shutdown instead of Restart may delay Windows' recognition of these changes until the second subsequent shutdown!)
5. XCAP is now ready to run, by clicking the optional shortcut, or by clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

The *Driver Assistant* feature within XCAP simplifies configuration of the PIXCI® frame grabber's driver and the authorization key's driver(s). Under Windows 8/10 32/64-Bit, such a feature must have administrator privileges. To run XCAP once with administrator privilege, right click on its shortcut on the desktop or on the "XCAP for Windows" tile on the start screen and select "Run as administrator". To always run XCAP with administrator privilege, right click on its shortcut on the desktop or right-click on the "XCAP for Windows" tile on the start screen and select "Open file location" then right click on its shortcut and select "Properties", "Shortcut", "Run as administrator", and "OK".

3.4. Windows 8/10 32/64-Bit Esoterica

3.4.1. Windows 8/10 32/64-Bit - Installation Details

Use of the Windows Device Manager and

```
EPIXXCW2.INF
EPIXXCW2.CAT
EPIXXCW2.SYS
```

for Windows 8/10 32-Bit, or

```
EPIXXCW6.INF
EPIXXCW6.CAT
EPIXXCW6.SYS
```

for Windows 8/10 64-Bit, as described above, provides automatic installation of the PIXCI® frame grabber's driver.

The following information assists in correcting problems or integration with an OEM's procedures.

1. The EPIXXCW2.SYS for Windows 8/10 32-Bit or EPIXXCW6.SYS for Windows 8/10 64-Bit is copied to the SYSTEM32\DRIVERS directory, typically:

```
C:\WINDOWS\SYSTEM32\DRIVERS
```

2. A registry entry, such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW2
```

for Windows 8/10 32-Bit, or

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW6
```

for Windows 8/10 64-Bit is created with keys such as:

```
ErrorControl  =  0x00000001
Group         =  "Extended base"
Start         =  0x00000001
Type          =  0x00000001
```

In addition, the entry may contain, or have added by XCAP, the key:

```
PIXCI         =  "-IM <memorysize>"
```

with Driver Configuration Parameters, as described below.

3. A registry entry, such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCW2
```

for Windows 8/10 32-Bit or

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCW6
```

for Windows 8/10 64-Bit is created by the Device Manager with keys such as:

```
EventMessageFile = "%SystemRoot%\System32\IoLogMsg.dll"
TypesSupported   = 0x00000007
```

3.4.2. Windows 8/10 32/64-Bit - Frame Buffer Memory Allocation

Under Windows 8/10 32/64-Bit, frame buffer memory must be allocated during Windows' initialization.

The requested frame buffer memory size must be specified in the Registry entry described above, using an entry named "PIXCI", such as:

```
PIXCI         =  "-IM <memorysize>"
```

replacing the "<memorysize>" with the desired memory size in kBytes. If no frame buffer memory size is specified, a default size of 32768 kBytes is used. Windows must be restarted for the new specification to take effect. Note that using Windows' Shutdown instead of Restart may delay Windows' recognition of these changes until the second subsequent shutdown!

Optionally,

```
"-MB <memory_partition_size>"
```

specifies that the requested

```
"-IM <memorysize>"
```

is to be allocated in blocks or partitions of the stated size. Requesting memory partitioned into blocks may allow receiving more memory that would be available as a single block. However, (a) Each frame buffer must be completely contained within a partition, and (b) The maximum number of partitions is 256 under 32 bit operating systems, the maximum number of partitions is 256 under 64 bit operating systems. Systems with very high resolution cameras using large frame buffers should choose the partition size carefully, so as to minimize the unusable memory remaining, smaller than a frame buffer, at the end of each partition.

For the PIXCI® CL3SD and SI2, which have on-board frame buffer memory, memory reserved by the -IM parameter is needed as a DMA buffer (approximately 1 MByte) and optionally for support of time stamping of captured frames as specified by the "-MU" parameter (see PIXCI® Driver Esoterica) specifies use of frame buffer memory for that purpose. Currently, 64 bytes are needed for each frame buffer's capture status.

Windows 8/10 32/64-Bit limits the maximum amount of allocatable frame buffer memory, dependent upon what other devices are installed, the total computer memory size, and other factors. Under Windows 8/10 32-Bit, the amount of memory that Windows may grant during startup is typically limited to 1024 MByte, but not more than half of the computer memory size. Under Windows 8/10 64-Bit, the amount of memory that Windows may grant during startup has not yet been determined, but is probably similar to the limit for Windows Vista 64-Bit: the smaller of 6 GByte or one half of the computer memory size.

Windows may provide less frame buffer memory than was requested. If no memory could be allocated, the PIXCI® frame grabber will not be available, stating "Can't allocate frame buffer memory". Otherwise, within XCAP, the number of available frame buffers can be checked under *PIXCI®*, *PIXCI® Video Setup*, *Resolution*. As the frame buffer memory is

allocated once during Windows initialization; the contents of frame buffers are retained as XCAP is closed and restarted, but lost if Windows is restarted.

3.4.3. Windows 8/10 32/64-Bit - Forceful Frame Buffer Memory Allocation

As described above, frame buffer memory allocated by EPIXXCW2.SYS for Windows 8/10 32-Bit, or EPIXXCW6.SYS for Windows 8/10 64-Bit, during Windows startup may be limited to a small percentage of total computer memory. Under Windows 8/10 32-Bit, the amount of memory that Windows may grant during startup is typically limited to 1024 MByte, but not more than half of the computer memory size. Under Windows 8/10 64-Bit, the amount of memory that Windows may grant during startup has not yet been determined, but is probably similar to the limit for Windows Vista 64-Bit: the smaller of 6 GByte or one half of the computer memory size. Some computer and/or Windows configurations may have lower limits.

A larger frame buffer memory can be obtained by limiting the amount of memory recognized by Windows, and then instructing EPIXXCW2.SYS for Windows 8/10 32-Bit, or EPIXXCW6.SYS for Windows 8/10 64-Bit, to explicitly use a section of memory without allocating it from Windows 8/10:

1. Use the Windows' `BCDEDIT` utility to create a copy of the "{CURRENT}" boot entry, set the new entry use limit memory usage via "truncatememory", and changing the new entry's description.

   Typical commands are:

   ```
   BCDEDIT  /enum
   ```

   to list current entries and obtain the current entry's description,

   ```
   BCDEDIT  /copy  {current}  /d  "CURRENT_ENTRY_DESCRIPTION [PIXCI=##M NT=##M"
   ```

   to create a new entry with modified description and boot prompt including a reminder of the amount of memory provided to Windows and to the PIXCI® imaging card,

   ```
   BCDEDIT /enum  /v
   ```

   to get the ID of the new entry, and:

   ```
   BCDEDIT /set <new_entry_id> truncatememory <memory_size>
   ```

   to limit the Windows memory size to <memory_size>, in bytes.

   Also using `BCDEDIT` change the timeout selection to be greater than 0:

   ```
   BCDEDIT /timeout 30
   ```

   Otherwise the boot configuration options will not be shown when Windows starts.
2. Edit the registry entry:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW2
   ```

   for Windows 8/10 32-Bit, or

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCW6
   ```

   for Windows 8/10 64-Bit. On the "PIXCI" field add:

   ```
   -IA <image_memory_adrs_in_kByte>
   -IM <size_of_image_memory_in_kByte>
   -MB <image_memory_partition_size_in_kByte>
   -BH <size_of_BIOS_hole_below_4GB_in_kByte>
   ```

   In practice, all four fields are on the same line.

   The -MB partition size specifies the size into which image memory is partitioned for the sake of virtual memory management: (a) Each frame buffer must be completely contained within a partition, (b) A value of 0 specifies that the entire image memory is to be handled as one partition, and (c) The maximum number of partitions is 256 under 32 bit operating systems, the maximum number of partitions is 256 under 64 bit operating systems. For most systems, a value of 8192 or 16384 is suggested; though the value need not be a power of two. Systems with very high resolution cameras using large frame buffers should choose the partition size carefully, so as to minimize the unusable memory remaining, smaller than a frame buffer, at the end of each partition.

   When using more than 1 or 2 GBytes of image memory, it may be necessary to append:

```
-MU 0x01
```

to the "PIXCI" field, conserving system memory mapping resources by not mapping the image memory directly into the application program's space. It may also be necessary to append:

```
-MU 0x03
```

which additionally conserves system resources by mapping memory only on demand.

Be careful that the -IA address is equal to (or above) the specified "truncatememory" limit - including exact base2 to base10 conversions! Likewise, be certain that the -IA plus -IM values do not exceed the amount of memory available!

On a computer populated with 4 or more GBytes of memory, some of the memory directly below the 4 GByte address overlaps other hardware resources such as BIOS, memory mapped I/O, PCI configuration space, etc.[2] and is unavailable to either the operating system or for use as frame buffers. The usable frame buffer memory is therefore reduced by the amount by which the -IA address up to the -IA address plus -IM size overlap the 4 GByte address minus -BH size up to the 4 GByte address. The -BH size may be set to 0 (or not specified) if the computer has significantly less than 4 GBytes of memory.

On computers with Intel vPro Technology, computer memory between the 768 MByte and 1024 MByte addresses may be reserved; the -IA address should not be lower than the 1024 MByte address.

3. Restart Windows, using the newly added boot selection. Note that using Windows' Shutdown instead of Restart may delay Windows' recognition of these changes until the second subsequent shutdown!

For example, for a computer with 1 GByte of memory, allocating 256 MByte for Windows and the remainder for frame buffer memory, use:

```
BCDEDIT /set NEW_ENTRY_ID truncatememory 268435456
```

and use:

```
PIXCI = -IA 262144 -IM 786432 -MB 8192
```

in the registry entry. Note that 262144 is 256×1024, and 786432 is (1024-256)×1024.

Note that if this memory allocation method is used, program access to image data may be slower. Thus, the video display rate (and image processing) may be slower, but the video capture rate (such as sequence capture) is not adversely affected. This method of memory allocation is primarily used for video rate acquisition of long sequences, followed by off-line analysis or saving of the sequence.

3.4.4. Windows 8/10 32/64-Bit - Authorization Key - Manual Installation

Use of `HASPDINST.EXE`, as described above, provides automatic installation of the printer port authorization key's driver, needed under Windows 8/10 32/64-Bit for XCAP-Plus, XCAP-Std, and XCAP-Ltd (but not needed for XCAP-Lite). The following information allows manual installation, correcting problems, or integration with an OEM's procedures for the printer port version of authorization keys.

1. The file HARDLOCK.SYS must be copied to the Windows SYSTEM32\DRIVERS directory, typically:

```
C:\WINNT\SYSTEM32\DRIVERS
```

2. Using the Registry Editor (REGEDIT) provided with Windows, create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock
```

This key must contain values:

```
ErrorControl  =  0x00000001
Group         =  "Extended Base"
Start         =  0x00000002
Type          =  0x00000001
```

or, if using REGEDT32, the values should appear as:

```
ErrorControl:REG_DWORD:0x1
Group:REG_SZ:ExtendedBase
Start:REG_DWORD:0x2
Type:REG_DWORD:0x1
```

3. Shut down and restart Windows for the new registry entries to take effect.
4. If the authorization key is connected to a non-standard printer port, an additional entry may be required:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\HardLock\Parameters
```

which contains a value:

```
IoPortAddress0  = 0x????           (for REGEDIT)
IoPortAddress0:REG_DWORD:0x????    (for REGEDT32)
```

where the "????" is replaced with the parallel port's I/O address in hexadecimal. As before, Windows must be shut down and restarted.

The

```
HASPDINST.EXE -install
HASPDINST.EXE -remove
HASPDINST.EXE -info
HASPDINST.EXE -help
```

provides for installing, uninstalling, and listing the installed modules to support authorization keys. The authorization key's vendor does not provide detailed information regarding installation of drivers for USB port authorization keys.

3.5. For older versions of Windows

See the XCAP Reference Manual for detailed installation instructions.

3.6. For Linux

Super user privileges are required to complete the installation procedure.

1. Install Files:
   a. If XCAP is provided on a compact disk (CD):
      i. Assuming the CD has already been mounted, execute:

```
/media/.../PIXCI(R)/XCAP/xcaplnx_i386.bin
```

for 32-bit Linux, or:

```
/media/.../PIXCI(R)/XCAP/xcaplnx_x86_64.bin
```

for 64-bit Linux. Some systems mount the CD under `/mnt/cdrom` instead of `/media/{loginname}`.

      ii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is `/usr/local/xcap`, or `/usr/local/xcap32` for 32 bit XCAP on an x86-64 platform.
   b. If XCAP is provided via the internet:
      i. Download:

```
ftp.epixinc.com/software/xcap_v38/xcaplnx_i386.bin    (for 32-bit Linux & Intel i386)
```

or

```
ftp.epixinc.com/software/xcap_v38/xcaplnx_x86_64.bin  (for 64-bit Linux & Intel x86-64)
```

or

```
ftp.epixinc.com/software/xcap_v38/xcaplnx_armv7l.bin  (for 32-bit Linux & nVidia TK1 (ARM A15))
ftp.epixinc.com/software/xcap_v38/xcaplnx_armv7l.bin  (for 32-bit Linux & Boundary Devices NITROGEN6 (ARM
```

or

```
ftp.epixinc.com/software/xcap_v38/xcaplnx_aarch64.bin  (for 64-bit Linux & nVidia Nano, TX1, TX2, Xavier,
```

from the EPIX, Inc. ftp site, or via the

```
www.epixinc.com
```

website.

ii. Execute the downloaded program[3] from a shell prompt.

iii. Follow the installation program's directions, such as to select an installation directory. The default installation directory is `/usr/local/xcap`, or `/usr/local/xcap32` for 32 bit XCAP on an x86-64 platform.

iv. Delete the downloaded `.bin` file from your computer's hard drive.

c. The installation procedure creates a "stub" to start XCAP in one of the `/usr/local/bin`, `/usr/bin`, or `/bin` directories, which should already be in the user's execution "PATH". Several `.txt` files are installed under `help` in the installation directory containing these installation instructions, a list of distributed files, corrections or additions to this manual, or other up-to-date information. The `pcitips.txt` file provides the *PCI Configuration Tips*, with tips for resolving hardware and software conflicts.

d. The installation procedure also, optionally, creates a desktop shortcut for XCAP. On some versions of Linux, the desktop manager may not show the shortcut created by the installer; using the Linux file browser, find, copy, and paste `/usr/share/applications/xcap.desktop` onto the desktop.

e. For Intel i386 and x86-64 platforms, XCAP includes a Java Runtime Environment (JRE) and can use either the included JRE or a pre-installed JRE.

For other platforms, XCAP expects a JRE to have been installed from the Linux distribution. Typically, using:

```
apt-get update
apt-get install openjdk-8-jre
```

See a platform specific application note:

- *Installation: Boundary Devices NITROGEN6 (ARM imx6)*
- *Installation: nVidia Nano (ARM Cortex-A57)*
- *Installation: nVidia TK1 (ARM Cortex-A15)*
- *Installation: nVidia TX1 (ARM Cortex-A57)*
- *Installation: nVidia TX2 (ARM Cortex-A57)*
- *Installation: nVidia Xavier (ARM Cortex-A57)*
- *Installation: nVidia Xavier NX (ARM Cortex-A57)*

for tips on installing the Java JRE and other platform specific idiosyncrasies.

2. Install Authorization Key (for XCAP-Plus, XCAP-Std, and XCAP-Ltd):

a. XCAP-Plus, XCAP-Std, and XCAP-Ltd, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

The printer port authorization key is black and approximately the size and shape of a printer cable's connector (5.5×4.5×1.6 cm), but having 25-pin connectors at both ends and no cable attached. If provided, connect the authorization key to any printer port. If a printer cable was attached to the printer port, reconnect the printer cable to the back of the authorization key. The authorization key will not affect normal printer operation.

Do not connect the printer port authorization key to a 25-pin serial (RS-232) port, or to any other interface that happens to use the same style connector; the authorization key will not function, might be permanently damaged, and the warranty will be void!

The USB port authorization key is blue and approximately the size of the little (i.e. small) finger (6.0×1.6×0.8 cm, or 5.2×1.6×0.8 cm), having a USB standard 4-pin connector at one end. If provided, connect the authorization key to a USB port. Operating system support for USB devices is required; XCAP does not add USB support to the operating system.

The authorization key must remain attached, to the printer port or USB port as appropriate, while XCAP is running. If the authorization key is missing, or disconnected while XCAP is running, then XCAP-Plus, XCAP-Std or XCAP-Ltd, will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

The XCAP-Plus, XCAP-Std, and XCAP-Ltd and its authorization key are supported only on Intel i386 and x86-64 platforms,

b. The *Driver Assistant* within XCAP, provides simple, interactive installation of the authorization key's driver(s).

3. Install PIXCI® Frame Grabber Driver:

a. The *Driver Assistant* within XCAP, provides interactive installation of the PIXCI® driver.

4. Configure Graphics Display:

a. Configuring the graphics display to TrueColor or DirectColor modes (using XWindows terminology), or to 24 or 32 bit modes (using graphic display hardware terminology) is suggested for higher quality, and quicker

display of images and overlay graphics.

Within XCAP, the current graphics display configuration can be checked under *Utility*, *Linux Info*, *X11*.

5. XCAP is now ready to run, by executing[4] "xcap", or by clicking the optional shortcut.

3.7. Linux Esoterica

3.7.1. Linux 2.6.x, 3.x, 4.x, 5.x - Manual Installation

Use of the *Driver Assistant* within XCAP provides interactive installation of the `pixci_i386.ko` 32 bit driver for Intel i386, or the `pixci_x86_64.ko` 64 bit driver for Intel x86-64, or the `pixci_armv7l.ko` 32 bit driver for nVidia TK1 (ARM Cortex-A15), or the `pixci_armv7l.ko` 32 bit driver for Boundary Devices NITROGEN6 (ARM imx6), or the `pixci_aarch64.ko` 64 bit driver for nVidia Nano, TX1 ,TX2, Xavier, Xavier NX (ARM Cortex-A57) in most circumstances. The following information allows manual installation, correcting problems, or integration with an OEM's procedures.

1. Use `pixci.sh` (and the `pixci.rc` implied by `pixci.sh`) files to install the required `pixci_i386.ko`, `pixci_x86_64.ko`, `pixci_armv7l.ko`, or `pixci_aarch64.ko` driver, configuring Linux to automatically load the driver upon execution and during subsequent reboots:

   ```
   pixci.sh install
           <absolute path of directory containing pixci.rc>
           <absolute path of directory containing pixci*.ko>
   ```

   The `pixci.rc` loads `pixci_i386.ko`, `pixci_x86_64.ko`, `pixci_armv7l.ko`, or `pixci_aarch64.ko` with Driver Configuration Parameters taken from `/etc/default/pixci` (reread each time the driver is loaded).
2. Optionally, for Linux "tty" style access to the serial ports of Camera Link compatible PIXCI® cards, the `pixcitty_i386.ko`, `pixcitty_x86_64.ko`, `pixcitty_armv7l.ko`, or `pixcitty_aarch64.ko` drivers can be installed with:

   ```
   pixcitty.sh install
              <absolute path of directory containing pixcitty.rc>
              <absolute path of directory containing pixcitty*.ko>
   ```

   and its implied `pixcitty.rc`.

   The optional `pixcitty_i386.ko`, `pixcitty_x86_64.ko`, `pixcitty_armv7l.ko`, or `pixcitty_aarch64.ko` is NOT needed for access to the Camera Link serial port via XCLIB's proprietary API, nor is it needed by XCAP.

In some circumstances, it may be necessary to avoid use of `pixci.sh` and `pixci.rc` (and the implied use of Linux' `/etc/rc` to automatically loading of drivers during boot), and instead manually load the driver when needed.

1. Run

   ```
   insmod pixci_i386.ko [ "PIXCIPARM=<driver_config_parameters>" ]
   ```

   or

   ```
   insmod pixci_x86_64.ko [ "PIXCIPARM=<driver_config_parameters>" ]
   ```

   or

   ```
   insmod pixci_armv7l.ko [ "PIXCIPARM=<driver_config_parameters>" ]
   ```

   or

   ```
   insmod pixci_aarch64.ko [ "PIXCIPARM=<driver_config_parameters>" ]
   ```

   using *PIXCIPARM=* to specify any optional Driver Configuration Parameters described below. For example,

   ```
   insmod pixci_i386.ko "PIXCIPARM=-IM 8192 -DM 1"
   ```

   or

   ```
   insmod pixci_x86_64.ko "PIXCIPARM=-IM 8192 -DM 1"
   ```

or

```
insmod pixci_armv7l.ko "PIXCIPARM=-IM 8192 -DM 1"
```

or

```
insmod pixci_aarch64.ko "PIXCIPARM=-IM 8192 -DM 1"
```

Some versions of *insmod* under 2.6 kernels do not accept quoted spaces in the Driver Configuration Parameters; an underscore (i.e. "_") may be used instead of each space. For example,

```
insmod pixci_i386.ko PIXCIPARM=-IM_8192_-DM_1
```

To use the Driver Configuration Parameters as last set by XCAP's *Driver Assistant*:

```
insmod pixci_i386.ko PIXCIPARM=$(grep pixci.driver.parm= < /etc/default/pixci | sed -e "s/driver.pixci.parm=//"
```

2. Run

```
cat /proc/devices
```

and note the major device number which is assigned to the `pixci` block device. Run

```
rm -f /dev/pixci
mknod /dev/pixci c <major_device_number> 0
chmod 666 /dev/pixci
```

If embedding these commands into a shell script:

```
rm -f /dev/pixci
mknod /dev/pixci c $(awk "\\$2==\"PIXCI(R)\" {print \\$1}" /proc/devices) 0
chmod 666 /dev/pixci
```

automatically "reads" and incorporates the major device number.

3. Optionally, for Linux "tty" style access to the serial ports of Camera Link compatible PIXCI® cards:

```
insmod pixcitty_i386.ko
```

or

```
insmod pixcitty_x86_64.ko
```

or

```
insmod pixcitty_armv7l.ko
```

or

```
insmod pixcitty_aarch64.ko
```

The

```
/dev/ttySPIXCI0
/dev/ttySPIXCI1
...
```

nodes for the first, second, etc. cards are created automatically. The optional `pixcitty_i386.ko`, `pixcitty_x86_64.ko`, `pixcitty_armv7l.ko`, or `pixcitty_aarch64.ko` driver is used in addition to, and installed after, the `pixci_i386.ko`, `pixci_x86_64.ko`, `pixci_armv7l.ko`, or `pixci_aarch64.ko`, driver. The optional `pixcitty_i386.ko`, `pixcitty_x86_64.ko`, `pixcitty_armv7l.ko`, or `pixcitty_aarch64.ko` is NOT needed for access to the Camera Link serial port via XCLIB's proprietary API, nor is it needed by XCAP.

4. For PIXCI® SV2, SV3, SV4, SV5, SV5A, SV5B, and SV5L frame grabbers, drivers other than those provided by EPIX, Inc. may have been installed during Linux's configuration. See *http://will.freehosting.net/bttv-HOWTO.html*, section 5.1 for information on removing the drivers. In brief, use

```
lsmod
```

for a list of currently installed modules and remove any named *videodev*, *i2c*, *i2c-char*, *tuner*, *msp3400*, *bt878*, or *bttv* by using *rmmod*.

3.7.2. Linux 2.4.x, 2.6.x, 3.x, 4.x, 5.x - Frame Buffer Memory Allocation

Under Linux, frame buffer memory must be allocated during the driver's installation.

The requested frame buffer memory size must be specified in the Driver Configuration Parameters, described above, using parameter

```
"-IM <memorysize>"
```

replacing the "<memorysize>" with the desired memory size in kBytes. If no frame buffer memory size is specified, a default size of 4096 kBytes is used under 32 bit Linux. 32768 kBytes is used under 64 bit Linux.

Optionally,

```
"-MB <memory_partition_size>"
```

specifies that the requested

```
"-IM <memorysize>"
```

is to be allocated in blocks or partitions of the stated size. Requesting memory partitioned into blocks may allow receiving more memory that would be available as a single block. However, (a) Each frame buffer must be completely contained within a partition, and (b) The maximum number of partitions is 256 under 32 bit operating systems, the maximum number of partitions is 256 under 64 bit operating systems. Systems with very high resolution cameras using large frame buffers should choose the partition size carefully, so as to minimize the unusable memory remaining, smaller than a frame buffer, at the end of each partition.

For the PIXCI® CL3SD and SI2, which have on-board frame buffer memory, memory reserved by the -IM parameter is needed as a DMA buffer (approximately 1 MByte) and optionally for support of time stamping of captured frames as specified by the "-MU" parameter (see PIXCI® Driver Esoterica) specifies use of frame buffer memory for that purpose. Currently, 64 bytes are needed for each frame buffer's capture status.

Linux limits the maximum amount of allocatable frame buffer memory, dependent upon what other devices are installed, the computer's total memory size, and other factors. Installing the driver immediately after booting Linux improves the likelihood of being able to allocate large amounts of memory.

Linux may provide less frame buffer memory than was requested. If no memory could be allocated, the PIXCI® frame grabber will not be available, stating "Can't allocate frame buffer memory". Otherwise, within XCAP, the number of available frame buffers can be checked under *PIXCI®*, *PIXCI® Video Setup*, *Resolution*. As the frame buffer memory is allocated once during the driver's initialization; the contents of frame buffers are retained as XCAP is closed and restarted, but lost if the driver is uninstalled or Linux is restarted.

For the nVidia TK1 (ARM Cortex-A15), the nVidia TX1/TX2 (ARM Cortex-A57), the nVidia Nano (ARM Cortex-A57) and the Boundary Devices NITROGEN6 (ARM imx6) (but not the nVidia Xavier or Xavier NX), the amount of frame buffer memory that can be allocated is limited by the kernel's "coherent pool" size. For these embedded systems, the memory is split into various special purpose pools - unlike a typical desktop system. For the TK1, TX1, TX2, increasing the "coherent pool" size requires editing the `/boot/extlinux/extlinux.conf` file and setting the "vmalloc", "CMA", and "coherent-pool" parameters. For the NITROGEN6, increasing the "coherent pool" size requires editing the `/6x_bootscript.txt` file and setting the "coherent-pool" parameter, followed by compilation of `/6x_bootscript.txt` via a Boundary Devices tool, and replacement of the `/6x_bootscript` file. Values for "coherent-pool" and other parameters must take into account all devices and requirements of the system.

3.7.3. Linux 2.6.x, 3.x, 4.x, 5.x - Forceful Frame Buffer Memory Allocation

As described above, frame buffer memory allocated by `pixci_i386.ko` or `pixci_x86_64.ko` during its installation may be limited to a small percentage of the computer's total memory.

A larger frame buffer memory can be obtained by limiting the amount of memory recognized by Linux, and then instructing `pixci_i386.ko` or `pixci_x86_64.ko` to explicitly use a section of memory without allocating it from Linux:

1. Edit `/boot/grub/grub.conf` (renamed to `/boot/grub/menu.lst` on some systems), restricting Linux to use no more than a set amount of memory: by copying an existing configuration group, adding mem=XXM (where XX is the memory size in MByte) to the "kernel" line, and changing the prompt name. For example, changing:

```
title Fedora Core (2.6.5-1.358)
    root (hd0,0)
    kernel /vmlinuz-2.6.5-1.358 ro root=LABEL=/ rhgb quiet
    initrd /initrd-2.6.5-1.358.img
```

   to

```
title Fedora Core (2.6.5-1.358) + PIXCI
    root (hd0,0)
    kernel /vmlinuz-2.6.5-1.358 ro root=LABEL=/ rhgb quiet mem=64M
    initrd /initrd-2.6.5-1.358.img
```

When booting, the modified "title" provides a reminder of the modified configuration being selected.

2. Change the Driver Configuration Parameters. Add:

```
-IA <image_memory_adrs_in_kByte>
-IM <size_of_image_memory_in_kByte>
-MB <image_memory_partition_size_in_kByte>
-BH <size_of_BIOS_hole_below_4GB_in_kByte>
```

In practice, all four fields are on the same line.

The -MB partition size specifies the size into which image memory is partitioned for the sake of virtual memory management: (a) Each frame buffer must be completely contained within a partition, (b) A value of 0 specifies that the entire image memory is to be handled as one partition, and (c) The maximum number of partitions is 256 under 32 bit operating systems, the maximum number of partitions is 256 under 64 bit operating systems. For most systems, a value of 8192 or 16384 is suggested; though the value need not be a power of two. Systems with very high resolution cameras using large frame buffers should choose the partition size carefully, so as to minimize the unusable memory remaining, smaller than a frame buffer, at the end of each partition.

Be careful that the -IA address is equal to (or above) the specified "mem=" limit - including exact base2 to base10 conversions! (i.e. for mem=64M, the smallest valid value of -IA is 65536, not 64000!). Likewise, be certain that the -IA plus -IM values do not exceed the amount of memory available!

On a computer populated with 4 or more GBytes of memory, some of the memory directly below the 4 GByte address overlaps other hardware resources such as BIOS, memory mapped I/O, PCI configuration space, etc.[5] and is unavailable to either the operating system or for use as frame buffers. The usable frame buffer memory is therefore reduced by the amount by which the -IA address up to the -IA address plus -IM size overlap the 4 GByte address minus -BH size up to the 4 GByte address. The -BH size may be set to 0 (or not specified) if the computer has significantly less than 4 GBytes of memory.

On computers with Intel vPro Technology, computer memory between the 768 MByte and 1024 MByte addresses may be reserved; the -IA address should not be lower than the 1024 MByte address.

3. Reboot, using the newly added configuration.

For example, for a computer with 1 GByte of memory, allocating 256 MByte for Linux and the remainder for frame buffer memory, use:

```
mem=256M
```

in `grub.conf` (or `menu.lst`), and use:

```
-IA 262144 -IM 786432 -MB 8192
```

in the Driver Configuration Parameters. Note that 262144 is 256×1024, and 786432 is (1024-256)×1024.

Forceful frame buffer memory allocation is not available for `pixci_aarch64.ko` on the nVidia/ARM TX/TX21/Cortex-A57.

Forceful frame buffer memory allocation is not available for `pixci_armv7l.ko` on the nVidia/ARM TK1/Cortex-A15.

Forceful frame buffer memory allocation is not available for `pixci_armv7l.ko` on the Boundary Devices/ARM NITROGEN6/imx6.

3.7.4. Linux 2.6.x, 3.x, 4.x, 5.x - Authorization Key - Manual Installation

Use of the *Driver Assistant* within XCAP, provides interactive installation of the authorization key's driver(s).

For manual installation, correcting problems, or integration with an OEM's procedures, installation instructions are provided in text file `hardlock/INSTALL` within the XCAP installation directory. Alternately, see the `hardlock/drv/src_i386/Makefile` for compiling the parallel port key driver under the current kernel, the `hardlock/drv/pinst` shell file for installing the parallel port key driver, and the `hardlock/sbin/dinst` shell file for installing the USB key daemon, all within the XCAP installation directory.

The parallel port key driver is needed under 2.4.x, 2.6.x, 3.x, 4.x, and 5.x 32-bit kernels even if the parallel port version of the key isn't used. Parallel port keys are not currently supported under 64-bit kernels; the `hardlock/drv/src_x86_64/Makefile` and related files are still provided for legacy systems.

The authorization key and drivers are not supported on nVidia Nano, TX1, TX2, Xavier, Xavier NX (ARM Cortex-A57) systems.

The authorization key and drivers are not supported on nVidia TK1 (ARM Cortex-A15) systems.

The authorization key and drivers are not supported on Boundary Devices NITROGEN6 (ARM imx6) systems.

3.8. PIXCI® Driver Esoterica

The various Driver Configuration Parameters for all operating systems are summarized below.

The Driver Configuration Parameter string may contain any of the following parameters, separated by spaces, in any order. Each parameter's flag is followed by a number, whose value is interpreted as hexadecimal if preceded by "0x" or "0X", octal if preceded by "0o" or "0O", binary if preceded by "0b" or "0B", and is otherwise interpreted as decimal.

-BH *n*

If *n*≠0, the amount of memory space, in kByte, directly below the 4 GByte address which overlaps other hardware resources such as BIOS, memory mapped I/O, PCI configuration space, etc. and is unavailable to either the operating system or for use as frame buffers.[6] The usable frame buffer memory is therefore reduced by the amount by which the -IA address up to the -IA address plus -IM size overlap the 4 GByte address minus -BH size up to the 4 GByte address. Only used with forceful image frame buffer allocation, under Windows NT, 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, 8/10 32/64-Bit, Linux 32 Bit, and Linux 64 Bit. Default: 0.

-BS *n*

If *n*≠0, per-frame buffer capture status is maintained. If *n*=0, per-frame buffer capture status is not maintained. Also see the -MU parameter. Default: 1.

-CL *n*

If bit 0x01 is set, Power over Camera Link (PoCL) is maintained after the PIXCI® frame grabber is closed and later reopened by software. Only selected versions of Camera Link PIXCI® frame grabbers support PoCL; older versions apply PoCL whenever the frame grabber is powered on; newer versions disable PoCL when the PIXCI® frame grabber is closed by software - subject to this option. Setting bit 0x01 will also disable running of "data path" startup diagnostics. Default: 0.

-CQ *n*

Size of queue for video capture enqueue/capture/dequeue services, i.e. pxd_quSnap and pxd_quLive. Queue size is low 10 bits of value (i.e. 0 through 1023) plus, if bit 0x8000 set, the current number of frame buffers (as per the size of frame buffer memory versus the current video resolution). The requested value is forced to the next highest power of 2 and forced to be no smaller than 2; however this behavior is subject to change. Under Windows 95, 98, and ME, the maximum value is 2. Default: 0.

-DM *n*

A bit map selecting which of the PIXCI® frame grabbers present should be used. The *i'th* bit of the bit-map selects the *i*'th board found, sequentially, on the PCI, PCIe, or ExpressCard bus(es). The relationship between bit *i* and the order of motherboard slots is motherboard, BIOS, and OS dependent and can not be specified or queried via XCAP.

For example, 0x01 selects the first board, 0x04 selects the third board, and 0b1001 selects the first and fourth board.

For the PIXCI® E1DB, E4DB, E4G2-2F, E4TX2-2F, E8CAM, E8DB, e104x4-2f, ECB2, EL1DB, ELS2, SI2, and SV7 frame grabbers which contain two independent functional units within a single physical board, and for the PIXCI® E4G2-F2B, E4TX2-F2B, and e104x4-f2b frame grabbers which contains three independent functional units within a single physical board, and for the PIXCI® E4G2-4B, E4TX2-4B, e104x4-4b, and SI4 frame grabbers which contain four independent functional units within a single physical board: Under Windows 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, 8/10 32/64-Bit, Linux 32 Bit, and Linux 64 Bit, each functional unit is handled as an independent frame grabber and may be opened and closed independently. Under other operating systems, the first functional unit (i.e. half, third, or quarter) must be opened before latter functional units of the same physical board. A bit map of 0b1101 selects the first half of the first physical PIXCI® E1DB, E4DB, E4G2-2F, E4TX2-2F, E8CAM, E8DB, e104x4-2f, EL1DB, ECB2, ELS2, SI2, or SV7 frame grabber and both halves of the second physical PIXCI® E1DB, E4DB, E4G2-2F, E4TX2-2F, E8CAM, E8DB, e104x4-2f, EL1DB, ECB2, ELS2, SI2, or SV7;

0b11111001 selects the first and fourth quarter of the first physical PIXCI® E4G2-4B, E4TX2-4B, e104x4-4b, or SI4 frame grabber and all quarters of the second physical PIXCI® E4G2-4B, E4TX2-4B, e104x4-4b, or SI4. Default: 0x01, except under a Windows Plug & Play O.S. where the default is a bitmap of all functional units of the first physical board.

-IA *n*

If *n*≠0, the physical address of memory, in kByte, at which image frame buffers are assumed to start. Only used with forceful image frame buffer allocation, under Windows 95, 98, ME, NT, 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, 8/10 32/64-Bit, Linux 32 Bit, and Linux 64 Bit. Default: 0.

-IM *n*

Requested size, in kByte, to be reserved for the entire image frame buffer memory. Default: 32768 kByte under Windows NT, 2000, XP, Vista 32-Bit, 7 32-Bit, and 8/10 32-Bit, 32768 kByte under Windows XP(x64), Vista 64-Bit, 7 64-Bit, 8/10 64-Bit, and Linux 64 Bit, 4096 kByte for others.

For the PIXCI® CL3SD and SI2 which have on-board frame buffer memory, memory reserved by this parameter is needed for DMA buffers (approximately 1 MByte). Memory reserved by this parameter is also, optionally, used for support of recording per-frame buffer capture status, as specified by the "-MU" parameter. Currently, 64 bytes are needed for each frame buffer's capture status. Default: 4096 kByte.

-I2C *n*

Bit rate of the I^2C or other two wire serial bus used within some PIXCI® frame grabbers. Specifies an upper bound for the bit rate; actual bit rate is dependent on characteristics of the computer system and is typically slower. Value of 0 selects predefined, board-dependent, default values.

Particularly useful for use with SILICON VIDEO® 10C6, 10M6, 1281M, 1281C, 1310, 1310C, 15C5, 1C45, 1M45 2112, 2112C, 2KS-C, 2KS-M, 5C10, 5M10, 642M, 642C, 643M, 643C, 9C10, 9M001, 9M001C, 9T001C, WGA-C, and WGA-M cameras; these SILICON VIDEO® camera heads use a I^2C or similar two wire serial bus to control camera head features.

Does not affect the serial baud rate of Camera Link compatible frame grabbers.

Default: 0.

-LX *n*

If bit 0x20 is set, a high resolution kernel timer (i.e. "do_gettimeofday" for earlier kernels or "getnstimeofday" for kernel 5.x and later) is used for time stamping video events instead of "jiffies" and "HZ"; however, the high resolution timer incurs additional overhead. Only used with Linux 32 Bit and Linux 64 Bit. The new -TI option supersedes this option.

If bit 0x80 is set with non forceful memory allocation, frame buffer memory below 4 GByte is requested; on 64 bit systems with more than 4 GByte of memory, this allows allows use of 32 bit PCI cards. Option is quietly ignored for kernels that don't support the necessary feature(s).

Only used under Linux. Other bits to be described. Default: 0.

-MB *n*

If *n*≠0, the image frame buffer memory, of size specified by "-IM", is split into partitions of this size, in kByte. Depending on operating system and "-IA" parameters, this may imply that each partition is individually allocated, so that a larger, total amount of memory can be allocated. Or that the contiguous memory is treated as individual partitions for the sake of the operating system and processor's virtual memory management, which could not otherwise "map" the entire frame buffer memory at once. In either case, (a) A single frame buffer can't extend across partitions, (b) The partition size should be a multiple of the frame buffer size so as to maximize the number of buffers and minimize wasted space, and (c) A maximum of 256 partitions is supported under 32 bit operating systems, a maximum of 256 partitions is supported under 64 bit operating systems. Default: 0.

-MH *n*

If *n*≠0, the amount of lower memory, in kByte, to pass over before allocating the requested image frame buffer memory. This may be necessary for use with some graphics display or network interface cards which, a) May be allocating memory later than the PIXCI® driver, and b) May require memory with lower addresses. Only used with non-forceful image frame buffer allocation, under Windows NT, 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, and 8/10 32/64-Bit. Default: 0 kByte under Windows NT, 2000, XP, Vista 32-Bit, 7 32-Bit, and 8/10 32-Bit; 512 kByte under Windows XP(x64), Vista 64-Bit, 7 64-Bit, and 8 64-Bit.

-MO *n*

Reserved for future use. Default: 0.

-MU *n*

If bit 0x01 is not set, the frame buffer memory is not mapped directly into the application's address space. If bit 0x02 is set, the frame buffer memory is not permanently mapped into the driver's address space. These options minimize use of the operating systems memory management resources, but may increase overhead in accessing frame buffer memory. These options are typically required when using very large amounts of frame buffer memory (typically, more than 1 or 2 GByte under Windows NT, 2000, XP, Windows NT, 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, and 8/10 32/64-Bit or more than a few hundred MByte under Windows 95/98/ME), but are not currently supported for all Video Format Configurations.

If bit 0x04 is not set, the frame buffer memory is not cleared after allocation, minimizing delay, particularly when using several GBytes of frame buffer memory.

If bit 0x08 is not set, a portion of frame buffer memory is reserved for recording each per-frame buffer's capture status, such as stamping the time of capture. Use of frame buffer memory for capture status may not be supported when using forceful image frame buffer allocation. If bit 0x08 is set, memory is allocated dynamically from the operating system for recording each frame buffer's capture status. The amount of space reserved, or the amount of space allocated, is proportional to the number of frame buffers. The dynamic memory allocation option is not available under Windows 95, 98, or ME; and the per-frame buffer status is discarded upon closing the PIXCI® frame grabber(s).

If bit 0x20 is not set, a portion of frame buffer memory is reserved for serial data buffers used in conjunction with Camera Link serial communication. (For the PIXCI® CL3SD which has on-board frame buffer memory, a small static buffer is used in place of frame buffer memory). If bit 0x20 is set, memory is allocated dynamically from the operating system for serial data buffers. The dynamic memory allocation option is not available under Windows 95, 98, or ME.

If bit 0x40 is set, the frame buffer memory and memory used for recording per frame buffer's capture status is cleared (i.e. set to zero) whenever the capture format resolution, bit depth, bit packing, or color space options are changed. This is intended so that display of the contents of the frame buffer(s), under the new format but before a new image is captured, will show a black image (or green for YUYV formats) rather than "garbled" pixel data. This option is ignored when using forceful image frame buffer allocation, or for frame grabbers with on-board frame buffer memory.

Default: 0x01 under Windows 95, 98, ME. 0x28 under Linux 32 Bit and Linux 64 Bit. 0x29 under Windows NT, 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, 8/10 32/64-Bit.

-PO *n*

If *n*≠0, the polling period, in µseconds, for driver features that are not driven by an interrupt. Ignored under Tenberry DOS4GW DOS extender. Default: 5000 µseconds.

-QP *n*

The XCAP normally installs a bimodal interrupt handler so that XCAP interrupts are handled in both real and protected modes. The Tenberry DOS4GW DOS extender included with Watcom C/C++ does not have all of the features (DPMI services) required by XCAP, the Tenberry DOS4GW Professional DOS extender must be used. Alternately, if *n*≠0, an assigned auxiliary interrupt number (not IRQ number!) within Tenberry's range of auto pass-up interrupts: 0x08 to 0x2E. Only used with the Tenberry DOS4GW DOS extender. Default: 0.

-QS *n*

If *n*≠0, allow sharing the frame grabbers' assigned hardware interrupt with other devices. IRQ sharing is possible problem for cards using the older PCI bus w. IRQ pins, but not for cards using PCI Express and its Message Signaled Interrupts (MSI). Ignored under Tenberry DOS4GW DOS extender. Default: 1.

-QU *n*

If *n*≠0, utilize the frame grabbers' hardware interrupts. For PIXCI® A, A110, A310, CL1, CL2, CL3SD, D, D24, D32, D2X, D3X, D3XE, E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8CAM, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1-PoCL, EB1mini, EC1, ECB1, ECB1-34, ECB2, EL1, EL1DB, ELS2, SI, SI1, SI2, SI4, SV4, SV5, SV5A, SV5B, SV5L, SV7, and SV8 frame grabbers, the interrupt may be disabled if the polling period (-PO) is small relative to a field's period. For PIXCI® SV2 and SV3, disabling the interrupt will adversely affect all capture modes other than snap. For PIXCI® D, D24, and D32, the interrupt may be disabled only if the interrupt is not shared. For all PIXCI® frame grabbers operated under Tenberry DOS4GW DOS extender, use of hardware interrupts is required. Disabling use of interrupts is intended primarily for diagnosing interrupt conflicts, and is not recommended. Default: 1.

-SB *n*

Size of serial data buffers, in bytes, for PIXCI® frame grabbers supporting Camera Link cameras. Currently, the driver rounds the specified value to a power of 2. Default: 1024 bytes.

-SX *n*

Serial options, for PIXCI® frame grabbers supporting Camera Link cameras. If bit 0x01 is set, serial framing errors are ignored. Default: 0.

-SM *n*

Total amount of memory, in kByte, on the computer system. This parameter and value is currently ignored by the PIXCI® driver, but used by XCAP's Driver Assistant in conjunction with -IM and -IA to note the "context" under which the -IM and -IA values were set.

Default: 0.

-XM *n*

If *n*≠0, reserve the proportionate share of image frame buffer memory for frame grabbers not opened by the first application, for use with other frame grabbers opened later. If 0, all image frame buffer memory is shared amongst the frame grabbers opened by the first application. Affects PIXCI® frame grabbers other than CL3SD and SI2, which have on-board frame buffer memory. Default: 1.

-SV5 *n*

Setting bit 0x02 enables compatibility with 430FX PCI controllers. Setting bit 0x04 enables compatibility with VIA/SIS PCI controllers. Only used with PIXCI® SV5, SV5A, SV5B, SV5L. Default: 0.

-TI *n*

If *n*=0, time stamping video events is disabled.

Under Linux: If *n*=1, the "jiffies" and "HZ" are used for time stamping video events. If *n*=2, the high resolution kernel timer (i.e. "do_gettimeofday" for earlier kernels or "do_getnstimeofday" for kernel 5.x and later) is used for time stamping video events. If *n*=3, the "get_jiffies_64" is used for time stamping video events.

Under Windows 95, 98, and ME: If *n*=1, the "Get_Last_Updated_System_Time" is used for time stamping video events.

Under Windows NT: If *n*=1, the "KeQuerySystemTime" is used for time stamping video events.

Under Windows 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit: If *n*=1, the "KeQuerySystemTime" is used for time stamping video events. If *n*=2, the "KeQueryPerformanceCounter" is used for time stamping video events. If *n*=3, the "KeQueryInterruptTime" is used for time stamping video events. If *n*=4, the "KeQueryTickCount" is used for time stamping video events.

Under Windows 8/10 32/64-Bit: If *n*=1, the "KeQuerySystemTime" is used for time stamping video events. If *n*=2, the "KeQueryPerformanceCounter" is used for time stamping video events. If *n*=3, the "KeQueryInterruptTime" is used for time stamping video events. If *n*=4, the "KeQueryTickCount" is used for time stamping video events. If *n*=5, the "KeQuerySystemTimePrecise" is used for time stamping video events.

Each option has various advantages and disadvantages, as described by the operating system's documentation. Default: For backward compatibility, time stamping as per -WT or -LX is used.

-WT *n*

If bits 0x05 are set to 0x01 or to 0x05, alternate methods of Windows NT resource allocation are used, avoiding problems seen on some motherboards where the same resources are assigned to multiple frame grabbers. Only used with Windows NT.

If bit 0x20 is set, a high resolution kernel timer is used for time stamping video events. Windows documentation states that use of this timer incurs additional overhead. Only used with Window NT, 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, and 8/10 32/64-Bit. The new -TI option supersedes this option.

If bit 0x80 is set, frame buffer memory below 4 GByte is requested; on 64 bit systems with more than 4 GByte of memory, this allows allows use of 32 bit PCI cards, and/or allows allows use of 32 bit applications. Only used with Window XP, XP(x64), Vista 64-Bit, 7 64-Bit, and 8/10 64-Bit.

if bit 0x100 is set, the driver applies a patch so that the frame grabber can be opened after Windows awakes from sleep or hibernation modes. Only used with Vista 32/64-Bit, 7 32/64-Bit, and 8/10 32/64-Bit.

If bit 0x200 is set, the driver does not use IOCTL "DIRECT" mode.

If bit 0x1000 is set, the driver implements a work-around so that Windows sleep or hibernation does not adversely affect the operation of older PIXCI® frame grabbers

Only used under Windows. Other bits to be described. Default: 0x20.

-XU *n*

If *n*≠0, allow other applications to share use of frame grabbers previously opened for use by the first application. Not supported under Windows 95, 98, ME: Default: 0. Supported under Windows NT, 2000, XP, XP(x64), Vista 32/64-Bit, 7 32/64-Bit, and 8/10 32/64-Bit: Default: 1. Supported under Linux: Default: 0. Not supported under Tenberry DOS4GW DOS: Default: 0.

4. Getting Started with XCAP

This chapter will guide the user through the initial steps common to most applications using the PIXCI® frame grabber: capturing, viewing, examining, and saving images. This guide is not intended to discuss every feature of every window in XCAP, only the most important features to "get up and running".

Following the previous instructions:

a. The PIXCI® frame grabber has been installed.
b. The camera has been connected to the PIXCI® frame grabber.
c. The XCAP software has been installed.
d. For XCAP-Plus, XCAP-Std, or XCAP-Ltd, but not XCAP-Lite, the authorization key has been installed on a USB port, or, for older systems, installed on the parallel port.
e. Under Windows, the graphics display has been set for 16 bits (minimum required), or 24 or 32 bits (preferred), per pixel. Under Linux, the graphics display has been set to DirectColor or TrueColor.
f. The PIXCI® driver for current version of Windows or Linux has been installed.
g. The computer has been rebooted (Ctrl+Alt+Del) so that the installed driver and the modified graphics display settings (if any) have taken effect.

4.1. Start XCAP

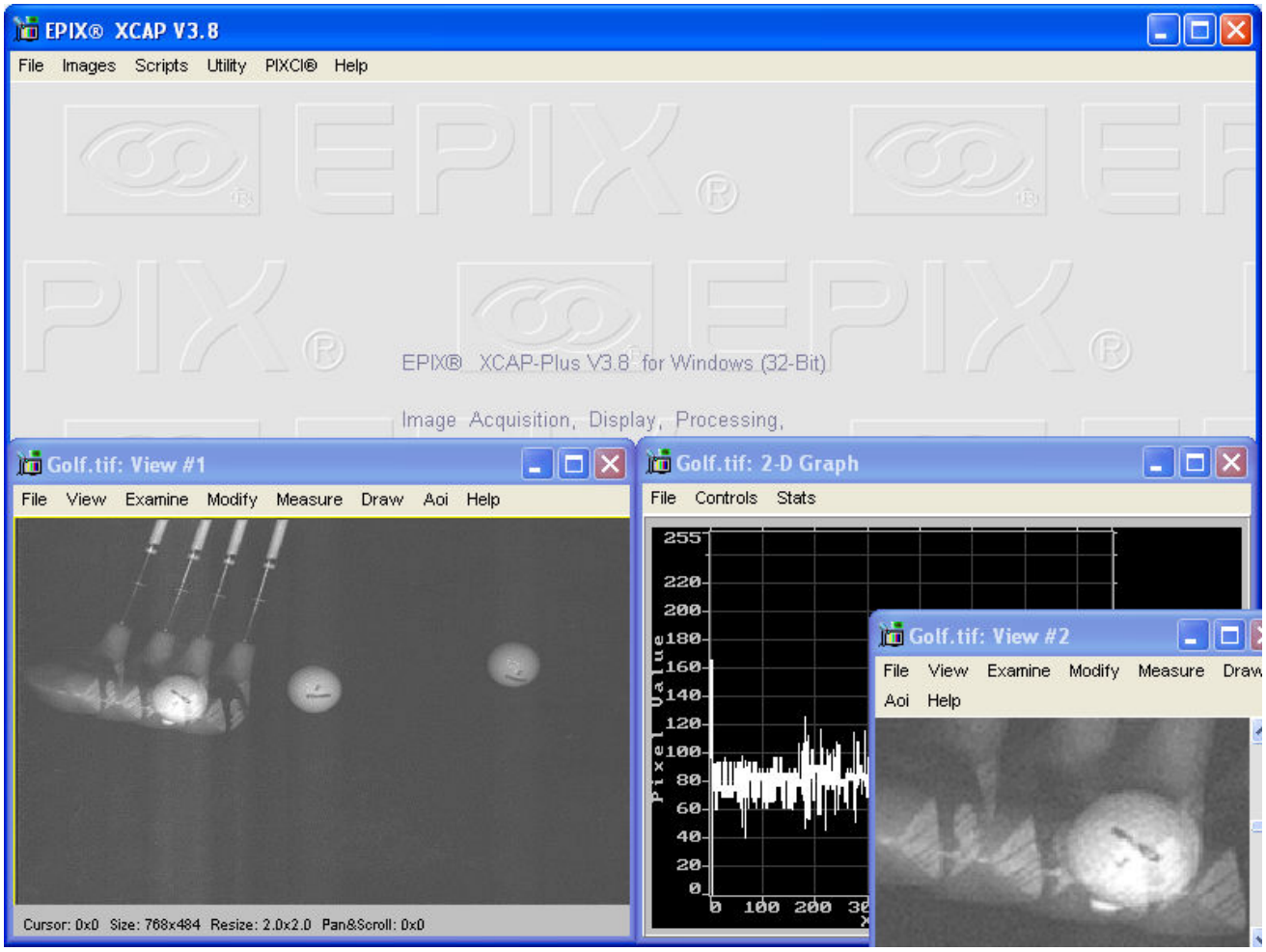
Under Windows, start XCAP by clicking:

```
Start (on the Windows Taskbar)
All Programs (skip for Windows Vista & earlier)
XCAP Imaging
XCAP for Windows
```

Under Linux, start XCAP by executing:

```
xcap
```

The XCAP Main Window now appears.



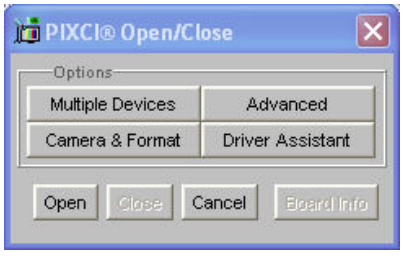
4.2. Open PIXCI® Frame Grabber

XCAP is normally configured to automatically open the PIXCI® frame grabber for use and show the PIXCI® Image Viewer window.

Alternately, in the XCAP Main Window, click:

```
PIXCI®
PIXCI® Open/Close
```

A dialog window appears.



Clicking:

```
Open
```

opens the PIXCI® frame grabber for use, removes the Open/Close dialog.

Upon opening selected PIXCI® frame grabbers, XCAP may display a Camera & Format dialog listing various compatible cameras. Simply click:

```
.. select camera from list ..
OK
Open
```

Opening the PIXCI® frame grabber creates a PIXCI® Image Viewer window showing the first PIXCI® frame buffer, creates a Capture & Adjust dialog with commonly used camera and video capture adjustments and creates a Shortcuts Toolbar for accessing the most commonly needed features.

The following windows are now active:

1. The Main Window, which has options for reconfiguring the PIXCI® frame grabber, and has features independent of the PIXCI® frame grabber, such as loading images into image buffers unrelated to video capture hardware.
2. The PIXCI® Image Viewer window, from which the PIXCI® frame buffers are captured, viewed, examined, processed, measured, and saved, with a status bar below the image with cursor coordinates, video frame rate, and other information.
3. The PIXCI® Shortcut Toolbar, with shortcuts for the most commonly needed features relating to the PIXCI® frame grabber and its frame buffers. The Shortcuts may appear within the PIXCI® Image Viewer window, to the left of the image, rather than a separate window.
4. A Capture & Adjust dialog, with commonly used camera specific and video capture adjustments, or a Capture & Adjust dialog with generic adjustments for use with any Camera Link camera, as specified in that frame grabber's EEPROM.

XCAP may have been configured for one or more variations, such as, (a) Automatically opening, or not opening, the PIXCI® frame grabber and displaying the PIXCI® Image Viewer, (b) Eliminating the Main Window with its menus integrated into the PIXCI® Image Viewer window, (c) Configuring the Shortcuts and/or Capture & Adjust features to be attached to the PIXCI® Image Viewer window rather than detached in their own windows, (d) Selecting whether the Shortcuts and/or Capture & Adjust features appear automatically, or only when:

```
Capture
Shortcuts
```

or

```
Capture
Adjustments
```

are clicked, or (e) Removing the status bar to increase the screen area available for image display. These variations allow custom configuration of XCAP, but do not affect the functionality of the Shortcuts or Adjustments features.

4.3. PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, EL1DB Video Configuration

XCAP selects the camera for which the current PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, or EL1DB frame grabber is intended, as coded into the frame grabber's EEPROM, and typically defaults, for area scan cameras, to capturing full video resolution from the specified camera. Or, if the frame grabber's EEPROM is coded for "Generic Camera Link" the capture resolution is initially set to 888×888 and easily customized, as described below.

To select a different camera from XCAP's list of predefined camera configuration files, or to select Generic Camera Link mode, from the Main window, click:

```
PIXCI®
PIXCI® Open/Close
Close (if open)
Camera & Format
.. select camera from list ..
OK
Open
```

4.4. Capturing Images

Once the PIXCI® frame grabber is opened for use, images can be captured from the PIXCI® Image Viewer, by clicking:

```
Capture
Snap
```

or

```
Capture
Live
```

The *Snap* captures a single image into the current frame buffer, while *Live* continuously captures images into the current frame buffer and continuously updating the image shown on the graphics display.

The *Live* mode can be used to adjust the camera's focus, aperture, and position. The *Live* mode can be halted by clicking:

```
Capture
UnLive
```

A *Live* followed immediately by *Unlive* has the same effect as *Snap*, assuming the camera is in the most-common, free-run mode.

If the current video resolution and frame buffer memory size allows more than one frame buffer, clicking:

```
Capture
Adjustments
```

provides the:

```
Current (Frame) Buffer:   0
```

which may be incremented or decremented at any time, whether in *Live* or *UnLive* mode. The window reached by clicking:

```
Capture
Adjustments
```

has convenient buttons that duplicate the *Snap*, *Live*, and *UnLive* features.

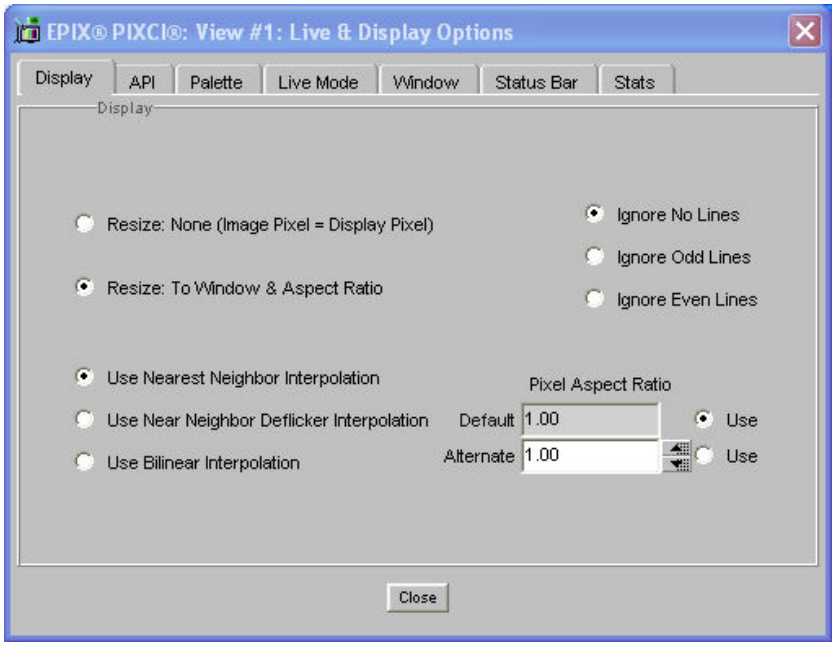
As three of the most commonly used operations, the *Snap*, *Live*, and *UnLive* are also available in the Shortcuts Toolbar, as two shortcuts with a graphic of camera; one for snap and the other for live/unlive. The Shortcuts also allow changing the current frame buffer, as four shortcuts with the graphic of a book's pages; switch to the first frame buffer, to the next frame buffer (e.g. current buffer +1), to the previous frame buffer (e.g. current buffer -1), and to the last frame buffer. The relative position of these shortcuts changes depending on whether the Shortcuts Toolbar is standalone window or within the PIXCI® Image Viewer window, and depending on the graphic display resolution and size of the windows; hovering the mouse over the shortcuts will explain the use of each.

4.5. Examining Images

4.5.1. Altering How the Image is Displayed

The PIXCI® Image Viewer can be moved and resized, using standard techniques (drag the window's title bar, drag the window's corner, etc). By default, the captured image is displayed with resizing, so that the entire image fits within the Image Viewer.

For many engineering and scientific applications, examination of individual pixel values is critically important. Resizing the image may "hide" defective pixels; resizing an image with interlace jitter may turn odd/even line striping into bars of striping.



To view pixels without resizing artifacts, from the PIXCI® Image Viewer, click:

```
View
Display
Resize: None (Image Pixel = Display Pixel)
```

Each image pixel is now displayed as exactly one graphics display pixel. Of course, depending upon the image resolution, graphics display resolution, and window size, the entire image may not fit. If the image doesn't fit, then (a) Scroll bars appear, allowing the viewed portion of the image to be panned and scrolled throughout the entire image, and (b) Moving the mouse with right button held over the displayed image causes panning or scrolling (if there is more image to be seen in the direction the mouse is moving).

For cameras that don't have square pixels (i.e. aspect ratio), after selecting:

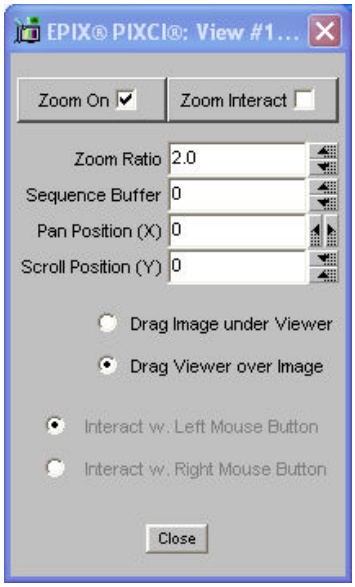
```
Resize: None (Image Pixel = Display Pixel)
```

the displayed image's aspect ratio may not appear correct; the aspect ratio can't be corrected without some form of resizing or resampling!

4.5.2. Zoom

To magnify the image, from the PIXCI® Image Viewer, click:

```
View
Zoom, Pan, Scroll
Zoom On
```



The magnification factor can be adjusted with:

```
Zoom Ratio
```

Or, if

```
Zoom Interact
```

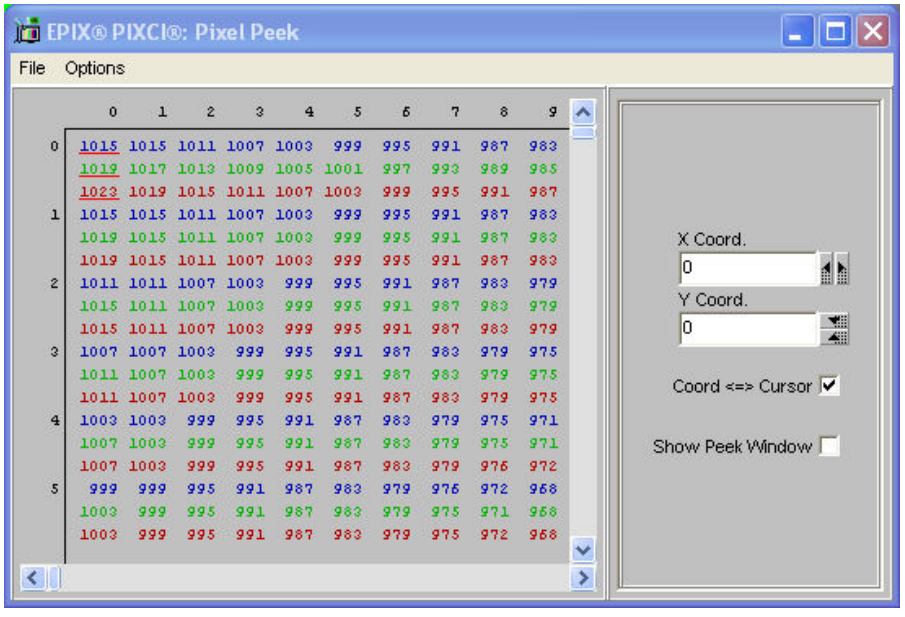
is enabled, magnification can be increased or decreased by clicking on the image. When magnified, only a portion of the image is visible. As described above, the viewed portion may be panned and scrolled through the entire image with the scroll bars, or by moving the mouse over the image with right button held.

4.5.3. Numeric Pixel Values

To examine numeric values of pixels as a table, from the PIXCI® Image Viewer, click:

```
Examine
Pixel Peek
```

A table of pixel values for a portion of the image appears, showing pixel values in the neighborhood of the displayed X and Y coordinates. The portion of the image numerically displayed can be moved by using the scroll bars, or by entering new X and Y coordinates.



The portion of the image which is numerically displayed can also be moved interactively by clicking:

```
Coord<=>Cursor
```

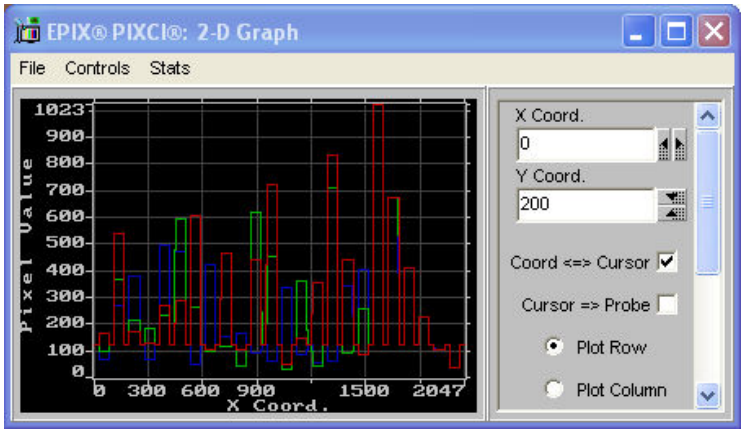
A cursor now appears over the image window (the Pixel Peek window may have to be moved to the side so that both the pixel peek window and the image viewer window can be seen); clicking the mouse on the image viewer window moves the cursor to that position, and repositions the numerically displayed portion of the image to be centered at that position.

To examine pixel values as a two-dimensional graph, click:

```
Examine
Pixel Plot
```

and

```
Controls
Where
and Plot Row
or  Plot Column
```



A graph of pixel values for a line (column) of the image appears, showing pixel values along the line (column) at the displayed Y (X) coordinate. The selected line (column) of the image can be moved interactively by clicking:

```
Coord<=>Cursor
```

A cursor now appears over the image window; clicking the mouse on the image window moves the cursor to that position, and repositions the displayed line (column) to that Y (X) coordinate.

4.6. PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, EL1DB Video Adjustments

4.6.1. Video Resolution

For area scan cameras, reducing the video resolution (the number of pixels captured per line and column) allows capturing more video frames in a given size of frame buffer memory. From the PIXCI® Image Viewer, click:

```
Capture
Adjustments
Res(olution)
```

Click:

```
Set Video Window
```

and draw the new desired area to be captured by left clicking and dragging over the displayed image. Click:

```
OK
```

to accept the new capture resolution. Note: Changing the capture resolution will destroy any images previously captured in the frame buffers!

For line scan cameras, the number of scanned lines which compose each two-dimensional image can be set: From the PIXCI® Image Viewer, click:

```
Capture
Adjustments
Res(olution)
```

Set the:

```
Lines per Field
```

to the desired number.

The

```
Capt(ure)
Frame Buffers
```

shows the number of frame buffers available with the current selections.

4.6.2. Saving the Video Configuration

The selections under the PIXCI® Image Viewer:

```
Adjustments
```

are automatically saved when the PIXCI® frame grabber is closed, and/or XCAP is exited. When the PIXCI® frame grabber is next opened, clicking (from the XCAP Main Window):

```
PIXCI®
PIXCI® Open/Close
Camera & Format
```

Choose:

```
Open w. last used Video Setup
```

to use the previous video setup, or choose:

```
Open w. default Video Setup
```

to start afresh with the default video format and resolution.

4.6.3. Camera Controls

Most of the supported cameras provide controls and features above and beyond sending imagery to the PIXCI® frame grabber. For most cameras, these controls are either switches on or within the camera, commands sent through an RS-232 port, or commands sent through Camera Link serial.

4.6.3.1. Integrated Camera Controls

For selected cameras, XCAP provides convenient, camera specific, integrated, controls.

XCAP integrates controls within the Capture & Adjust window. The left side of the Capture & Adjust window contains controls for the PIXCI® frame grabber. The right side of the Capture & Adjust window provides camera specific controls; these utilize the same concepts and terminology as specified by the camera's manufacturer, so that the camera manufacturer's documentation can be directly applied to these features and controls.

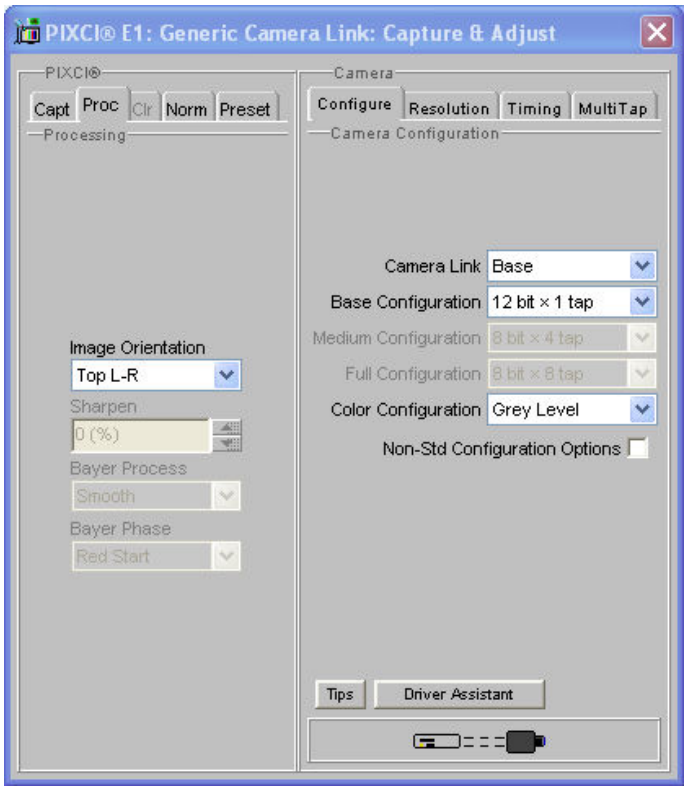
For cameras with switches, the camera's settings can neither be set nor sensed by XCAP! Instead, the Capture & Adjust window shows a sketch of the camera's controls. After selecting a camera operating mode by setting the camera's switches, adjust the sketch's controls to match those of the camera. This convenient technique advises XCAP of the camera's configuration, and allows automatically setting the PIXCI® frame grabber's configuration to match.

For cameras with RS-232 controls, connect the camera's RS-232 connector to the computer's RS-232 (aka "COM") port. In the Capture & Adjust window, use:

```
RS-232 Port
```

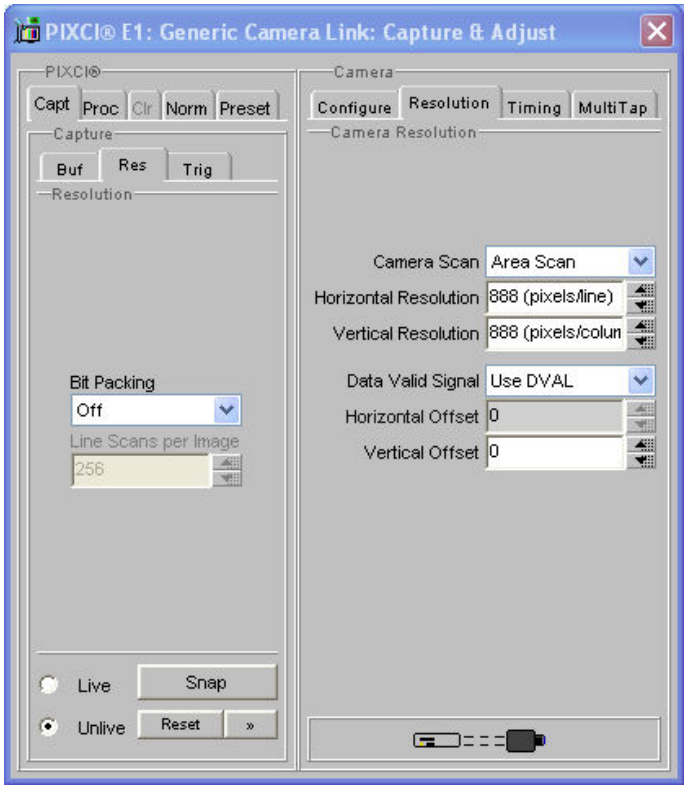
to select the connected "COM" port (under Windows) or "ttyS" device (under Linux). Thereafter, any change of the camera's controls shown in the Capture & Adjust window simultaneously programs the camera and automatically sets the PIXCI® frame grabber's configuration to match! There is no need to run the camera manufacturer's separate RS-232 control program.

For cameras Camera Link serial controls, the serial commands are sent via the same Camera Link cable used for image data. As for cameras with RS-232 controls, any change of the camera's controls shown in the Capture & Adjust window simultaneously programs the camera and automatically sets the PIXCI® frame grabber's configuration to match. There is no need to connect a second cable, nor any need to run the camera manufacturer's separate control program.



4.6.3.2. Generic Controls

For other cameras, XCAP offers generic controls. The camera should be configured by following the camera manufacturer's instructions, typically using a "Control Panel" application supplied by the camera manufacturer.



XCAP provides generic controls within the Capture & Adjust window. The right side of the Capture & Adjust window provides Camera Link specification controls, using standard Camera Link terminology; these controls allow configuring the PIXCI® frame grabber's video resolution, trigger modes, bit depth, color space, etc. so as to be consistent with the camera. The left side of the Capture & Adjust window provides the remaining controls for the PIXCI® frame grabber.

4.6.4. Color Cameras

For color cameras with so-called "Bayer format output", it is XCAP software which performs color adjustments and white balancing, not the camera. From the PIXCI® Image Viewer, click:

```
Capture
Adjustments
Color (or Clr)
```

For most common conditions:

a. Select one of the pre-defined correlated color temperatures, either based on best appearance, or matching the color temperature of the current illumination. The *5000°K* selection is average overcast daylight, the *4100°K* selection is a typical cool white fluorescent bulb, and the *2800°K* selection is a typical 60 to 100 watt tungsten bulb.
b. Choose one of the predefined color qualities, trading quality for speed.
c. If none of the predefined settings is satisfactory, start with the best setting and click:

```
Customize
```

Cover the camera's lens and click:

```
Black Balance
```

Finally point the camera at a white target (but preferably not a target using fluorescent brighteners) and click:

```
White Balance
```

4.7. Saving Images

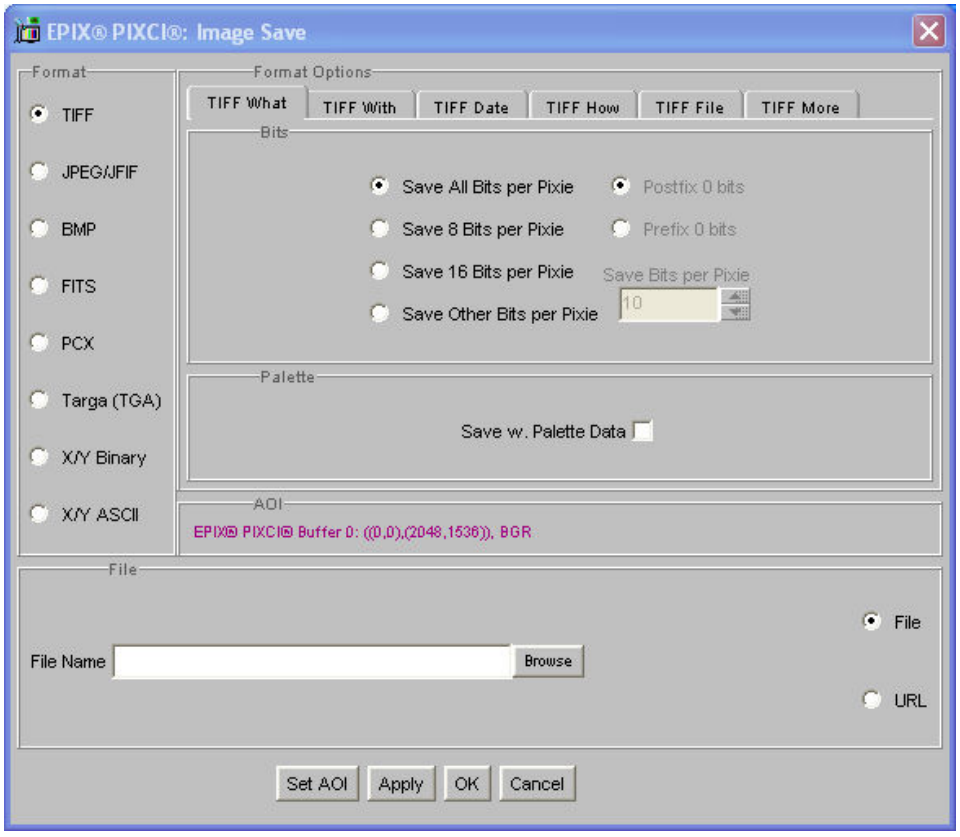
To save a captured image, from the PIXCI® Image Viewer, click:

```
File
Save Image
```

Choose a file format, such as:

```
TIFF
JPEG/JFIF
BMP
FITS
PCX
Targa (TGA)
Portable Map
X/Y Binary
X/Y ASCII
```

TIFF is an industry standard, and the most commonly used image file format; TIFF is suggested for saving and reloading an image into XCAP, and suggested for exporting images to other programs which support TIFF. The JPEG/JFIF is also a commonly used image file format and can provide high, but "lossy", compression (i.e. the reconstructed image is not, numerically, exactly the same as the original image). The FITS is a commonly used format within the scientific - particularly astronomy - community. The BMP, PCX, and TGA formats are useful when exporting an image into other programs that don't support TIFF; but these file formats support only 8 bits per pixel component (such as 8 bit monochrome or 24 bit RGB).



The X/Y Binary and X/Y ASCII export raw pixels, left to right, top to bottom, with no excess information such as dimensions, bit depth, date, format, etc; these are useful for exporting images to a spreadsheet (X/Y ASCII), or to your own program that can assume the image's dimensions and can simply read a 2-D array of values. The Portable Map also export raw binary pixels, left to right, top to bottom, but with minimal information at the start of the file.

After selecting a file format, enter a file name:

```
File Name:  xx.tif
```

and click

```
OK
```

to save the image. Or, use the:

```
Browse
```

button to access the standard Windows or Linux File Dialog, click

```
Accept
```

to accept the filename selected by browsing, and click

```
OK
```

to save the image.

4.8. Capturing an Image Sequence

To capture an image sequence into the frame buffers:

```
Capture
Sequence Capture
Video to Frame Buffers
```

select:

```
Start/End All Buffers
```

to capture into all of the frame buffer memory,

```
Capture Video Fastest
```

to capture each video frame (rather than intentionally skipping frames),

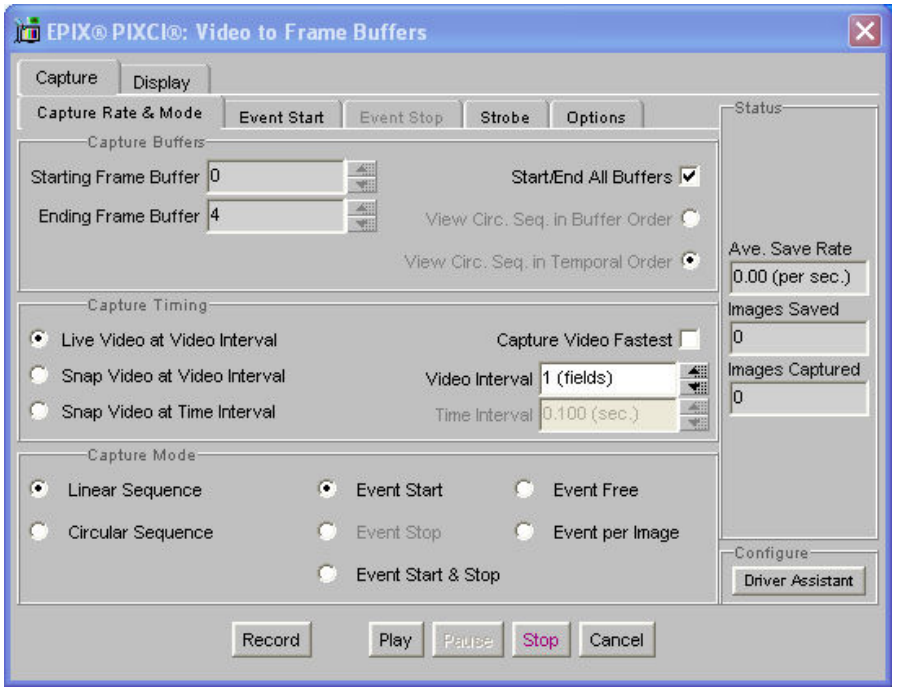
```
Linear Sequence
```

to capture into each frame buffer once, then stop (rather than capturing continuously, reusing frame buffers until explicitly stopped),

```
Event Free
```

to capture without waiting for additional events, and and click:

```
Record
```



The *Video*to*Frame*Buffers captures into frame buffer memory; to request more frame buffer memory and a thereby a longer sequence use the

```
Driver Assistant
```

A variety of *Sequence Capture* features are available, providing tradeoffs between capture rate vs. convenience vs. total number of images captured. The *Video to Frame Buffers* captures sequences directly into pre-configured frame buffer memory, and can support the maximum frame rate. The *Video to Virtual Memory* captures and copies sequences into host

computer (virtual) memory which is conveniently allocated as-needed, but may not support maximum frame rate capture for all cameras on all computers. The *Video to Disk File* captures and copies sequences into a disk file in an efficient, internal format (after capture the sequence can be saved in a standard format), but frame rate is limited by the bandwidth of the computer and disk subsystem.

The *Video to Image Files* captures and copies sequences directly into standard format image files, but with more overhead than the *Video to Disk File* feature. Optionally, each captured image can also be saved offsite directly to an FTP URL. Optionally, the HTTP server (i.e. web server) feature of XCAP allows access to the sequence of images - as they are being captured - via an internet web browser.

4.9. Saving Image Sequences

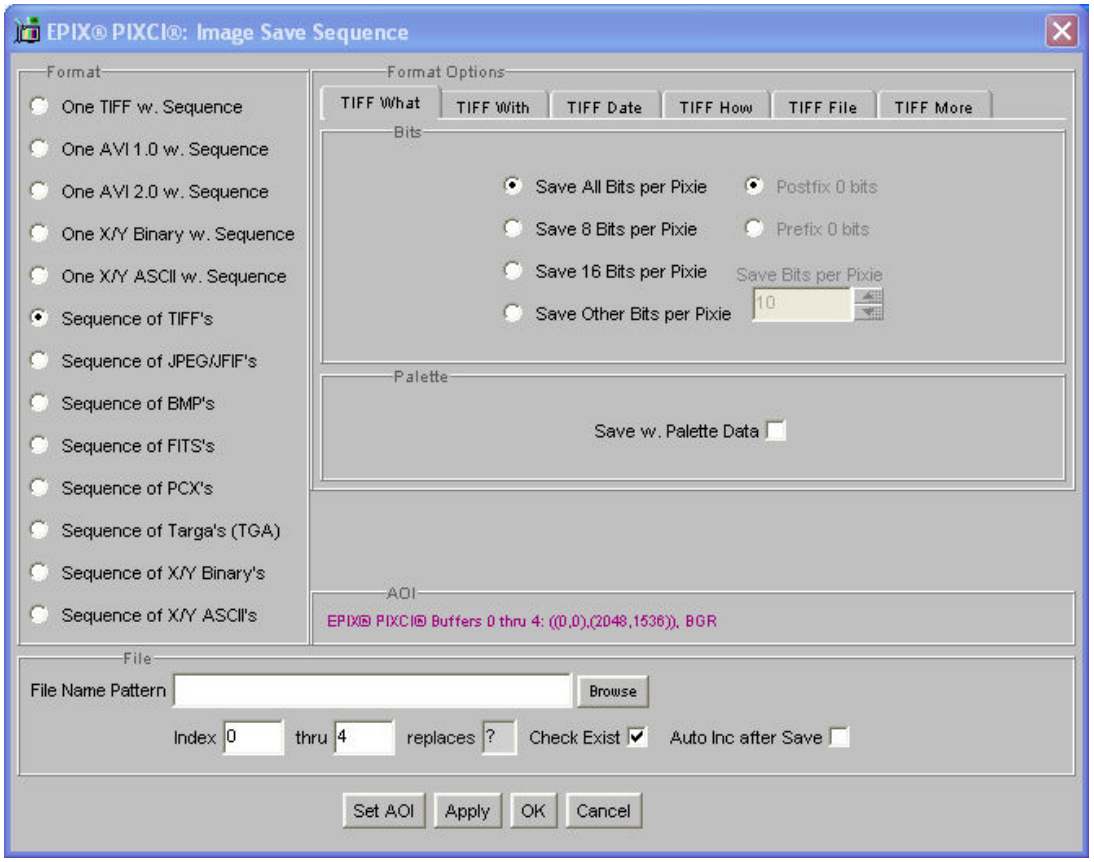
To save a captured image sequence, from the PIXCI® Image Viewer, click:

```
File
Save Image Sequence
```

Choose a file format, such as:

```
One TIFF w. Sequence
One AVI w. Sequence
One Portable Map w. Sequence
Sequence of TIFF's
Sequence of JPEG/JFIF's
Sequence of BMP's
Sequence of FITS's
Sequence of PCX's
Sequence of Targa's (TGA)
Sequence of Portable Map's
Sequence of X/Y Binary's
Sequence of X/Y ASCII's
```

The One TIFF, One AVI, and One Portable Map store the entire sequence into a single file; the other options store each image into an individual file. Similar to BMP format (discussed above), the AVI format only supports 8 bits per pixel component (such as 8 bit monochrome or 24 bit RGB).



After selecting any of the "One .. w. Sequence", file formats, enter a file name:

```
File Name:  xx.tif
```

and click:

```
OK
```

to save the image(s). Or, use the:

```
Browse
```

button to access the standard Windows or Linux File Dialog, click:

```
Accept
```

to accept the filename selected by browsing, and click:

```
OK
```

to save the image(s).

If using any of the "Sequence of .." file formats, enter a file name pattern:

```
File Name:  xx???.tif
```

where the "?" characters will be replaced by a numerical index, (enter sufficient "?" characters as per sequence length; three "?"'s are sufficient for 1000 images) and click:

```
OK
```

to save the image(s).

4.10. Additional XCAP Documentation

For additional guidance in using XCAP, click

```
Help
XCAP Reference Manual
```

to browse the full manual.

5. XCAP Software Guide

XCAP is a family of sophisticated, interactive, imaging programs specifically designed to support the PIXCI® series of frame grabbers, but also able to process and analyze images from other imaging sources. Several versions of XCAP are available: XCAP-Plus, XCAP-Std, XCAP-Ltd, XCAP-Lite, and XCAP-Viewer. All versions share the same user interface and menu structure, but selected features in XCAP-Std, XCAP-Ltd, XCAP-Lite, and XCAP-Viewer are not operational. XCAP is distributed on CD, or downloadable from the EPIX, Inc. website. After installation, a 12 character identification code[7] is entered to configure XCAP as either XCAP-Plus, XCAP-Std, XCAP-Ltd,[8] or XCAP-Lite; or, lacking a valid code, configured as XCAP-Viewer to browse, but not use, XCAP's features.

XCAP-Std is an interactive, imaging program designed for scientific, industrial, and machine vision applications. XCAP-Std supports the PIXCI® frame grabber, providing video format and resolution configuration; continuous (live), video rate sequence, and triggered capture; and single or sequence, zoomed or resized, display. The image frame buffers of PIXCI® frame grabbers can be loaded, examined, processed, analyzed, measured, printed, annotated, and saved.

XCAP-Std also allows loading, analyzing, modifying, and saving a pre-existing image or image sequence with size, pixel depth, and color space independent of the PIXCI® frame grabber's configuration; XCAP-Std can be used with pre-existing images even when the PIXCI® frame grabber is not present. XCAP-Std can also acquire images from TWAIN compliant devices.

XCAP-Plus provides extra, advanced, features in addition to all of the capabilities of the XCAP-Std, such as support for specialized, optional, hardware.

XCAP-Ltd is a simplified version of XCAP-Std. XCAP-Ltd provides the same image acquisition and PIXCI® frame grabber control capabilities, the same image display features, and the same image loading, examining, printing, and saving of single image or sequences of images. Only minimal image processing, measurement, analysis, and scripting features are functional. XCAP-Ltd can be used with pre-existing images even when the PIXCI® frame grabber is not present.

XCAP-Lite is a much simplified version of XCAP-Std. XCAP-Lite provides similar image acquisition and PIXCI® frame grabber control capabilities, video format and resolution configuration; continuous (live), video rate sequence, and triggered capture; and single or sequence, zoomed or resized, display. XCAP-Lite also provides some of the image loading, examining, printing, and saving features, but minimal processing, measurement, analysis, and scripting features are functional. XCAP-Lite can also be used with pre-existing images, but only while the PIXCI® frame grabber is present and opened for use.

XCAP-Viewer allows browsing through the dozens of processing, measurement, analysis, and graphics features provided in XCAP-Plus, XCAP-Std, XCAP-Ltd, or XCAP-Lite. Images can't be loaded from, or saved to, files. Nor can the PIXCI® frame grabber be operated with the XCAP-Viewer version.

As XCAP-Plus, XCAP-Std, XCAP-Ltd, XCAP-Lite, and XCAP-Viewer share many common features, this manual typically refers to all versions as XCAP, except where explicitly differentiated.

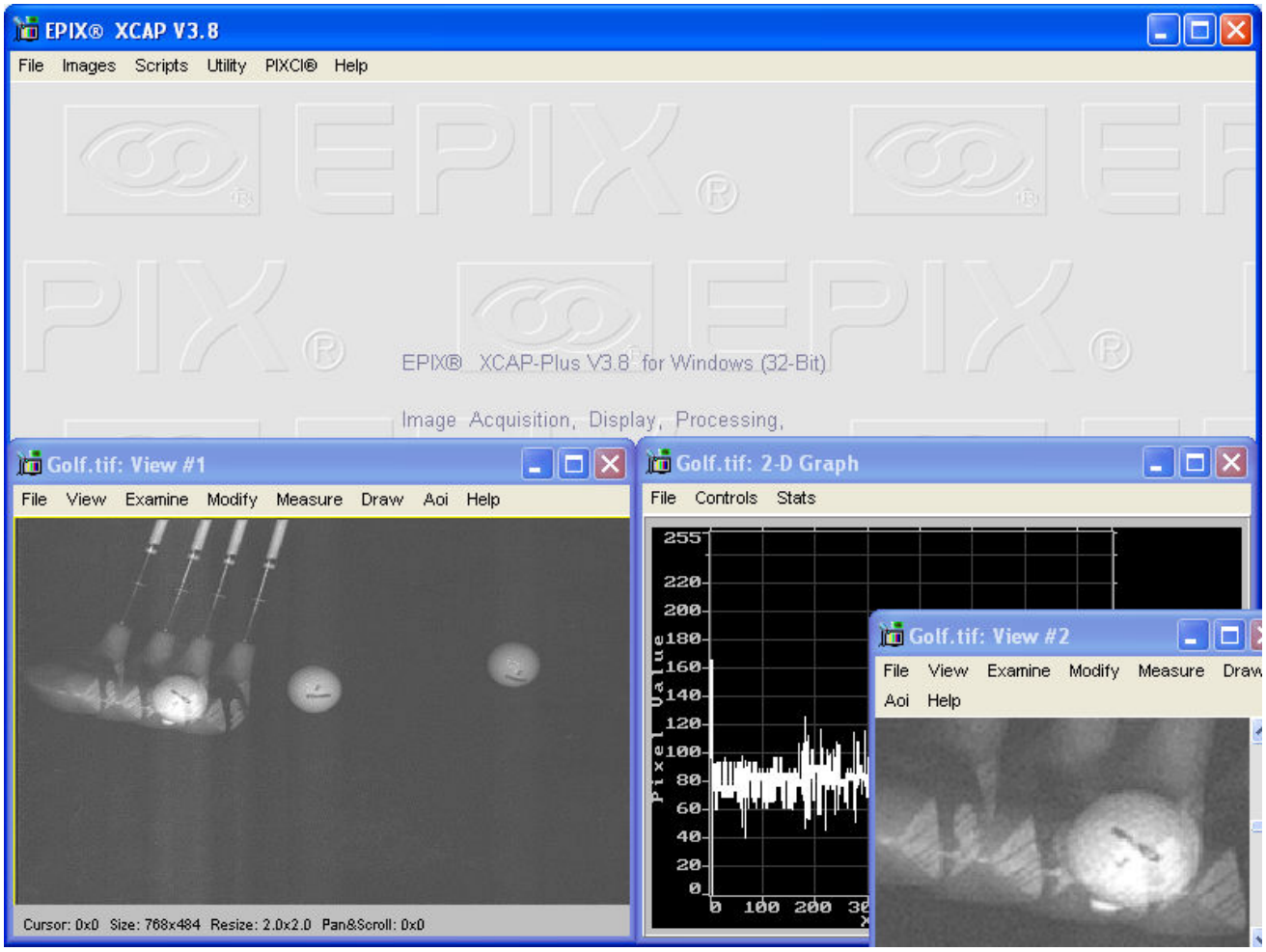
The XCAP features are organized into two major types of windows, the Main Window and one or more Image Viewer Windows.

For each image, or sequence of images, an Image Viewer Window shows that image, or a selected image of that sequence, and via its menu bar allows viewing, examining, processing, analyzing, or drawing upon that image (sequence). The Image Viewer Window associated with the PIXCI® frame grabber's frame buffers also provides features for capturing new images. There can be multiple Image Viewer Windows for the same image (sequence), allowing, for example, viewing the image both magnified (i.e. zoom) and unmagnified, or simultaneous viewing of different images of a sequence.

The Main Window allows creating new image (sequences), and thus new Image Viewer Windows, either by loading a new image from file, explicit specification of the new image's dimensions, or by opening the PIXCI® frame grabber for use. Video setup for the PIXCI® frame grabber, such as modifying the video resolution or color space, are also in the Main Window; these features may close and re-create the PIXCI® frame grabber's Image Viewer Window. The Main Window also provides features not directly associated with an image (sequence), such as scripts, RS-232 device control, and features to customize XCAP.

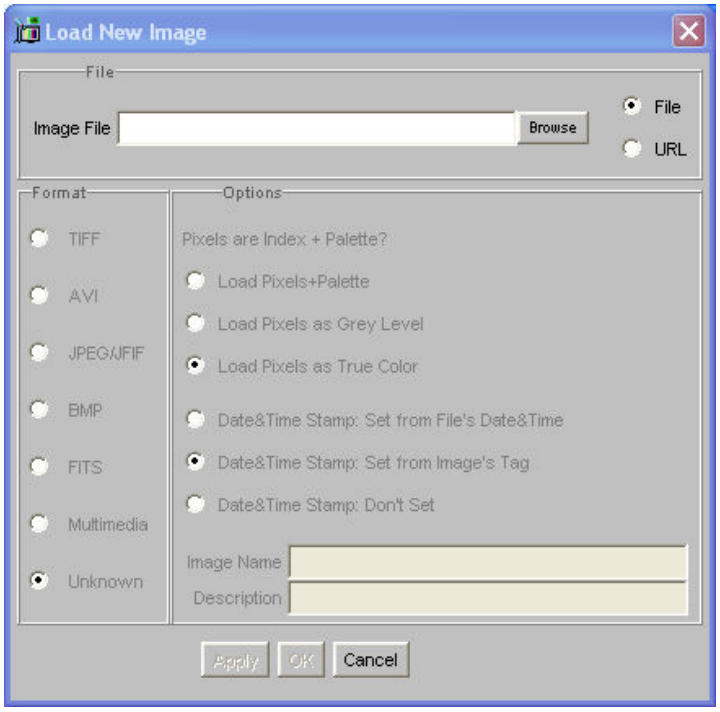
5.1. The Main Window

The XCAP main window provides a menu bar with *File*, *Images*, *Scripts*, *Utility*, *PIXCI®*, and *Help* features.

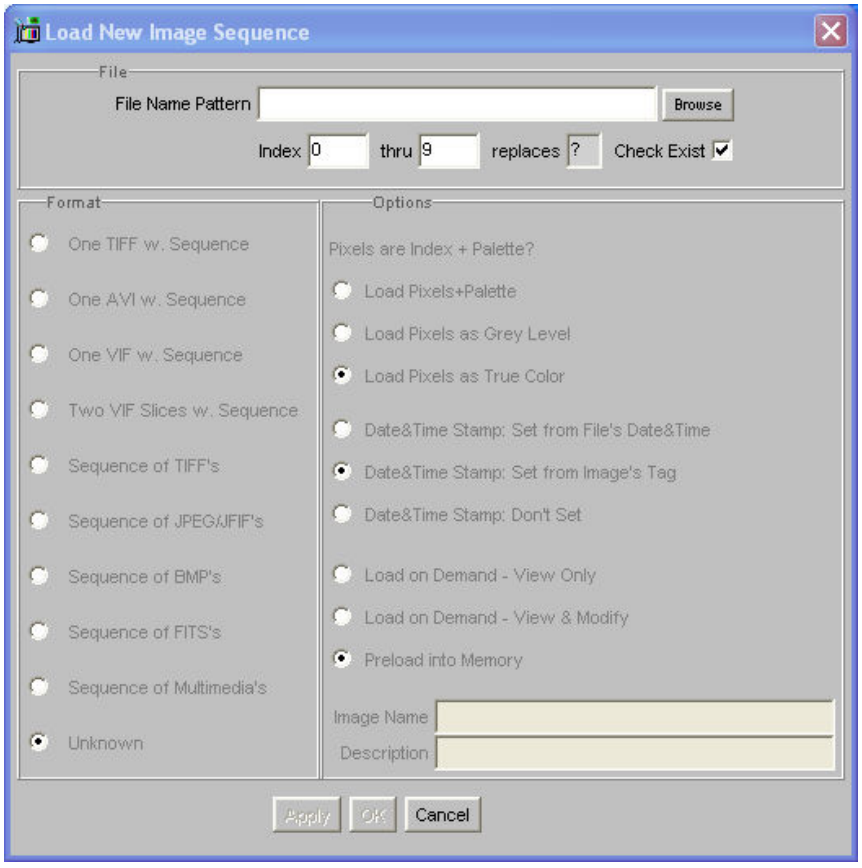


5.1.1. Main Window - File

The main window's *File* allows loading of pre-existing images into new image buffers, displaying attributes about pre-existing images, and acquiring images from TWAIN compliant devices.



The *Load New Image* and *Load New Image Sequence* creates a new image buffer (sequence) with dimensions, pixel depth, and color space matching a specified TIFF (Tagged Image File Format), AVI (Audio Video Interleaved), BMP (Biitmap), JPEG (Joint Photographic Exports Group), FITS (Flexible Image Transport System), PBM/PGM/PBM (Portable Bit/Gray/Pixel Map), VIF (Video Frame Files - Video to Disk) or multimedia format file(s), and loads the image(s) from the file(s). This feature, and the image buffer (sequence) created, is unrelated to the PIXCI® frame grabber's frame buffers. After creation and loading, the new image (sequence) is displayed, processed, and analyzed in a new instance of *The Image Viewer Window*, described below.



The *Load New Image* can also load images directly from an Internet URL. The XCAP-Lite version does not provide the *Load New Image Sequence* or loading directly from an URL features. The XCAP-Ltd version does not support VIF format files.

The *Image File Info* displays information about a specified TIFF, BMP, JPEG, FITS, PBM/PGM/PPM, or VIF format file without loading the image. The information displayed includes the image's dimensions, pixel depth, color space, palette option, and other file format specific information.

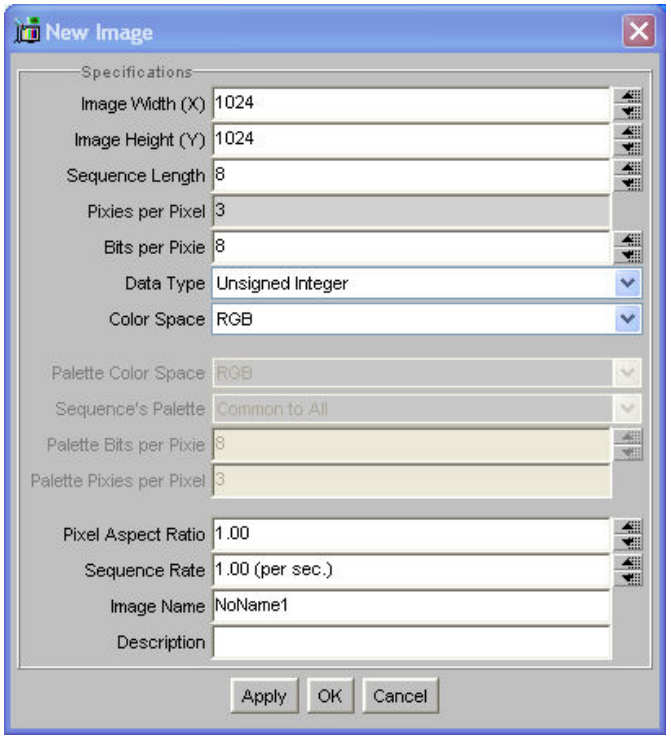
The *TWAIN Select Source* and *TWAIN New Acquire* allow using XCAP as a TWAIN Application, acquiring images from TWAIN compliant imaging devices (TWAIN Sources). The *TWAIN Select Source* allows selecting which TWAIN Source is to be used, and the *TWAIN New Acquire* allows acquiring one image from the TWAIN Source. The XCAP-Lite and XCAP-Ltd versions do not support being used as a TWAIN Application.

The *Window List* displays a list of active windows belonging to XCAP; selecting a window causes that window to appear, if previously hidden, and/or to appear over other windows (subject to the priority of selected windows to always appear "on top").

5.1.2. Main Window - Images

The main window's *Images* allows creating new image buffers and activating any existing image windows that may not be on-screen.

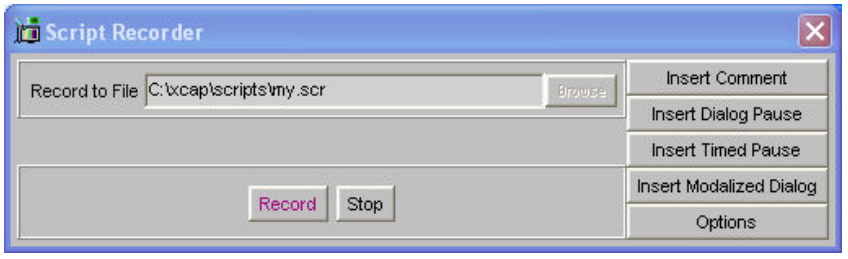
The *New Image* creates a new image buffer, or sequence of image buffers, with specified dimensions, pixel depth, color space, and palette. This feature, and the image buffer created, is unrelated to the PIXCI® frame grabber's frame buffers. After creation, the new image is displayed in a new instance of *The Image Viewer Window*, as described below.



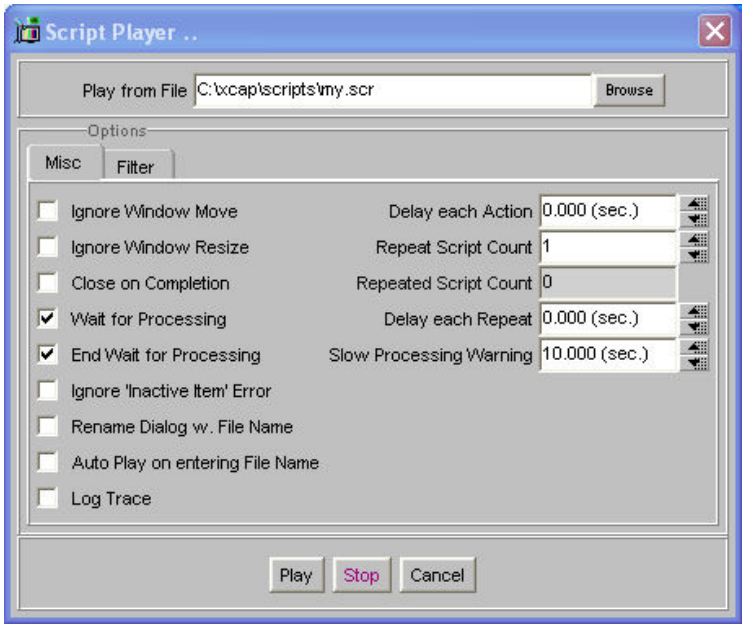
Underneath *New Image* are listed all existing image windows, whether for PIXCI® frame grabber frame buffers, or for independent image buffers. (The image window for PIXCI® frame grabber frame buffers appears only after the PIXCI® frame grabber has been opened for use, see below). An image window which has been closed and is thereby off-screen can be reactivated by clicking the image window's name.

5.1.3. Main Window - Scripts

The main window's *Scripts* provides features for recording and playing scripts. A script recording contains most of the user's interactions with the windows of XCAP; playing the script duplicates the original actions.

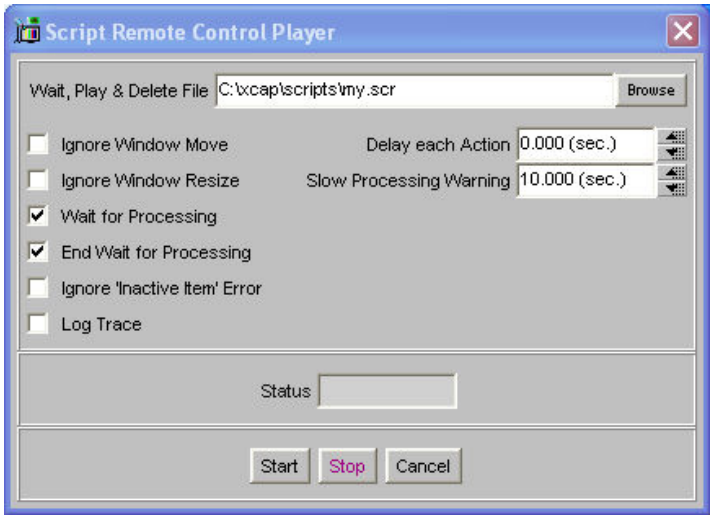


Some user actions are not recorded. Using the mouse to drag the cursor or other graphic across an image is not recorded as these actions are highly dependent upon image content (such as the typical scenario of dragging the cursor until it is positioned next to an artifact in a captured image), would likely be inappropriate to other captured images, and recording each mouse "step" would consume a significant amount of disk space. Instead, after positioning the cursor interactively the user can record the final position by clicking the appropriate numeric cursor coordinates. Similarly, the activation of a feature with shortcut keys or shortcut icons is not recorded; instead features can be activated via the non-shortcut alternative, which is recorded.



A recorded script is in a human readable form and can be altered with any common editor capable of handling ASCII text, allowing scripts to be modified or combined. A selected script may be executed automatically after XCAP starts, this feature is set in *Utility*, *Program Setup*, *Startup Script*.

The *Load Tool Bar* provides one or more user-defined tool bars of shortcuts, each shortcut represented by an icon which, when clicked, executes a user-specified script. Each shortcut may also specify an optional keyboard key which, when pressed, also executes the user-specified script.

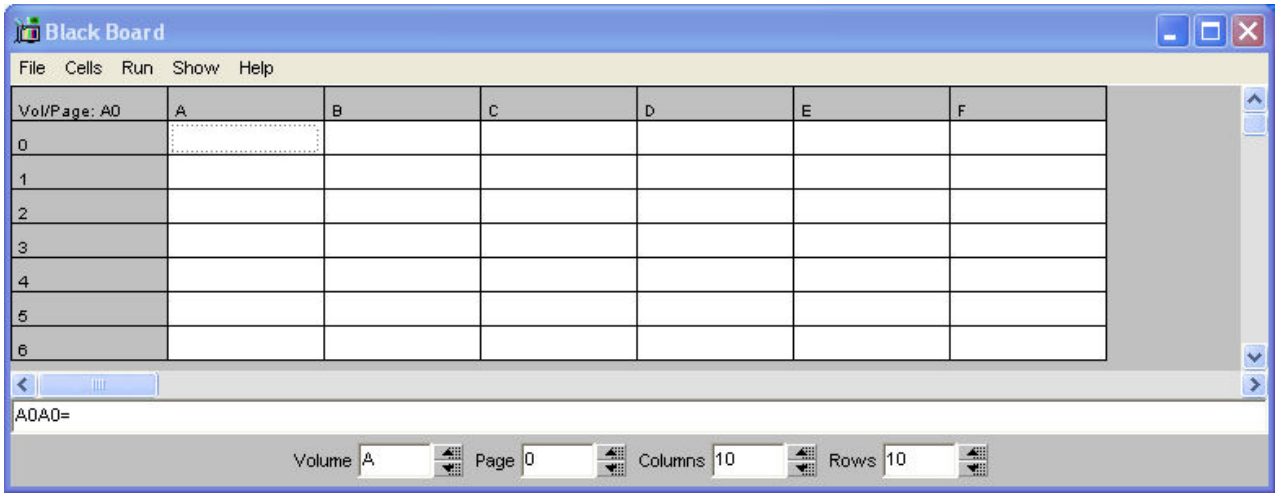


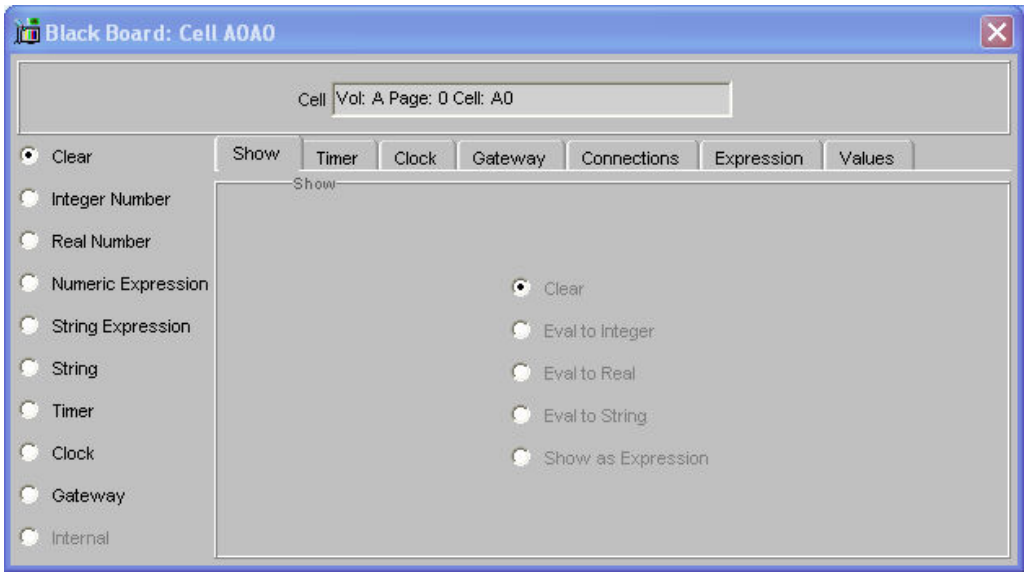
The *Script Remote Control* allows using XCAP as a hidden, off-screen, "black box"; any end-user application that can manipulate text files, can also remotely control XCAP.

The XCAP-Lite and XCAP-Ltd versions do not support recording scripts, creating user-defined tool bars, or the remote control feature. The XCAP-Lite and XCAP-Ltd versions can play scripts previously created with XCAP.

5.1.4. Main Window - Utility

The main window's *Utility* provides an assortment of features that are of secondary importance; features that allow fine tuning of XCAP, or features needed in relatively few circumstances.



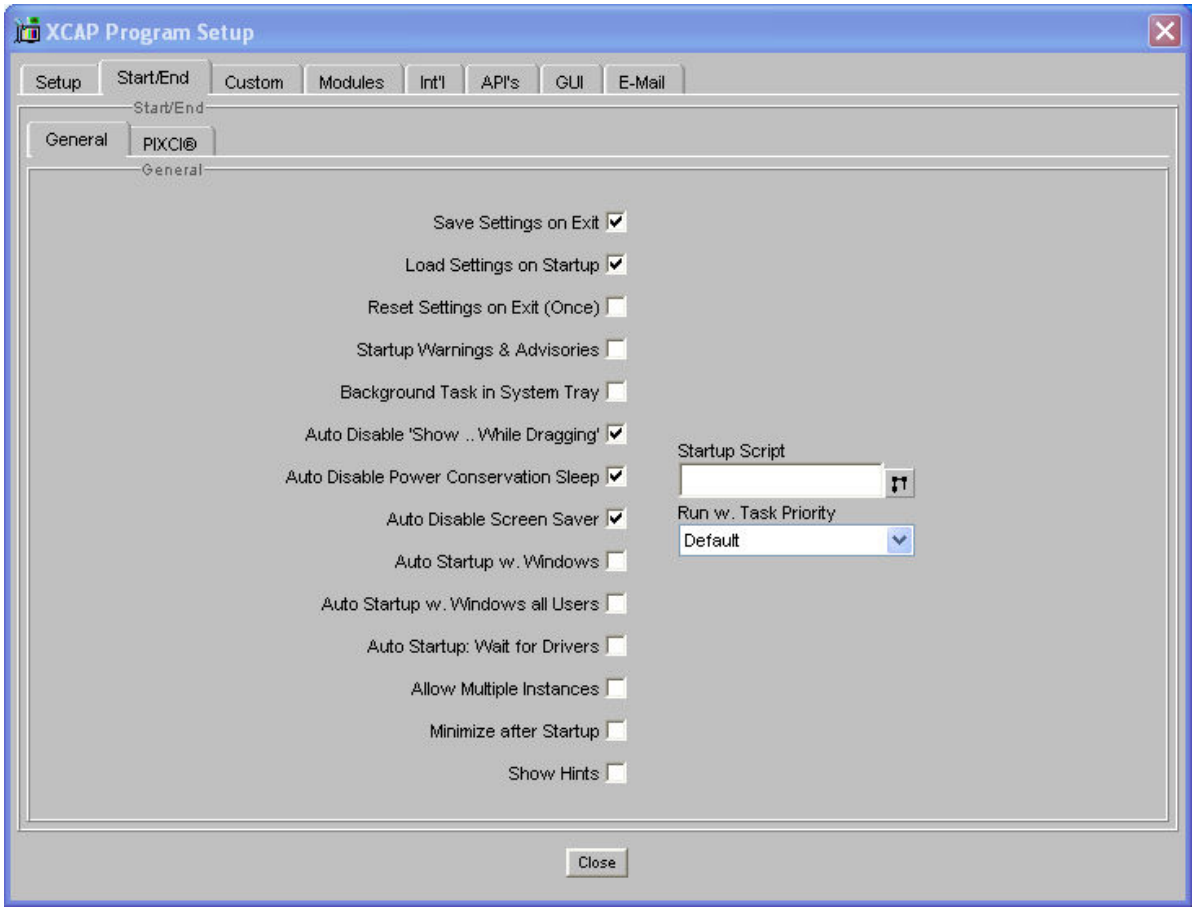


The *Black Board* allows customizing XCAP, creating non-procedural programs, and collecting data. The black board allows inter-connecting the numeric and text field of other windows; computed results, such as center-of-mass, may be written onto the black board - parameters for other features, such as the coordinates of a displayed grid, may be extracted from the black board - combining these automatically repositions the grid as the center of mass is recomputed! Other features allow computed values (similar to a spreadsheet), "push"ing buttons, timed updates, creating a report to file or an RS-232 port, collecting data, and graphing the black board's contents. The XCAP-Lite and XCAP-Ltd versions allow use of the *Black Board* for computing values (similar to a spreadsheet), but do not allow inter-connections with other features or creating reports or graphs.

A *Message Log* window lists warnings and errors that arise from performing various operations. By default, the message log window appears automatically when a message is added, and disappears a few seconds later. Auto appearance, auto hide, and audible clicks can be disabled (from the message log window's menu bar). The menu-bar's *Message Log* allows explicit activation of the message log window.

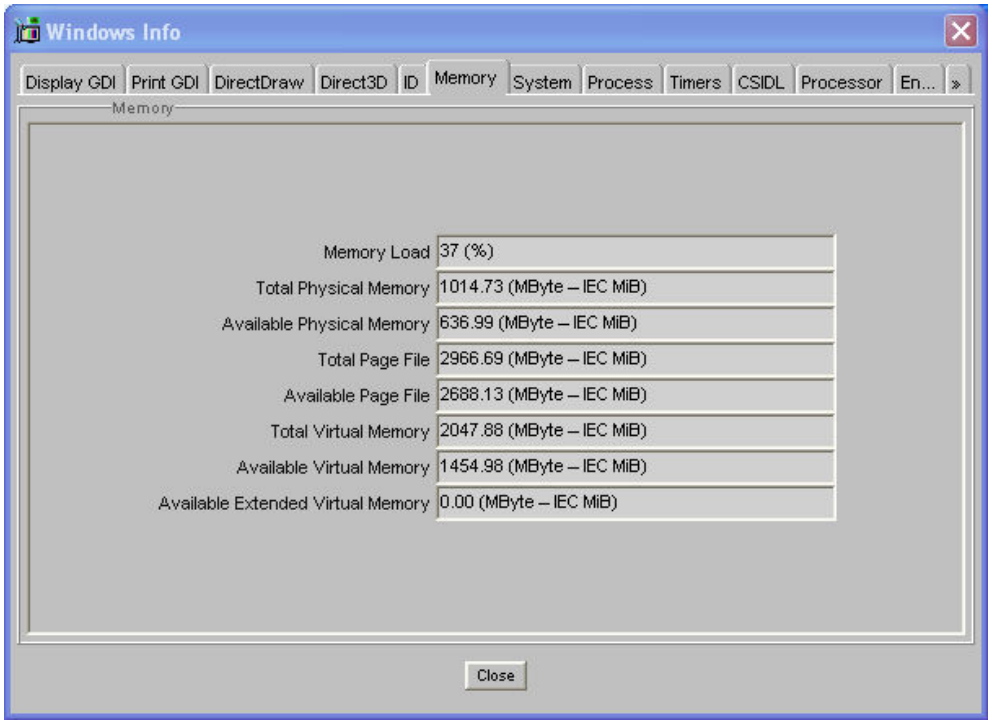
The *Program Setup* shows information about the installed XCAP components, such as their revision level, and sets various configuration options. For versions of XCAP that require an authorization key, it also shows the ID of the key required by the instant copy of XCAP.

The *Program Setup* allows specifying the name of a script to be executed when XCAP starts, whether warning pop-up windows (if any) are to be shown, whether previously saved settings are to be loaded, and other similar initial or terminal conditions.

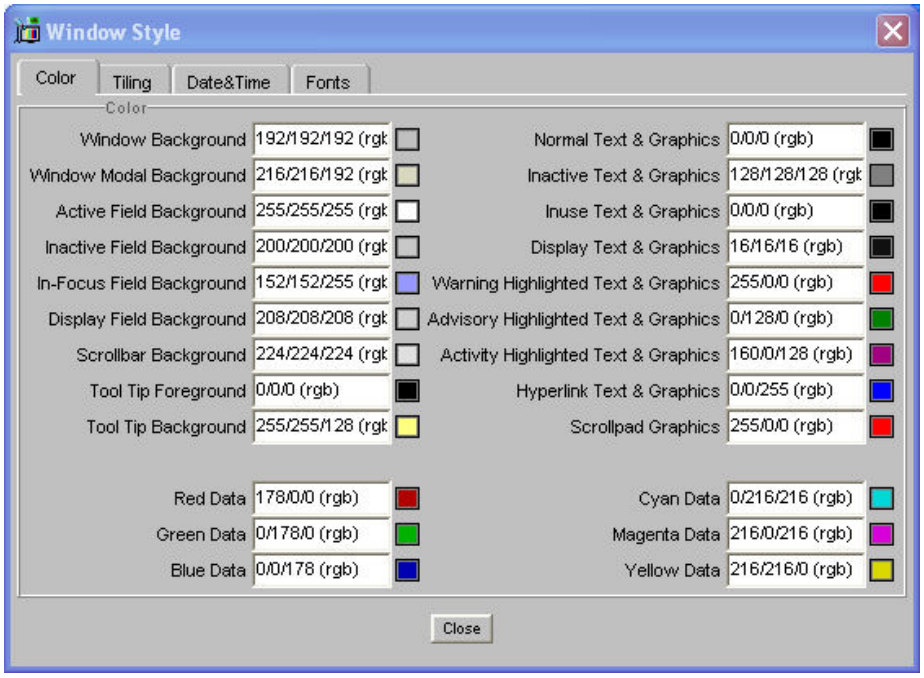


The *Program Setup* also enables user-defined translation of XCAP labels and messages for use in non-English speaking countries. The XCAP-Lite version does not support creating user-defined translated labels and messages, but may use translated labels and messages previously created with XCAP.

The *Windows Info* displays information about the current Windows environment, such as memory usage and the graphics display system's features, as reported by Windows.

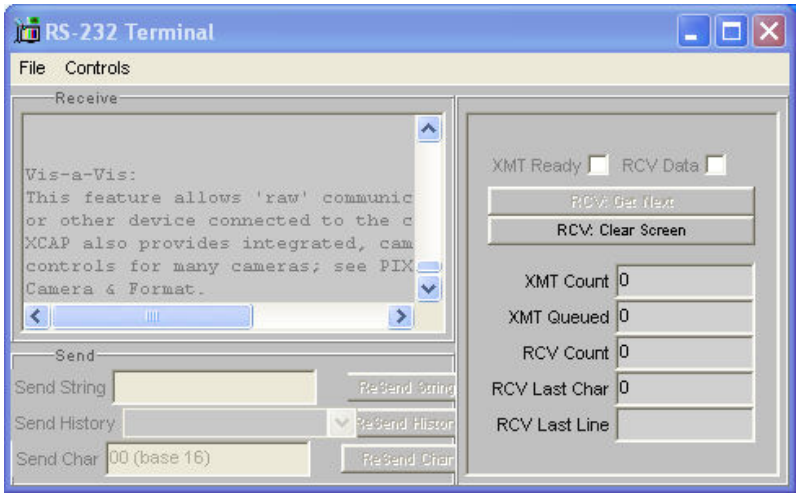


The *Linux Info* displays information about the current Linux environment, such as memory usage and the graphics display system's features, as reported by Linux. The *Java Info* displays information about the status of Java, under which XCAP runs. Both of these features are primarily of use in resolving questions submitted to EPIX, Inc. Technical Support.



The *Window Style* allows setting some characteristics of XCAP windows, such as color or character size and font. Some characteristics of window style are instead controlled by the Windows Control Panel.

The *Audio Clip* (only under Windows) allows recording and playing short audio "clips".



The *RS-232 Terminal* allows "raw" communication with a camera or other device connected via the computer's RS-232 port. The *RS-232 Terminal* is designed specifically for device control, including options to communicate with byte values, rather than as a common "terminal emulator". XCAP may also provide more convenient, camera-specific "smart" controls, provided after a camera-specific frame grabber is opened, via the *Capture - Adjustments*.

The *I/O Port Peek & Poke* allows controlling arbitrary devices accessible via I/O port peeks and pokes. This feature must be used with caution; peeking or poking arbitrary ports will cause computer malfunction! This feature is only available under Windows 95, 98, and ME.

The *Screen Capture* allows capturing the current graphics display screen, saving the graphics to a file, or printing the graphics. The *Screen Capture* also allows capturing numeric and textual parameters into a text file, suitable for loading into a spreadsheet or other programs. The XCAP-Lite version does not support screen capture.

The *Volpi intralux dc-1100* and *Illumination Technologies 3900* provide support for controlling these light sources through their RS-232 ports.

The *Birger EF232* provides support for controlling the Birger EF232 RS-232 Lens Mount.

The *Fujinon CCTV Lens* provides support for controlling Fujinon CCTV Lenses that follow the Fujinon C10 Protocol.

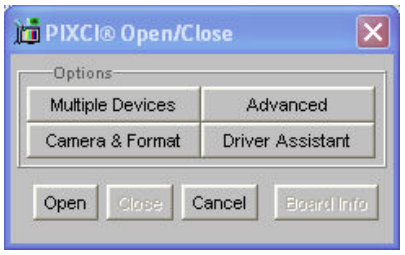
The *Directed Perception Pan-Tilt Unit* provides support for controlling the Directed Perception Pan-Tilt Units.

The *Sagebrush Pan-Tilt Gimbal* provides support for controlling the Sagebrush Pan-Tilt Gimbals that follow the Sagebrush 2.0 Protocol.

The *EPIX® SILICON VIDEO® 20C-CL*, *EPIX® SILICON VIDEO® 20M-CL*, *EPIX® SILICON VIDEO® 1514CL*, and *EPIX® SILICON VIDEO® 1820CL* provide support for configuring the EPIX® SILICON VIDEO® 10C-CL, SILICON VIDEO® 10M-CL, SILICON VIDEO® 20C-CL, SILICON VIDEO® 20M-CL, SILICON VIDEO® 1514CL, and SILICON VIDEO® 1820CL cameras via a virtual "COM" port (under Windows), a virtual "ttyS" device (under Linux), or a Camera Link Serial API DLL (i.e. a clserXXX.DLL, under Windows). These are provided for configuring the camera when using a frame grabber other than an PIXCI® frame grabber, leaving configuration of the frame grabber to its software. When using a PIXCI® frame grabber, the alternative *PIXCI® - Open/Close* is recommended as it provides integrated controls for both camera and frame grabber.

5.1.5. Main Window - PIXCI®

The main window's *PIXCI®* allows initiating access to the PIXCI® frame grabber and provides configuration options. Actual operation of the PIXCI® frame grabber is performed through the PIXCI® image viewer window's menu-bar.



The *PIXCI® Open/Close* allows opening access to, or closing access to, the PIXCI® frame grabber. Once open, the model, and submodel or preset camera & format selection, as appropriate, of the PIXCI® frame grabber is available via the *Board Info* button. After opening, the contents of the PIXCI® frame grabber's image frame buffer(s) are displayed in a new instance of *The Image Viewer Window*, along with a tool bar of PIXCI® Image Viewer - Capture - Shortcuts and a status bar of Image Viewer - View - Status Bar are shown as described below.

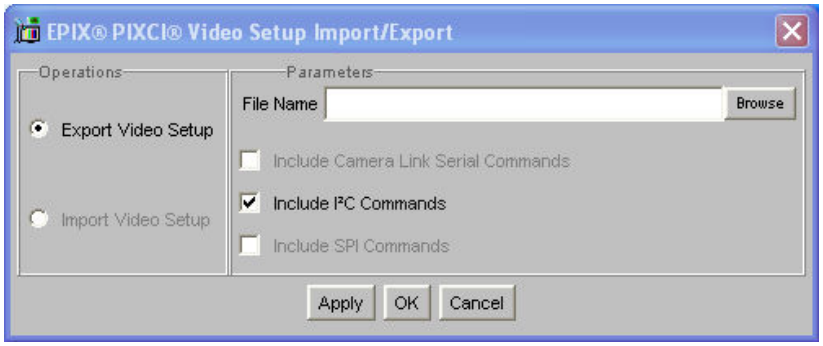
The *PIXCI® Video Setup* allows configuring the video format, video resolution and other, model specific, video characteristics. For the PIXCI® SV2, SV3, SV4, SV5, SV5A, SV5B, and SV5L models, the *PIXCI® Video Setup* allows selecting *NTSC*, *RS-170*, *NTSC/S-VIDEO*, *CCIR*, *PAL*, or *PAL/S-Video* formats, allows selecting the video window size, capture resolution, and other video acquisition characteristics.

For the PIXCI® SV7 models, the *PIXCI® Video Setup* allows selecting *NTSC*, *RS-170*, *CCIR*, or *PAL* formats , allows selecting the video window size, capture resolution, and other video acquisition characteristics.

For the PIXCI® SV8 models, the *PIXCI® Video Setup* allows selecting *NTSC*, *RS-170*, *NTSC/S-VIDEO*, *CCIR*, *PAL*, or *PAL/S-Video formats*, allows selecting the video window size, capture resolution, and other video acquisition characteristics.

For the PIXCI® A310 model, the *PIXCI® Video Setup* allows selecting *Video 720x480i 60Hz (RS-170)*, *Video 720x480i 60Hz RGB*, *Video 720x576i 50Hz (CCIR)*, *Video 720x576i 50Hz RGB*, *Video 1920x1080i 60Hz*, *Video 1920x1080i 60Hz RGB*, *Video 1920x1080i 50Hz*, *Video 1920x1080i 50Hz RGB*, *Video 1920x1080p 60Hz*, *Video 1920x1080p 60Hz RGB*, *Video 1920x1080p 50Hz*, *Video 1920x1080p 50Hz RGB*, *Video 1280x720p 50Hz*, *Video 1280x720p 50Hz RGB*, *Video 1280x720p 60Hz*, *Video 1280x720p 60Hz RGB*, *RS343 875i 60Hz*, *RS343 875i 60Hz RGB*, *SVGA 800x600 60Hz*, *SVGA 800x600 60Hz RGB*, *SXGA 1280x1024 60Hz*, *SXGA 1280x1024 60Hz RGB*, *VGA 640x480 60Hz*, *VGA 640x480 60Hz RGB*, *XGA 1024x768 60Hz* or *XGA 1024x768 60Hz RGB* formats, allows modifying the PLL, A/D, and sync processor parameters to accommodate other video formats, allows selecting the capture resolution, and selecting other video acquisition characteristics. For the PIXCI® A110 model, the *PIXCI® Video Setup* is similar, but does not allow selecting RGB formats.

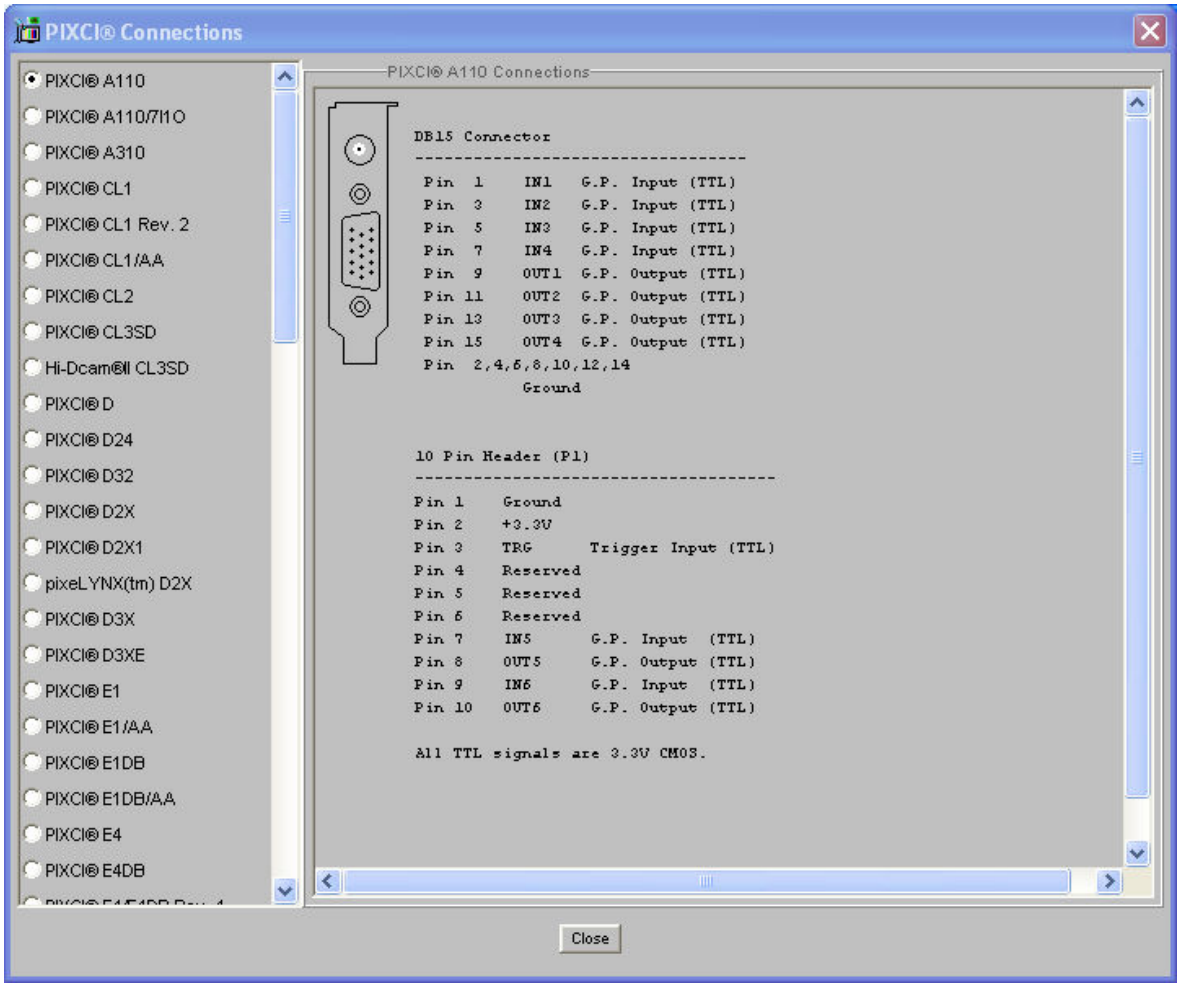
For the PIXCI® CL1, CL3SD, D, D24, D32, D2X, D3X, and D3XE models, fewer options are provided, as these frame grabbers are each customized to specifically support one camera, or a related group if cameras. For the PIXCI® CL2, E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EB1mini, miniH2B, miniH2F, miniH2x4F, EC1, ECB1, ECB1-34, ECB2, EL1, and EL1DB models, which provide universal support for Camera Link cameras, fewer options are provided. For the PIXCI® E8CAM, ELS2, SI, SI1, SI2, and SI4 models, which support SILICON VIDEO® cameras, fewer options are provided. For all of these, a different camera can be selected, if available, via *PIXCI® Open/Close*, *Camera & Format*.



The current video setup is automatically saved when access to the PIXCI® frame grabber is closed, and reloaded when the PIXCI® frame grabber is later opened. The *PIXCI® Export Video Setup* and *PIXCI® Import Video Setup* may be used to explicitly save or reload the current video setup, such as to choose amongst several favorite setups, or to export the current video setup to the XCLIB library.

The *PIXCI® Status* shows the PIXCI® frame grabber's current status, such as the state of the general purpose (formerly referred to as an external TTL) trigger input(s) and output(s), the number of elapsed video fields, the board's model, submodel or preset camera & format selection, as appropriate, and configured image memory size.

The *PIXCI® Serial Terminal* allows "raw" communication with a camera connected to the serial port on selected models of the PIXCI® frame grabber. For many cameras, XCAP includes more convenient, camera-specific "smart" controls, provided after a camera-specific frame grabber is opened, via the *Capture - Adjustments*.



The *PIXCI® Connections* provides, as appropriate for the specific model of PIXCI® frame grabber, a map of the board's connections, connectors, option jumpers, and adjustments.

The *PIXCI® Camera Info* provides a list of cameras and video formats supported by XCAP and various PIXCI® frame grabbers. The *PIXCI® Camera Info* also allows viewing a non-operational *Capture - Adjustments* window (i.e. the "Control Panel", which provides integrated control of both frame grabber and any supported camera).

The *PIXCI® TWAIN Sourcery* (only under Windows) allows using XCAP, in conjunction with the "XCAP Sourcery" TWAIN driver, as a component of a "smart" TWAIN Source, allowing other applications to capture images from the PIXCI® frame grabber, while XCAP provides frame grabber controls, camera controls, and, optionally, image preprocessing.[9] (The XCAP-Lite and XCAP-Ltd versions do not provide image preprocessing). The *PIXCI® TWAIN Sourcery* should not be confused with *TWAIN New Acquire*; the former allows XCAP to provide image data to other, TWAIN compliant applications; the latter allows XCAP to accept image data from other TWAIN compliant sources. The *TWAIN New Acquire* should never be used to attempt to acquire image data from the *PIXCI® TWAIN Sourcery*!

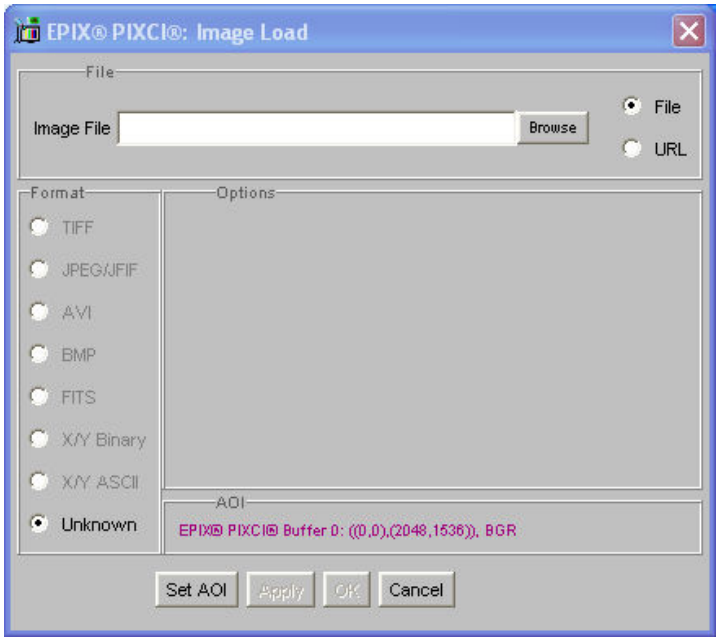
The *PIXCI® Image-Pro Sourcery* (only under Windows) allows using XCAP, in conjunction with the "XCAP Sourcery" Image-Pro driver, as a component of a "smart" video source, allowing Image-Pro to capture images from the PIXCI® frame grabber, while XCAP provides frame grabber, camera controls, and, optionally, image preprocessing.[10]

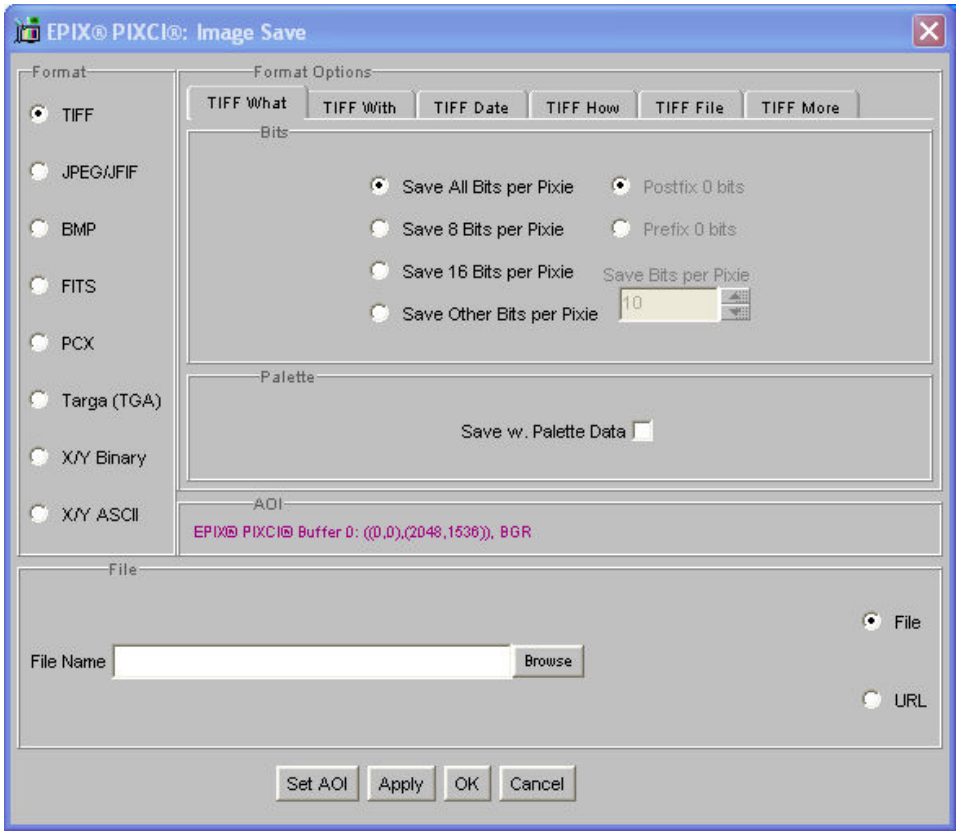
5.2. The Image Viewer Window

Each image buffer (sequence), or frame buffer (sequence), is displayed in an image viewer window, which is the focus of activity for examining, processing, or analyzing that image buffer (sequence). The image viewer window provides a menu bar with *File*, *View*, *Examine*, *Modify*, *Measure*, *Draw*, *AOI*, and *Help* features. The image viewer window associated with the PIXCI® frame grabber's frame buffer(s) also provides a *Capture* feature.

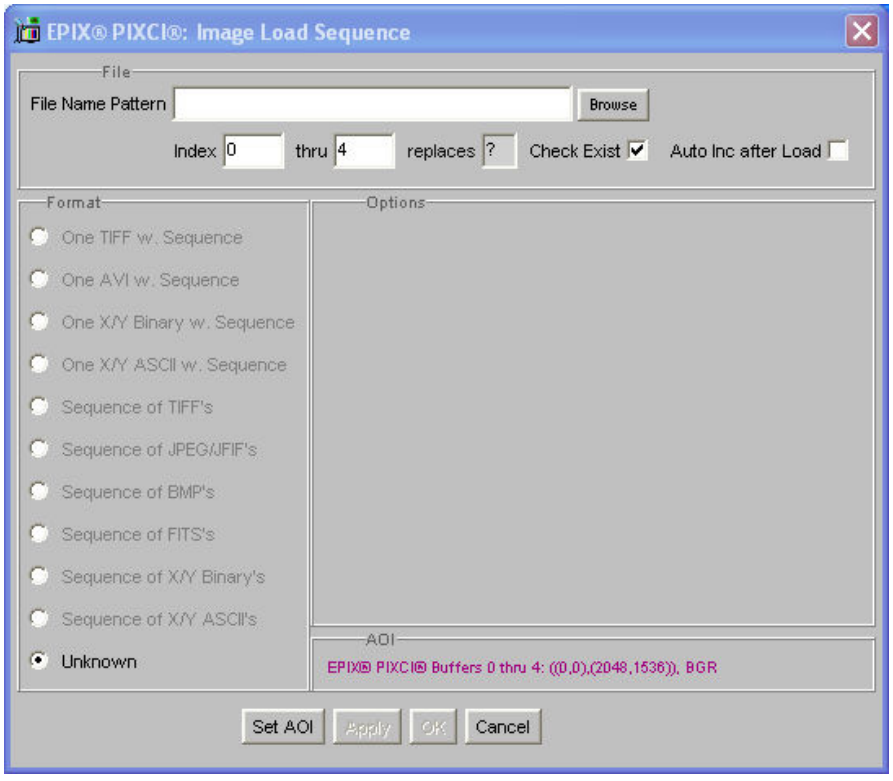
5.2.1. Image Viewer - File

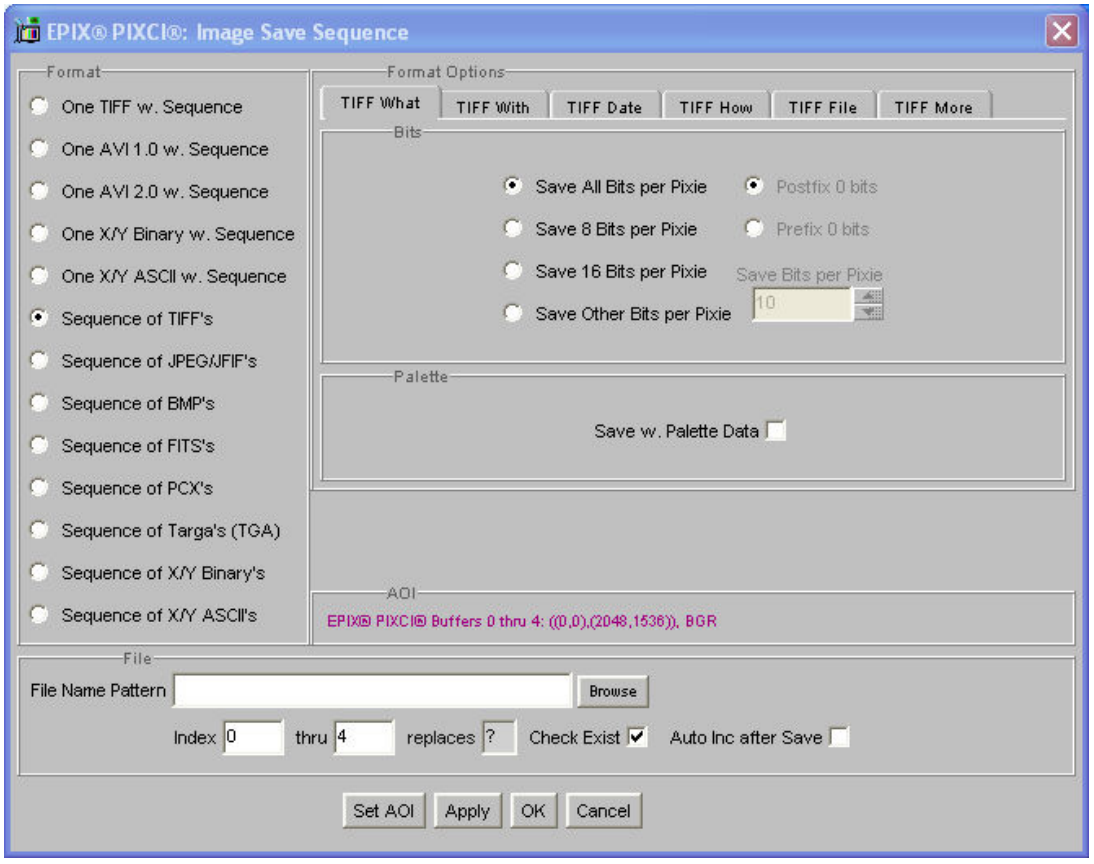
The image viewer window's *File* allows saving, loading, or printing the image, shows information about the image's dimensions, pixel depth and color space, and allows closing the image viewer window.



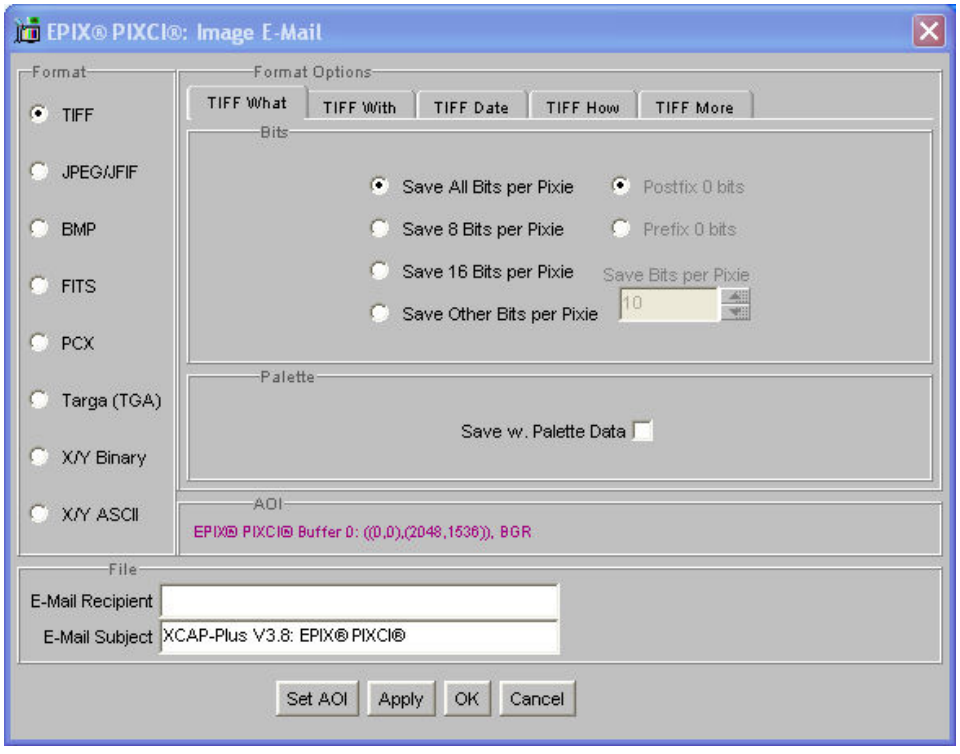


The *Load Image* and *Save Image* allow saving or loading the image in a variety of file formats. The *Load Image*, unlike the *Load New Image* described above, loads an image file into the current image buffer, resizing and/or color converting to fit the image buffer's existing dimensions, pixel depth, and color space. The *Load Image* can also load images directly from an Internet URL. The XCAP-Lite version does not support loading images directly from an Internet URL.

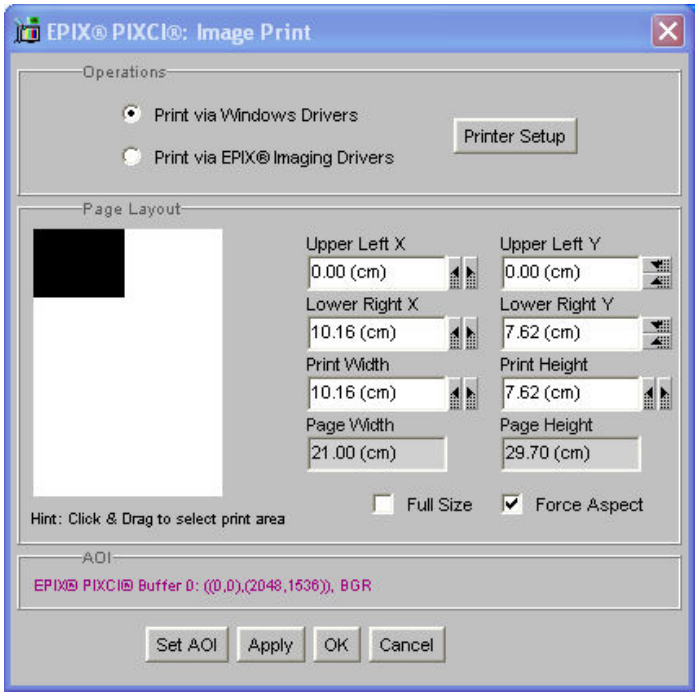




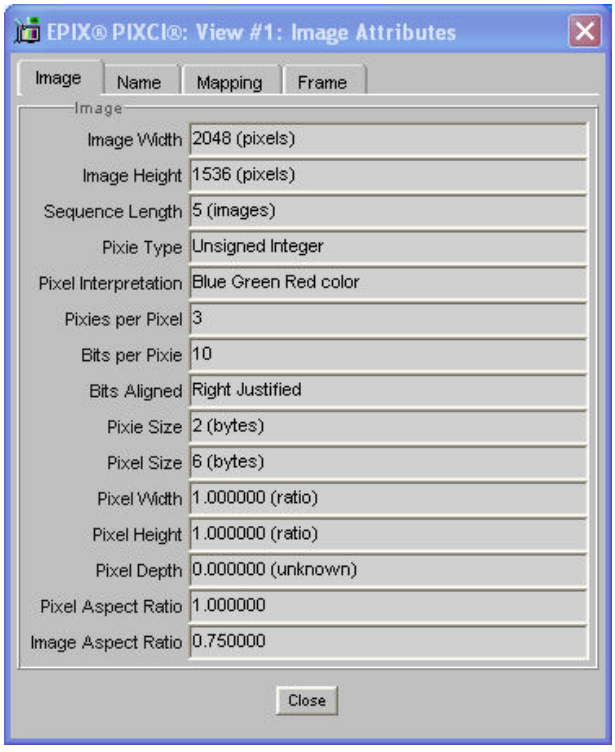
For image viewer windows associated with an image buffer sequence, the *Save Image Sequence* and *Load Image Sequence* allow saving or loading multiple images of the sequence as a numbered sequence of image files, or as a single TIFF, AVI, or PBM/PGM/PPM format image file with multiple images. The XCAP-Lite version only supports loading or saving of image buffer sequences in TIFF format; however multiple uses of *Load Image* or *Save Image* can load or save each image buffer of a sequence in other formats. The *Save Image* can also save images directly to an FTP URL. The XCAP-Lite version does not support saving images directly to an FTP URL.



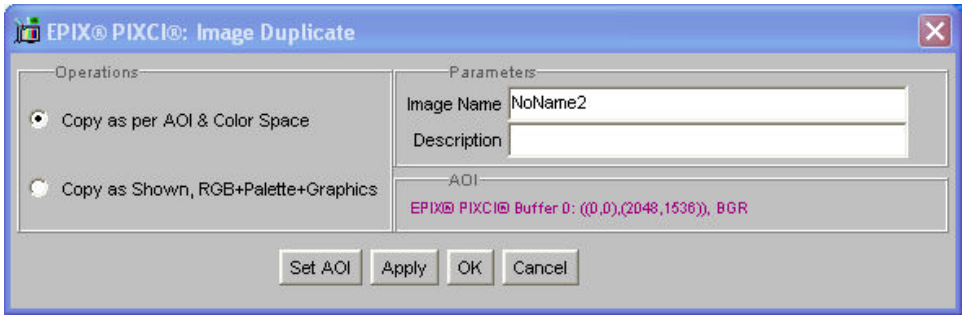
The *E-Mail Image* allows directly e-mailing the image, in a variety of file formats, from within XCAP. The XCAP-Lite version does not support the *E-Mail Image* feature.



The *Print Image* allows printing the image; either via the operating system's built-in image printing feature(s) which typically supports a wide variety of printers, or via EPIX® imaging drivers which support only the most popular printers, but providing precise control of print options. The XCAP-Lite version does not allow printing via EPIX® imaging drivers.



The *Image Attributes* shows the image's (or image sequence's) dimensions, pixel depth, and color space.



The *Duplicate Image* and *Duplicate Image Sequence* allows creating a new image buffer and copying the current image, or creating a new sequence of image buffers and copying the current image sequence, respectively, in one step. It optionally allows copying the image's (or image sequence's) current appearance, as modified by the palette and graphics, instead of the underlying image (or image sequence). The XCAP-Lite version does not provide *Duplicate Image* or *Duplicate Image Sequence*.

The *BlackBoard Image* allows copying the image's pixel values into the *Black Board*. The XCAP-Lite and XCAP-Ltd versions do not provide *BlackBoard Image*.

The *Close Viewer* closes the window, but does not destroy the image (sequence). The *Close & Dispose of Image* closes the window and destroys the image (sequence). The image viewer window associated with the PIXCI® frame grabber's frame buffer(s) does not provide a *Close & Dispose of Image*; an image viewer window is available whenever the PIXCI® frame grabber is open for use.

5.2.2. Image Viewer - View

The image viewer window's *View* provides options governing the appearance of the displayed image.

The *Shortcuts* allows activating or deactivating a tool bar of icons providing shortcuts for accessing often used features, and is described under Image Viewer - View - Shortcuts.

The *Status Bar* allows activating or deactivating a small status bar with current information, and is described under Image Viewer - View - Status Bar.

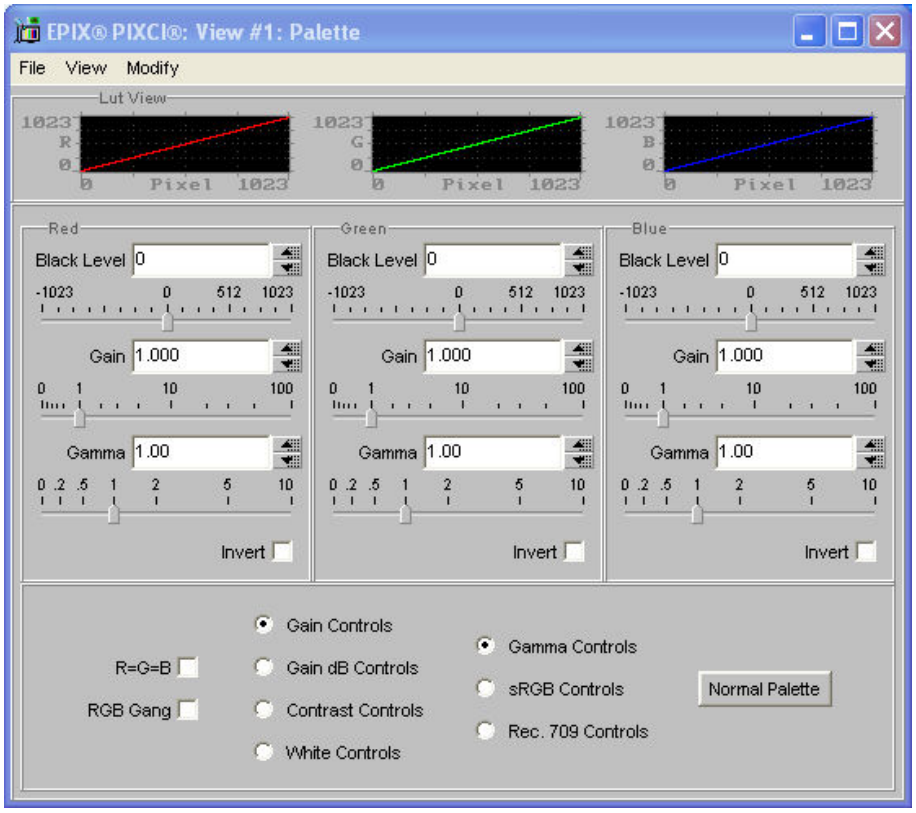
The *Menu Bar* allows activating or deactivating the menu bar; when deactivated, clicking the mouse right-click button allows restoring the menu bar.

For image viewer windows associated with the PIXCI® frame grabber's image frame buffer(s), the *Adjustments* allows setting common adjustments, as suitable for the model of the PIXCI® frame grabber in use, and is described under PIXCI® Image Viewer - Capture.

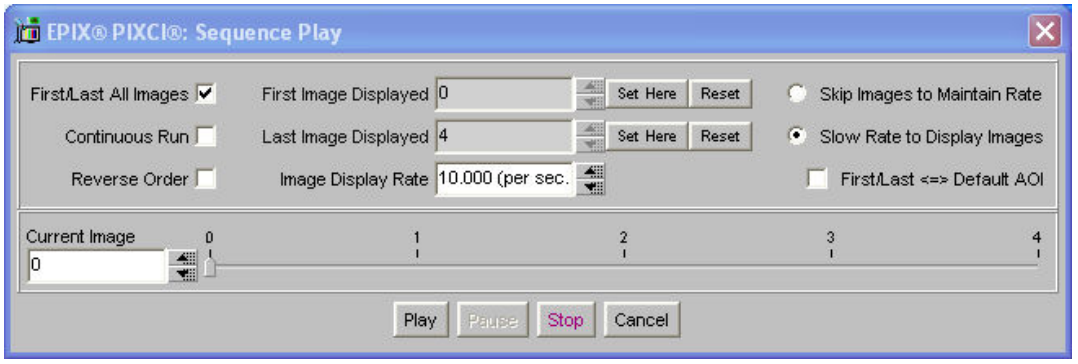
The *Full Screen* allows displaying the image in the full graphics display screen without the menu bar, centered with black border (if needed), and with little or no window "frame" around the image. The previous display mode can be restored via a mouse right-click. The *Full Screen* display without window "frame" is not available under Linux nor in the XCAP-Lite version.

The *Always-On-Top* allows forcing the image viewer window, and its subwindows, to always be "above" other windows; subject to the other windows' also requesting *Always-On-Top*, and the whims of the host operating system. This option is typically useful only when XCAP is being used in combination with other applications, such as in conjunction with the *PIXCI® TWAIN Sourcery* or *PIXCI® Image-Pro Sourcery* feature. The *Always-On-Top* feature is only supported under Windows.

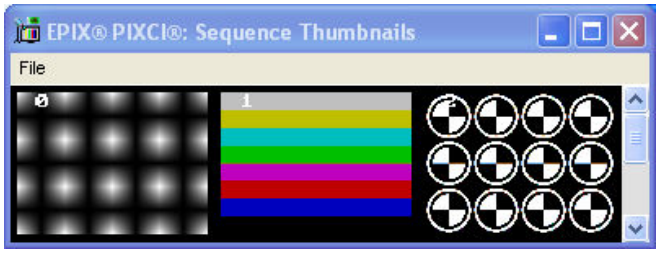
The *Refresh* forces the displayed image to be redrawn once; normally manual refresh is not needed, but occasionally, when the image was (partly) covered and uncovered by other window(s), the displayed image might "forget" to be updated.



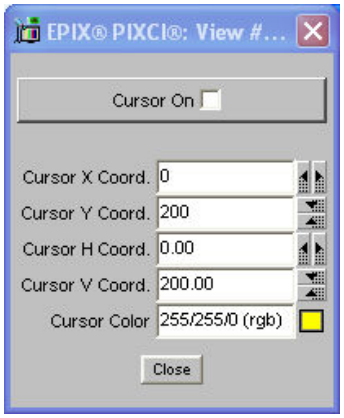
For images composed of index pixels and palette, the *Image's Palette* allows manipulating the image's attached palette; for images of other types, the *Image's Palette* is not selectable. For all images, the *Viewer's Palette* allows manipulating a palette which is not attached to the image. Either can be used for contrast enhancement, adjustment of black level and gain, or, for monochrome images, false coloring. Either, or neither, of the palettes can be selected for use under *Display*.



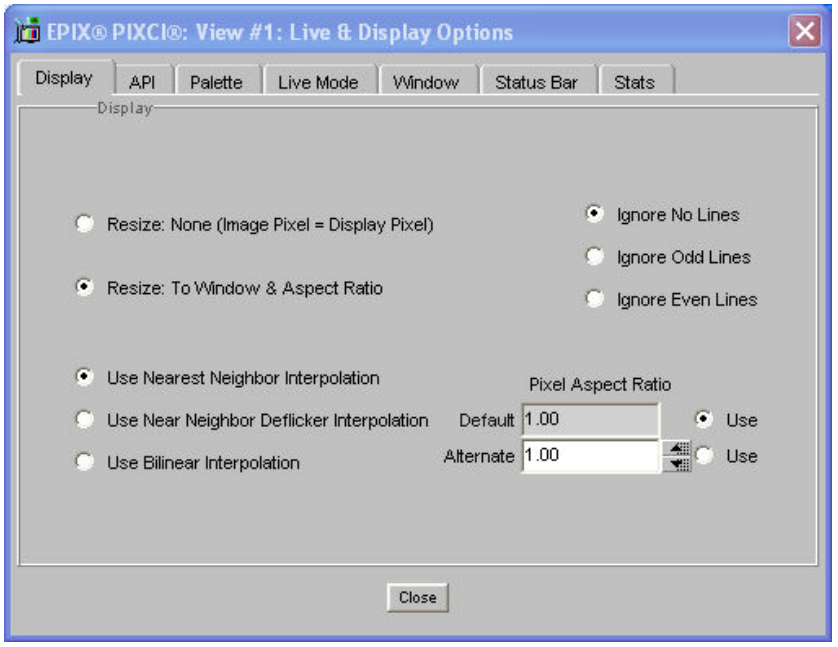
For image sequences, the *Sequence Play* allows "playing" the sequence, image by image, at a selected rate.



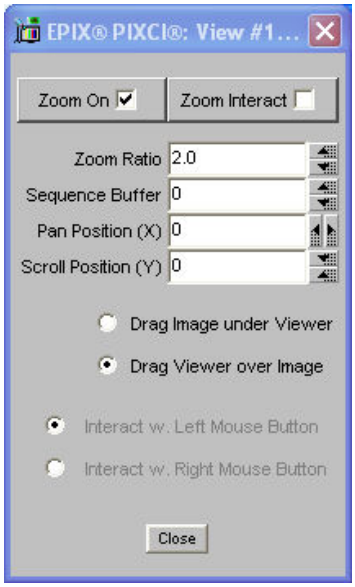
The *Sequence Thumbnails* shows a window in which each image of the sequence is a small "snapshot"; clicking a snapshot selects that image for display by the image viewer window. The XCAP-Lite version does not provide the *Sequence Thumbnails*.



The *Cursor* allows activating a cursor over the image, which may be positioned via coordinates, or by clicking the mouse on an image feature.



The *Display* allows selecting how the image is displayed: (a) No resizing so there is a one to one relationship between an image pixel and a displayed graphics display pixel and is the quickest, although the entire image may not fit within the window and must therefore be panned and scrolled, (b) Resize by nearest neighbor which is relatively quick, or (c) Resize by bilinear interpolation which may produce better results for continuous tone images, but is slower. For the resize modes, the aspect ratio can also be modified. The *Display* allows selecting which palette, if any, is to be used during display and during file loads and saves. An option to display only even lines, or only odd image lines, allows avoiding interlace artifacts during display. For the image viewer window associated with the PIXCI® frame grabber's frame buffer(s), the *Display* provides additional features, identical to the *Live Options* described below.

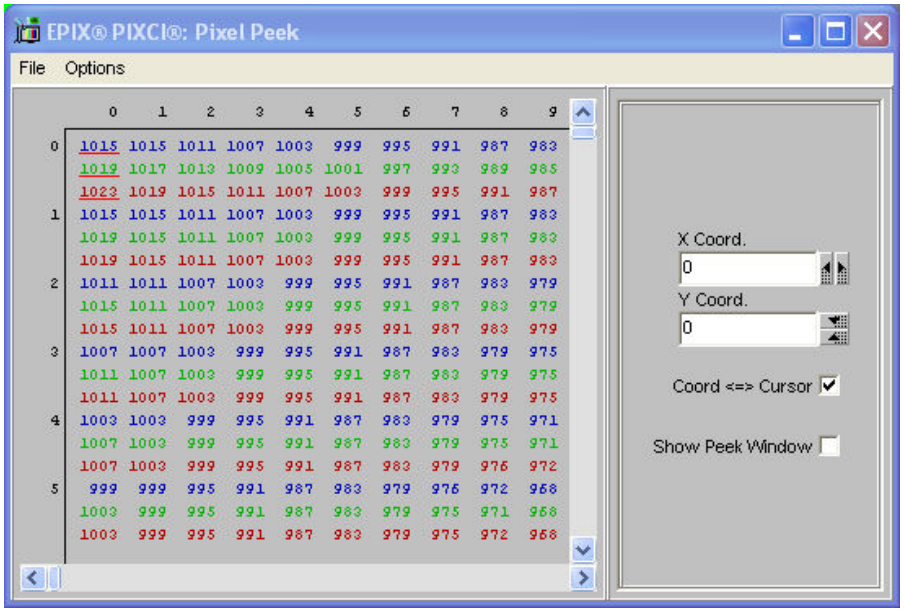


The *Zoom, Pan, Scroll* allows magnifying the displayed image, and panning and scrolling to view different portions of the image under magnification. For image sequences, a specific image of the sequence can be selected for display. In addition to panning and scrolling via explicit coordinates and via scrollbars, holding the right mouse button and moving the mouse over the image also implements panning and scrolling. Optionally, the left or right mouse button can be used to increase magnification (i.e. zoom-in) or decrease magnification (i.e. zoom-out).

Each image buffer (sequence) may have several simultaneously active viewers, allowing, for example, viewing the same image buffer both magnified and unmagnified. The *Launch 2nd Viewer* creates a second image viewer window into the same image buffer (sequence), with the same features as the original image viewer window. The XCAP-Lite version does not provide the *Launch 2nd Viewer* feature.

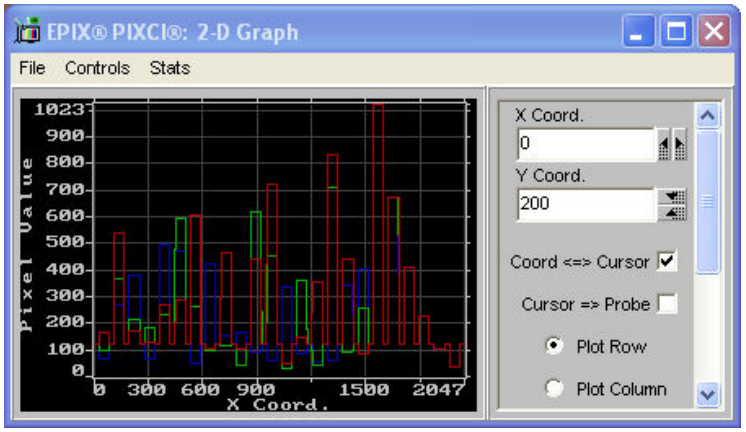
5.2.3. Image Viewer - Examine

The image viewer window's *Examine* provides options to examine the image.

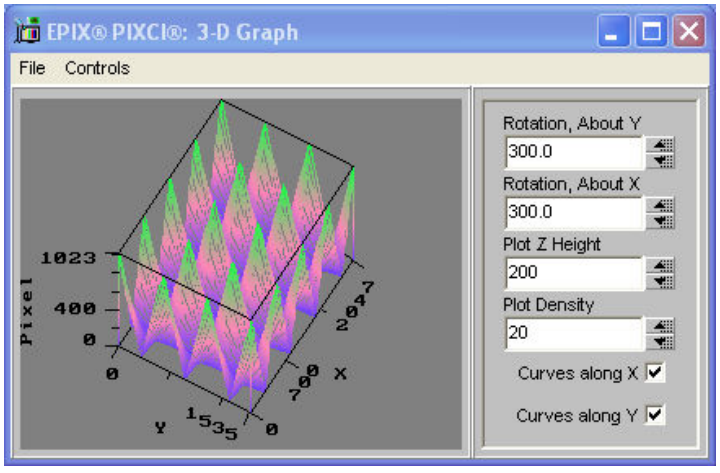


The *Pixel Peek* allows numeric display of the pixel values in the vicinity of the image cursor, within a single image, or across a sequence of images. The feature also graphically displays each pixel's value or trends.

The *Pixel Peek & Poke* allows numeric display and modification of individual pixel values.



The *Pixel Plot* displays a two-dimensional graph of pixels values along a selected image line or column, of all image lines or columns, of an image pixel as it varies across an image sequence, or rows or columns as they vary across an image sequence. The recent trends of pixel values can also be shown, as an fading "echo," to help visually evaluate the fluctuations of live video or the effects of camera adjustments. Features attached to the graph show specific pixel values and descriptive statistics such as lowest value, highest value, mean value, and standard deviation. The XCAP-Lite version only provides a graph of a selected row or column, or pixel value across sequence, and does not provide descriptive statistics.



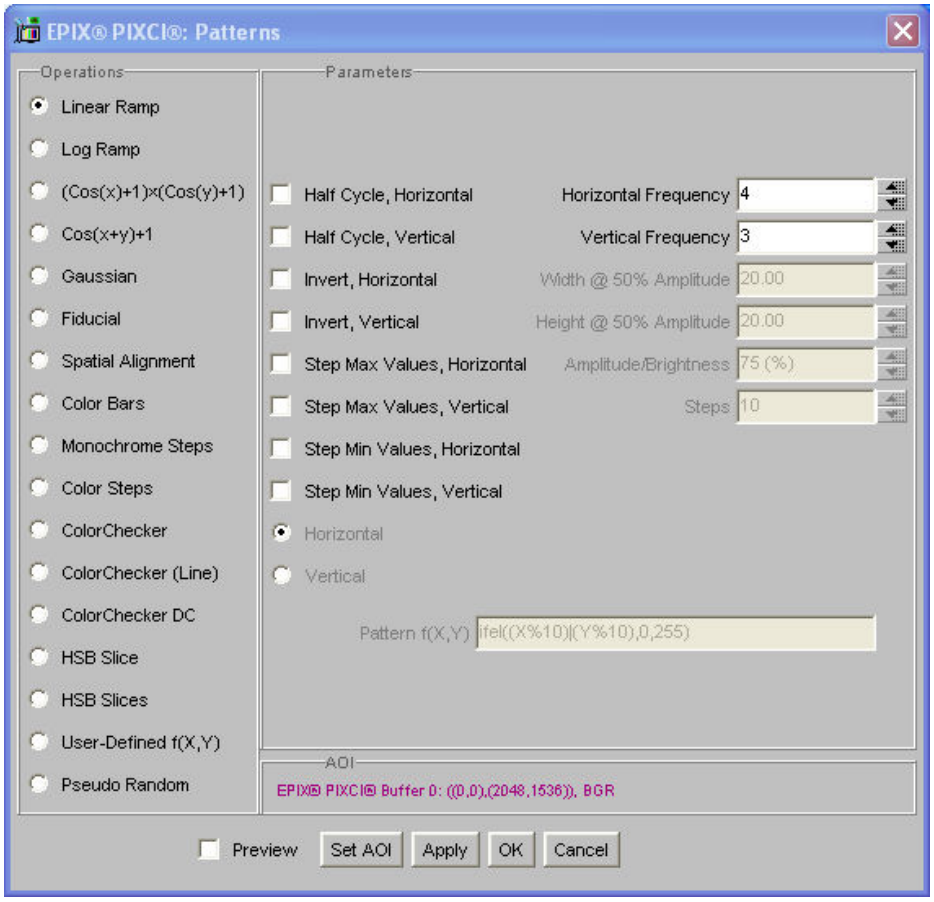
The *Pixel Plot 3D* displays a three-dimensional graph projection of the image.

The *SMPTE VITC* allows searching the image for valid SMPTE Vertical Interval Time Codes and displaying the decoded codes.

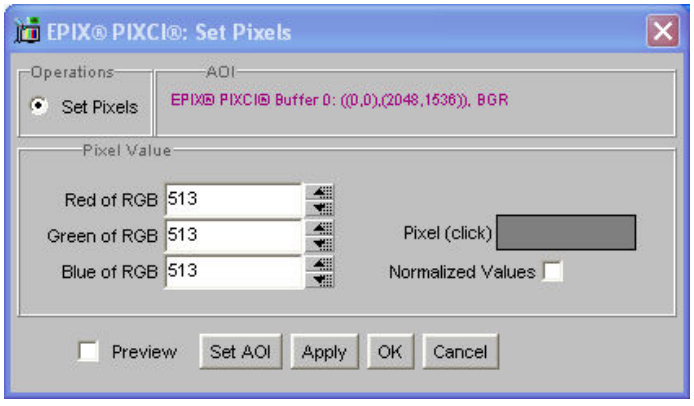
The XCAP-Lite and XCAP-Ltd versions do not provide the *SMPTE VITC* features.

5.2.4. Image Viewer - Modify

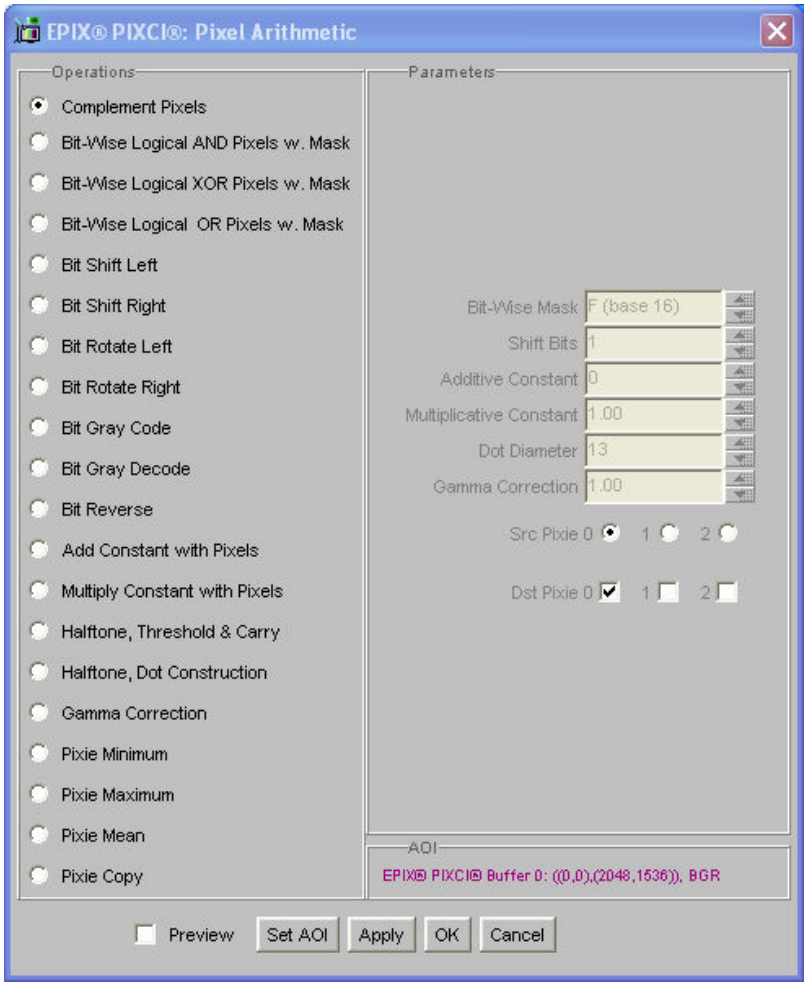
The image viewer window's *Modify* provides image processing operations which modify the image, modify each image (independently) in a sequence (typically named "Sequence ...") or modify one or more images in a sequence by combining data from across multiple images (typically named "... Sequence)."



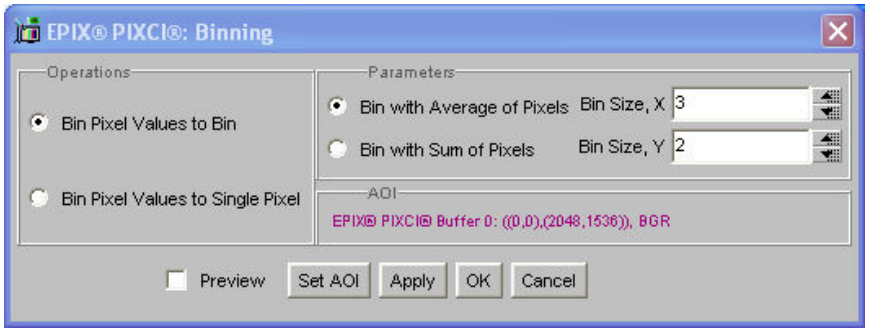
The *Patterns* draws various test patterns in the image. The *Sequence Patterns* does the same on each image of a sequence.



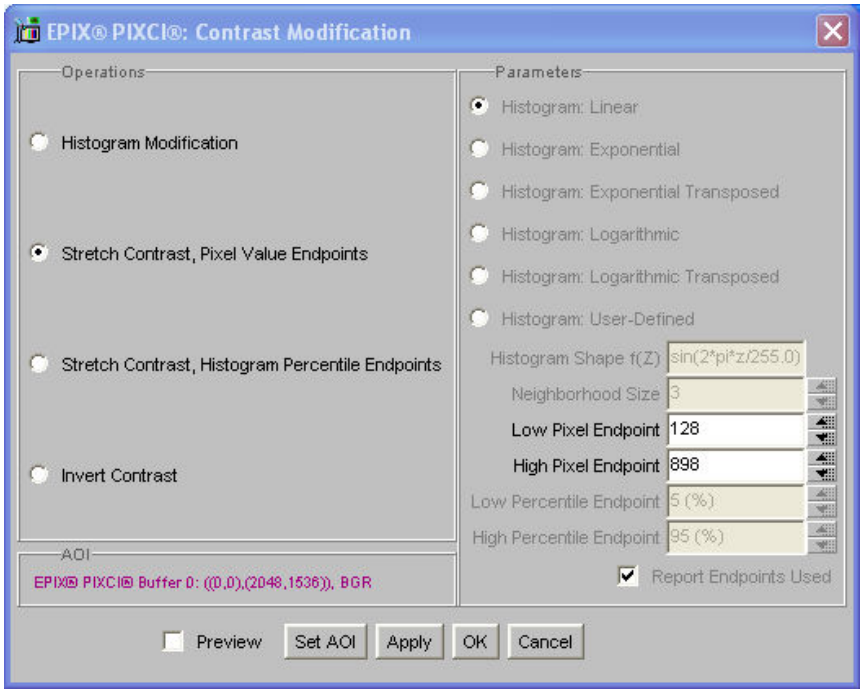
The *Set* sets image pixels to a specified value. The *Sequence Set* does the same on each image of a sequence.



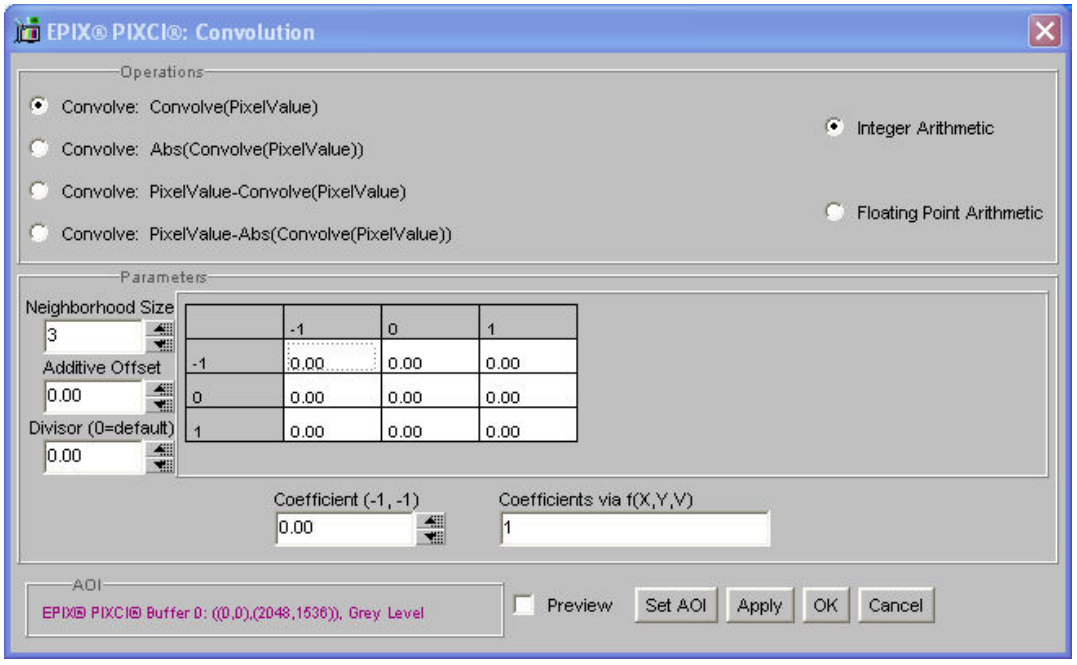
The *Arithmetic* provides pixel arithmetic, such as adding a constant value or multiplying by a constant value. The *Sequence Arithmetic* does the same on each image of a sequence. The *Src+Dst Arithmetic* does the same with distinct source and destination images.



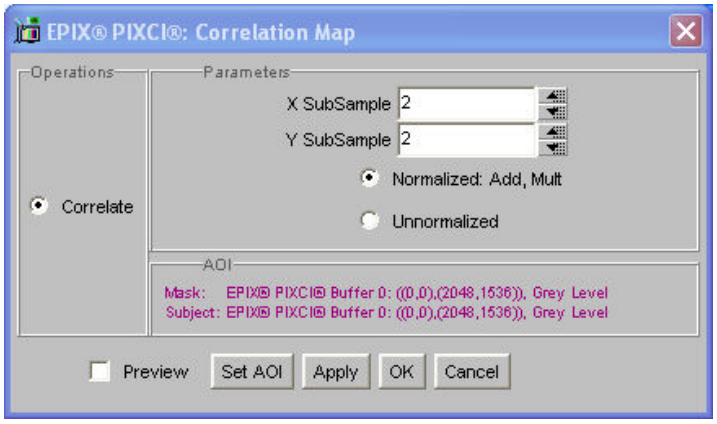
The *Binning* provides averaging or integrating pixel values in "bins" of a checkerboard. The *Sequence Binning* does the same on each image of a sequence. The *Src+Dst Binning* does the same with distinct source and destination images.



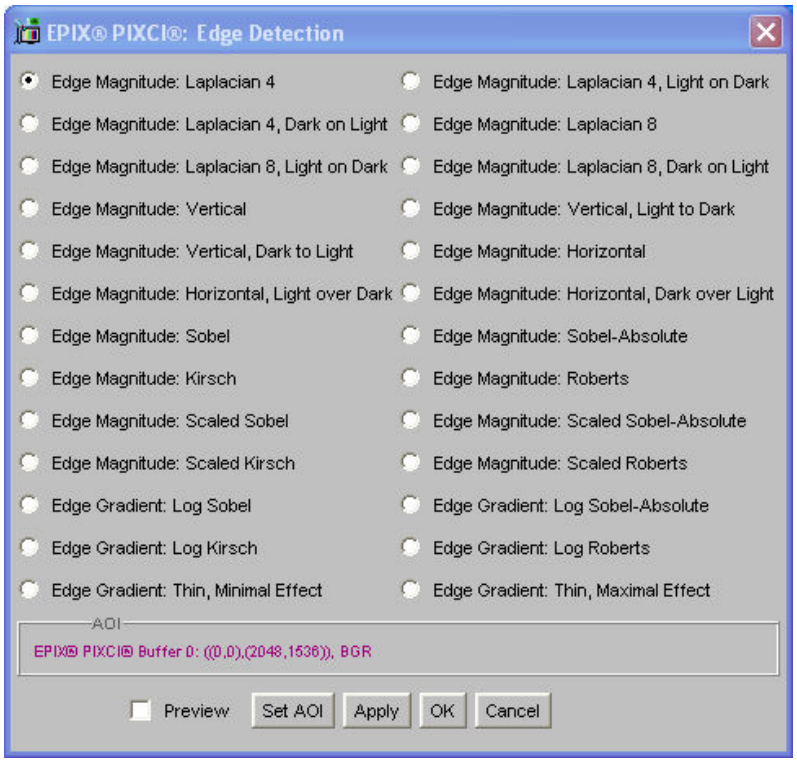
The *Contrast Modification* allows modifying the image's contrast. The *Sequence Contrast Modification* does the same on each image of a sequence. The *Src+Dst Contrast Modification* does the same with distinct source and destination images.



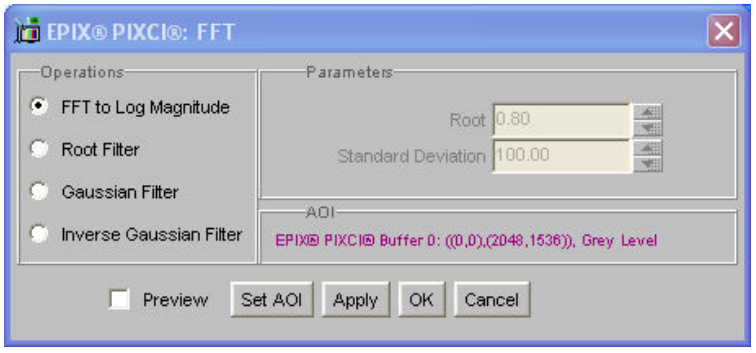
The *Convolution* allows convolving the image with user-defined kernels. The *Sequence Convolution* does the same on each image of a sequence. The *Src+Dst Convolution* does the same with distinct source and destination images.



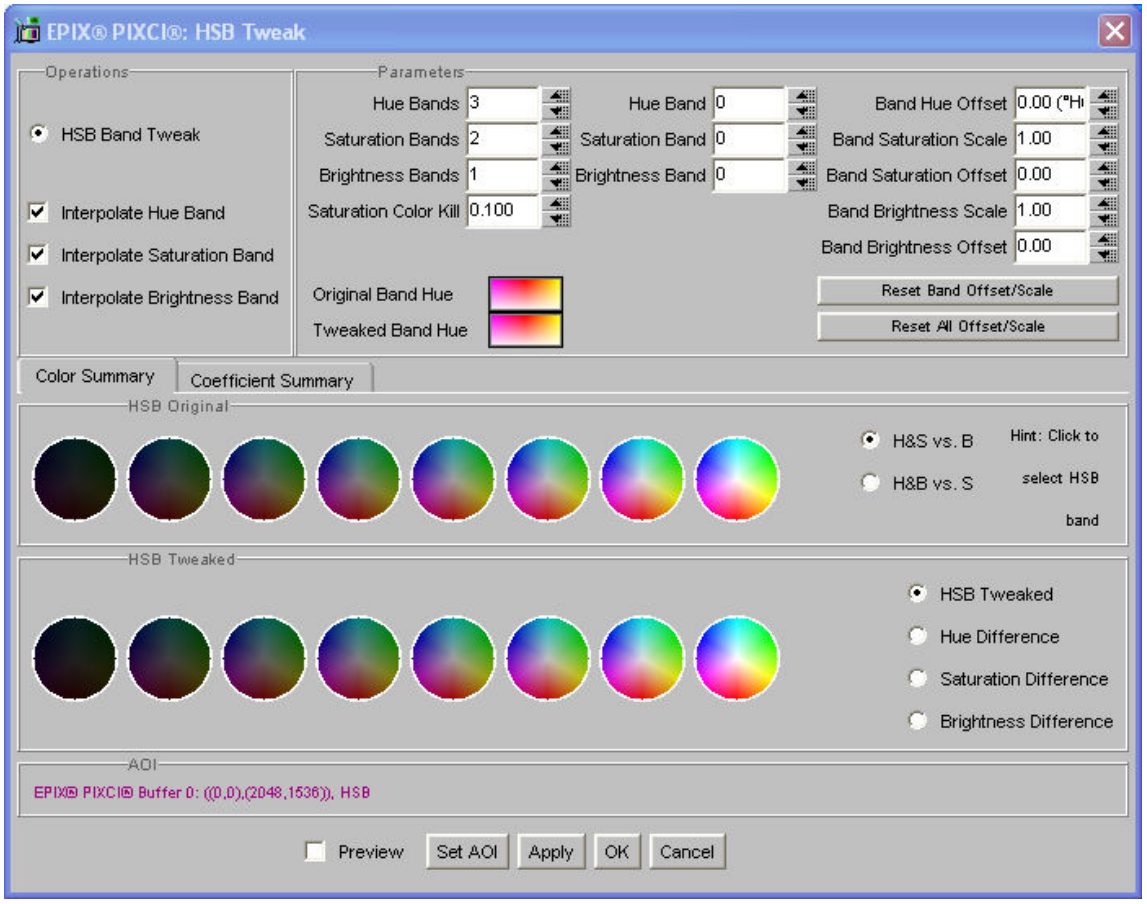
The *Correlation Map* allows correlating, or matching, a kernel image over a larger image, resulting in a profile image whose intensity, at each location, varies in proportion to the degree of match at that location. The *Sequence Correlation Map* does the same on each image of a sequence. The *Src+Dst Correlation Map* does the same with distinct source and destination images.



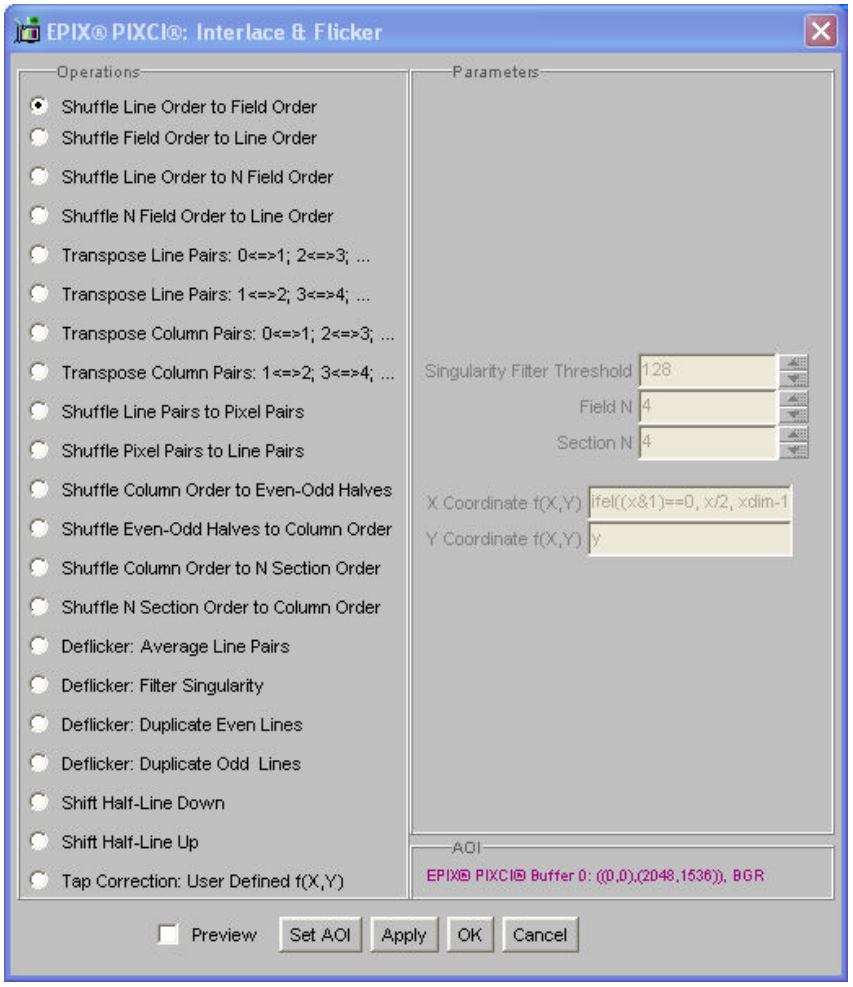
The *Edge Detection* provides Kirsch, Sobel, and other standard edge detectors. The *Sequence Edge Detection* does the same on each image of a sequence. The *Src+Dst Edge Detection* does the same with distinct source and destination images.



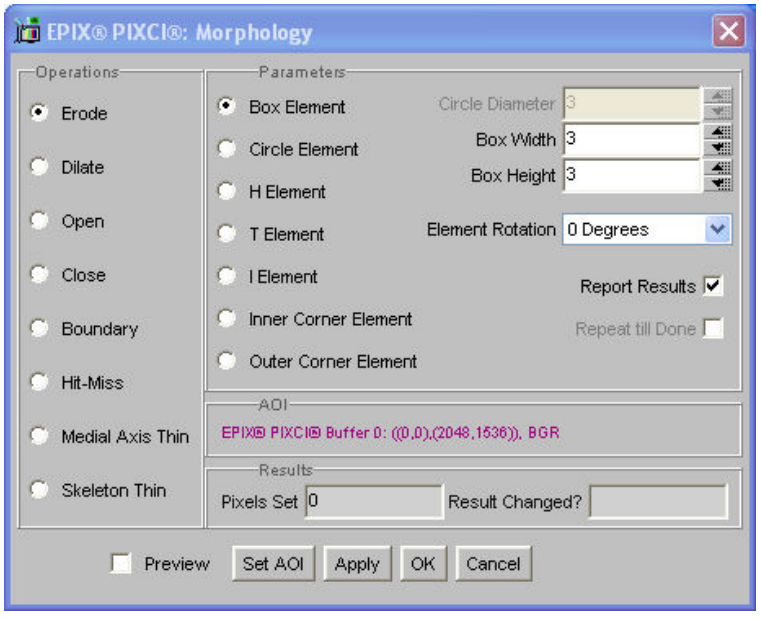
The *FFT* provides Fast Fourier Transforms and Discrete Fourier Transforms. The *Sequence FFT* does the same on each image of a sequence. The *Src+Dst FFT* does the same with distinct source and destination images.



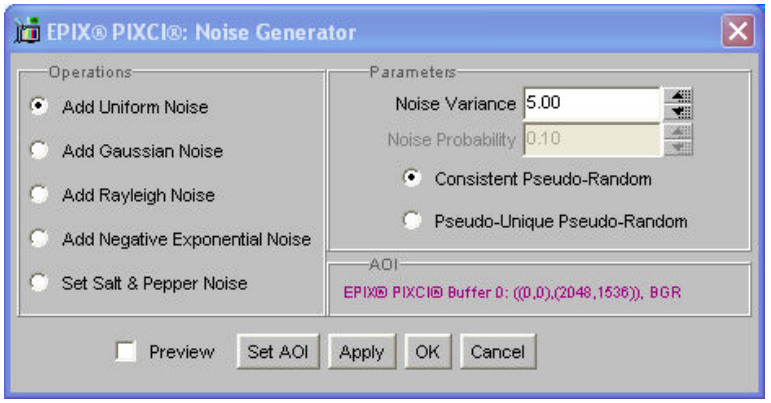
The *HSB Tweak* provides hue, saturation, and brightness adjustments within the HSB color space. While *Arithmetic* and other operations can optionally use the HSB color space to, for example, multiply all saturation values by a constant, the *HSB Tweak* allows adjusting selected portions of the HSB space, such as adjusting the brightness of red pixels with high saturation. The *Sequence HSB Tweak* does the same on each image of a sequence. The *Src+Dst HSB Tweak* does the same with distinct source and destination images.



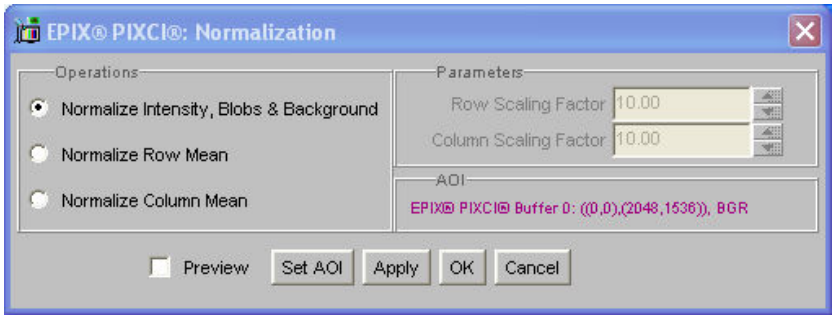
The *Interlace & Flicker* provides line and pixel shuffling operations. The *Sequence Interlace & Flicker* does the same on each image of a sequence. The *Src+Dst Interlace & Flicker* does the same with distinct source and destination images.



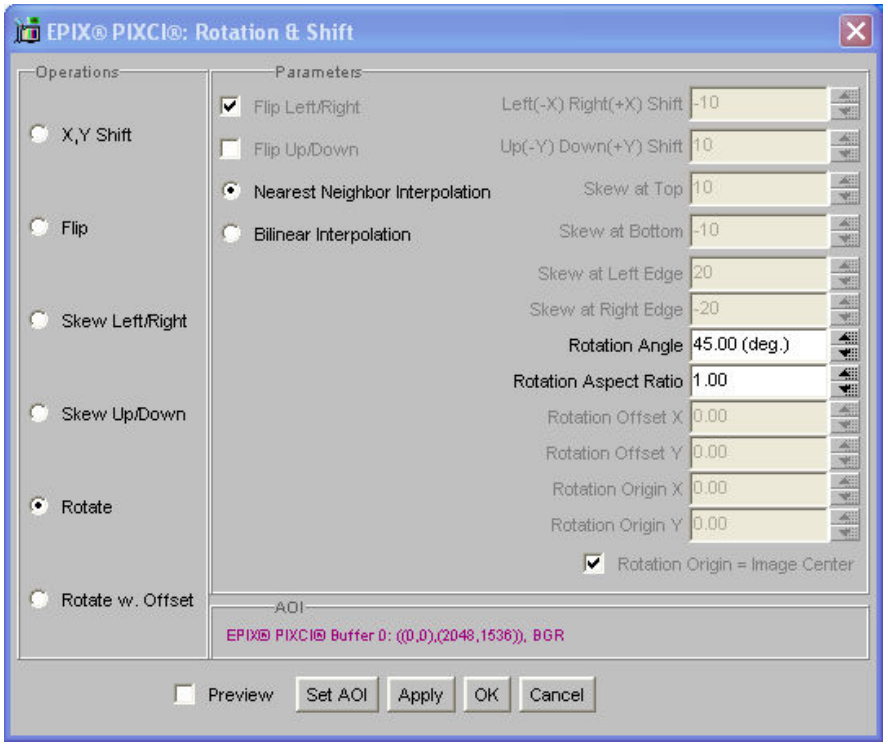
The *Morphology* provides morphological operations with user-defined kernels. The *Sequence Morphology* does the same on each image of a sequence. The *Src+Dst Morphology* does the same with distinct source and destination images.



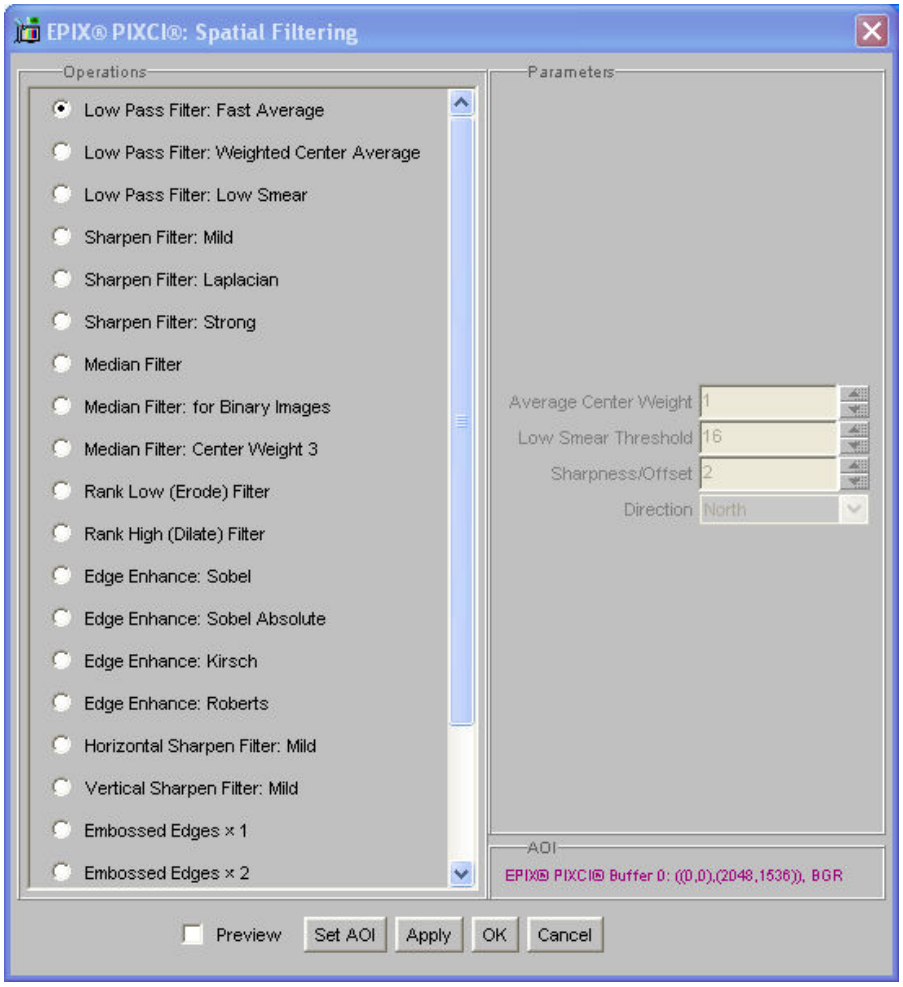
The *Noise Generator* allows adding pseudo-random noise with uniform and other distributions to an image. The *Sequence Noise Generator* does the same on each image of a sequence. The *Src+Dst Noise Generator* does the same with distinct source and destination images.



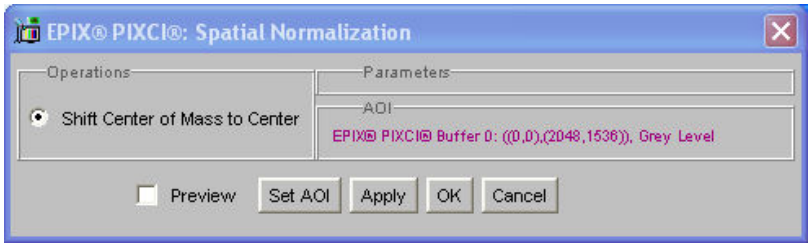
The *Normalization* provides intensity normalizations based upon a single image. The *Sequence Normalization* does the same on each image of a sequence. The *Src+Dst Normalization* does the same with distinct source and destination images.



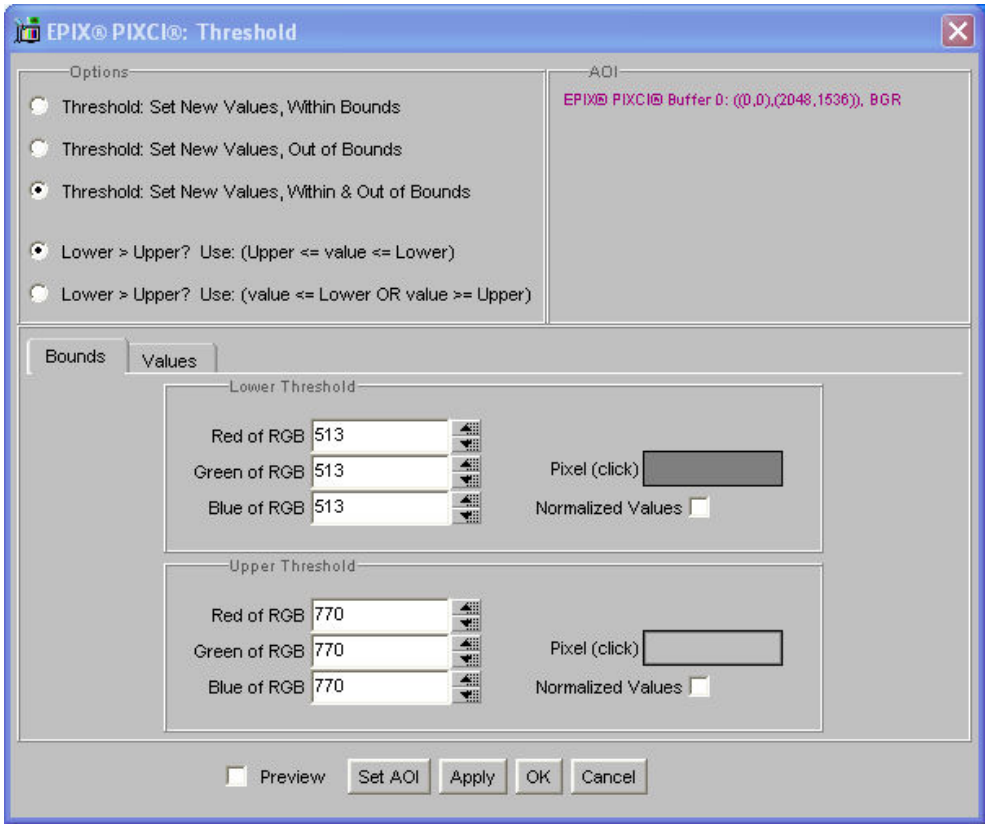
The *Rotation & Shift* provides image rotations and shifts. The *Sequence Rotation & Shift* does the same on each image of a sequence. The *Src+Dst Rotation & Shift* does the same with distinct source and destination images.



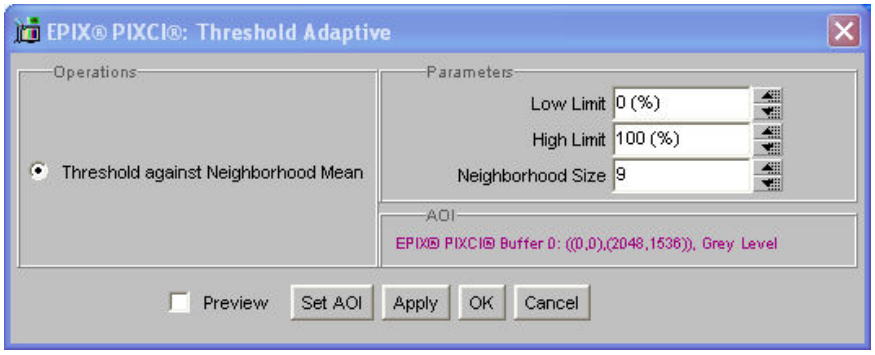
The *Spatial Filtering* provides low pass, high pass, and other filters. The *Sequence Spatial Filtering* does the same on each image of a sequence. The *Src+Dst Spatial Filtering* does the same with distinct source and destination images.



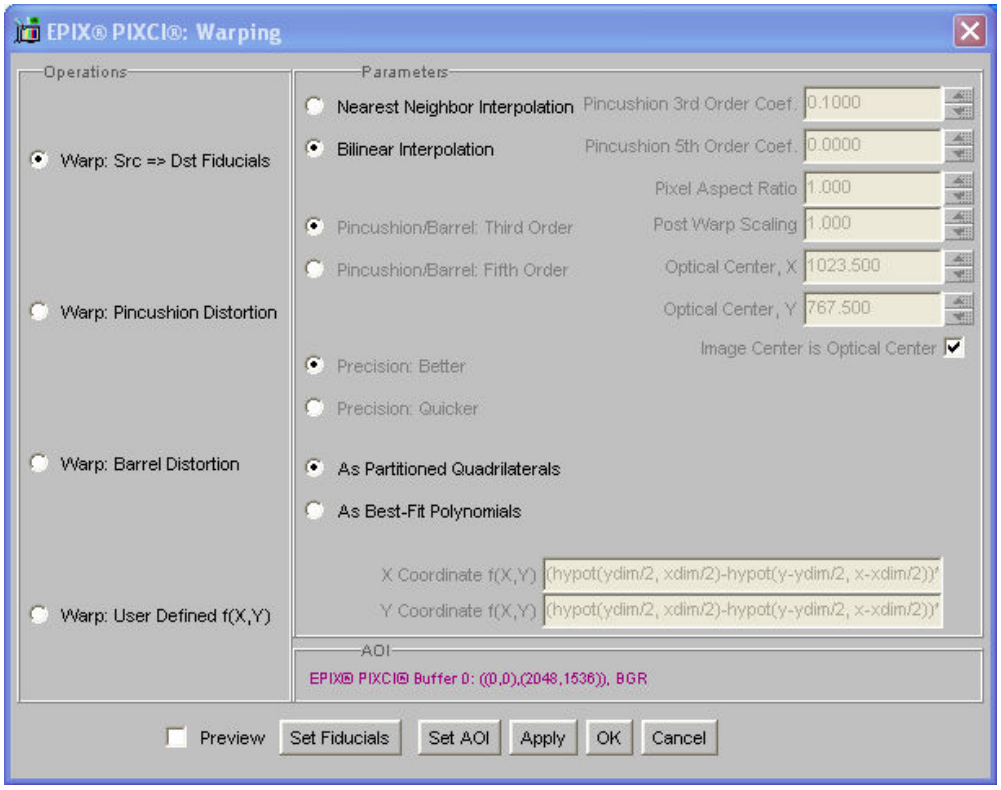
The *Spatial Normalization* provides spatial normalizations based upon a single image. The *Sequence Spatial Normalization* does the same on each image of a sequence. The *Src+Dst Spatial Normalization* does the same with distinct source and destination images.



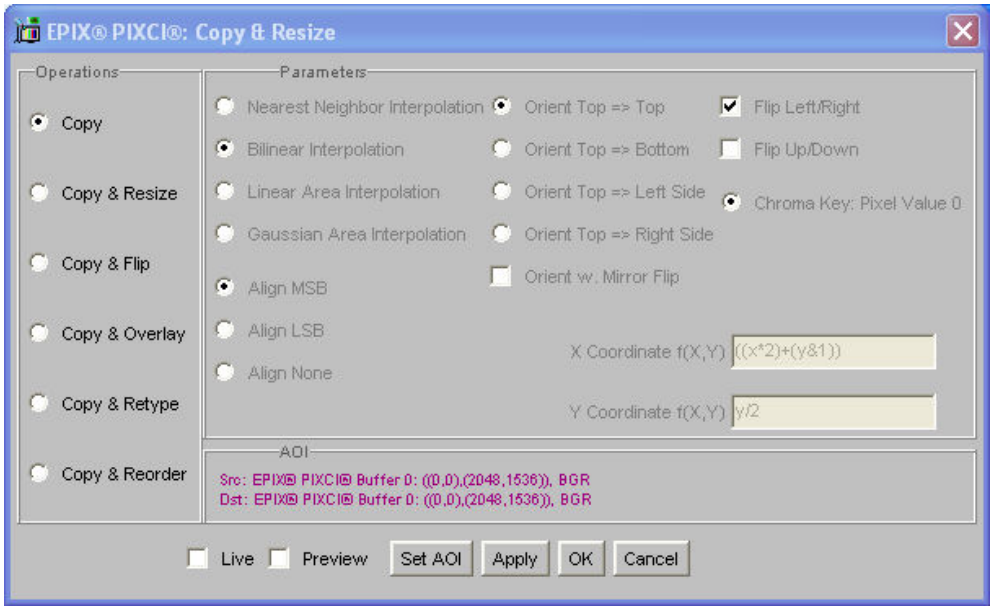
The *Threshold* allows thresholding an image against user-defined, fixed, boundary values. The *Sequence Threshold* does the same on each image of a sequence. The *Src+Dst Threshold* does the same with distinct source and destination images.



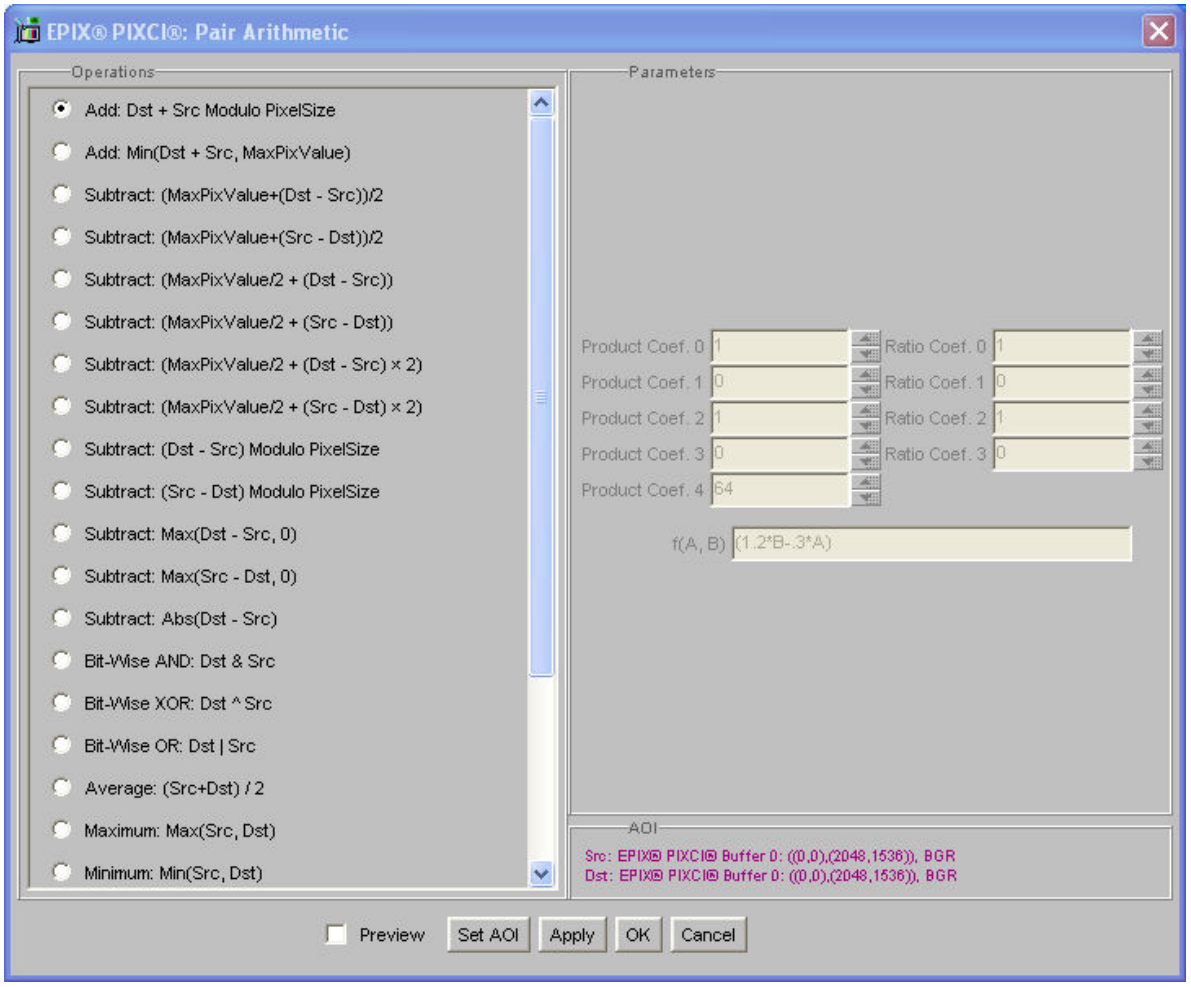
The *Threshold Adaptive* allows thresholding an image against boundary values that are automatically adjusted. The *Sequence Threshold Adaptive* does the same on each image of a sequence. The *Src+Dst Threshold Adaptive* does the same with distinct source and destination images.



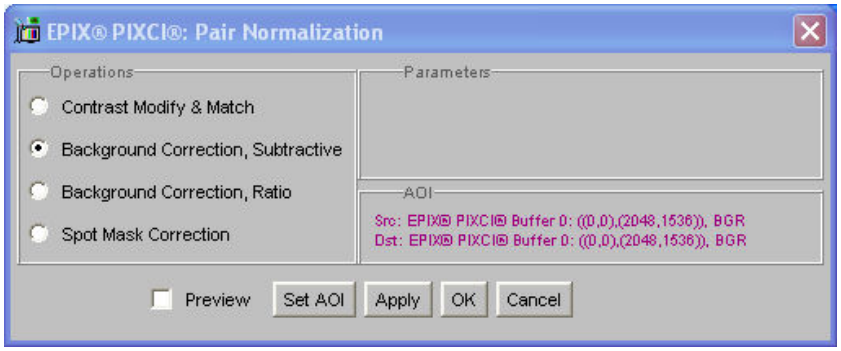
The *Warping* allows "rubber-sheet" transformations governed by a list of initial and final fiducial locations, governed by pincushion/barrel lens distortion, or specified by mathematical expressions. The *Sequence Warping* does the same on each image of a sequence. The *Src+Dst Warping* does the same with distinct source and destination images.



The *Copy & Resize* allows copying and resizing an image from one image buffer to another. The *Sequence Copy & Resize* does the same on each image of a sequence.

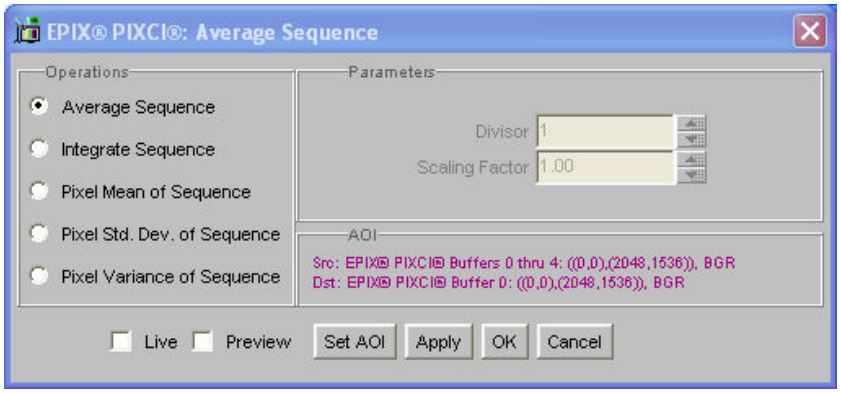


The *Pair Arithmetic* provides pixel arithmetic, such as summation, between one image buffer and another. The *Src+Dst Arithmetic* does the same with distinct source and destination images.

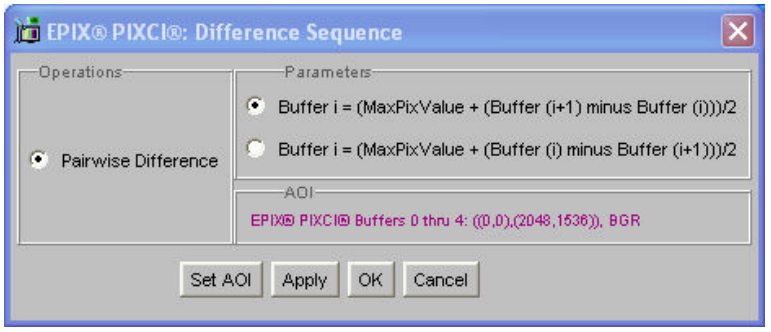


The *Pair Normalization* allows normalizing various intensity based attributes of an image, based upon a second reference, or background, image. The *Src+Dst Pair Normalization* does the same with distinct source and destination images.

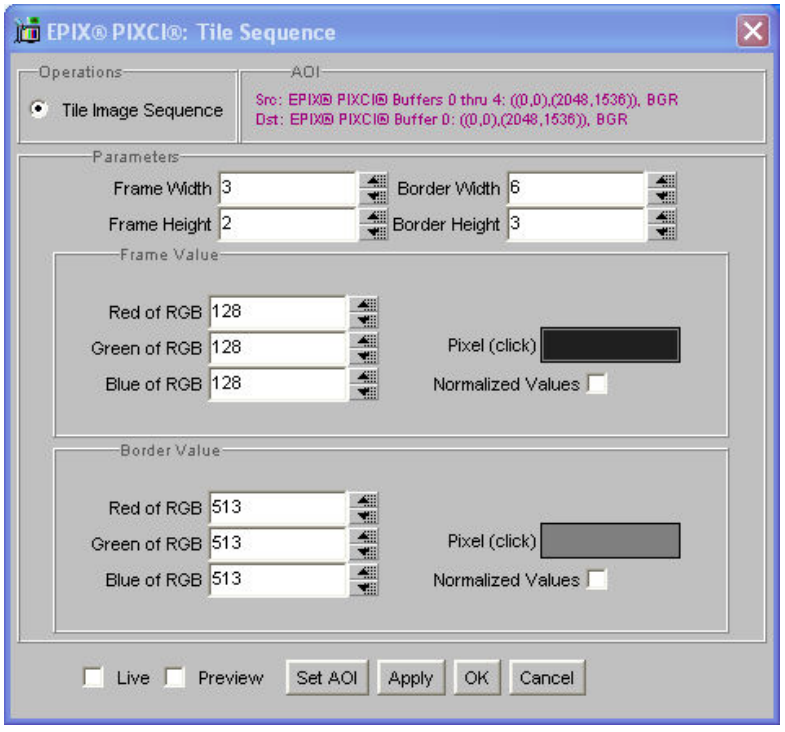
The *Triplet Normalization* allows normalizing various intensity based attributes of an image, based upon two other reference, or background, images. The *Src+Dst Triplet Normalization* does the same with distinct source and destination images.



The *Average Sequence* allows forming the average or sum of an image sequence.



The *Difference Sequence* allows forming the difference of each pair of images of an image sequence.



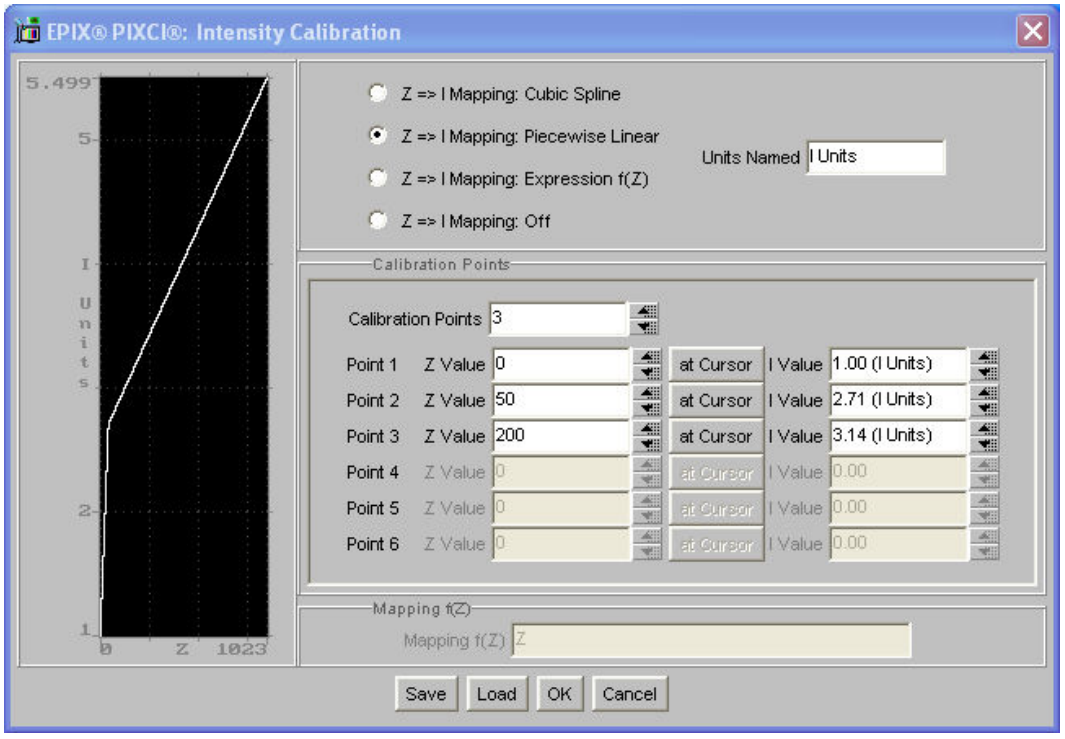
The *Tile Sequence* allows forming a grid of reduced images from an image sequence.

For image copy and other image processing operations utilizing a distinct source and destination, the image viewer window from which the operation is selected is always the modified destination; an image (or sequence) associated with a different image viewer window can be selected as the unmodified source.

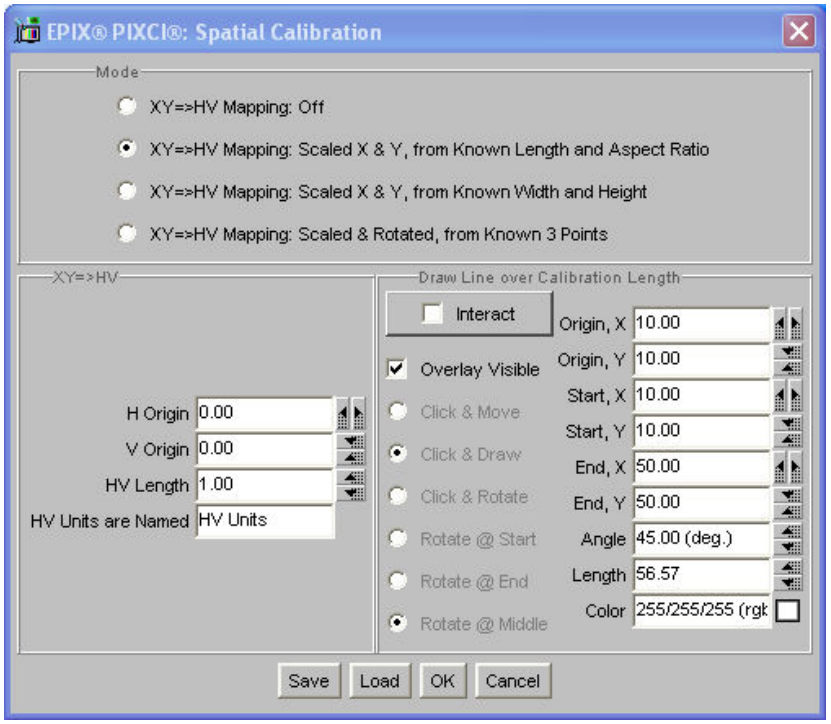
The XCAP-Lite and XCAP-Ltd versions only provide the *Patterns* and *Set* features.

5.2.5. Image Viewer - Measure

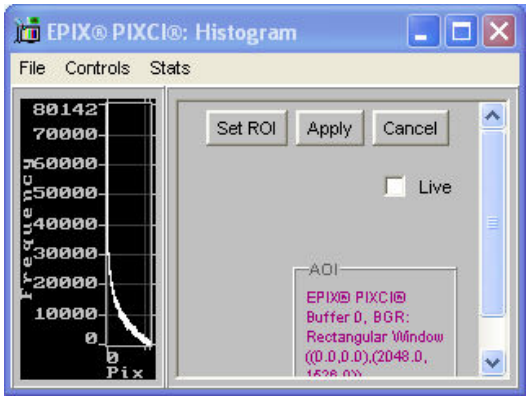
The image viewer window's *Measure* provides features for image measurement and analysis, including user-defined coordinate systems and mapping intensities into user-defined units.



The *Intensity Calibration* allows creating a mapping (correspondence) from monochrome image pixel values into user-defined units, for example from grey level into brightness, or grey level into density of material.

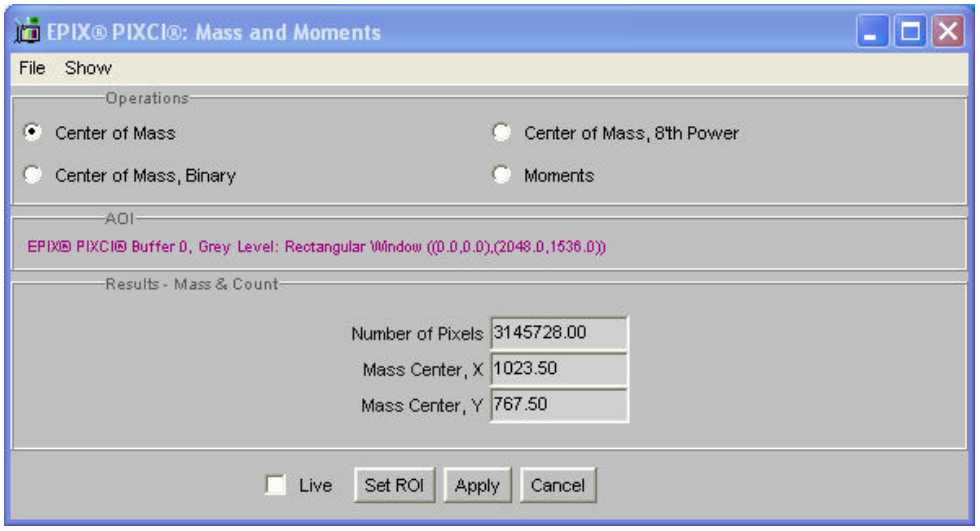


The *Spatial Calibration* allows creating a mapping (correspondence) from pixel X,Y coordinates into a user-defined H,V coordinate system. The H,V coordinates may be translated, scaled, and/or rotated with respect to X,Y coordinates.



The *Histogram* computes and displays a graph of an image's histogram.

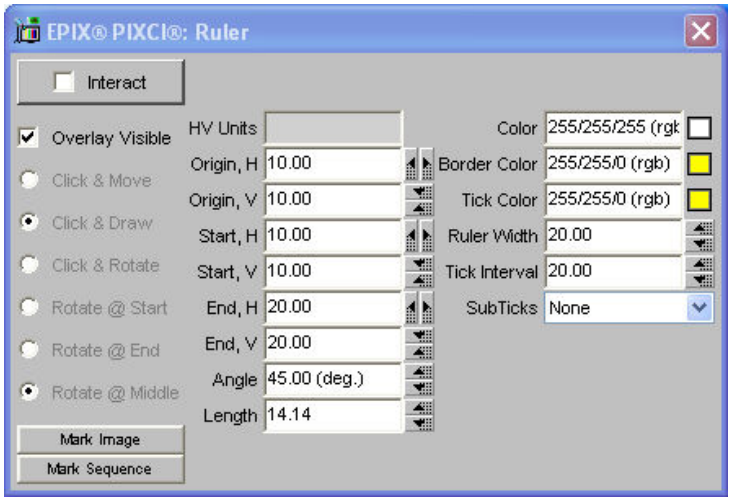
The *Histogram Pair* computes and displays a graph of the histogram of difference of a pair of images.



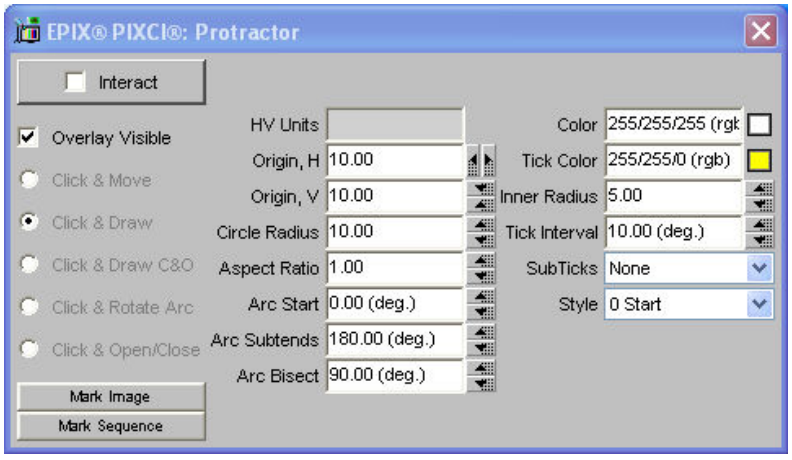
The *Mass & Moments* computes and displays various moments of an image.

The *Line Profile* displays a two-dimensional graph of pixels values along an arbitrary oriented line, arc, polyline, Bezier, and other curves.

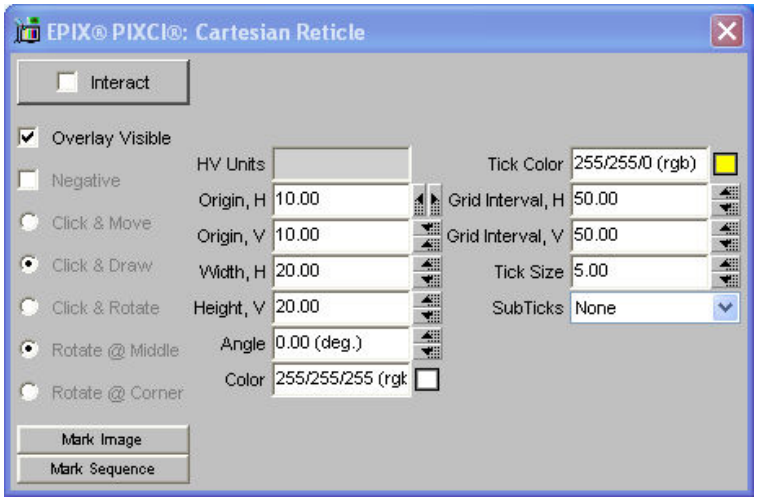
The *Radial Mass Plot* displays a two-dimensional graph of the sum of pixel values versus the pixels' distance from an origin.



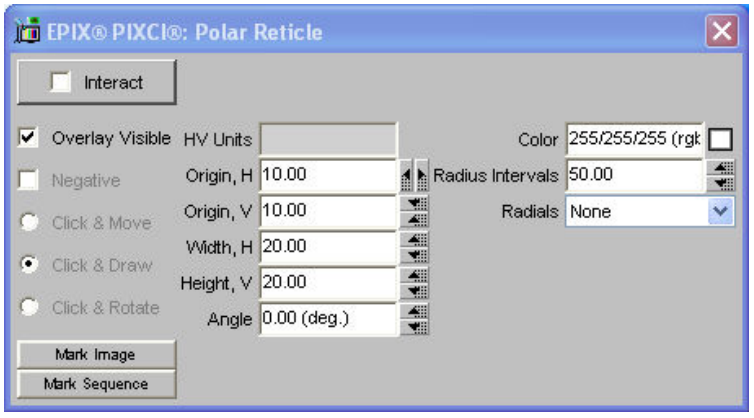
The *Ruler* overlays a ruler on the image, with user-defined length, width, and tick marks, all based on the H,V coordinate system. Multiple rulers can be overlaid on each image.



The *Protractor* overlays a protractor on the image, with user-defined radius, arc, and tick marks, all based on the H,V coordinate system. Multiple protractors can be overlaid on each image.



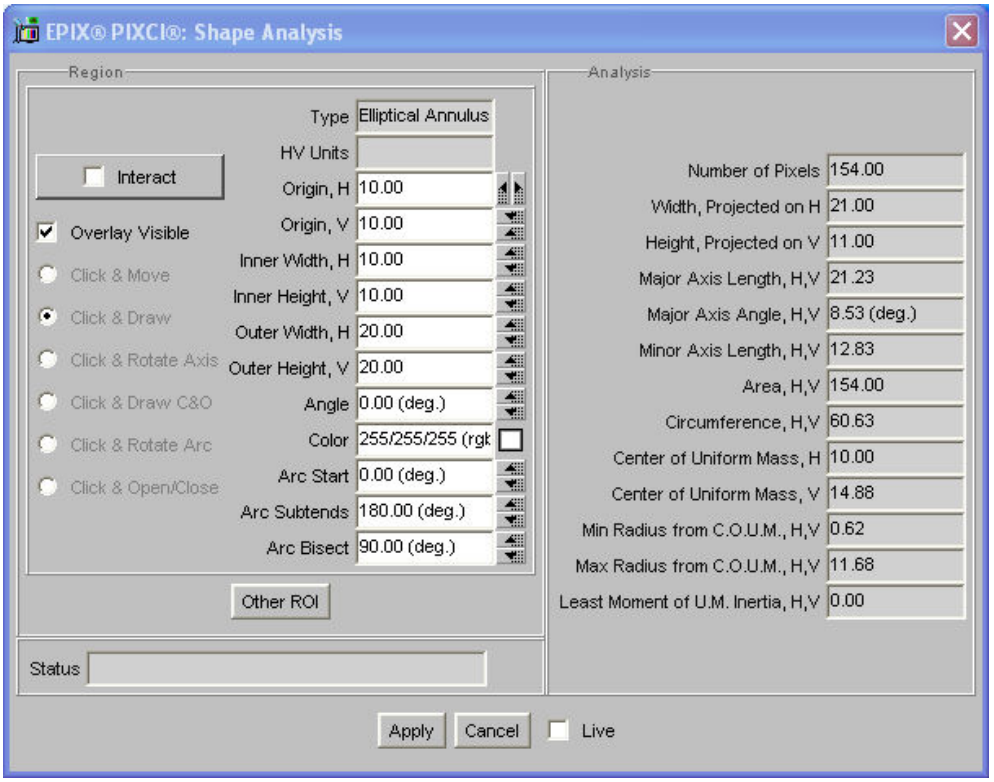
The *Cartesian Reticle* overlays a Cartesian coordinate reticle on the image, based on the H,V coordinate system. Multiple Cartesian reticles can be overlaid on each image.



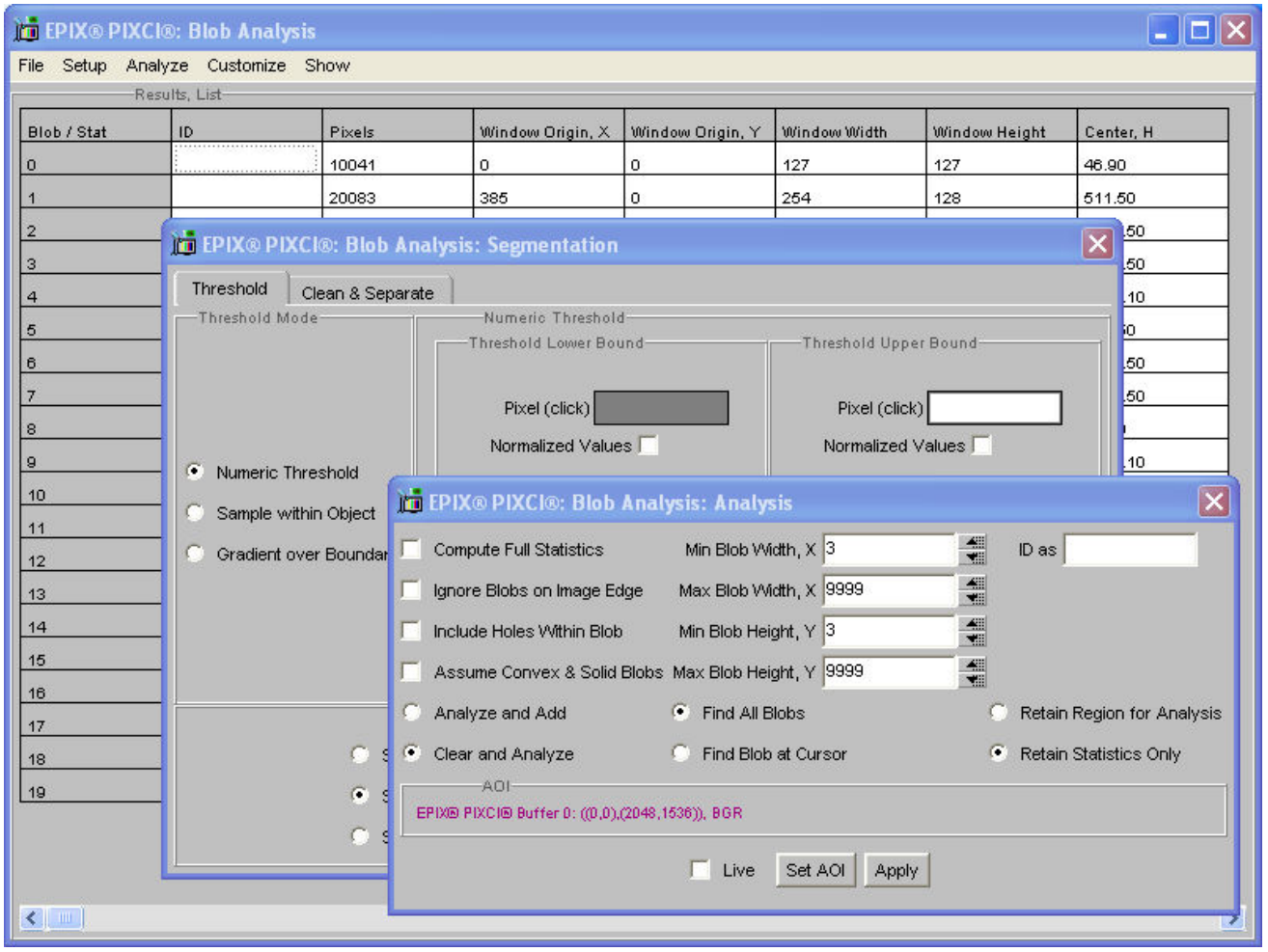
The *Polar Reticle* overlays a polar coordinate reticle on the image, based on the H,V coordinate system. Multiple polar reticles can be overlaid on each image.



The *Distance & Angle Crosshairs* provides spatial calibration and measurement of absolute position, relative position, length and angles. While these capabilities are also available elsewhere in Image Viewer - Measure and Image Viewer - Draw, the *Distance & Angle Crosshairs* collects chosen features to provide a single window with the equivalent of a so-called "Video Crosshair Overlay & Measurement" system.

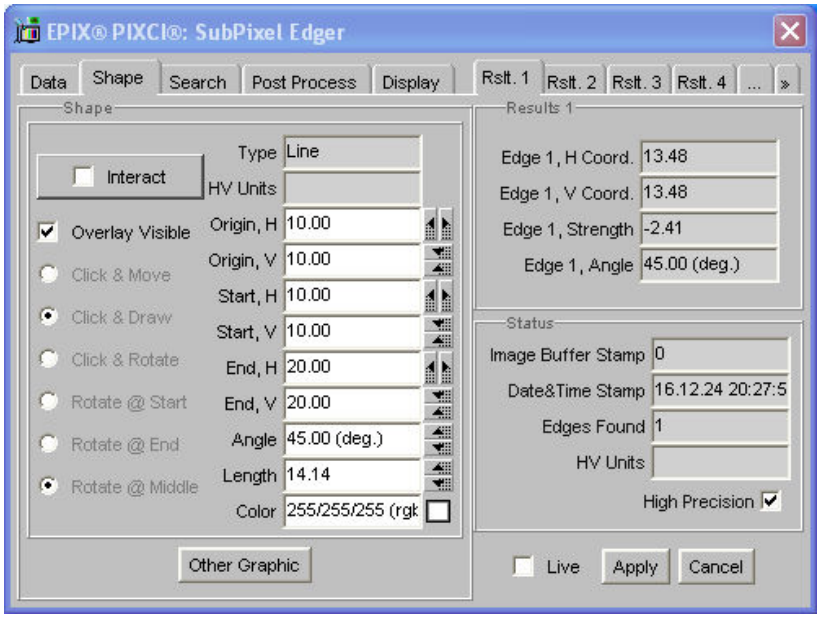


The *Shape Analysis* provides descriptive statistics about the shape of elliptical, rectangular, or polygonal regions.

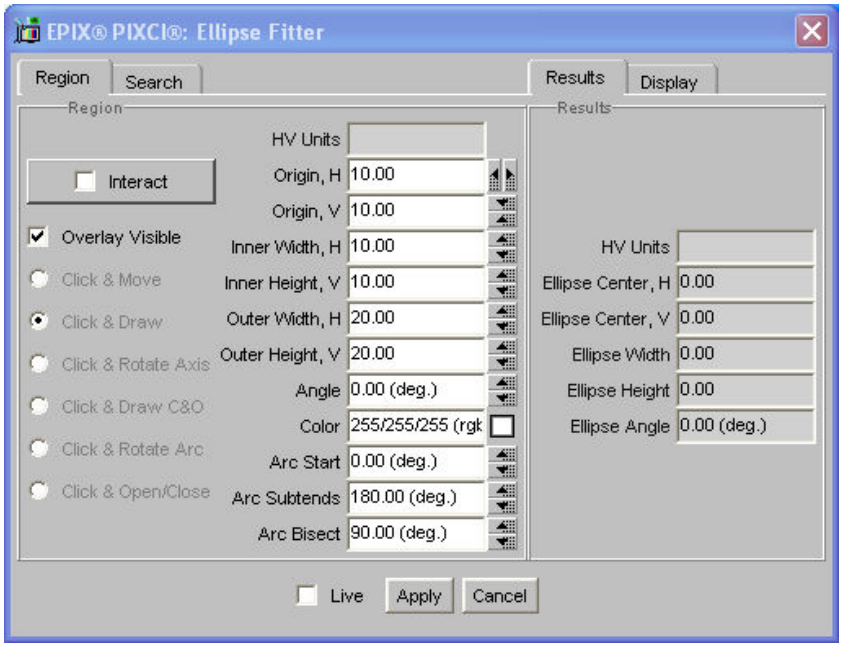


The *Blob Analysis* identifies image blobs, based upon thresholding the image into foreground and background, and provides descriptive statistics about the blobs found.

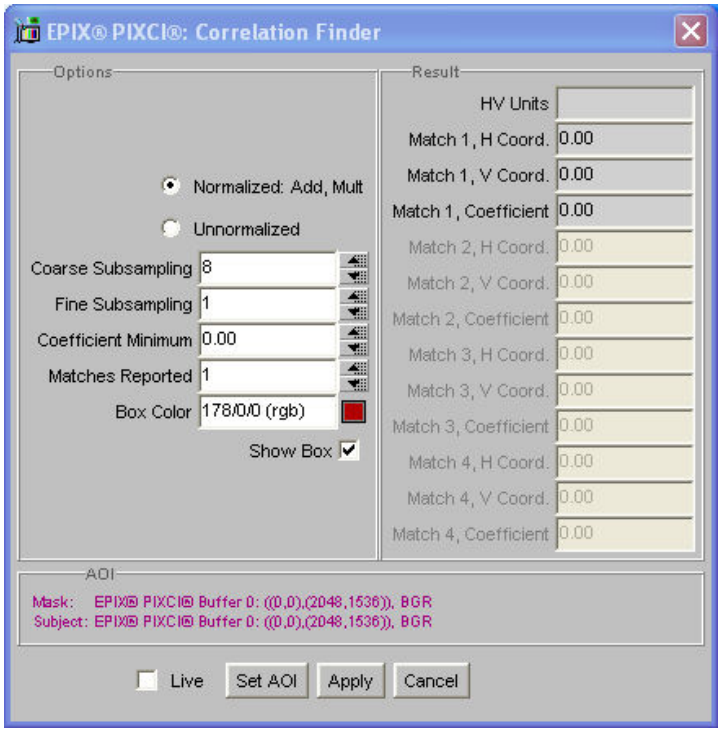
The *Particle Tracking* provides identification and tracking of particles (blobs) over a sequence of images. Individual particles are detected based upon a thresholded (bi-level) image. In one method, multiple image occurrences of a common particle are identified across a sequence of images by position extrapolation and verification. In a second method, vectors of particles that are close together are compared and expected to yield consistent magnitude and direction. In a third method, which requires the fewest setup parameters, common particles are grouped by nearest neighbor. For any method, the particle's trajectories are displayed and reported.



The *SubPixel Edger* overlays a line or curve tool on the image, analyzes the pixel values under the line or curve finding edges or lines to subpixel accuracy, and displays the position of the edges or lines both graphically, on the image, and numerically.



The *Ellipse Fitter* overlays an elliptical pattern of subpixel edger tools on the image, and computes a best-fit elliptical curve from the edges found.



The *Correlation Finder* correlates, or matches, a kernel image over a larger image, showing the coordinates of, and displaying a box around, the best match(es).

The XCAP-Lite and XCAP-Ltd versions do not provide the *Intensity Calibration*, *Spatial Calibration*, *Histogram*, *Histogram Pair*, *Mass & Moments*, *Radial Mass Plot*, *Protractor*, *Polar Reticle*, *Distance & Angle Crosshairs*, *Shape Analysis*, *Blob Analysis*, *Particle Tracking*, *SubPixel Edger*, *Ellipse Fitter*, or *Correlation Finder* features; the *Line Profile* is limited to straight lines.

5.2.6. Image Viewer - Draw

The image viewer window's *Draw* provides features for drawing graphics and text over the image. One or more of: line, circle with aspect ratio correction, rotated rectangle, rotated ellipse, arc of circle with aspect ratio correction, arc of rotated

ellipse, annulus, arc of annulus, rectangular frame, list of points, polygon, polyline (connected line segments not closed into a polygon), Bezier curve, or Bezier region (Bezier curve closed to form region), rotated text, and arrow may be overlaid over the image (non destructive) or written into the image. The individual menu items such as Text, Line, Rectangle, etc. allow quick drawing of graphics or text. The *Graphic Manager* permits drawing the same graphics or text, but in addition manages a list of graphic or text objects, including loading and saving of the graphic or text objects.

The *Image Overlay* feature allows overlaying a second image, containing graphics on a "transparent" background, over the current image.

The *Paint Brush* feature allows interactive "painting" onto the image with selectable color, patterns, and "brush" shapes.

The *Paint Fill* feature allows filling (flooding) an image region with "paint" of selectable color and patterns, using specified pixel values as the boundary terminating the "filling".

The XCAP-Lite version only provides the graphic line, graphic window, and graphic arrow features. The XCAP-Lite version does not provide the image overlay feature.

5.2.7. Image Viewer - AOI

The image viewer window's *Aoi* allows defining areas of interest (AOI) and regions of interest (ROI) upon which future image processing, measurement, analysis, print, load, and save features will operate. As used in XCAP, an "AOI" is a rectangular area with sides parallel to the image axis, while an "ROI" is of arbitrary shape, such as an ellipse or rectangle which may be rotated with respect to the image axis, or an arbitrary path or polygon. The image print, load, save, and many other features only allow use of an AOI; selected image processing, measurement, analysis and other features also allow use of an ROI.

The *Set AOI* defines the default area of interest and color space upon which future image processing, printing, load, and save features will operate.

The *Set ROI* defines the default region of interest and color space upon which future image measurement, analysis, and other selected features which accept an ROI will operate.

The *Set Full Image* quickly sets the default area of interest and region of interest to the image's full dimensions, and the default color space to the image buffer's natural color space, without entering the *Set AOI* or *Set ROI* window.

The *AOI/ROI Manager* maintains a list of often used areas of interest (AOI) and regions of interest (ROI).

Within each of the image processing, measurement, analysis, print, load, and save features a different AOI (or ROI, if applicable) can be selected, temporarily overriding the default AOI (or ROI). Within the feature, the new AOI (or ROI) can be specified numerically or interactively drawn, or an AOI (ROI) previously defined within the *AOI/ROI Manager* can be selected.

5.2.8. Image Viewer - View - Shortcuts

A tool bar of icons provides shortcuts for accessing often used features of *The Image Viewer Window*. Selected shortcuts can also be activated by key clicks when the tool bar window has the "input focus" (i.e. that window's title bar is highlighted). The shortcuts provided are:

a. Switch to first buffer of sequence (*Key HOME*).
b. Switch to next buffer of sequence (*Key PAGE UP*).
c. Switch to previous buffer of sequence (*Key PAGE DOWN*).
d. Switch to last buffer of sequence (*Key END*).
e. Copy image to new image buffer.
f. Adjust palette.
g. Activate or deactivate zoom (i.e. magnification).
h. Peek at numeric pixel values.
i. Activate or deactivate cursor overlay.
j. Draw a two-dimensional plot of line or column of pixel values.
k. Draw a histogram of pixel values.
l. Select resizing of the image to fit *The Image Viewer Window*, or no resizing so that there is a one to one relationship between an image pixel and a graphics display system's pixel (although the entire image may not fit within the window and must therefore be panned and scrolled, and the displayed aspect ratio will be incorrect for image's whose aspect ratio differs from the graphics display system's aspect ratio).

The first four shortcuts appear only for *The Image Viewer Window*'s which access a sequence of images.

The shortcuts may either be attached and part of *The Image Viewer Window*, or may be detached into its own window, as set by *Display* under Image Viewer - View.

5.2.9. Image Viewer - View - Status Bar

A status bar provides information about the image resolution, current cursor coordinates, current buffer of a sequence, and other similar information. The information to be shown can be selected by *Display* under Image Viewer - View.

5.2.10. PIXCI® Image Viewer - Capture

The image viewer window associated with the PIXCI® frame grabber's image frame buffer(s) has *Capture* which provides for capturing images from the PIXCI® frame grabber and other features associated with the PIXCI® frame grabber. Any additional image viewer windows created by *Launch 2nd Viewer* do not provide *Capture*, but only view, modify, examine, and/or draw the frame buffers.

The *Snap* captures and displays a single image. The *Live* continuously captures and displays images; the *UnLive* terminates the *Live* mode, displaying the last captured image.

The *First Buffer* switches to the first buffer of the frame buffer sequence, the *Last Buffer* switches to the last buffer of the frame buffer sequence, the *Next Buffer* switches to the next buffer of the frame buffer sequence, and the *Previous Buffer* switches to the previous buffer of the frame buffer sequence.

The *Adjustments* allows setting common adjustments, as suitable for the model of the PIXCI® frame grabber in use. For the PIXCI® SV2, SV3, SV4, SV5, SV5A, SV5B, and SV5L models, the *Adjustments* allows selecting the video input connection (N/A for PIXCI® SV5B) and adjusting the gain, black level, hue, and saturation.

For the PIXCI® SV7 model, the *Adjustments* allows selecting AGC and adjusting the gain, black level, hue, and saturation.

For the PIXCI® SV8 model, the *Adjustments* allows selecting AGC and adjusting the gain, black level, hue, saturation, and sharpness.

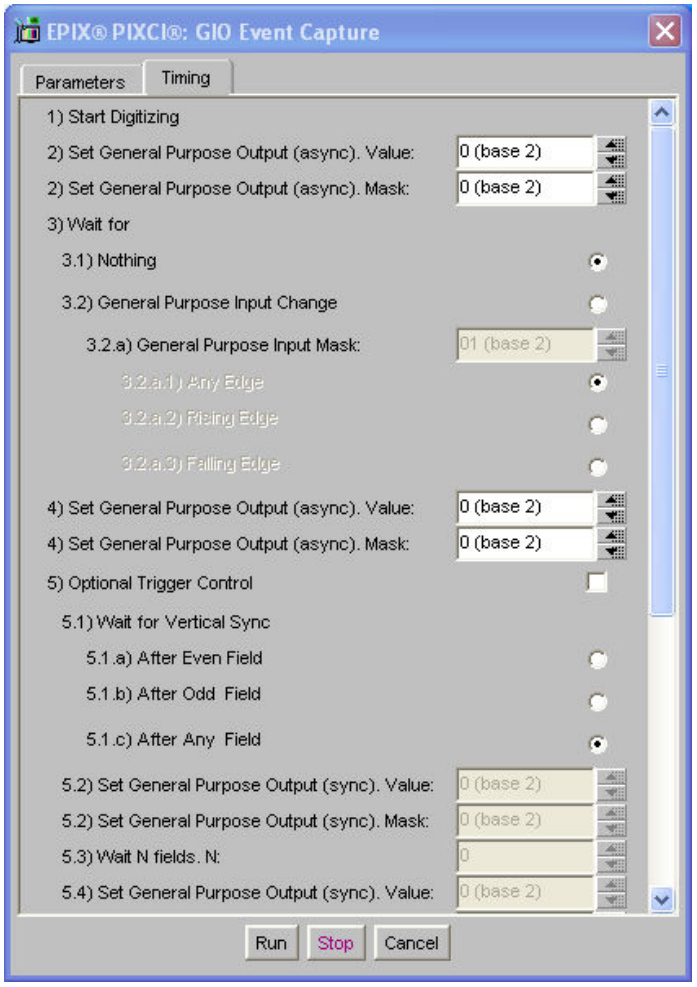
For the PIXCI® A110 and A310 models, the *Adjustments* allows adjusting the analog gain and offset, and the digital gain and offset. Less frequently used, and more esoteric, adjustments may be found under *PIXCI® Video Setup*, described above. For the PIXCI® CL1, CL3SD, D, D24, D32, D2X, D3X, and D3XE models, the *Adjustments* provide camera specific controls.

For the PIXCI® CL2, E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EB1mini, miniH2B, miniH2F, miniH2x4F, EC1, ECB1, ECB1-34, ECB2, EL1, and EL1DB models, the *Adjustments* provide camera specific controls. Or, for "Generic Camera Link" mode, the *Adjustments* allow configuring the PIXCI® frame grabber's video resolution, trigger modes, bit depth, color space, etc. so as to be consistent with the camera.

For the PIXCI® E8CAM, ELS2, SI, SI1, SI2, and SI4 models, the *Adjustments* provide camera specific controls.

The *Adjustments* also provide duplicate features to *Snap*, *Live*, *UnLive*, select the frame buffer, and set the video window size. A duplicate menu item to access *Adjustments* is provided under Image Viewer - View.

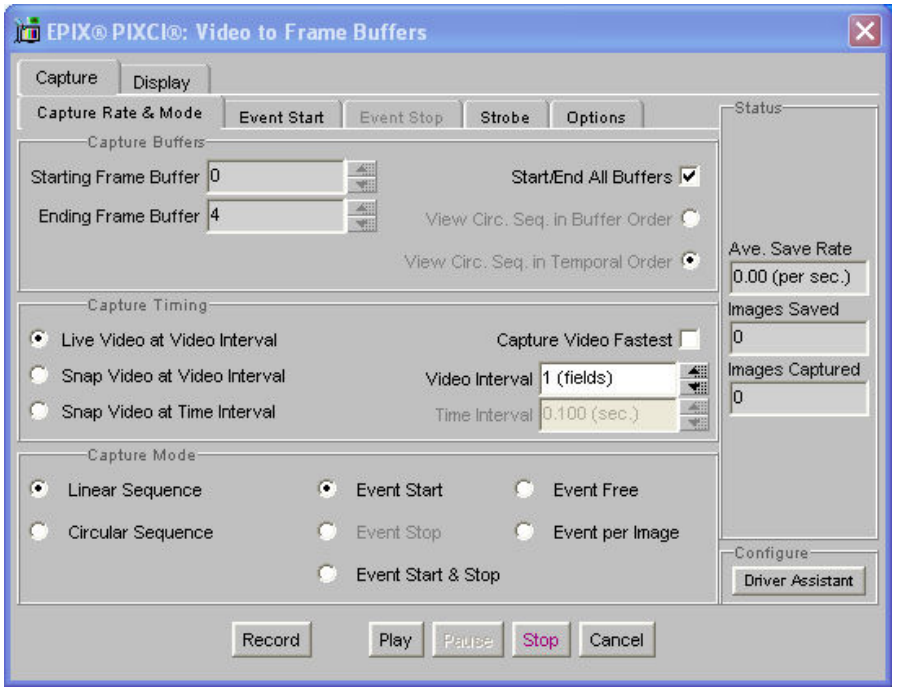
The *Shortcuts* activates or deactivates the PIXCI® Image Viewer - Capture - Shortcuts, described below. A duplicate menu item to access *Shortcuts* is provided under Image Viewer - View.



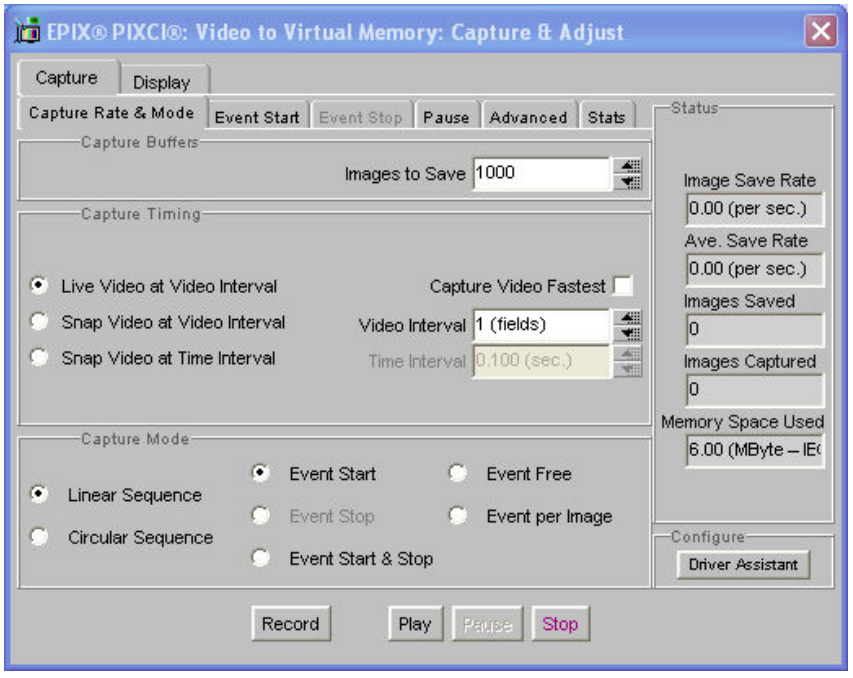
The *GIO Event Capture* provides single or sequence image capture, each image triggered in conjunction with the frame grabber's general purpose (formerly referred to as an external TTL) input and output signals. The XCAP-Lite version does not provide the sequence option of the *GIO Event Capture* feature.

The *Sequence Capture* features allow capturing a timed sequence of images. The *Sequence Capture* features may be started by an event (trigger), run continuously until stopped by an event, or each individual image may be captured in response to an event. Events include mouse clicks, time of day, and the frame grabber's general purpose (formerly referred to as external TTL) inputs; when used with general purpose input events the *Sequence Capture* differs from *GIO Event Capture* in that the latter provides more options and higher accuracy and repeatability for the manipulation of the general purpose inputs and outputs in response to video timing. A time stamp feature allows recording the time that each image was captured, and either overlaying the time nondestructively or permanently marking the image with the time.

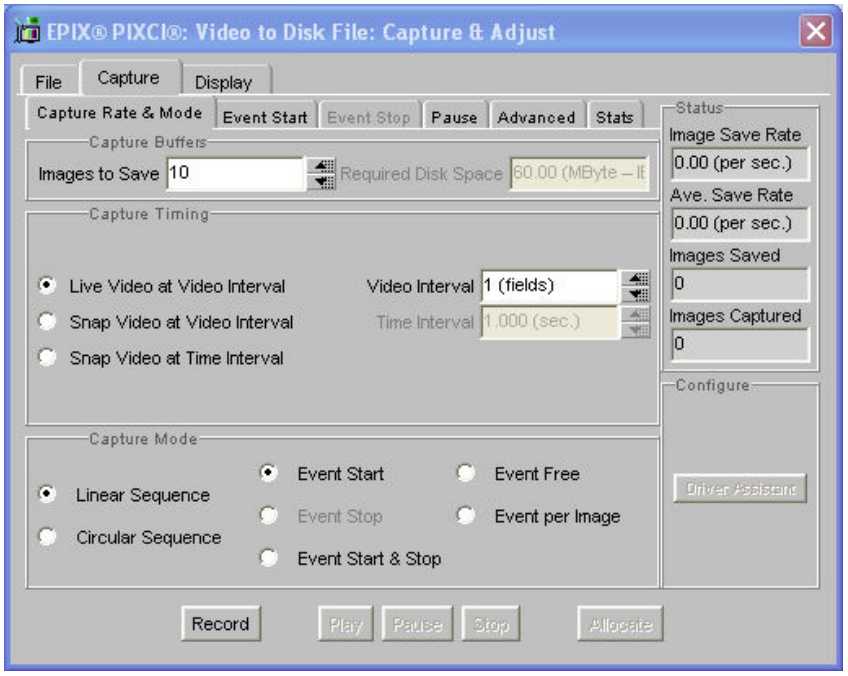
A variety of *Sequence Capture* features provide tradeoffs between capture rate vs. convenience vs. total number of images captured.



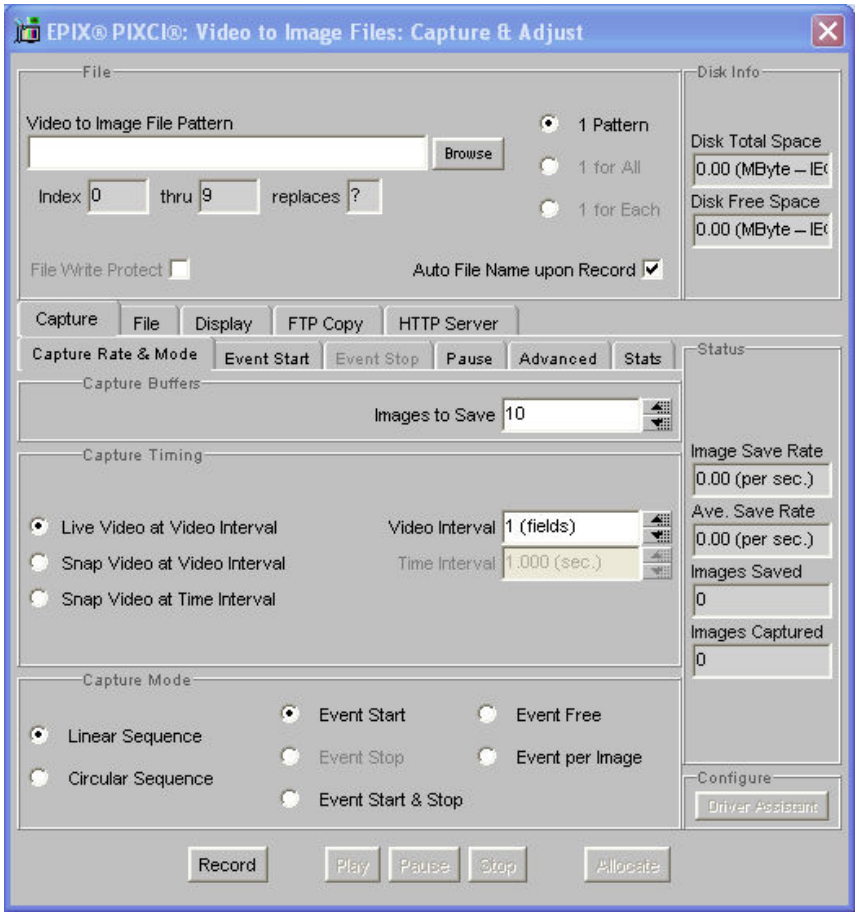
The *Video to Frame Buffers* captures sequences directly into pre-configured frame buffer memory, and can support any video rate or bandwidth.



The *Video to Virtual Memory* captures and copies sequences into convenient dynamically allocated host computer (virtual) memory, but may not support high video rate or bandwidth sequence capture for all cameras on all computers.



The *Video to Disk File* captures and copies sequences into a disk file in an efficient, internal format; after capture the sequence can be saved in a standard format.

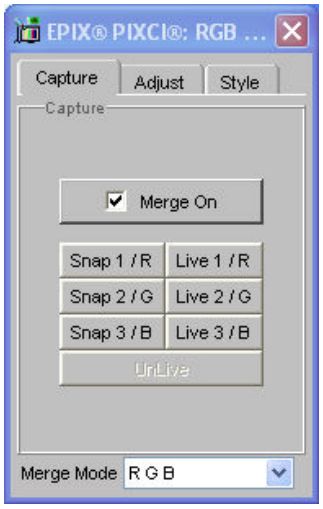


The *Video to Image Files* captures and copies sequences directly into standard format image files, but may not obtain as high video rate capture as the *Video to Disk File* feature. The XCAP-Lite version does not provide the *Video to Image Files* or *Video to Disk File* features. The XCAP-Lite version does not provide the time stamp feature, or the event (trigger) option of the *Video to Frame Buffers* or *Video to Virtual Memory* features. The XCAP-Ltd version does not provide the *Video to Disk File* feature.

The *Waterfall Display* displays a chosen line of the frame buffer, in a "waterfall" fashion, updating the screen once per field, or as often as the host computer's speed allows. This feature is primarily intended for adjusting line scan type cameras. The

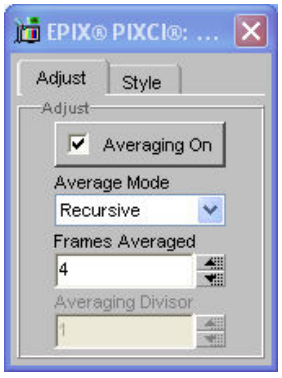
waterfall display is intended only for viewing; it can't be analyzed, and can be saved only as a side effect of *Screen Capture*.

The *Video to StreamStor* (only under Windows) allows recording and playing video to and from Boulder Instruments StreamStor High-Speed Disk Recorders, allowing recording at video rate with almost all cameras and resolutions. The *Video to StreamStor* is provided only in the XCAP-Plus version.



The *RGB Merge* allows interpreting and viewing three monochromatic frame buffers as a single color (e.g. RGB) image, with adjustments for registration and coloring. The XCAP-Lite version does not provide the *RGB Merge* feature.

The *Quad Pixel Merge* allows interpreting and viewing four monochromatic frame buffers, each one captured after shifting the image sensor by ½ pixel horizontally and vertically, as a single high resolution image. The XCAP-Lite and XCAP-Ltd versions do not provide the *Quad Pixel Merge* feature.



The *Frame Average* allows performing recursive, continuous, averaging of live video frames (or fields) and viewing the live result. The XCAP-Lite and XCAP-Ltd versions do not provide the *Frame Average* feature.

The *Live Options* combines the *View - Display* options, above, with additional choices governing *Live* mode. During *Live* mode, the PIXCI® frame grabber can: (a) Capture continuously into the specified frame buffer, however the image shown on the graphics display may contain portions from different video frames, (b) Snap, display on the graphics display, and repeat, however the image capture and display rate will be slower, or (c) Alternate capturing into the specified frame buffer and the last frame buffer (dual buffering). On host computers with insufficient PCI bandwidth to simultaneously capture into host computer memory and display from host computer memory to the graphics display, option (b) reduces the required bandwidth by approximately half.

The *Lens Control - Birger EF232* allows controlling the aperture and focus of a compatible lens via a Birger EF232 Lens Mount. Both manual aperture and focus control, through the GUI, as well as automatic aperture and focus control, in response to the image intensity and sharpness, are provided. The XCAP-Lite and XCAP-Ltd versions do not provide the automatic aperture and focus control features.

5.2.11. PIXCI® Image Viewer - Capture - Shortcuts

A tool bar of icons provides shortcuts for accessing often used features of the PIXCI® frame grabber, and is an extension of the Image Viewer - View - Shortcuts described above. Selected shortcuts can also be activated by key clicks when the tool bar window has the "input focus" (i.e. that window's title bar is highlighted). The shortcuts provided are:

a. Switch to first buffer of frame buffer sequence (*Key HOME*).
b. Switch to next buffer of frame buffer sequence (*Key PAGE UP*).
c. Switch to previous buffer of frame buffer sequence (*Key PAGE DOWN*).
d. Switch to last buffer of frame buffer sequence (*Key END*).
e. Snap single image (*Key S*).
f. Toggle between:
    - Live mode - continuously capture and display images (*Key L*), and
    - Unlive mode - cease continuously capturing and displaying (*Key U*).
g. Duplicate image.
h. Adjust palette.
i. Activate or deactivate zoom (i.e. magnification).
j. Activate or deactivate cursor overlay.
k. Select resizing of the image to fit *The Image Viewer Window*, or no resizing so that there is a one to one relationship between an image pixel and a graphics display system's pixel (although the entire image may not fit within the window and must therefore be panned and scrolled, and the displayed aspect ratio will be incorrect for image's whose aspect ratio differs from the graphic display system's aspect ratio).
l. Peek at numeric pixel values.
m. Draw a two-dimensional plot of line or column of pixel values.
n. Draw a histogram of pixel values.
o. Acquire sequence.
p. Display sequence.

The shortcuts may either be attached and part of The Image Viewer Window, or may be detached into its own window, as set by *Display* under Image Viewer - View.

5.3. Other Features

Other useful features of XCAP are associated with many, or all, of its windows.

Most windows of XCAP provide fields for numeric entry. Typically, to the right of the numeric entry field are two up/down or left/right buttons. Left clicking a button allows incrementing or decrementing the numeric value. Left clicking within a button's shaded area yields larger increment or decrement values, depending on the distance from the opposite button.

Right clicking the numeric field, either button, or the area between buttons, yields an options menu. The options menu typically provides the following:

i. Selecting the base to which integer numbers are displayed, or the format and precision to which non-integer numbers are displayed.
ii. Changing the increment and decrement values to be applied when the buttons are left clicked. Selecting whether the increment or decrement is added or subtracted, whether a percentage up or down, or is the number of "steps" unique to that numeric field.
iii. Activating a *ScrollPad* (a miniature scroll bar which overlays the displayed number) allowing adjustment of the numeric value with mouse clicks and drags.
iv. Selecting units and range for display of angles, such as 0 to 360 degrees, -180 degrees to +180 degrees, 0 to 2pi radians, or -pi to +pi radians.
v. Selecting units for display of temporal intervals, such as milliseconds, seconds, minutes, or hours.
vi. Selecting units for display of lengths, such as millimeters, centimeters, meters, inches, or feet.
vii. Selecting units for display of frequencies, such as Hertz, kiloHertz, megaHertz, or the corresponding period in seconds, milliseconds, or microseconds.
viii. Selecting units for display of memory sizes, such as bytes, kilobytes, megabytes, gigabytes, or IEC kibibytes, IEC mebibyte, IEC gibibyte, etc.
ix. Selecting units for display of temperature, such as Fahrenheit, Celsius, or Kelvin.
x. Connecting the field to receive new content from a specified cell of the *Black Board*, or connecting the field to transmit its content to a specified cell of the *Black Board*.
xi. Providing a larger *Big Field* in which to view or enter a number.
xii. Providing an *Expression* field in which a mathematical expression can be entered and evaluated to a numeric value.
xiii. Providing editing controls such as *Cut*, *Copy*, *Paste*, and *Delete*.

Numeric fields which only display computed results, text entry fields, and text display fields, may provide some of the above options — accessed by right clicking the field.

Some numeric fields may have an associated, explicit, "slider" control in addition to the implicit *ScrollPad*. Right clicking the slider allows enlarging a portion of the slider's range for finer control.

Various windows of XCAP provide fields for entry of text, or file and path names. Right clicking the field yields an options menu. The options menu typically provides the following:

i. Connecting the field to receive new content from a specified cell of the *Black Board*, or connecting the field to transmit its content to a specified cell of the *Black Board*.
ii. Providing a larger *Big Field* in which to view or enter text.
iii. Providing a history of previously used values, allowing convenient reuse without retyping.
iv. Providing editing controls such as *Cut*, *Copy*, *Paste*, and *Delete*.
v. Automatically generating a unique file name representing the current date and time (for files to be saved or created).

Various windows of XCAP provide fields for entry of pixel colors. Typically, the color can be entered numerically, and a small color "swatch" appears next to the color entry field, showing the selected color. Right clicking the swatch activates a color cylinder from which new colors may be selected by mouse clicks.

Various windows of XCAP provide a drop-down list selection field. Right clicking the selection field yields an options menu which in turn provides a *Search* feature. The *Search* allows convenient searching through a long list of selections. Selected drop-down list selection fields may have an explicit, adjacent, *Search* button to access the same service.

For drop-down list selection fields used to select a serial "COM" port (for Windows) or "ttyS" device (for Linux), right clicking the selection field yields an options menu which in turn provides a *Refresh* feature which updates the list based on the operating system's currently installed ports or devices.

Editing of numeric and text fields follows standard conventions. In brief, mouse click once or use left/right arrow keys to position the caret - characters are inserted at the caret as typed. Double mouse click to highlight all text or single click and drag to highlight a portion of text - a Delete or Backspace removes the highlighted text, a character replaces the highlighted text, and the left/right arrow keys cancel the highlight mode.

Hovering the mouse over a numeric, text, list selection, checkbox, radio button, button, or other control will cause the associated *Tool Tip*, if any, to pop-up; the *Tool Tip* will automatically disappear. The *Tool Tip* can also be displayed by right-clicking on the control for its options menu, which in turn provides a *Tool Tip* feature; the *Tool Tip* must be explicitly closed. The *Big Field*, *Expression*, and *Search* features also display the *Tool Tip*.

The user interface can be navigated without a mouse by using Tab and Shift-Tab to shift input focus, arrow keys and PgUp/PgDn to scroll, arrow keys to select tabs and list items, Enter to select choices and push buttons, and Alt-Tab (under Windows) or Ctrl-Alt-Tab (under Linux) to select a Window.

5.4. Road Map - Main Window

```
Main Window

    File
        Load New Image
        Load New Image Sequence
            TIFF
            JPEG/JFIF
            BMP
            AVI
            FITS
            Portable Map
            VIF (Video Frame Files - Video to Disk)
            Multimedia
        Image File Info
        TWAIN Select Source
        TWAIN New Acquire
        TWAIN Source Info
        Window List
         -- List of current windows
        Exit

    Images
        New Image
        -- List of current images

    Scripts
        Script Record
        Script Play
        Script Remote Control
        Script Edit
        Script Tools
        Load Tool Bar
        Freeze Display
        Thaw & Refresh Display
```

```
    Utility
        Black Board
        Message Log
        Audio Clip (Windows only)
        RS-232 Terminal
        Screen Capture
        I/O Port Peek & Poke (Windows 95, 98, ME only)
        Program Setup
        Windows Info (Windows only)
        Linux Info (Linux only)
        Window Style
        Java Info
        Devices
            Birger EF232
            Directed Perception Pan-Tilt Unit
            EPIX® SILICON VIDEO® 10C-CL
            EPIX® SILICON VIDEO® 10M-CL
            EPIX® SILICON VIDEO® 20C-CL
            EPIX® SILICON VIDEO® 20M-CL
            EPIX® SILICON VIDEO® 1514CL
            EPIX® SILICON VIDEO® 1820CL
            Fujinon CCTV Lens
            Illumination Technologies 3900
            Sagebrush Pan-Tilt Gimbal
            Volpi intralux dc-1100

    PIXCI®
        PIXCI® Open/Close
            Multiple Devices
            Camera & Format
            Driver Assistant
            Advanced
            Board Info
        PIXCI® Video Setup
            Format  (dependent on frame grabber)
            Resolution
            Sync
            Custom

        PIXCI® Export Video Setup
        PIXCI® Import Video Setup
        PIXCI® TWAIN Sourcery (Windows only)
        PIXCI® Image-Pro Sourcery (Windows only)
        PIXCI® Status
        PIXCI® Serial Terminal
        PIXCI® Connections
        PIXCI® Camera Info

    Help
        About
        License
        XCAP Release Notes
        XCAP Reference Manual
        PCI Configuration Tips
        Getting Started w. XCAP (via Web)
            for PIXCI® A110
            for PIXCI® A310
            for PIXCI® CL1
                ...
            for SILICON VIDEO® 10M6
            for SILICON VIDEO® 10C6
                ...
```

5.5. Road Map - PIXCI® Image Viewer Window

```
PIXCI® Image Viewer Window

    File
        Save Image
            TIFF
            JPEG/JFIF
            BMP
            FITS
            PCX
            Targa
            Portable Map
            X/Y Binary
            X/Y ASCII

        Load Image
```

```
            TIFF
            JPEG/JFIF
            BMP
            FITS
            Portable Map
            X/Y Binary
            X/Y ASCII

        Save Image Sequence
            One TIFF w. Sequence
            One AVI w. Sequence
            One Portable Map w. Sequence
            One X/Y Binary w. Sequence
            One X/Y ASCII w. Sequence
            Sequence of TIFF
            Sequence of JPEG/JFIF
            Sequence of BMP
            Sequence of FITS
            Sequence of PCX
            Sequence of Targa (TGA)
            Sequence of Portable Map
            Sequence of X/Y Binary
            Sequence of X/Y ASCII

        Load Image Sequence
            One TIFF w. Sequence
            One AVI w. Sequence
            One Portable Map w. Sequence
            One X/Y Binary w. Sequence
            One X/Y ASCII w. Sequence
            Sequence of TIFF
            Sequence of JPEG/JFIF
            Sequence of BMP
            Sequence of FITS
            Sequence of Portable Map
            Sequence of X/Y Binary
            Sequence of X/Y ASCII

        E-Mail Image
        Save Frame Buffer Memory
        Load Frame Buffer Memory
        Print Image
        Duplicate Image
        Duplicate Image Sequence
        BlackBoard Image
        Image Attributes
        Close Viewer

    View
        Shortcuts
        Adjustments
        Status Bar
        Menu Bar
        Full Screen
        Always-On-Top
        Refresh
        Image's Palette
        Viewer's Palette
            Black & Gain
            Numerically
            Band Coloring
            Bit Slice
            Bit Transposition
            White Balance

        Sequence Play
        Sequence Thumbnails
        Cursor
        Display
        Zoom, Pan, Scroll
        Launch 2nd Viewer

    Examine
        Pixel Peek
            Peek X/Y
            Peek X/B
            Peek Y/B
        Pixel Peek & Poke
        Pixel Plot
            Plot Row
            Plot Column
            Plot Buffer
            Plot All Rows

        Pixel Plot 3D
```

```
        SMPTE VITC

    Modify
        Patterns [Sequence Patterns]
        Set [Sequence Set]
        Arithmetic [Sequence Arithmetic] [Src+Dst Arithmetic]
            Complement Pixels
            Bit Wise Logical AND Pixels w. Mask
            Bit Wise Logical XOR Pixels w. Mask
            Bit Wise Logical OR Pixels w. Mask
            Bit Shift Left
            Bit Shift Right
            Bit Rotate Left
            Bit Rotate Right
            Bit Gray Code
            Bit Gray Decode
            Bit Reverse
            Add Constant with Pixels
            Multiply Constant with Pixels
            Add Uniform Random Dither to Pixels
            Add Gaussian Random Dither to Pixels
            Halftone, Threshold & Carry
            Halftone, Dot Construction
            Gamma Correction
            Pixie Minimum
            Pixie Maximum
            Pixie Mean
            Pixie Copy

        Binning [Sequence Binning] [Src_Dst Binning]
            Average
            Integrate
        Contrast Modification [Sequence Contrast Modification] [Src+Dst Contrast Modification]
            Stretch Contrast, Pixel Value Endpoints
            Stretch Contrast, Histogram Percentile Endpoints
            Invert Contrast
            Histogram Modification

        Convolution [Sequence Convolution] [Src+Dst Convolution]
            Convolve: Convolve(PixelValue)
            Convolve: Abs(Convolve(PixelValue))
            Convolve: PixelValue Convolve(PixelValue)
            Convolve: PixelValue Abs(Convolve(PixelValue))

        Correlation Map [Sequence Correlation Map] [Src+Dst Correlation Map]
        Edge Detection [Sequence Edge Detection] [Src+Dst Edge Detection]
            Edge Magnitude: Laplacian
            Edge Magnitude: Vertical
            Edge Magnitude: Horizontal
            Edge Magnitude: Sobel
            Edge Magnitude: Kirsch
            Edge Magnitude: Roberts
            Edge Gradient: Log Sobel
            Edge Gradient: Log Sobel Absolute
            Edge Gradient: Log Kirsch
            Edge Gradient: Log Roberts
            Edge Gradient: Thin, Minimal Effect
            Edge Gradient: Thin, Maximal Effect

        FFT [Sequence FFT] [Src+Dst FFT]
            FFT to Log Magnitude
            Root Filter
            Gaussian Filter
            Inverse Gaussian Filter

        HSB Tweak
        Interlace & Flicker [Sequence Interlace & Flicker] [Src+Dst Interlace & Flicker]
            Shuffle Line Order to Field Order
            Shuffle Field Order to Line Order
            Transpose Line Pairs
            Transpose Column Pairs
            Shuffle Line Pairs to Pixel Pairs
            Shuffle Pixel Pairs to Line Pairs
            Shuffle Column Order to Even-Odd Halves
            Shuffle Even-Odd Halves to Column Order
            Shuffle Column Order to N Section Order
            Shuffle N Section Order to Column Order
            Deflicker: Average Line Pairs
            Deflicker: Filter Singularity
            Shift Half-Line Down
            Shift Half-Line Up
            Tap Correction: User Defined f(X,Y)

        Morphology [Sequence Morphology] [Src+Dst Morphology]
            Erode
```

```
    Dilate
    Open
    Close
    Boundary
    Hit Miss
    Medial Axis Thin
    Skeleton Thin

Noise Generator [Sequence Noise Generator] [Src+Dst Noise Generator]
    Uniform Noise
    Gaussian Noise
    Rayleigh Noise
    Negative Exponential Noise
    Salt & Pepper Noise

Normalization [Sequence Normalization] [Src+Dst Normalization]
    Normalize Intensity, Blobs & Background
    Normalize Row Mean
    Normalize Column Mean

Rotation & Shift [Sequence Rotation & Shift] [Src+Dst Rotation & Shift]
    X, Y Shift
    Flip
    Skew Left/Right
    Skew Up/Down
    Rotate
    Rotate w. Offset

Spatial Filtering [Sequence Spatial Filtering] [Src+Dst Spatial Filtering]
    Low Pass Filter
    Sharpen Filter
    Median Filter
    Rank Low (Erode) Filter
    Rank High (Dilate) Filter
    Edge Enhance: Sobel
    Edge Enhance: Sobel Absolute
    Edge Enhance: Kirsch
    Edge Enhance: Roberts
    Horizontal Sharpen Filter
    Vertical Sharpen Filter
    Embossed Edges
    Emboss Enhance

Spatial Normalization [Sequence Spatial Normalization] [Src+Dst Spatial Normalization]
    Shift Center of Mass to Center

Threshold [Sequence Threshold] [Src+Dst Threshold]
Threshold Adaptive [Sequence Threshold Adaptive] [Src+Dst Threshold Adaptive]
Warping [Sequence Warping] [Src+Dst Warping]
    Warp: Src => Dst Fiducials
    Warp: Pincushion Distortion
    Warp: Barrel Distortion
    Warp: User Defined f(X,Y)
Copy & Resize [Sequence Copy & Resize]
    Copy
    Copy & Resize
    Copy & Flip
    Copy & Overlay
    Copy & Retype
    Copy & Reorder
Pair Arithmetic [Sequence Pair Arithmetic] [Src+Dst Pair Arithmetic]
    Add: Dst+Src Modulo PixelSize
    Add: Min(Dst+Src, MaxPixValue)
    Subtract: (MaxPixValue+(Dst Src))/2
    Subtract: (MaxPixValue+(Src Dst))/2
    Subtract: (Dst Src)Modulo PixelSize
    Subtract: (Src Dst)Modulo PixelSize
    Subtract: (Src Dst)Modulo PixelSize
    Subtract: Max(Dst Src, 0)
    Subtract: Max(Src Dst, 0)
    Subtract: Abs(Dst Src)
    Bit Wise AND: Dst & Src
    Bit Wise XOR: Dst ^ Src
    Bit Wise OR: Dst | Src
    Average: (Src+Dst)/2
    Product: (c0*Src+c1)*(c2*Dst+c3)/c4
    Product: (c0*Dst+c1)/(c2*Src+c3)
    Ratio: (c0*Dst+c1)/(c2*Src+c3)
    User-Defined f(PixA, PixB)

Pair Normalization [Sequence Pair Normalization] [Src+Dst Pair Normalization]
    Contrast Modify & Match
    Background Correction, Subtractive
    Background Correction, Ratio
    Spot Mask Correction
```

```
    Triplet Normalization [Sequence Triplet Normalization] [Src+Dst Triplet Normalization]
        Gain & Offset Normalization: MeanSrcB*(Dst-SrcA)/(SrcB-SrcA)
        Gain & Offset Normalization: MaxSrcB*(Dst-SrcA)/(SrcB-SrcA)
        Gain & Offset Normalization: MinSrcB*(Dst-SrcA)/(SrcB-SrcA)

    Average Sequence
        Average Sequence
        Integrate Sequence
        Pixel Mean of Sequence
        Pixel Std. Dev. of Sequence
        Pixel Variance of Sequence
    Difference Sequence
    Tile Sequence

Measure
    Intensity Calibration
    Spatial Calibration
    Histogram
    Histogram Pair
    Mass & Moments
        Center of Mass
        Center of Mass, Binary
        Moments

    Line Profile
    Radial Mass Plot
    Ruler
    Protractor
    Cartesian Reticle
    Polar Reticle
    Distance & Angle Crosshairs
    Shape Analysis
    Blob Analysis
    Particle Tracking
    SubPixel Edger
    Ellipse Fitter
    Correlation Finder

Draw
    Arrow
    Text
    Point
    Points
    Bezier Curve
    Circle
    Circle Arc
    Ellipse
    Ellipse Arc
    Line
    Parallel Lines
    Path Curve
    Polyline
    Rectangle
    Window
    Annulus
    Annulus Arc
    Bezier Region
    Elliptical Annulus
    Elliptical Annulus Arc
    Rectangle Array
    Path Enclosed
    Polygon
    Rectangular Frame
    Graphic Manager
    Image Overlay
    Paint Brush
    Paint Fill

AOI
    Set AOI
    Set ROI
    Set Full Image
    AOI/ROI Manager

Capture
    Adjustments
    Shortcuts
    Snap
    Live
    UnLive
    First Buffer
    Last Buffer
    Next Buffer
    Previous Buffer
```

```
    Sequence Capture
        Video to Frame Buffers - Single Sequence
        Video to Frame Buffers - Single Sequence w. Event Start
        Video to Frame Buffers - Single Sequence w. Event per Image
        Video to Frame Buffers - Continuous Sequence
        Video to Frame Buffers - Continuous Sequence w. Event Stop
        Video to Frame Buffers - Continuous Sequence w. Event per Image
        Video to Virtual Memory - Single Sequence
        Video to Virtual Memory - Single Sequence w. Event Start
        Video to Virtual Memory - Single Sequence w. Event per Image
        Video to Virtual Memory - Continuous Sequence
        Video to Virtual Memory - Continuous Sequence w. Event Stop
        Video to Virtual Memory - Continuous Sequence w. Event per Image
        Video to Disk File - Single Sequence
        Video to Disk File - Single Sequence w. Event Start
        Video to Disk File - Single Sequence w. Event per Image
        Video to Disk File - Continuous Sequence
        Video to Disk File - Continuous Sequence w. Event Stop
        Video to Disk File - Continuous Sequence w. Event per Image
        Video to Image Files - Single Sequence
        Video to Image Files - Single Sequence w. Event Start
        Video to Image Files - Single Sequence w. Event per Image
        Video to Image Files - Continuous Sequence
        Video to Image Files - Continuous Sequence w. Event Stop
        Video to Image Files - Continuous Sequence w. Event per Image
        Video to StreamStor (Windows only)
    GIO Event Capture

    Waterfall Display
    Video to Disk
    RGB Merge
    Quad Pixel Merge
    Frame Average
    Lens Control
        Birger EF232
    Live Options

Help
    Vis-a-Vis
    PIXCI® --- User's Manual (via Web)
        (for specific PIXCIXCAP in use)
    SILICON VIDEO® --- User's Manual (via Web)
        (for specific SILICON VIDEOXCAP in use, if any)
```

Optionally, the Main Window and the PIXCI® Image Viewer Window's may be combined (see *Utilities - Program Setup*) with the following features of the Main Window added to the PIXCI® Image Viewer Window:

```
File
    Window List
     -- List of current windows
    Image List
    -- List of current images
    Exit
Utility
    Message Log
    Program Setup
    Windows Info (Windows only)
    Linux Info (Linux only)
    Window Style
    Java Info

PIXCI®
    PIXCI® Open/Close
    PIXCI® TWAIN Sourcery (Windows only)
    PIXCI® Image-Pro Sourcery (Windows only)
    PIXCI® Connections
    PIXCI® Video Setup
    PIXCI® Serial Terminal

Help
    XCAP Release Notes
    XCAP Reference Manual
    PCI Configuration Tips
    License
    About
```

Optionally, if XCAP is intended to be used solely in conjunction with a TWAIN compliant application or with Image-Pro, many of the menu features of the Main Window and the PIXCI® Image Viewer Window may be removed so as to provide a simplified appearance (see *Utilities - Program Setup*). The same option also removes several PIXCI® Image Viewer - Capture - Shortcuts and adds shortcuts duplicating features of the *PIXCI® - TWAIN Sourcery and Image-Pro Sourcery*.

5.6. XCAP Software Feature Comparison

Feature	XCAP-Plus	XCAP-Std	XCAP-Ltd	XCAP-Lite(A)	XCAP-Viewer
File -					
- Load New Image	Yes	Yes	Yes	Yes (C)	Yes (C)
- Load New Image Sequence	Yes	Yes	Yes	Yes (C)	Yes (C)
- Image File Info	Yes	Yes	Yes	Yes	Yes
- TWAIN Select Source (Win)	Yes	Yes	No	No	No
- TWAIN New Acquire (Win)	Yes	Yes	No	No	No
Images -					
- New Image (Workspace)	Yes	Yes	Yes	Yes	Yes
Scripts -					
- Record	Yes	Yes	No	No	No
- Play	Yes	Yes	Yes	Yes	No
- Remote Control	Yes	Yes	No	No	No
- Load Tool Bar	Yes	Yes	No	No	No
Utility -					
- Black Board	Yes	Yes	No	No	No
- Message Log	Yes	Yes	Yes	Yes	Yes
- Audio Clip (Win)	Yes	Yes	Yes	Yes	No
- RS-232 Terminal	Yes	Yes	Yes	Yes	Yes
- Screen Capture	Yes	Yes	Yes	No	No
- I/O Port Peek & Poke (W95)	Yes	Yes	Yes	Yes	Yes
Devices -					
- Birger EF232	Yes	Yes	Yes	Yes	Yes
- Directed Perception Pan-Tilt Unit	Yes	Yes	Yes	Yes	Yes
- EPIX® SILICON VIDEO® 10C-CL	Yes	Yes	Yes	Yes	Yes
- EPIX® SILICON VIDEO® 10M-CL	Yes	Yes	Yes	Yes	Yes
- EPIX® SILICON VIDEO® 20C-CL	Yes	Yes	Yes	Yes	Yes
- EPIX® SILICON VIDEO® 20M-CL	Yes	Yes	Yes	Yes	Yes
- EPIX® SILICON VIDEO® 1514CL	Yes	Yes	Yes	Yes	Yes
- EPIX® SILICON VIDEO® 1820CL	Yes	Yes	Yes	Yes	Yes
- Fujinon CCTV Lens	Yes	Yes	Yes	Yes	Yes
- Illumination Technologies 3900	Yes	Yes	Yes	Yes	Yes
- Sagebrush Pan-Tilt Gimbal	Yes	Yes	Yes	Yes	Yes
- Volpi intralux dc-1100	Yes	Yes	Yes	Yes	Yes
PIXCI® -					
- Open/Close -					
- Single Board	Yes	Yes	Yes	Yes	No
- Multiple Identical Boards	Yes	Yes	Yes	Yes	No
- Multiple Different Boards	Yes	Yes	No	No	No
- Frame Buffer Memory Limit -					
w. PIXCI® CL3SD	None (E)	None (E)	None (E)	None	N/A
w. PCI 32 bit	None (E)	None (E)	4 GByte (E)	256 MByte(E)	N/A

w. PCI 64 bit	None (E)	None (E)	4 GByte (E)	256 MByte(E)	N/A
w. PCI Express & 32 bit O.S.	None (E)	None (E)	4 GByte (E)	256 MByte(E)	N/A
w. PCI Express & 64 bit O.S.	None (E)	None (E)	8 GByte (E)	256 MByte(E)	N/A
w. ExpressCard/54 & 32 bit O.S.	None (E)	None (E)	4 GByte (E)	256 MByte(E)	N/A
w. ExpressCard/54 & 64 bit O.S.	None (E)	None (E)	8 GByte (E)	256 MByte(E)	N/A
- Driver Assistant/Wizard	Yes	Yes	Yes	Yes	No
- Video Setup	Yes	Yes	Yes	Yes	No
- Export Video Setup	Yes	Yes	Yes	Yes	No
- Import Video Setup	Yes	Yes	Yes	Yes	No
- TWAIN Sourcery (Win)	Yes	Yes	Yes	Yes	No
- Image-Pro Sourcery (Win)	Yes	Yes	Yes	Yes	No
- Status	Yes	Yes	Yes	Yes	No
- Serial Terminal	Yes	Yes	Yes	Yes	No
- Connections Info	Yes	Yes	Yes	Yes	Yes
- Camera Info	Yes	Yes	Yes	Yes	Yes
- Camera Specific Controls	Yes (F)	Yes (F)	Yes (F)	Yes (F)	No
Help -					
- XCAP Release Notes	Yes	Yes	Yes	Yes	Yes
- XCAP Reference Manual	Yes	Yes	Yes	Yes	Yes
- PCI Configuration Tips	Yes	Yes	Yes	Yes	Yes
- Getting Started w. XCAP (via Web)	Yes	Yes	Yes	Yes	Yes
File -					
- Save Image	Yes	Yes	Yes	Yes (C)	No
- Load Image	Yes	Yes	Yes	Yes (C)	Yes (C)
- Save Image Sequence	Yes	Yes	Yes	Yes (C)	No
- Load Image Sequence	Yes	Yes	Yes	Yes (C)	Yes (C)
- E-Mail Image	Yes	Yes	Yes	No	No
- Print Image	Yes	Yes	Yes	Yes (R)	No
- Duplicate Image	Yes	Yes	Yes	No	No
- Duplicate Image Sequence	Yes	Yes	Yes	No	No
- BlackBoard Image	Yes	Yes	No	No	No
View -					
- Full Screen	Yes (W)	Yes (W)	Yes (W)	Yes (W)	Yes (W)
- Palette	Yes	Yes	Yes	Yes (G)	Yes (G)
- Sequence Play	Yes	Yes	Yes	Yes	Yes
- Sequence Thumbnails	Yes	Yes	Yes	No	No
- Cursor	Yes	Yes	Yes	Yes	Yes
- Zoom, Pan, Scroll	Yes	Yes	Yes	Yes	Yes
- Launch 2nd Viewer	Yes	Yes	Yes	No	No
Examine -					
- Pixel Peek X vs Y	Yes	Yes	Yes	Yes	Yes (H)
- Pixel Peek X vs B	Yes	Yes	Yes	Yes	Yes (H)
- Pixel Peek B vs Y	Yes	Yes	Yes	Yes	Yes (H)
- Pixel Peek & Poke	Yes	Yes	Yes	Yes	Yes
- Pixel Plot Row	Yes	Yes	Yes	Yes (I)	Yes (I)

- Pixel Plot Column	Yes	Yes	Yes	Yes (I)	Yes (I)
- Pixel Plot Pixel × B	Yes	Yes	Yes	Yes (I)	Yes (I)
- Pixel Plot Rows × Y	Yes	Yes	Yes	No	No
- Pixel Plot Rows × B	Yes	Yes	Yes	No	No
- Pixel Plot Cols × X	Yes	Yes	Yes	No	No
- Pixel Plot Cols × B	Yes	Yes	Yes	No	No
- Pixel Plot 3D	Yes	Yes	Yes	Yes (S)	Yes (S)
- SMPTE VITC	Yes	Yes	Yes	Yes	No
Modify -					
- Patterns	Yes	Yes	Yes	Yes	Yes
- Set	Yes	Yes	Yes (J)	Yes (J)	Yes (J)
- Arithmetic	Yes	Yes	No	No	No
- Binning	Yes	Yes	No	No	No
- Contrast Modification	Yes	Yes	No	No	No
- Convolution	Yes	Yes	No	No	No
- Correlation Map	Yes	Yes	No	No	No
- Edge Detection	Yes	Yes	No	No	No
- FFT	Yes	Yes	No	No	No
- HSB Tweak	Yes	Yes	No	No	No
- Interlace & Flicker	Yes	Yes	No	No	No
- Morphology	Yes	Yes	No	No	No
- Noise Generator	Yes	Yes	No	No	No
- Normalization	Yes	Yes	No	No	No
- Rotation & Shift	Yes	Yes	No	No	No
- Spatial Filtering	Yes	Yes	No	No	No
- Spatial Normalization	Yes	Yes	No	No	No
- Threshold	Yes	Yes	No	No	No
- Threshold Adaptive	Yes	Yes	No	No	No
- Warping	Yes	Yes	No	No	No
- Copy & Resize	Yes	Yes	No	No	No
- Pair Arithmetic	Yes	Yes	No	No	No
- Pair Normalization	Yes	Yes	No	No	No
- Average Sequence	Yes	Yes	No	No	No
- Difference Sequence	Yes	Yes	No	No	No
- Tile Sequence	Yes	Yes	No	No	No
Measure -					
- Intensity Calibration	Yes	Yes	No	No	No
- Spatial Calibration	Yes	Yes	No	No	No
- Histogram	Yes	Yes	No	No	No
- Histogram Pair	Yes	Yes	No	No	No
- Mass & Moments	Yes	Yes	No	No	No
- Line Profile	Yes	Yes	Yes (K,L)	Yes (I,K,L)	Yes (I,K,L)
- Radial Mass Plot	Yes	Yes	No	No	No
- Ruler	Yes	Yes	Yes (K)	Yes (K)	Yes (K)
- Protractor	Yes	Yes	No	No	No

- Cartesian Reticle	Yes	Yes	Yes (K)	Yes (K)	Yes (K)
- Polar Reticle	Yes	Yes	No	No	No
- Dist. & Angle Crosshairs	Yes	Yes	No	No	No
- Shape Analysis	Yes	Yes	No	No	No
- Blob Analysis	Yes	Yes	No	No	No
- Particle Tracking	Yes	Yes	No	No	No
- SubPixel Edger	Yes	Yes	No	No	No
- Ellipse Fitter	Yes	Yes	No	No	No
- Correlation Finder	Yes	Yes	No	No	No
Draw -					
- Arrow	Yes	Yes	Yes	Yes	Yes
- Text	Yes	Yes	Yes	No	No
- Point	Yes	Yes	Yes	No	No
- Points	Yes	Yes	Yes	No	No
- Bezier Curve	Yes	Yes	Yes	No	No
- Circle	Yes	Yes	Yes	No	No
- Circle Arc	Yes	Yes	Yes	No	No
- Diamond	Yes	Yes	Yes	No	No
- Ellipse	Yes	Yes	Yes	No	No
- Ellipse Arc	Yes	Yes	Yes	No	No
- Line	Yes	Yes	Yes	Yes	Yes
- Parallel Lines	Yes	Yes	Yes	No	No
- Path Curve	Yes	Yes	Yes	No	No
- Polyline	Yes	Yes	Yes	No	No
- Rectangle	Yes	Yes	Yes	No	No
- Window	Yes	Yes	Yes	Yes	Yes
- Annulus	Yes	Yes	Yes	No	No
- Annulus Arc	Yes	Yes	Yes	No	No
- Bezier Region	Yes	Yes	Yes	No	No
- Elliptical Annulus	Yes	Yes	Yes	No	No
- Elliptical Annulus Arc	Yes	Yes	Yes	No	No
- Rectangle Array	Yes	Yes	Yes	No	No
- Path Enclosed	Yes	Yes	Yes	No	No
- Polygon	Yes	Yes	Yes	No	No
- Rectangular Frame	Yes	Yes	Yes	No	No
- Graphic Manager	Yes	Yes	Yes	Yes	Yes
- Paint Brush	Yes	Yes	Yes	No	No
- Paint Fill	Yes	Yes	Yes	No	No
- Image Overlay	Yes	Yes	No	No	No
Capture -					
- Snap (Video)	Yes	Yes	Yes	Yes	No
- Live (Video)	Yes	Yes	Yes	Yes	No
- Frame Date&Time Stamp	Yes	Yes	Yes	Yes	No
- First Buffer	Yes	Yes	Yes	Yes	No
- Next Buffer	Yes (M)	Yes (M)	Yes (M)	Yes (M)	No

- Previous Buffer	Yes (M)	Yes (M)	Yes (M)	Yes (M)	No
- Last Buffer	Yes (M)	Yes (M)	Yes (M)	Yes (M)	No
- Adjustments -					
- Snap/Live Buffer Number	Yes	Yes	Yes	Yes	No
- Resolution (video window)	Yes	Yes	Yes	Yes	No
- Camera Specific Controls	Yes (F)	Yes (F)	Yes (F)	Yes (F)	No
- Color & White Balance	Yes (N)	Yes (N)	Yes (N)	Yes (N)	No
- Auto Gain/Exposure Control	Yes (O)	Yes (O)	Yes (O)	No (O)	No
- Pixel Normalization	Yes (V)	Yes (V)	Yes (V)	Yes (V)	No
- Load & Save Presets	Yes	Yes	Yes	No	No
- Shortcuts	Yes	Yes	Yes	Yes	No
- GIO Event Capture Single	Yes	Yes	Yes	Yes	No
- GIO Event Capture Sequence	Yes	Yes	Yes	No	No
- Waterfall Display	Yes	Yes	Yes	Yes	No
- RGB Merge	Yes	Yes	Yes	No	No
- Frame Average	Yes	Yes	No	No	No
- Quad Pixel Merge	Yes	No	No	No	No
- Lens Control -					
- Birger EF232	Yes	Yes	No(U)	No(U)	No
Sequence Capture (Single Sequence and Continuous Sequence) -					
- to Frame Buffers	Yes (E)	Yes (E)	Yes (E)	Yes (P)(E)	No
- to Frame Buffers at Event	Yes	Yes	Yes	No (Q)	No
- to Virtual Memory	Yes	Yes	Yes (T)	Yes (P)(T)	No
- to Virtual Memory at Event	Yes	Yes	Yes (T)	No (Q)	No
- to Image Files	Yes	Yes	Yes	No	No
- to Image Files at Event	Yes	Yes	Yes	No	No
- to Image Files - FTP Copy	Yes	Yes	Yes	No	No
- to Image Files - HTTP Server	Yes	Yes	Yes	No	No
- to Disk File	Yes	Yes	No	No	No
- to Disk File at Event	Yes	Yes	No	No	No
- to StreamStor (Win)	Yes	No	No	No	No

Notes: (A) For XCAP-Lite, the PIXCI® frame grabber is assumed installed and open for use, otherwise XCAP-Lite provides the same features as XCAP-Viewer. (C) For XCAP-Lite and XCAP-Viewer, images may not be loaded directly from an Internet URL, or saved directly to an FTP URL. For XCAP-Lite, Load & Save Image Sequence is only available in TIFF format. (E) A combination of the characteristics of PIXCI® imaging cards, operating systems, and of XCAP software. The PIXCI® CL3SD and SI2 have on-board frame buffer memory, other PIXCI® imaging cards use computer based frame buffer memory. The PIXCI® CL1, CL2, D, D24, D32, D2X, D3X, SI, SV2, SV3, SV4, and SV5 are designed to access up to 4 GB of computer memory. The PIXCI® A110, A310, D3XE, E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8CAM, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EB1mini, miniH2B, miniH2F, miniH2x4F, EC1, ECB1, ECB1-34, ECB2, EL1, EL1DB, ELS2, SI1, SI4, SV7, and SV8 are designed to access up to 16 EByte of computer memory (a theoretical limit, as no currently available computer system provides 16 EByte of memory). For XCAP-Lite, a maximum of 256 MByte of computer based frame buffer memory is supported (but allows one full resolution image buffer w/out size restriction). On 32 bit systems, XCAP-Std and XCAP-Ltd support up to 4 GBytes of computer based frame buffer memory. On 64 bit systems, XCAP-Std supports up to 16 EByte of computer based frame buffer memory; XCAP-Ltd supports up to 8 GByte of computer based frame buffer memory. The maximum available computer based frame buffer memory is also limited by the computer hardware, configuration, and memory needed by the operating system. (F) Camera specific controls provided for cameras supported by PIXCI® E8CAM, ELS2, SI, SI1, SI2, and SI4, and for most digital cameras supported by PIXCI® CL1, CL2, CL3SD, D, D24, D32, D2X, D3X, D3XE, E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EB1mini, miniH2B, miniH2F, miniH2x4F, EC1, ECB1, ECB1-34, ECB2, EL1, and EL1DB; the 'PIXCI® Camera

Info' feature shows the specific, customized, support provided for each camera. (G) For XCAP-Lite and XCAP-Viewer, the View, Palette feature does not include save, load, import, or export, nor the "Extract Bright/Dark Reference" features. (H) For XCAP-Viewer, the Examine, Pixel Peek feature does not include save. (I) For XCAP-Lite and XCAP-Viewer, plotting features do not include statistics, save, or export options. For XCAP-Viewer, plotting features do not include printing. (J) For XCAP-Ltd, XCAP-Lite, and XCAP-Viewer, the Modify, Set feature does not include non-rectangular regions. (K) For XCAP-Ltd, XCAP-Lite, and XCAP-Viewer, the Measure features do not include calibration. (L) For XCAP-Ltd, XCAP-Lite, and XCAP-Viewer, the Line Profile is limited to straight lines. (M) Subject to the amount of frame buffer memory versus image resolution yielding more than one frame buffer. (N) For Bayer output digital color cameras with software providing white balance and color corrections. The XCAP-Lite provides automatic, continuous, white balance only for SILICON VIDEO® cameras. The XCAP-Lite does not provide custom color calibration from a Macbeth chart or other color reference. (O) Software implemented AGC/AEC is provided for selected cameras; of those, XCAP-Lite provides AGC/AEC only for SILICON VIDEO® cameras. (P) For XCAP-Lite, the Sequence Capture does not include the time stamp feature, nor the strobe features added by software (as selected in the Sequence Capture dialog); any strobe features provided by the PIXCI® frame grabber or camera (either inherent or selected in the Capture & Adjust dialog) are available. (Q) For XCAP-Lite, the "triggered" sequence capture is provided when the camera is being triggered (often referred to as "Async Reset Mode"); sequence capture from a free-running camera where the trigger or event is handled separately is not provided. (R) For XCAP-Lite, the image printing feature supports only the operating system's built-in image printing feature(s), not printing via EPIX® imaging drivers. (S) For XCAP-Lite and XCAP-Viewer, plotting features do not include save or export options. For XCAP-Viewer, plotting features do not include printing. (T) For XCAP-Lite, the sequence capture to virtual memory is limited to using 1 GByte of virtual memory For XCAP-Ltd, the sequence capture to virtual memory is limited to using 4 GByte of virtual memory. The operating system's configuration may impose additional limitations. (U) Interactive control of the lens is provided, but not automatic aperture or automatic focus features. (V) Software implemented pixel normalization is provided for SILICON VIDEO® and other selected cameras; of those, XCAP-Lite does not provide pixel normalization in generic Camera Link mode. (W) 'Frameless' full screen not available in XCAP-Lite or under Linux. (W95) Feature available only under Windows 95, 98, and ME. (Win) Feature available only under Windows.

6. Getting Started with XCLIB

The optional XCLIB C/C++ library allows controlling the PIXCI® frame grabber from "C/C++" programs. Under Windows, the XCLIB library can also be accessed by any programming environment able to call functions within a DLL; a partial list includes Visual Basic, VB.NET, LabView, Matlab, and Borland Delphi.

The XCLIB library is designed to be a component which is called by the user's application, rather than an application template with pre-selected and limited customizability. In other words, the XCLIB library forces the fewest possible architectural choices upon the user's application. Under Windows the XCLIB library is composed of "C" functions within a DLL and can be used from non-MFC, MFC, C#, or even "console" applications. With one optional exception, the XCLIB library does not create any windows or dialogs of its own; rather it allows displaying imagery into a window provided by the user.

This quick introduction focuses primarily on XCLIB library functions themselves; programming environment, operating system issues, and compilation instructions are addressed in the *XCLIB Reference Manual* and in the example programs provided with the XCLIB library. Nor is this introduction intended to cover every XCLIB library function or to provide complete programs; rather it is intended to provide the "feel" of XCLIB library programming, without the complications of user interfaces and application specific functionality.

6.1. XCLIB Architecture Overview

The XCLIB library has two series of functions. The Simple C Functions (SCF), whose names start with *pxd_*, suffice for most application programs. This introduction only discusses the SCF functions.

Frame buffers are preallocated by the library, and selected by ordinals 1, 2, etc. The number of frame buffers is dependent on the camera resolution and the total memory size reserved for frame buffers. Under Windows and Linux, the reserved memory size can easily be set in XCAP application's Driver Assistant, or by following the installation instructions.

For cameras with raw Bayer output, the XCLIB library automatically provides processed RGB pixel values. For multi-tap cameras with pixels output in an order other than left-to-right, top-to-bottom, the XCLIB library automatically provides pixels in the correct order.

Functions to snap a video field (such as *pxd_goSnap*, discussed below) capture the next video field following its invocation. In other words, the function "arms" the PIXCI® frame grabber to capture the next video field into a frame buffer. This is in contrast to having the frame grabber consume resources continuously capturing everything, and having a hypothetical snap function retrieve the last field captured. This hypothetical behavior can be obtained in XCLIB using *pxd_goLivePair* (also discussed below) or similar functions, but it is not the behavior of the snap function.

6.2. The Simplest XCLIB Program

The following code captures an image into the first frame buffer with the frame grabber and camera in the default mode:

```
#include "xcliball.h"
    ...
pxd_PIXCIopen("",           // driver configuration parameters: use default
              "Default",    // video format name: use default as per specific frame grabber
              "");          // video setup file exported by XCAP: none
pxd_doSnap(0x1,             // select PIXCI(R) unit 1
           1,               // select frame buffer 1
           0);              // default timeout
pxd_PIXCIclose();
```

For a shorter program, under Windows and Linux (but not DOS) the:

```
pxd_PIXCIclose();
```

may be eliminated, but for the sake of robustness and portability including the *pxd_PIXCIclose* is recommended.

A note on syntax for users of languages other than C/C++. A string of characters in C/C++ is denoted by " characters; a "" represents the empty string. XCLIB doesn't expect the " characters. Use whatever syntax is required by the current language to provide the characters shown within the "" characters.

For PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, and EL1DB frame grabbers, the *pxd_PIXCIopen* parameter "Default" selects the camera for which the current PIXCI® frame grabber is intended, as coded into the PIXCI® frame grabber's EEPROM. If no selection is coded, or "Generic Camera Link" is coded (image resolution, *pxd_imageXdim()* and *pxd_imageYdim()*, of 888×888), after configuring the XCAP application to the desired camera and format, a video setup file can be exported and its path name specified as the third parameter to *pxd_PIXCIopen*.

A slightly longer program that does something useful with the captured image:

```
#include "xcliball.h"
    ...
pxd_PIXCIopen("", "Default", "");
pxd_doSnap(0x1, 1, 0);
pxd_saveTiff(0x1,           // select PIXCI(R) unit 1
             "image.tif",   // pathname
             1,             // select frame buffer 1
             0, 0,          // upper left X, Y AOI of buffer
             -1, -1,        // lower right X, Y AOI of buffer,
                            // -1 is an abbreviation for the maximum X or Y
             0, 0);         // reserved
pxd_PIXCIclose();
```

which saves the captured image to a file. Or:

```
#include "xcliball.h"
    ...
pxd_PIXCIopen("", "",  "/user/application/myVideoSetup.fmt");
pxd_doSnap(0x1, 1, 0);
{
    void *buf = malloc(  pxd_imageXdim()    // horizontal resolution
                       * pxd_imageYdim()    // vertical resolution
                       * sizeof(short));

    pxd_readushort(0x1,         // select PIXCI(R) unit 1
                   1,           // select frame buffer 1
                   0, 0,        // upper left X, Y AOI of buffer
                   -1, -1,      // lower right X, Y AOI of buffer,
                                // -1 is an abbreviation for the maximum X or Y
                   buf,         // program buffer to be filled
                   pxd_imageXdim() * pxd_imageYdim(),
                                // size of program buffer in short's
                   "Grey");     // color space to access
    .. process data ..
    free(buf);
}
pxd_PIXCIclose();
```

which copies the captured image into a program buffer. Both *pxd_saveTiff* and *pxd_readushort* allow saving or reading from an area of interest (AOI) of the captured image. The latter example also shows use of a video setup file exported by the XCAP application. (Use of a solidus ("/") instead of reverse solidus ("\") is allowed by all operating systems and avoids any complications of C/C++ treating the latter as a special character).

The XCLIB library provides data conversions, "unsigned char" versus "unsigned short", as necessary, as well as color space conversions. Thus, *pxd_readushort* will work with 8, 10, or 12 bit pixels, enlarging 8 bit pixels to unsigned shorts (right justified). And the similar *pxd_readuchar* also works with 8, 10, or 12 bit pixels, truncating 10 or 12 bit pixels to unsigned chars (keeping the most significant bits).

Similarly, these functions convert color spaces as needed; in the example above, correct grey level data is provided regardless of whether the captured image is monochrome, RGB, BGR, or Bayer.

The XCLIB-Lite library does not provide data size or color space conversions. For data size and color space dependent access to pixel data the pixel size, resolution and color space can be queried:

```
..
pxd_doSnap(0x1, 1, 0);
{
    void *buf = malloc(  pxd_imageXdim()    // horizontal resolution
                       * pxd_imageYdim()    // vertical resolution
                       * (pxd_imageBdim()>8? sizeof(short): sizeof(char))
                                            // bit depth
                       * pxd_imageCdim());  // number of color components

    if (pxd_imageBdim() <= 8)
        pxd_readuchar(0x1, 1, 0, 0, -1, -1, buf,
                      pxd_imageXdim() * pxd_imageYdim() * pxd_imageCdim(),
                      pxd_imageCdim()==1? "Grey": "RGB");
    else
        pxd_readushort(0x1, 1, 0, 0, -1, -1, buf,
```

```
                        pxd_imageXdim() * pxd_imageYdim() * pxd_imageCdim(),
                        pxd_imageCdim()==1? "Grey": "RGB");
    .. process data ..
    free(buf);
}
```

In practice, most application programs are designed for a specific camera and resolution, and the above code can be simplified by using only the relevant *pxd_readuchar* or *pxd_readushort*.

For Bayer output cameras, the *pxd_imageCdim()* is the number of effective and useful color components, namely 3, not the number of raw values per pixel!

6.3. XCLIB Error Detection

Every real application should check for errors. Most XCLIB library functions return an integer value, with values less than 0 indicating an error. The *pxd_mesgErrorCode* function provides a textual description for each error:

```
int     r;
r = pxd_saveTiff(0x1, "image.tif", 1, 0, 0, -1, -1, 0, 0);
if (r < 0) {
    // For Windows GUI
    MessageBox(NULL, pxd_mesgErrorCode(r)), "XCLIB Error", MB_OK|MB_TASKMODAL);
    // For Windows Console, DOS, Linux
    printf("XCLIB Error: %s\n", pxd_mesgErrorCode(r));
}
```

In addition, the *pxd_mesgFault* provides a detailed report for errors occurring during *pxd_PIXCIopen* and video capture functions.

```
int     r;
r = pxd_PIXCIopen("", "Default", "");
if (r < 0)
    pxd_mesgFault(0x1); // select PIXCI(R) unit 1
```

Under Windows, the *pxd_mesgFault* pops up a dialog. Under DOS or Linux it displays error information to "stderr".

Hereafter, for the sake of brevity and clarity, error checking will not be shown.

6.4. PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, EL1DB Video Configuration

The PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, or EL1DB video setup defaults to match the camera's default configuration. For most cameras the default configuration is full resolution, free-running.

To change the video setup, such as to select a camera trigger mode (if available on the camera used) or to reduce resolution so as to obtain more frame buffers within a given amount of memory:

a. Using XCAP, configure the desired format and resolution.
b. Use:

```
PIXCI®
PIXCI® Export Video Setup
```

   to save the video setup to a specified file name.
c. Use:

```
pxd_PIXCIopen("", "", "/user/application/myVideoSetup.fmt");
```

   to open XCLIB with the same video setup. The third parameter can be a fully qualified path name or a file name; if the latter, the standard operating system default determines what directory (folder) is expected to contain the file name. (Use of a solidus ("/") instead of reverse solidus ("\") is allowed by all operating systems, and avoids any complications of C/C++ treating the latter as a special character).

Alternately, the *pxd_videoFormatAsIncluded* allow switching the video setup without re-opening XCLIB, as well as compiling the video setup file into the application. See the *XCLIB Reference Manual* for more information.

For many Camera Link cameras, the exported video setup file also includes the RS-232-like Camera Link serial commands to setup the camera; these commands are automatically sent to the camera by *pxd_PIXCIopen* or *pxd_videoFormatAsIncluded*.

For other cameras, the camera's default configuration can be changed using the manufacturer's software. Alternately, an application note in the *XCLIB Reference Manual* describes how to explicitly send serial commands to re-configure the camera via XCLIB. In all cases, it is important that the camera's configuration, such as trigger mode versus free-run mode, match the PIXCI® frame grabber's configuration.

6.5. More Video Capture Modes

The:

```
pxd_doSnap(...);
```

is the easiest function for capturing single images; the programmer specifies the buffer and the function returns when the capture is completed.

Other capture functions return immediately, allowing the application to proceed with other tasks without having to utilize multiple execution threads. The:

```
pxd_goSnap(0x1, // select PIXCI(R) unit 1
           1);  // select frame buffer 1
```

initiates capture of a single video field into the specified buffer, the:

```
pxd_goLive(0x1, // select PIXCI(R) unit 1
           1);  // select frame buffer 1
```

initiates continuous capture of each video field into the specified buffer, the:

```
pxd_goLivePair(0x1, // select PIXCI(R) unit 1
               1,   // select frame buffer 1
               2);  // select frame buffer 2
```

initiates continuous captured of each video field into alternate buffers, the:

```
pxd_goLiveSeq(0x1              // select PIXCI(R) unit 1
              1,               // select start frame buffer 1
              pxd_imageZdim(), // select end as last frame buffer
              1,               // incrementing by one buffer
              pxd_imageZdim(), // once per buffer
              1);              // advancing to the next buffer after each frame
```

initiates capture at video rate of ten fields into ten buffers, and finally the:

```
pxd_goLiveSeq(0x1              // select PIXCI(R) unit 1
              1,               // select start frame buffer 1
              pxd_imageZdim(), // select end as last frame buffer
              1,               // incrementing by one buffer
              0,               // for ever
              1);              // advancing to next buffer after each 1 frame
```

initiates continuous capturing of video fields at video rate into a "ring" composed of all frame buffers.

For use along with capture functions that run in the "background" are functions to monitor their progress. For example:

```
pxd_goSnap(0x1, 1);
for (;;) {
    if (!pxd_goneLive(0x1, 0))
        break;
    .. do some useful work while waiting..
}
```

is one method of checking whether the previous *pxd_goSnap* is done. Or,

```
pxbuffer_t  last = -1;

pxd_goLivePair(0x1, 1, 2);
```

```
for (;;) {
    if (pxd_capturedBuffer(0x1) == last)
        continue;   // nothing new captured yet
    last = pxd_capturedBuffer(0x1);
    .. process last captured image ..
}
```

continuously captures into a pair of buffers, processing each video field as the next is being captured and can also be used with *pxd_goLiveSeq()*.

Of course, many applications prefer to avoid "polling" for status within a loop. The XCLIB library also provides asynchronous notification of both:

a. A field has arrived from the camera (whether PIXCI® frame grabber was instructed to capture it or not), and
b. A field or frame has been captured.

In Windows these notifications take the form of an "Event", in DOS these notifications take the form of a callback function, and in Linux these notifications take the form of a "signal". For example, under Windows:

```
HANDLE event = pxd_eventCapturedFieldCreate(0x1);   // select PIXCI(R) unit 1
```

Thereafter, any thread waiting upon the event will be notified whenever a field has been captured by *pxd_goSnap*, *pxd_goLive*, *pxd_goLivePair*, *pxd_goLiveSeq*, or by the *pxd_goLiveTrig* discussed below.

The *pxd_goLivePair* or *pxd_goLiveSeq* start the video engine to continuously and automatically fill the ring of frame buffers; the application monitors progress and must read data from a frame buffer before being overwritten by the video engine. An alternative approach is to queue empty frame buffers which are to be filled by the DMA engine:

```
pxbuffer_t  last = -1;
pxd_quLive(0x1, 1); // add buffer 1 to video engine queue
pxd_quLive(0x1, 2); // add buffer 2 to video engine queue
for (;;) {
    if (pxd_capturedBuffer(0x1) == last)
        continue;   // nothing new captured yet
    last = pxd_capturedBuffer(0x1);
    .. process last captured image ..
    pxd_quLive(0x1, last);  // re-add buffer to video engine queue
}
```

The application monitors progress and must read data and re-queue each frame buffer; if no frame buffer is queued the video engine skips capture of a frame. Both approaches share the same performance - video, bus, and CPU efficiency; they differ as to what is captured when the application falls behind its processing of image data.

6.6. PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, EL1DB Triggered Capture

Cameras used with the PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, or EL1DB frame grabber typically have a free-run mode; continuously exposing and sending fields or frames to the frame grabber. Some may also have a asynchronous trigger mode; where the camera exposure and video is quiescent until arrival of a trigger, upon which the sensor is exposed once and a single image sent to the frame grabber.

When combined with the capabilities of the PIXCI® frame grabber, the camera may be in asynchronous trigger mode but with the frame grabber generating periodic triggers (in XCAP this is usually governed by the *Controlled Frame Rate*). For the purposes of this discussion on XCLIB triggered capture, this combination is effectively the same as if the camera were in a free-run mode.

6.6.1. Free-Run Trigger Capture

For a camera and frame grabber combination in free-run mode, triggering consists of selecting a field or frame to capture.

A simple trigger example using the general purpose level sensitive input, is:

```
int odata;
odata = pxd_getGPIn(0x1,    // select PIXCI(R) unit 1
```

```
                    0);     // reserved
while (odata == pxd_getGPIn(0x1, 0))
    ;
pxd_doSnap(0x1, 1, 0);
```

which waits until any of the general purpose input(s) have changed, then snaps the next field or frame arriving from the camera.

Or,

```
int odata = pxd_getGPIn(0x1, 0);    // save current G.P inputs
pxd_goLive(0x1, 1);                 // capture continuously
pxd_setGPout(0x1, 0x01);            // set output flag that we are ready
while (odata == pxd_getGPIn(0x1, 0))
    ;                               // wait for trigger
pxd_setGPout(0x1, 0x00);            // set output flag that we saw the trigger
pxd_goUnLive(0x1);                  // terminate continuous capture
while pxd_goneLive(0x1, 0))         // wait for capture to cease
    ;
pxd_setGPout(0x1, 0x01);            // set output flag that we are done
```

This variation captures the field or frame which was being sent while the trigger was received; the former example captures the field or frame following the trigger. It also demonstrates use of the general purpose output for "handshaking" with the external equipment.

Both of these examples depend on the application responding to the general purpose input in a timely manner, and both consume time in wait loops. Neither is a significant problem under single-tasking DOS, but can be a problem under multi-tasking Windows or Linux depending upon how much latency the application allows and what other tasks are running.

Alternately, the *pxd_goLiveTrig* described in the *XCLIB Reference Manual* performs the same function as the latter example including use of general purpose output "strobes", but returns immediately leaving the trigger capture running in the "background". It also provides minimal latency and additional options for delaying the capture following the trigger by a specified number of fields or frames.

Triggering can also be done using the general purpose edge sensitive trigger:

```
int ocnt = pxd_getGPTrigger(0x1, 0);        // save current trigger count
while (ocnt == pxd_getGPTrigger(0x1, 0))    // wait for change
    ;
pxd_doSnap(0x1, 1, 0);                      // snap
```

or

```
int ocnt = pxd_getGPTrigger(0x1, 0);        // save current trigger count
pxd_goLive(0x1, 1);                         // capture continuously
while (ocnt == pxd_getGPTrigger(0x1, 0))    // wait for change
    ;
pxd_goUnLive(0x1);                          // terminate continuous capture
while pxd_goneLive(0x1, 0))                 // wait for capture to cease
    ;
```

For applications which prefer to avoid "polling" for status within a loop, XCLIB also provides asynchronous notification of the general purpose trigger. As for video field notifications, in Windows these notifications take the form of an "Event", in DOS these notifications take the form of a callback function, and in Linux these notifications take the form of a "signal". For example, under Windows:

```
HANDLE event = pxd_eventGPTriggerCreate(0x1, 0, 0);   // select PIXCI(R) unit 1
```

Thereafter, any thread waiting upon the event will be notified upon the general purpose trigger, and can then do a *pxd_goSnap* or *pxd_goUnLive*, as appropriate.

6.6.2. Asynchronous Trigger Capture

For a camera in asynchronous trigger mode, there are two possible submodes. In one submode, the trigger is external. An example of capturing a single triggered image is:

```
pxd_goSnap(0x1, 1);             // call BEFORE trigger is expected
while pxd_goneLive(0x1, 0))     // wait for trigger then
    ;                           // wait for capture to cease
```

The pxd_doSnap should not be used, unless its *timeout* parameter adjusted to accommodate the delay before the trigger arrives. The *pxd_goLive*, *pxd_goLivePair*, and *pxd_goLiveSeq* can also be used to continuously capture triggered images, or to capture a sequence of triggered images. Neither *pxd_getGPTrigger* nor its asynchronous notification (e.g. *pxd_eventGPTriggerCreate*) need be used.

In the second submode, the PIXCI® frame grabber automatically issues a single trigger pulse (in XCAP this is described as the "Button" or "Snap Button" trigger selection.) In XCLIB, the equivalent is simply:

```
pxd_doSnap(0x01, 1);
```

or

```
pxd_goSnap(0x01, 1, 0);
```

which both "arm" the PIXCI® frame grabber to capture an image and trigger the camera. Neither *pxd_getGPTrigger* nor its asynchronous notification (e.g. *pxd_eventGPTriggerCreate*) need be used. The *pxd_goLive*, *pxd_goLivePair*, and *pxd_goLiveSeq* are not appropriate for this mode.

6.7. PIXCI® E1, E1DB, E4, E4DB, E4G2-2F, E4G2-4B, E4G2-F2B, E4TX2-2F, E4TX2-4B, E4TX2-F2B, E8, E8DB, e104x4-2f, e104x4-4b, e104x4-f2b, EB1, EB1G2, EB1-PoCL, EB1G2-PoCL, EL1, EL1DB Triggered Sequence Capture

For a camera and frame grabber combination in free-run mode, triggering consists of selecting a field or frame on which to start or end capture. For example:

```
int odata;
odata = pxd_getGPIn(0x1,    // select PIXCI(R) unit 1
                    0);     // reserved
while (odata == pxd_getGPIn(0x1, 0))
    ;
pxd_goLiveSeq(0x1               // select PIXCI(R) unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              pxd_imageZdim(),  // for this many captures
              1);               // advancing to next buffer after each 1 frame
while pxd_goneLive(0x1, 0))     // wait for capture to cease
    ;
```

which waits until any of the general purpose inputs have changed, then fills the frame buffers with fields or frames at video rate.

Or,

```
int ocnt = pxd_getGPTrigger(0x1, 0);
pxd_goLiveSeq(0x1               // select PIXCI(R) unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              0,                // for ever
              1);               // advancing to next buffer after each 1 frame
while (ocnt == pxd_getGPTrigger(0x1, 0))
    ;
pxd_goUnlive(0x1);
while pxd_goneLive(0x1, 0))         // wait for capture to cease
    ;
printf("Most recent captured buffer: %d\n", pxd_capturedBuffer(0x1);
```

which continuously captures until the general purpose trigger arrives, leaving the frame buffers filled with video fields or frames that predate the trigger.

Or,

```
int         odata = pxd_getGPIn(0x1, 0);
pxvbtime_t  fieldcount;
pxd_goLiveSeq(0x1               // select PIXCI(R) unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              0,                // for ever
              1);               // advancing to next buffer after each 1 frame
while (odata == pxd_getGPIn(0x1, 0))
    ;
fieldcount = pxd_videoFieldCount(0x1);  // get current value of field counter
while (pxd_videoFieldCount(0x1) < fieldcount+(pxd_imageZdim()/2)*pxd_imageIdim())
    ;
pxd_goUnlive(0x1);
```

```
while pxd_goneLive(0x1, 0))         // wait for capture to cease
    ;
printf("Most recent captured buffer: %d\n", pxd_capturedBuffer(0x1);
```

which continuously captures until the trigger arrives, waits for half of the frame buffers to be filled following the trigger, then terminates capture. The captured result is half of the frame buffers predate the trigger and half postdate the trigger.

As for single image trigger capture, polling on the *pxd_getGPTrigger* can be avoided by using asynchronous notifications (e.g. *pxd_eventGPTriggerCreate*). Alternately, the *pxd_goLiveSeqTrig* described in the *XCLIB Reference Manual* performs the same function as the last three examples, but returns immediately leaving the trigger capture running in the "background" and provides minimal latency.

For a camera in asynchronous trigger mode, with an external trigger, sequence capture is simply:

```
pxd_goLiveSeq(0x1               // select PIXCI(R) unit 1
              1,                // select start frame buffer 1
              pxd_imageZdim(),  // select end as last frame buffer
              1,                // incrementing by one buffer
              pxd_imageZdim(),  // for this many captures
              1);               // advancing to next buffer after each 1 frame
while pxd_goneLive(0x1, 0))     // wait for capture to cease
    ;
```

In the second trigger submode, where the PIXCI® frame grabber automatically issues a single trigger pulse (in XCAP this is described as the "Button" or "Snap Button" trigger selection), sequence capture is simply:

```
int     i;
for (i = 1; i <= pxd_imageZdim(); i++) {
    pxd_goSnap(0x1, i);
    while pxd_goneLive(0x1, 0))         // wait for capture to cease
        ;
}
```

As before, the polling can be avoided by using asynchronous event notifications.

6.8. Additional XCLIB Documentation

For additional guidance in using the XCLIB library, consult the *XCLIB Reference Manual* and the example programs provided with the XCLIB library.

7. Specifications

7.1. Signal Input and Output:

EIA RS-644 (LVDS) drivers and receivers are used as the interface circuits.

7.2. EIA RS-644 Low Voltage Differential Signaling Devices (LVDS)

DS90LT012A/NOPB receiver
Differential Input High Threshold: Typical -30 mV, Maximum 0 mV
Differential Input Low Threshold: Minimum -100 mV, Typical -30 mV
Input Current VIN = +2.8V: Minimum -10 µA, Maximum +10 µA
Input Current VIN = 0V: Minimum -10 µA, Maximum +10 µA
Input Current VIN = +3.6V: Minimum -20 µA, Maximum +20 µA

DS90CR288AMtD/NOPB receiver
Differential Input High Threshold VCM = +1.2V: Maximum +100 mV
Differential Input Low Threshold: Minimum -100 mV
Input Current VIN = +2.4V: Maximum ±10 µA
Input Current VIN = 0V: Maximum ±10 µA

DS90LV011ATMF/NOPB driver
Output Differential Voltage RL = 100 ohms: Minimum 250 mV, Maximum 450 mV
Output Short Circuit Current: Maximum -12 mA

SN65LVDM176DGK transceiver used as a driver
Differential output voltage: Minimum 247 mV, Maximum 454 mV
Short-circuit output current: Maximum -10 mA

7.3. Resolution:

The number of pixels and lines is determined by the camera.

7.4. Frame Rate

The frame rate of the camera determines the frame rate of the PIXCI® frame grabber.

7.5. Bus Requirements

7.5.1. PIXCI® E4, E4DB

PCI Express x4 or wider slot.
980 milliamps at +3.3 Volts.
5.15 inches long by 4.153 inches high.

7.5.2. PIXCI® E8, E8DB

PCI Express x8 or wider slot.
760 milliamps at +3.3 Volts.

105 milliamps at +12 Volts.
5.15 inches long by 4.153 inches high.

7.5.3. PIXCI® EL1, EL1DB

PCI Express x1 or wider slot.
180 milliamps at +3.3 Volts.
5.17 inches long by 4.153 inches high.

7.6. Connections

26 pin 3M MDR connectors for Camera Link.
Cables optionally available.

Specifications subject to change without notice.

8. Trigger and Camera Integration Control Registers

This chapter of the manual is a "generic" version that discusses triggering and camera integration control for most cameras. Note that some cameras use unique control signals which are not described here. Contact EPIX if detailed programming information is required for a specific camera.

The trigger and camera integration control registers generate the CC1 signal to the camera via the Camera Link cable. The CC1 signal can be generated in response to an external rising or falling edge trigger input, in response to a write to the EXSYNC register, or can be continuously running.

Two 16 bit counters and a pixel clock divider determine the timing of the CC1 signal. The EXSYNC counter determines the width of CC1 while the PRIN counter determines the time from the end of CC1 to the start of the next CC1. EXSYNC is used to program the exposure width, while PRIN is used to program the time for readout of the sensor. Some camera modes do not use the width of the CC1 signal, instead they use the edge of CC1 to start an exposure and readout with the exposure controlled internally by the camera.

8.1. PRIN and EXSYNC Bit Definitions

PRINC. Trigger Control and PRIN Delay Count. Write Only. 32 bits.
0x0000 on power up.
Bits 31 thru 16 control the width of PRIN.
0x0000 on power up.

Bits 9-7, EPCD, Exposure Pixel Clock Divide.
Selects one of 8 outputs of the Pixel Clock divide counter that clocks the camera control state machine clock.
9,8,7=111 selects Pixel Clock divide by 512.
9,8,7=110 selects Pixel Clock divide by 256.
9,8,7=101 selects Pixel Clock divide by 128.
9,8,7=100 selects Pixel Clock divide by 64.
9,8,7=011 selects Pixel Clock divide by 32.
9,8,7=010 selects Pixel Clock divide by 16.
9,8,7=001 selects Pixel Clock divide by 8.
9,8,7=000 selects Pixel Clock divide by 4.

Bit 4, TRIGNEG, Trigger Input Polarity Select.
Bit 4=1 selects a 1 to 0 transition of the Trigger input.
Bit 4=0 selects a 0 to 1 transition of the Trigger input. The trigger input is on the LEMO and P3 connectors.

Bit 2, EXPS, EXSYNC Polarity Select.
Bit 2=1 selects a positive CC1 pulse.
Bit 2=0 selects a negative CC1 pulse. The EXSYNC signal is connected to CC1.

Bit 1, CNTS, Continuous Select.
Bit 1=1 selects continuous operation of the EXSYNC state machine. If TIS=1, a trigger will generate an EXSYNC that is the width of the EXSYNC count down time, load the PRIN count, count down the PRIN count, and wait for the next trigger input. If TIS=0, the state machine will run continuously, counting down the EXSYNC (and generating CC1), then counting down PRINC, and looping.
Bit 1=0 selects single shot operation of EXSYNC. Each time the EXSYNC register is written, one EXSYNC pulse will be produced while the EXCYNC is counted down, followed by the PRINC count down. Each EXSYNC write will start this cycle.

Bit 0, TIS, Trigger Input Select.
Bit 0=1 causes the start of EXSYNC to be delayed until the trigger input goes from 0 to 1 (if TRIGNEG =1) or 1 to 0 (if TRIGNEG =0). CNTS must be =1 for TIS=1 to operate.
Bit 0=0 ignores the trigger input and causes the EXSYNC to be loaded after both counters have counted down (if CNTS =1), or wait for next write of EXSYNC (if CNTS =0).

EXSYNC. EXSYNC Count. Write Only. 32 bits.

0x0000 on power up.
Bits 31 thru 16 controls the width of EXSYNC.

8.2. Camera Timing Formula and Examples

Exposure for area scan cameras is determined by the formula:
Exsync = (Camera_clock x Exposure) / (1024 x 2^N)
Prin = Camera_clock x (Frame_time - Exposure_time - 2 x 10^{-6}) / (1024 x 2^N)

Exposure for line scan cameras is determined by the formula:
Exsync = (Camera_clock x Exposure) / (4 x 2^N)
Prin = Camera_clock x (Frame_time - Exposure_time - 2 x 10^{-6}) / (4 x 2^N)

Note that the value of the pixel clock divider, N, must be the same for both Exsync and Prin calculations. The Exsync and Prin counters are 16 bits and the value of Exsync and Prin must be less than 65535 (decimal) and greater than 0.

The examples that follow assume use of a line scan camera with a pixel clock of 67.58 MHz, and results are rounded to the nearest whole number.

8.2.1. PRIN and EXSYNC Calculations Example 1

For an exposure_time of 2 milliseconds and a line rate of 200 Hz (5 milliseconds) with N=0:
Exsync = (67.58 x 10^6 x 2 x 10^{-3}) / (4 x 2^0) = 33790.
Prin = 67.58 x 10^6 x (5 x 10^{-3} - 2 x 10^{-3} - 2 x 10^{-6}) / (4 x 2^0) = 50651.

8.2.2. PRIN and EXSYNC Calculations Example 2

For an exposure time of 4 milliseconds and a line rate of 50 Hz (20 milliseconds)with N=0:
Exsync = (67.58 x 10^6 x 4 x 10^{-3}) / (4 x 2^0) = 67580 (greater than 65535).
Prin = 67.58 x 10^6 x (20 x 10^{-3} - 4 x 10^{-3} - 2 x 10^{-6}) / (4 x 2^0) = 270286 (more than 4 times greater than 65535).
Since the line rate requires a divisor for the pixel clock, a divisor of N=3 is chosen. Recalculating:
Exsync = (67.58 x 10^6 x 4 x 10^{-3}) / (4 x 2^3) = 8448.
Prin = 67.58 x 10^6 x (20 x 10^{-3} - 4 x 10^{-3} - 2 x 10^{-6}) / (4 x 2^3) = 33786.

8.3. XCLIB Trigger and Camera Integration Register Programming

The EXSYNC and PRIN are set by loading a video configuration format file previously saved by XCAP, via

```
pxd_PIXCIopen(...)
```

or

```
pxd_videoFormatAsIncluded(...);
```

The EXSYNC and PRIN 16 bit count values, which are the upper 16 of the 32 bit registers, can set and queried in the XCLIB library with functions:

```
int  pxd_setExsyncPrin(int unitmap, uint exsync, uint prin);
uint pxd_getExsync(int unitmap);
uint pxd_getPrin(int unitmap);
```

The lower 16 bits of these registers can be queried and set in the XCLIB library with functions:

```
int  pxd_setExsyncPrincMode(int unitmap, uint exsyncbits, uint princbits);
uint pxd_getExsyncMode(int unitmap)
uint pxd_getPrincMode(int unitmap);
```

Only those bits which control the scaling of EXSYNC and/or PRIN values, or similar features should be changed by using *pxd_setExsyncPrincMode*. Other features, such as a change to resolution, or trigger mode also require a change to the video format configuration, which this function does not automatically perform. Use of *pxd_PIXCIopen* or *pxd_videoFormatAsIncluded* with a video format configuration exported by XCAP should be used to effect change to all EXSYNC and PRINC values and bits.

See the *XCLIB Reference Manual* for additional information.

9. In Case of Trouble

If problems are encountered during operation of the PIXCI® frame grabber, an error message may appear in the center of the XCAP main window, or a Message Log window may appear in the upper-right corner of the XCAP main window containing an error message, or if using XCLIB an error message window may appear. If using the XCLIB library, display of the error message is under control of the user's application. To help resolve any problems, it is recommended to first read the frequently asked questions (FAQ) posted on the support page of the EPIX, Inc. website. The FAQ addresses several of the most commonly encountered problems. Highly detailed computer configuration tips are available by selecting *PC Configuration Tips* from the Help menu in the XCAP main window.

Third party applications using XCLIB may choose not to display error messages. So as to assist providing technical support, error messages describing a fault on open of the PIXCI® frame grabber are automatically logged to the Windows Event Log (for Windows 2000 and later) or the Linux `syslog`.

Below are listed all of the potential errors that may be encountered, along with a brief description of the error and brief summary of how to resolve the error condition.

9.1. Fault on Open Error Messages

The following error messages are reported when a fault occurs preventing use of the PIXCI® frame grabber.

Bad Link/Load/Env! (NN)!

> For DOS. Contact EPIX, Inc. Technical Support.

Bad Linux memory specification? (-IA parameter inconsistent w. lilo/grub)!

> Using "forceful" frame buffer memory allocation, the specified frame buffer memory overlaps memory owned by Linux. Either the -IA Driver Configuration Parameter is invalid, or the Linux configuration via *lilo* or *grub* is invalid, or the option to reserve memory for frame buffers was not selected when Linux booted.

Bad or conflicting IRQ? (DD request_irq NN)!

> For Linux. Contact EPIX, Inc. Technical Support.

Bad or conflicting IRQ? (DDK VPICD_Virtualize_IRQ)!

> For Windows 95, 98, ME. Contact EPIX, Inc. Technical Support.

Bad or conflicting IRQ? (DDK IoConnectInterrupt NN)!

> For Windows NT, 2000, XP, Vista, 7, 8, 10. Contact EPIX, Inc. Technical Support.

Bad or conflicting register address? (DDK HalTranslateBusAddress)!

> For Windows NT. Contact EPIX, Inc. Technical Support.

Bad or conflicting register address? (DD request_(mem_)region)!

> For Linux. Linux refuses to grant access to the PIXCI® frame grabber's registers. Can occur when another driver already has exclusive access to the registers. Contact EPIX, Inc. Technical Support.

Bad Windows memory specification? (-IA parameter inconsistent w. boot.ini)!

> For Windows NT, 2000, XP, Vista, 7, 8, 10. Using "forceful" frame buffer memory allocation, the specified frame buffer memory overlaps memory owned by Windows. Either the -IA Driver Configuration Parameter is invalid, or

the Windows configuration via *boot.ini* or *bcdedit* is invalid, or the option to reserve memory for frame buffers was not selected when Windows booted.

Bad Windows memory specification? (Inconsistent MaxPhysPage and -IA parameters)!

For Windows 95, 98, ME. Using forceful memory allocation, either the -IA Driver Configuration Parameter is invalid, or the Windows configuration via *MaxPhysPage* is invalid, as the specified frame buffer memory overlaps memory used by Windows.

Can't access PCI Configuration Registers! (NN)!

Contact EPIX, Inc. Technical Support.

Can't access 24C16! (NN:NN).

Possible hardware fault. Contact EPIX, Inc. Technical Support.

Can't allocate frame buffer memory! (NN)!

The Driver Configuration Parameters do not specify a sufficiently large memory size. Or, the operating system is unable to provide sufficient memory.

Can't allocate serial data buffer(s)!

The operating system is unable to provide sufficient memory for serial data buffers.

Can't allocate capture enqueue/dequeue buffer!
The operating system is unable to provide sufficient memory for the "enqueue/capture/dequeue" video capture mode. Other video capture modes are unaffected.

Can't identify imaging board model! (NN/NN/NN)!

Deprecated, see "Can't identify frame grabber model! (NN/NN/NN)!".

Can't identify frame grabber model! (NN/NN/NN)!

The PIXCI® driver and/or library predates the installed PIXCI® frame grabber. Contact EPIX, Inc. for newer drivers and software.

Can't obtain DDK timer services! (NN)!

For Windows 95, 98, ME. Contact EPIX, Inc. Technical Support.

Can't open format file: ... !

A format (video setup) file specified in *pxd_PIXCIopen* or *xclib_open* does not exist or can't be opened.

Data path error! (%.8lX -> %.8lX)(%lc).

Possible hardware fault in PIXCI® frame grabber or computer's motherboard. Try a different slot on motherboard, or a different motherboard. With some PIXCI® frame grabbers, can also occur if Windows entered sleep or hibernation mode; newer drivers provide a "hibernate compatibility patch" enabled via registry (reboot to take effect), to resolve the problem. With some PIXCI® frame grabbers and motherboards, can occur if Windows' "Fast Startup" option is enabled; disable the "Fast Startup" option.

Camera serial configure: no response (error=NN)(Command = '...')

The camera did not respond, or did not respond as expected, to one or more serial commands contained in the video setup (video format). Check that the camera is connected and powered on. For most cameras, inclusion of serial commands in the video setup is optional.

DPMI host not found!

Only occurs under DOS.

DPMI error! (Op NN)!

The specified DPMI operation code failed. Only occurs under DOS.

Driver/Library Interface Phase Error! (NN:NN:NN)!

Contact EPIX, Inc. Technical Support.

Driver access denied: ... !

For Linux. The driver module appears to be installed (and is listed by "lsmod"), but the `/dev/pixci` node may not exist, have the wrong major or minor numbers, or have the wrong permissions. Generally, occurs only when alternate methods or scripts (other than those provided by EPIX, Inc.) have been used to install the driver.

Driver installed ... version is incompatible with library ... !

Self explanatory.

Driver installed ... is wrong version - requires ... !

Deprecated. Self explanatory.

Driver not installed - requires ... or frame grabber not installed!

Generally self explanatory.

Note that on Windows systems supporting Plug & Play (i.e. other than Windows NT), the driver will only be installed if a PIXCI® frame grabber is detected. Use the Windows' Device Manager (run "devmgmt.msc") to distinguish whether a PIXCI® frame grabber isn't installed versus the driver not installed. Error can also occur on Windows 2K and later if using a newer V3.8.1 driver with an older DLL, as the driver was modified to pass Microsoft's "style" checks; a driver registry option provides for backward compatibility.

On Linux, the driver is installed during boot. When compiled with current default options, the driver remains installed regardless of whether the PIXCI® frame grabber is detected. Compiled with backward-compatible options, the driver will remain installed only if a PIXCI® frame grabber is detected; run "lspci" to distinguish whether the driver wasn't installed upon boot versus a PIXCI® frame grabber isn't installed.[11]

Driver communication error!

For Linux. Contact EPIX, Inc. Technical Support.

Eeprom contents invalid! (NN:MN)

The EEPROM used to specify the PIXCI® frame grabber's default configuration can't be accessed or has been overwritten. Contact EPIX, Inc. Technical Support.

Format init error: ... !

An error occurred while initializing the library and the video setup. Contact EPIX, Inc. Technical Support.

Format init error ... for ... !

An error occurred while initializing the library and the video setup for the named video format. Contact EPIX, Inc. Technical Support.

Format name not recognized: ... !

The specified video format name is not recognized in conjunction with the current PIXCI® frame grabber.

Format unsupported for model=... submodel=... for: ... !

An error occurred while initializing the library and the video setup for the named video format. Contact EPIX, Inc. Technical Support.

Format init error: Can't open file ... !

The specified video format file can't be found or opened.

Format init error ... for file: ... !

An error occurred while initializing the library and the video setup for the specified video format file.

Frame buffer memory extends above the 4 GB address limit with 32 bit XCLIB on 64 bit O.S.!

On a 64 bit computer with more than 4 GB of memory, set the "Restrict Non-Forceful Memory to be below 4 GByte" (in PIXCI®, PIXCI® Open/Close, Advanced) option.

Imaging board already in exclusive use!

The PIXCI® frame grabber is already open, and was opened for exclusive use rather than for shared use.

Imaging board hardware resource conflict! (DDK HalAssignSlotResources NN)!

For Windows NT. Contact EPIX, Inc. Technical Support.

Imaging board hardware resource conflict? (DDK IoReportResourceUsage NN)!

For Windows NT. Contact EPIX, Inc. Technical Support.

Imaging board not correctly installed! (No PNP DevNode)!

For Windows 95, 98, ME. Windows Plug & Play configuration of the PIXCI® frame grabber and driver is incorrect.

Invalid driver configuration parameters!

The Driver Configuration Parameters (in the Windows registry entry of the PIXCI® driver, appended to the Linux *insmod* command, in the first parameter to *pxd_PIXCIopen*, or in the third parameter to *xclib_open*) are invalid, such as an undefined flag, or a numeric value containing invalid characters.

Invalid register base address! (NN)!

With some PIXCI® frame grabbers, can occur if Windows entered sleep or hibernation mode; newer drivers provide a "hibernate compatibility patch" enabled via registry, reboot Windows to resolve the problem. Otherwise, contact EPIX, Inc. Technical Support.

Multiple imaging boards not identical!

Deprecated, see "Multiple frame grabbers not identical!".

Multiple frame grabbers not identical!

Multiple PIXCI® frame grabbers opened "as a group" (i.e. with one instance of XCLIB, or under XCAP with "Common Controls") must be of identical models. Depending on the model and revision(s), some different revisions of a given model are transparent to the PIXCI® imaging board driver, for others, the revisions must also be identical.

Multiple imaging board revisions not identical!

Deprecated, see "Multiple frame grabber revisions not identical!".

Multiple frame grabber revisions not identical!

Multiple PIXCI® frame grabbers opened "as a group" (i.e. with one instance of XCLIB, or under XCAP with "Common Controls") must be of identical models. Depending on the model and revision(s), some different revisions of a given model are transparent to the PIXCI® imaging board driver, for others, the revisions must also be identical.

No imaging board installed!

Deprecated, see "No frame grabber installed!".

No frame grabber installed!

No PIXCI® frame grabber is installed; check if the PIXCI® frame grabber is properly seated or try a different slot.

No imaging board selected!

Deprecated, see "No frame grabber selected!".

No frame grabber installed!

No PIXCI® frame grabbers are installed.

No frame grabber selected!

XCAP's Multiple Devices selection (PIXCI®, PIXCI® Open/Close, Multiple Devices), or XCLIB's Driver Configuration Parameters, does not select use of any PIXCI® frame grabber.

Operating system not supported!

The PIXCI® driver and/or library predates the current operating system. Contact EPIX, Inc. for newer drivers and software.

PCI BIOS not present!

For DOS.

Selected imaging boards not installed! (Select=NN Install=NN)!

Deprecated, see "Selected frame grabbers not installed! (Select=NN Install=NN)".

Selected frame grabbers not installed! (Select=NN Install=NN)!

XCAP's Multiple Devices selection (PIXCI®, PIXCI® Open/Close, Multiple Devices), or XCLIB's Driver Configuration Parameters, selects use of the N'th PIXCI® frame grabber, but there are fewer PIXCI® frame grabber's installed.

Unable to access imaging board registers! (DDK MapPhysToLinear)!

Deprecated, see "Unable to access frame grabber registers! (DDK MapPhysToLinear)!".

Unable to access frame grabber registers! (DDK MapPhysToLinear)!

For Windows 95, 98, ME. Contact EPIX, Inc. Technical Support.

Unable to access imaging board registers! (DDK MmMapIoSpace)!

Deprecated, see "Unable to access frame grabber registers! (DDK MmMapIoSpace)!".

Unable to access frame grabber registers! (DDK MmMapIoSpace)!

For Windows NT, 2000, XP, Vista, 7, 8, 10. Contact EPIX, Inc. Technical Support.

Unable to access imaging board registers! (DD ioremap)!

Deprecated, see "Unable to access frame grabber registers! (DD ioremap)!".

Unable to access frame grabber registers! (DD ioremap)!

For Linux. Contact EPIX, Inc. Technical Support.

Unable to lock memory! (DDK VDMAD_Lock_DMA_Region)!

For Windows 95, 98, ME. Contact EPIX, Inc. Technical Support.

Unable to map image memory? (DD ioremap)!

For Linux. Contact EPIX, Inc. Technical Support.

Unable to map image memory? (DD request_mem_region)!

For Linux. Contact EPIX, Inc. Technical Support.

Unable to map image memory! (DDK PageReserve/CommitPhys/Lock)!

For Windows 95, 98, ME. Contact EPIX, Inc. Technical Support.

Unable to map image memory! (DDK MmMapIoSpace)!

For Windows NT, 2000, XP, Vista, 7, 8, 10. Contact EPIX, Inc. Technical Support.

Unable to map image memory! (DDK MapPhysToLinear)!

For Windows NT, 2000, XP, Vista, 7, 8, 10. Contact EPIX, Inc. Technical Support.

Unable to map image memory! (DDK ZwMapViewOfSection)!

For Windows NT, 2000, XP, Vista, 7, 8, 10. Contact EPIX, Inc. Technical Support.

Unable to map image memory! (DDK IoAllocateMdl/MmMapLockedPages NN)!

For Windows NT, 2000, XP, Vista, 7, 8, 10. Contact EPIX, Inc. Technical Support.

Unrecognized format: ... !

The named video format, specified in *pxd_PIXCIopen* or *xclib_open*, does not match any predefined video format for the current PIXCI® frame grabber.

Unsupported format: ... !

The named video format, specified in *pxd_PIXCIopen* or *xclib_open*, is not supported by the current PIXCI® frame grabber.

XCLIB-Lite does not support multiple imaging boards!

Deprecated, see "XCLIB-Lite does not support multiple frame grabbers!".

XCLIB-Lite does not support multiple frame grabbers!

Self explanatory.

XCLIB-Lite does not support more than 64 MByte of frame buffer memory!

Self explanatory.

9.2. Run-Time Error Messages

The following error messages are reported when a fault occurs during operation of the PIXCI® frame grabber.

Invalid frame buffer number! (.../...)!

A frame buffer number, larger than the current number of frame buffers, was specified for capture. Most likely an error by application software.

Serial communication receive framing error! (NN)

The camera sent a "break" signal, or the camera held the serial transmit line low during reset or while power is cycled.

May also occur if the camera power is cycled, or if cables are removed or attached, while the PIXCI® frame grabber is in use.

Serial communication receive overrun! (NN)

PIXCI® driver and/or application software could not process serial data from the camera quickly enough. Typically occurs when use of IRQ's are disabled (PIXCI®, PIXCI® Open/Close, Advanced).

May also occur if the camera power is cycled, or if cables are removed or attached, while the PIXCI® frame grabber is in use.

Unable to record frame buffer status & time stamp! (buffer/s=NN/NN)!

The frame buffer memory is not writable from the interrupt handler. Typically occurs when using forceful memory allocation. Set the "Per Frame-Buffer Status: Use System Memory" (in PIXCI®, PIXCI® Open/Close, Advanced) option.

Video not captured! (Image Adrs FIFO)!

Contact EPIX, Inc. Technical Support.

Video not captured! (PCI Bus Error NN)!

During video capture via DMA, the PCI Express bus logged an error. Contact EPIX, Inc. Technical Support.

Video not captured! (PCI FIFO Overflow)!

The bandwidth provided by the PCI Express bus is insufficient for capturing video-rate data. Updating the computer's firmware and BIOS, trying a different PCI Express slot, and disabling power conservation features in BIOS may increase the bandwidth provided by the bus. Reduce the camera's horizontal resolution, reduce the camera's bit depth, reduce the camera's pixel clock, or enable camera binning (subsampling), or, if capturing 10 or 12 bits per pixel enable use of bit-packing, to decrease the bandwidth required.

10. Hardware Revisions

10.1. PIXCI® E1

Revision 0: Frame grabber not released.

Revision 1: Fixed layout errors.

10.2. PIXCI® E4

Revision 0: Frame grabber released.

Revision A0: New FPGA, Arria GX.

Revision A1: NCSO and NCS nets connected.

Revision 2:

1. Removed nets CCA1, CCA2, CCA3, CCA4, SEROUT2, TRGOUT2, IOOUT2, FENOUT2, SERIN2, TRG2, FENIN2, IOIN2.
2. Removed components P5_HEADER, RB2, RB3, RB4, RB5, UB1, UB2, UB3, RB6, RB7, RB8, RB9.
3. Added test resistors to unused pins from unused nets and components.
4. Added series resistor on all 288 outputs to FPGA (84 lines).
5. Added 10uF, 0.1uF, 0,01uF capacitance to 3P3V (18 locations).
6. Added 0201 shorted option resistors between 288s and FPGA.
7. Revised differential traces spacing.
8. Replaced LLL capacitors with the smaller footprint.
9. Added "hats" symbols to PCB to allow for inspection of PCB finger alignment.

Revision 3:

1. Removed fan circuit (delete H3, RB15 through RB 20, K4, Q20, QB41, R50).
2. Removed CFGHDR.
3. Changed EPCS64SI16N (16 SOW) to EPCS4I8N (8 pin SOIC).
4. Replaced LLL capacitors with the longer pads.
5. Added "CONFIG" and net names to header P7.

Revision 4:

1. Schematic redesign based on PIXCI® E8 revision 2.
2. Schematic revised to x4 format.
3. Eprom dual selection switch between two pairs of 8-pin eproms with 16-pin eproms optional.
4. Connection changes on FPGA pins.
5. Optional pull-up and pull-down resistors on WP deleted.

Revision 5:

1. Improved the PoCL circuit to prevent damage to the frame grabber which can occur in previous revisions in rare instances when using certain non-PoCL cameras if the PIXCI® E4 PoCL feature is enabled and if the camera and PIXCI® E4 are connected while both are powered on.
2. Added jumpers near P1 and P2 to select PoCL enable/disable.

10.3. PIXCI® E8

Revision 0: Frame grabber released.

Revision 1:

1. Revised the silkscreen, adding Base/Base0 and Full/Base1, etc.

Revision 2:

1. Schematic changes per eprom circuitry, addition of 22pF capacitor and 22ohm resistor, moved 8-pin eprom on both side of 16-pin eprom for better routing of dclk signal, moved eproms to lower right of FPGA for shorter trace length of DCLK to FPGA, ran DCLK trace on layer 2 Gnd plane to FPGA for better isolation.
2. nconfig 10k ohm resistor changed from Gnd to 2p5a.
3. Deleted FUSE1, FUSE2.
4. Deleted SW1, SW2, and grounded pins C12 and G10 on FPGA.
5. Deleted RB3.
6. Deleted B6.
7. Deleted redundant resistors R6, R8, and RB48.
8. Eliminated all LL caps, changed to 0201 under FPGA and 0402 elsewhere.
9. Revised power supply's pad geometry.
10. All extra IO pins connected to Gnd at the FPGA and test resistor deleted.
11. Shorts deleted on switch H6.

Revision 3:

1. Improved the PoCL circuit to prevent damage to the frame grabber which can occur in previous revisions in rare instances when using certain non-PoCL cameras if the PIXCI® E8 PoCL feature is enabled and if the camera and PIXCI® E8 are connected while both are powered on.
2. Added jumpers near P1 and P2 to select PoCL enable/disable.

10.4. PIXCI® EL1

Revision 0: Frame grabber released. Wire required to connect SCL.

Revision 1: Fixed SCL layout error and released.

Revision 2:

1. Added 0.01uF and 22uF capacitors (12 each) to 288 cameralink receiver power supply pins.
2. Revised differential traces spacing.
3. Added "hats" symbols to PCB to allow for inspection of PCB finger alignment.

Revision 3:

1. Replaced B6 with an eight-pin device.
2. Added R81.
3. Added optional abm crystal for X1, called "X1A".

Revision 4:

1. New FPGA.
2. Corrected package types for 22uF and 47uF capacitors to 1210.
3. Corrected R28 value to be 22 kOhm.

10.5. PIXCI® EL1DB

Revision 0: Frame grabber released.

Revision 4: PCB is now same as PIXCI® EL1 revision 4, factory-configurable as either PIXCI® EL1 or PIXCI® EL1DB.

11. Glossary

Active Video
: Portion of an analog video signal which contains information on intensity and color; i.e the viewable portion.

  By analogy, the term may be used with digital video signals: the portion of signal(s) containing useful pixel values as indicated by the "Line Valid" and "Frame Valid" signals.

AOI
: Area of interest. An area of an image subject to modification, loading, saving, printing, etc. Typically, within EPIX® imaging software, when used in conjunction with, or contrasted against, the term "ROI": an AOI is rectangular, with sides parallel to the image axis while an ROI is any other closed geometric shape or orientation. However, there is no industry standard for use of AOI vs ROI, and within EPIX® imaging software various camera specific controls typically follow the conventions of each camera's manufacturer.

  An AOI is sometimes referred to as a "window" within the image, but is not to be confused with a "window" or "dialog" of a Graphical User Interface, such as Windows^{tm}, Java^{tm}, or GTK.

Analog Camera
: A video camera which outputs pixel intensities (imagery) and timing or synchronization information as one or more continuously varying electrical signals. A camera with analog output might contain an analog sensor or a digital sensor.

Analog Gain
: Amplification of the analog pixel intensity signal so as to modify the resulting pixel values. Ideal analog gain would multiply the pixel intensity by a constant without addition of noise. In practice, analog gain adds a random noise component which is independent of pixel intensity, and adds a random noise component which increases, perhaps non-linearly, for higher pixel intensities. Typically, both noise components increase for higher levels of gain.

  In contrast to "Digital Gain", use of analog gain on dim pixel intensities will, typically, produce an image with both greater contrast and greater continuous tonality, albeit with increased levels of random noise.

Aperture (Lens)
: The opening, often of adjustable diameter, through which light enters into the camera.

Area of Interest
: See "AOI".

Area Scan
: A method of image acquisition which uses a two-dimensional array of photo sensitive elements or a two-dimensional photo sensitive surface.

Aspect Ratio
: The ratio of a pixel's width to height, or the ratio of an image's width to height; the two are not equivalent, but can be related given the image's horizontal and vertical resolution. Image analysis and measurement is simplified by having square pixels - the real world distance represented by a given number pixels is the same whether extended horizontally or vertically. An image might consist of square pixels but with different horizontal and vertical resolution; resulting in a non-square image aspect ratio, but is still convenient for image analysis and measurement.

Authorization Key
: Small device which must be connected to a computer, typically via the parallel port or USB port, to enable use of software protected against unauthorized duplication.

AVI (.AVI)
: The Audio-Video Interleaved, multi-media, image file format specified by Microsoft for use with Windows. Can contain sequences of images within a single file. AVI 1.0 files may be as large as 4 GByte, however, some programs may not be able to read AVI 1.0 files larger than 2 GByte. AVI 2.0 files may be larger than 4 GByte.

Back Focus (Adjustment)

A mechanical adjustment within a camera to change the distance from the lens' back mounting flange to the image sensor. Adjustment may be required if, due to manufacturing tolerances, a lens set to a given object distance does not focus on an object at that distance. Adjustment may also be required when switching between visible and infrared illumination.

Back Porch
The portion of an analog video signal which follows the rising edge of the horizontal sync and precedes the active video.

Bayer Pattern
A 2×2 mosaic of red, green, green, and blue filters:

```
      . . . .
...  R  G  R  G  ...
...  G  B  G  B  ...
...  R  G  R  G  ...
...  G  B  G  B  ...
      . . . .
```

which cover the photosites of some CCD or CMOS image sensors. There are four possible alignments of the mosaic with the image's upper left photosite; a particular alignment is often referred to as "Bayer Phase". A color RGB image is constructed by interpolating the pixel values derived from photosites under the various filters.

Binary
The base 2 numbering system used by most computers and digital circuits.

Bit
The smallest, fundamental, unit of binary data.

Bits per Pixel
Number of bits assigned to represent grey intensity (or level), or luminance and chrominance intensity (or level), information in a single pixel. Indirectly, the number of different discrete levels that represent the variations of such information. For example, 8 bits per pixel yields 256 distinct grey levels.

For color pixels, the number of bits may refer to the number of bits per color component, or to the total number of bits for all components; "16 bit RGB" may refer to an older S/VGA standard that provides low quality color by using 5 or 6 bits for red, blue, and green, or may refer to high quality color using a total 48 bits per pixel and providing 65536 intensity levels for each of red, green, and blue.

BGR Color
Same as "RGB Color", with the order changed to blue, green, and red.

Black Level (Control)
Same as "Brightness (Control)".

BMP (.BMP)
The BitMaP image file format specified by Microsoft for use with Windows for saving graphics and digital images.

Brightness (Control)
A parameter to modify the image's brightness - the average pixel value. Typically, a brightness control modifies the image by adding or subtracting a constant from (digital) pixel values or (analog) pixel intensities.

Buffer
RAM or other memory used to store data. See "Image Buffer", "Frame Buffer".

Capture
To convert a field or frame of video into pixel values stored in a frame buffer.

Camera Format
A standardized numerical description of camera's sensor size, used to specify optics and select lenses. A camera format of 1/4 inch corresponds to a physical sensor size of 3.6×2.7 mm with a 4.5 mm diagonal a camera format of 1/3 inch corresponds to a physical sensor size of 4.8×3.6 mm with a 6.0 mm diagonal, a camera format of 1/2 inch corresponds to a physical sensor size of 6.4×4.8 mm with a 8.0 mm diagonal, a camera format of 1/1.8 inch corresponds to a physical sensor size of 7.2×5.4 mm with a 9.0 mm diagonal, a camera format of 2/3 inch corresponds to a physical sensor size of 8.8×6.6 mm with a 11.0 mm diagonal, a camera format of 1 inch corresponds to a physical sensor size of 12.8×9.6 mm with a 16.0 mm diagonal, a camera format of 1.1 inch

corresponds to a physical sensor size of 12×12 mm with a 17.0 mm diagonal. a camera format of 4/3 inch corresponds to a physical sensor size of 17.3×13.0 mm with a 21.6 mm diagonal.

Sensor formats and suggested lens formats for SILICON VIDEO® cameras are:

Camera	Sensor Format or Size	Suggested Lens Format	Pixel Size or Pitch(p), micrometer
10C-CL and 10M-CL	1/2.3 in.	1/2 in. C-Mount	1.67×1.67
10C6 and 10M6	1/2.3 in.	1/2 in. C-Mount	1.67×1.67
1281M and 1281C	2/3 in.	2/3 in. C-Mount	7.0×7.0
1310 and 1310C	1/2 in.	1/2 in. C-Mount	6.0×6.0 (p)
15C5 and 15M5	1/2.3 in.	1/2 in. C-Mount	1.4×1.4
1514CL	1/2.3 in.	1/2 in. C-Mount	1.4×1.4
1820CL	1/2.3 in.	1/2 in. C-Mount	1.25×1.25
1C45 and 1M45	1/3 in.	1/3 in. C-Mount	3.75×3.75 (p)
20C-CL and 20M-CL	32.77×24.58mm^2	F-Mount	6.4×6.4
2112 and 2112C	1 in.	1 in. C-Mount	7.5×7.5 (p)
2KS-C and 2KS-M	2/3 in.	2/3 in. C-Mount	5.5×5.5
5M10 and 5C10	1/2.5 in.	1/2 in. C-Mount	2.2×2.2
642M and 642C	1/2 in.	1/2 in. C-Mount	9.9×9.9
643M and 643C	1/2 in.	1/2 in. C-Mount	9.9×9.9
9C10	1/2.3 in.	1/2 in. C-Mount	1.75×1.75
9M001 and 9M001C	1/2 in.	1/2 in. C-Mount	5.2×5.2
9T001C	1/2 in.	1/2 in. C-Mount	3.2×3.2
WGA-M and WGA-C	1/3 in.	1/3 in. C-Mount	6.0×6.0

Camera Link

A standard for a high performance serial data interface using an 11 pair conductor cable and the MDR 26-pin connector, or the smaller SDR 26-pin connector, intended for the connection of digital cameras to frame grabbers. Camera Link utilizes the Channel Link interface and chips for transmission of pixel data and video timing, and utilizes LVDS for transmission of serial data and other signals. The cable length is limited to 10 meters; however, some cameras operating with higher pixel clock rates may specify a shorter maximum length; some thinner or more flexible cables may also specify a shorter maximum length. The cable may be effectively extended by use of a repeater.

The Base Configuration uses one Channel Link chip, one MDR or SDR 26-pin connector, and can transfer 24 pixel bits per clock, such as 8×1, 8×2, 8×3, 10×1, 10×2, 12×1, 12×2, 14×1, 16×1 monochrome or Bayer color, and 8×3 RGB color. The Medium Configuration uses two Channel Link chips, two MDR or SDR 26-pin connectors and can transfer 48 pixel bits per clock, such as 8×4, 10×3, 10×4, 12×3, 12×4 monochrome or Bayer color, and 10×3, 12×3 RGB color. The Full Configuration uses three Channel Link chips, two MDR or SDR 26-pin connectors and can transfer 64 pixel bits per clock, such as 8×8 monochrome or Bayer color. The 80-Bit Configuration (formerly referred to as Expanded Configuration, Extended Configuration, Full Plus Configuration or Deca Configuration), uses three Channel Link chips, two MDR or SDR 26-pin connectors and can transfer 80 pixel bits per clock, such as 8×10 or 10×8 monochrome or Bayer color.

The standard provides for four trigger/control signals, "CC1", "CC2", "CC3", and "CC4".

Camera Link DLL

A standardized API (Application Program Interface) that provides serial transport functions; i.e. to send a string of characters (bytes) or receive a string of characters (bytes). The standard does not specify how strings (bytes) are to be formatted into commands or responses; each camera manufacturer, or each camera, specifies its own syntax and semantics. Camera Link DLLs are assigned `clserXXX.DLL` names, where "XXX" is a unique frame grabber identifier or frame grabber manufacturer identifier. The Camera Link DLL for PIXCI® frame grabbers is named `clserEPX.DLL`.

Camera Link Lite
: A standard for a high performance serial data interface using a 7 pair conductor cable and SDR 14 pin connector, intended for the connection of digital cameras to frame grabbers and can transfer 10 pixel bits per clock, such as 8×1 or 10×1 monochrome or Bayer color. The standard provides for a single trigger/control signal, "CC1".

CCIR
: Consultative Committee International Radio. The European video standard for monochrome television transmission which specifies 625 lines per frame, divided into two interlaced fields, and a 25 Hz frame rate.

Channel Link
: A standard for a high performance serial data interface using a 9 or 11 conductor cable and operating at speeds of 840 to 1848 megabits per second, developed by National Semiconductor which provides Channel Link interface chips.

Chroma Key
: A rule for combining two video signals, or two images, based on the color of one image, such as: The output signal/image is taken from signal/image A, except where A contains the chroma key value, where the output is taken from signal/image B, allowing signal/image A and B to be overlaid, with A's chroma key pixels effectively transparent.

Clamping (in Analog Video)
: The process of restoring a DC reference level which was removed to make an AC coupled signal. Without a known DC reference level, an analog video waveform can't be digitized correctly.

Clipping
: Limiting a signal or numeric value, such as pixel intensity to not be below a limit and/or not be above a limit. For example: Eight bit pixel values are limited to be between values 0 and 255, inclusive; a pixel intensity greater than the intensity which corresponds to value 255 must be limited to value 255. Clipping pixel values introduces non-linear errors; non-linear errors cause problems with color correction, PRNU and DSNU correction, intensity based image measurements, and other features.

C-Mount Lens
: A lens specification in which the mounting threads are 1 inch diameter with 32 threads per inch, and a distance of 17.526 mm from the lens' back mounting flange to the image sensor. The similar "CS-Mount" lens specification has the same mounting threads but with a distance of 12.526 mm from the lens' back mounting flange to the image sensor.

CMY Color
: Color space composed of three components: cyan, magenta, and yellow. CMY and RGB are easily related: cyan is the complement of red, magenta the complement of green, and yellow the complement of blue. Alternately, red is the complement of cyan, green the complement of magenta, and blue the complement of yellow.

CMYK Color
: Color space composed of four components: cyan, magenta, yellow, and black. The "natural" color space for printing and graphic arts, as so-called "four color" material is printed using combinations of cyan, magenta, yellow, and black inks.

Color Temperature
: The spectrum of illumination produced by an ideal blackbody which is at a specified temperature in degrees Kelvin. Often used synonymously with Correlated Color Temperature which is the color temperature of a black body whose perceived color is most closely matched by a whitish illuminate, as judged by a human observer. Lower temperature illuminators such as tungsten lamps at *2800°K to 3000°K* radiate more reddish (lower energy) wavelengths, higher temperature illuminators such as cool white fluorescent lamps at *4100°K to 4300°K* radiate more bluish (higher energy) wavelengths. The color temperature of natural illumination - sunlight on planet Earth - varies depending on the season, time of day, and degree of cloud cover; typical values are *5000°K* for sunrise & sunset daylight, *6500°K* for noon daylight, and *7500°K* for overcast daylight.

Color Camera, One Chip
: A color camera with a single solid state imaging sensor in which the sensor's photosites are covered with different colored filters. Typically a pattern of red, green, and blue filters is used. Each color pixel is created by combining values from three or more adjacent photosites. Contrast to "Color Camera, Three Chip".

Color Camera, Three Chip
: A color camera with three solid state imaging sensors in which through the use of filters or other optical means, each sensor is exposed to a narrow color band of the full field of view. Typically, the sensors are exposed to reddish, greenish, and bluish colors (as typical filters are wideband and admit colors other than pure red, green, and blue).

Each color pixel is created by combining one value from corresponding photosites of each of the three imaging sensors. Contrast to "Color Camera, One Chip".

Color Gamut
Color range attainable by a display monitor or other media. The color gamut of a display monitor is dependent on the CRT's phosphor coating, or the LCD's filters and illuminant. A printed image's color gamut is dependent on the inks and paper.

Color Key
See "Chroma"Key"".

Color Lookup Table
An association between each possible value of an index pixel and (typically) an RGB color.

Composite Video
Analog video signal which combines active video, sync, and blanking into a single waveform. Examples include RS-170, NTSC, PAL, CCIR, and RS-343.

Compression
Reduction in the size of a image, usually in conjunction with being saved to disk or transmitted. See Lossy Compression and Lossless Compression.

Contrast
A measure of the relative intensity differences within an image. A low contrast image may be dark (e.g. a foggy night), or bright (e.g. a foggy day); a high contrast image has both bright and dark areas. Typically, the difference between an image's lightest and darkest grey level value.

Contrast (Control)
A parameter to modify the image's contrast - the difference between the brightest and darkest pixels. Typically, a contrast control modifies the image by multiplication of (digital) pixel values, or (analog) pixel intensities, with a constant.

Instead of multiplying pixel values (V) by a constant (C):

```
V*C
```

which leaves the 0 value pixel unchanged, image processing algorithms may instead use:

```
(V-(M/2))*C + (M/2)
```

where (M) is the maximum pixel value and leaves mid-value pixels unchanged. In this context, the former equation may be referred to as "Gain" and the latter as "Contrast". In other contexts, "Gain" and "Contrast" are synonyms.

Controlled (Video) Mode
A camera mode in which the camera is normally quiescent; that is, not continuously and autonomously exposing photosites and outputting the corresponding pixel values. Upon receiving an external trigger signal or command, the camera exposes and outputs a specified number of images, typically one, and resumes its quiescent state. The "Controlled (Video) Mode" allows synchronizing the camera's exposure to an external event, such as when an object obstructs a photoelectric sensor. The "Controlled (Video) Mode" also allows synchronizing two or more cameras, by use of a common external trigger signal. Contrast to "Free-Run (Video) Mode".

In "Controlled (Video) Mode" some cameras can overlap exposure of the next frame with output of the current frame, yielding the same frame rate as in free-run mode (assuming that the exposure period isn't longer than the output period). In other cameras, the exposure and output are sequential; the frame rate decreases as the exposure increases, and a frame rate near that of free-run mode is achieved only as the exposure period approaches zero.

Different camera manufacturers use various synonyms, such as "Frame on Demand Mode", "Triggered (Video) Mode", "External Triggered (Video) Mode", "External Sync (Video) Mode", "Single Shot (Video) Mode", "Controlled (Video) Mode", or "Async Shutter (Video) Mode".

CRT
Cathode Ray Tube. An older technology for display monitors and televisions, using an electron gun, magnetic or electrostatic deflection, and phosphors, coating the display surface, that fluoresce when struct by the electron beam.

CS-Mount Lens
See "C-Mount Lens".

Digital Camera
: A camera which outputs pixel intensities (imagery) and timing or synchronization information as discrete data.

Digital Gain
: Modifies pixel values by multiplying, or scaling, the digital pixel value by a constant. Any noise in the pixel values is scaled up, or down, in the same proportion as the original pixel values.

  Digital gain can make a dim image more pleasant to view, but can't introduce additional grey levels or colors. For example (assuming 8 bit pixels), a very dim grey level image whose pixel values range from zero through four can be scaled by 64. The result will have high contrast - both dark and bright pixels - but still have only 5 different grey levels and lack continuous tonality.

  Contrast to "Analog Gain".

Digitize
: To convert an analog signal into discrete values. Sometimes used as synonym for Capture, as in "to digitize an image".

Dongle
: Same as Authorization Key.

DSNU
: Dark Signal Non Uniformity. A camera or sensor's variation of values from pixel to pixel, other than random noise, with no illumination. The pattern of variation is typically unique to each camera or sensor. Some cameras correct DSNU within the camera, other cameras expect DSNU to be corrected outside of the camera. See also "FPN".

DSP
: Digital Signal Processor. Component which executes computations and gives instructions to manipulate data, specifically designed to operate on signals and images, in contrast to general purpose processors.

EISA Bus
: Extended Industry Standard Architecture Bus. Faster successor to the ISA bus. A ISA board will function correctly in an EISA slot.

EMI
: Electromagnetic interference.

Equalization Pulses
: Two groups of pulses used in some analog video signals which occur before and after serrated vertical sync pulses. Equalization pulses occur at twice the normal horizontal scan rate to insure correct 2:1 interlacing.

Even Field
: See "Interlace".

Exposure (Period)
: The duration of time that a sensor's photosites are sensitive to, and integrating the intensity of, light so as to affect the mage intensity. Often a synonym for "Shutter (Period)" when used in the context of a camera with digital sensor.

ExpressCard/34
: A style of peripheral card used on laptop computers. An ExpressCard/34 host supports both PCIExpress and USB 2.0; a specific ExpressCard/34 typically uses one or the other. See PCI-Express Interface.

  Actual throughput on most computers is approximately 190 MByte/sec.

  The PIXCI® ECB1-34 is an ExpressCard/34 card, using the PCIExpress x1 interface.

ExpressCard/54
: A style of peripheral card used on laptops. An ExpressCard/54 host supports both PCIExpress and USB 2.0; a specific ExpressCard/54 typically uses one or the other. See PCI-Express Interface.

  Actual throughput on most computers is approximately 190 MByte/sec.

  An ExpressCard/54 host accepts both ExpressCard/54 and ExpressCard/34 cards.

  The PIXCI® EC1, ECB1, and ECB2 are ExpressCard/54 cards, using the PCIExpress x1 interface.

File System

The partitioning and sharing of raw disk space into volumes, directories (folders), and multiple files, by the host operating system. Limits on the number of files and their sizes are imposed by the operating system.

File System	Max # of Files	Max File Size (bytes)
Windows FAT16	512 per folder	2^{32}-1
Windows FAT16 w. DOS, Win 95/98/ME	512 per folder	2^{31}-1
Windows FAT32	65534 per folder	2^{32}-1
Windows NTFS	2^{32}-1 per volume	2^{44} - 64*1024

Under Windows FAT16 and FAT32, the maximum number of files per folder (directory) is reduced when long file names (i.e. larger than 8.3) are used. Under Windows NTFS, using 300,000 or more long file names per folder decreases performance.

Under Linux, there are 10 or more varieties of file systems, each with unique limits.

The maximum number of files is significant when capturing video to multiple files, one per image. The maximum file size is significant when capturing video with multiple images in a single file.

FITS (.FTS)

The Flexible Image Transport System file format. An image file format popular in the scientific - particularly astronomy - communities.

Free-Run (Video) Mode

A camera mode in which the camera is continuously and autonomously exposing photosites and outputting the corresponding pixel values. The exposing and outputting of pixel values continues regardless of whether a frame grabber is connected, or whether the connected frame grabber is in capture mode. Contrast to "Controlled (Video) Mode".

Different camera manufacturers use various synonyms, such as "Continuous (Video) Mode", "Internal Sync (Video) Mode", "Auto (Video) Mode", or "Live (Video) Mode".

FPN

Fixed Pattern Noise. Used to describe the effects due to "DSNU", or used to describe the effects due to both DSNU and "PRNU".

Frame

For frame versus field: see "Interlace".

Frame Buffer

An "Image Buffer" specified to receive captured video fields or frames, or from which video fields or frames are displayed. Often, an Image Buffer physically attached to the video capture or display hardware.

Frame Valid

A Camera Link signal indicating which scan lines correspond to valid pixel values, and which is the first and last scan line of each image. Other cameras with digital output may also have a "Frame Valid" signal, or may have a "Vertical Blanking", "Vertical Sync", "V-Sync", or similar signal for the same (possibly logically inverted) purpose.

Front Porch

The portion of an analog video signal that follows the start of the horizontal blank and precedes the horizontal sync pulse.

Gain (Control)

See as "Contrast (Control)".

Gamut

See "Color Gamut".

Genlock

To recover and use the original horizontal and vertical timing control signals from an analog video signal.

Genlock (Video) Mode
: A camera mode in which the camera is continuously exposing photosites and outputting the corresponding pixel values, with the cycles synchronized to an external signal or video waveform.

  Typically, a camera in genlock video mode can only operate at, or near, a specific frame rate; a slower external signal or video waveform "genlock input" will either be ignored or corrupt the video output. In contrast, a camera in "Controlled (Video) Mode" can operate at various frame rates, from zero up to the camera's designed maximum rate.

Global Reset, Rolling Shutter
: Or, "Rolling Shutter, Global Reset". A mechanism within some CCD or CMOS sensors in which all photosites start exposing at the same time, but stop exposing at different times. Intended for use with a mechanical shutter or a strobe light to freeze motion. When used without a mechanical shutter and with "normal" lighting, the image will darker on one side (typically the top), and brighter on the opposite side (typically the bottom).

Global Shutter
: A mechanism within some CCD or CMOS sensors in which all photosites are exposed at the same time. Use of the term "Global Shutter" with an "Interlaced" camera is ambiguous; all photosites of both fields may be exposed at the same time, or only the photosites of each field may be exposed at the same time.

  Different camera manufacturers use various synonyms, such as "Free-Run Shutter" (but is not to be confused with "Free-Run (Video) Mode").

Gray
: Alternate spelling for "Grey".

Grey
: Alternate spelling for "Gray".

Grey Level Image
: An image in which each pixel has component value, interpreted as luminance and rendered as black, white, and, optionally, shades of grey. See also "Monochrome".

Halftoning
: Conversion of a grey level image so as to be representable by (typically) a printer that only prints black (over white), or white (over black). Conversion of a multi-toned color image so as to be representable by (typically) a printer that only prints three, four, or perhaps eight colors (over white).

Horizontal Blanking
: The portion of the analog video signal when brightness is suppressed at the end of a scan line during which the electron beam retraces from right to left on a CRT-based video monitor.

  By analogy, the term may be used with digital video signals as a synonym for the complement of "Line Valid".

Horizontal Sync
: A pulse contained within horizontal blanking of an analog video signal which synchronizes hardware with the start/end of each line of each frame.

  By analogy, the term may be used with digital video signals as a synonym for the complement of "Line Valid".

HSB Color
: Color space composed of Hue (e.g. red, yellow, orangish-red, etc.), Saturation (degree of dilution with white), and Brightness (level of intensity). The HSB color space is modeled upon human perception of color; in contrast to, for example, "RGB Color", which is derived from technical methods used to encode and reproduce color.

Image
: A rectangular grid of pixels.

Image Buffer
: RAM or other memory used to hold an image or images.

Image Frame Buffer
: See "Frame Buffer".

Image Sequence
: A linear group of images, usually time indexed.

Interlace
: Use of (typically) two fields, one termed "odd" and the other "even", to scan a video frame, each field representing alternate scan lines from the imaging sensor. An interlaced system decreases perceived flicker of live video by increasing the field update rate and originated with the earliest broadcast television systems. But captured and thus static images may show horizontal banding or show the subject material as a "ghost" due to each field being exposed at different times and the subject having moved between exposures. Contrast to "Progressive Scan".

  Some cameras are designed to expose all scan lines of the sensor at the same time, eliminating temporal shifts between fields, but output the scan lines in interlace format so as to maintain compatibility with display and capture devices, these are sometimes called "Progressive Exposure and interlaced Output".

Interrupt
: Technique used to determine when a device requires attention, by having the device alter the processor's execution in a controlled manner. Contrast to "Polling".

IR-Cut Filter
: An optical filter which blocks light of infrared (IR) wavelengths, passing other wavelengths. Most CCD and CMOS sensors are inherently sensitive to near-infrared, as well as visible, wavelengths. Lack of an IR-cut filter with a monochrome camera shifts the tonal balance of the image but increases sensitivity, and has (roughly) equal arguments for and against its use. Lack of an IR-cut filter with a single chip color camera using a Bayer pattern sensor will cause, unless the illumination contains little or no infrared, "washed out" color, as the typical Bayer pattern color filters all pass infrared wavelengths.

  Some cameras contain a built-in (perhaps removable) IR-cut filter between the sensor and the lens. Other cameras do not contain an IR-cut filter, allowing a filter, if desired, to be attached to the end of the lens farthest from the sensor.

  Most SILICON VIDEO® color cameras contain an optional IR-cut filter between the sensor and the lens - within the back focus adjustment ring. The filter can be removed by replacing one back focus adjustment ring with another.

IR Filter
: An optical filter which passes light of infrared (IR) wavelengths, blocking other, including visible, wavelengths. Not to be confused with an "IR-Cut Filter".

ISA Bus
: Industry Standard Architecture Bus. The original 8 or 16 bit peripheral bus of the IBM PC.

JPEG (.JPG)
: The Joint Photographic Experts Group file format. An industry standard file format used to save digital images. A widely used file format as it is not company or product specific. Most often uses - and to many people, it implies - lossy compression, although optional features also support lossless compression.

Line Valid
: A Camera Link signal indicating which pixel clocks correspond to a valid pixel value, and which is the first and last pixel of each scan line. Other cameras with digital output may also have a "Line Valid" signal, or have a "Horizontal Blanking", "Horizontal Sync", "H-Sync", or similar signal for the same (possibly logically inverted) purpose.

Line Scan
: A method of video acquisition which uses a one-dimensional array or line of photo sensitive elements. Color line scan cameras may have three, closely spaced, parallel one-dimensional arrays or lines of photo sensitive elements, one for each RGB color; or may have two, closely spaced, parallel one-dimensional arrays or lines of photo sensitive elements, the two lines covered by a "Bayer" mosaic of color filters; or may have a single array or line of photo sensitive elements, with every third pixel covered by a red, green, or blue filter. A two-dimensional image is "built up" by moving the sensor relative to the object being imaged.

Lossless Compression
: Any image compression method in which the decompressed image is an exact copy of the original image, bit for bit.

Lossy Compression
: Any image compression method in which the decompressed image is not an exact copy of the original image, bit for bit. The quality of lossy (de)compression varies from images which, to most observers, appear identical to the

original image, to images that are almost identical except for a few artifacts, to images which are obviously and grossly distorted.

LVDS
: Low Voltage Differential Signalling. Also known as RS-644, an EIA standard for differential signalling format for binary data. Capable of higher speeds over greater distance as compared to RS-422.

LVTTL
: Specifically: Low Voltage TTL. Generally: Single-ended signalling format for binary data using levels of 0.0 and +3.3 volts (nominal). TTL is intended for high speed signalling between integrated circuits on the same or adjacent boards, although may be used at slower speeds over several feet. Also referred to as "3.3V TTL".

Mapping
: A correspondence between one set of objects to another; often one set of numbers to another. Often used to describe a rule to convert measured units to real world units. For example, fractional inches on a map to miles, or a number of pixels to inches.

Monochrome
: In general: An image or other visual representation using a single color, or shades of a single color. Typically, in the context of digital imaging: An image using only black, white, and, optionally, shades of grey.

  A "grey level image" is monochrome.

  An image composed of RGB pixels, each pixel having identical red, green, and blue values, can be referred to as a monochrome image or a "colorless color" image. As can an image using any other color space (such as "HSB Color" or "YCrCb Color") in which each pixel value resolves to black, white, or a shade of grey.

Monochrome Video
: A video mode which has one component, usually luminance, producing a monochrome image.

Multiplexor
: A device or component which steers one of several input signals to its output as directed by a control input. Also spelled Multiplexer.

M.2
: The Next Generation Form Factor (NGFF) is a specification for expansion cards and connectors. The A-Key, B-Key, and E-Key variations support the PCIe x2 interface (along with other interfaces). The M-Key variation supports the PCIe x4 interface (along with other interfaces).

NTSC
: National Television Standards Committee. Color analog video standard composed of a luminance signal and two color difference signals. 30 frames per second, 525 lines per frame, where 483 of these lines are visible on the display, the remainder used for blanking. For interlaced video, the 525 lines are split into 262.5 lines per field. Also see "Interlace".

NUC
: Non-Uniformity (Pixel) Correction. See "PRNU".

Odd Field
: See "Interlace".

Offset (Control)
: Same as "Brightness (Control)".

PAL
: Phase Alternation Line. Color analog video standard used in Europe and other countries. 625 lines per frame, 25 frames per second.

Palette
: See Color Lookup Table.

Pan
: To move the viewed area of text or image left and right through the horizontally larger text or image. See also "Scroll".

PC/AT Bus

The ISA Bus, 16 bit version. Capable of transferring two to four megabytes per second.

PCI Bus

The Peripheral Component Interconnect Bus. A 32 or 64 bit wide bus operating at 33 or 66 MHz capable of transferring 132, 264, or 528 million bytes per second (or approximately 125.88, 251.77, or 503.54 megabytes per second). Actual throughput on most computers is approximately 100 to 110 MByte/sec. for 32 bit 33 MHz PCI, and approximately 480 MByte/sec. for 64 bit 66 MHz PCI.

The PIXCI® A, CL1, CL3SD, D, D24, D32, D2X, D3X, SI, SV2, SV3, SV4, SV5, SV5A, SV5B, and SV5L are 32 bit PCI cards. The PIXCI® CL2 is a 64 bit PCI card.

PCI-X Bus

A 64 bit wide bus operating at 133 MHz. The "PCI-X Bus" is not the same as "PCI-Express Interfaces".

PCI-Express 1.1 Interface

A four wire serial interface capable of a raw bidirectional data rate of 2.5 GBits per second (x1 link), 10 GBits per second (x4 link), 20 GBits per second (x8 link), or 40 GBits per second (x16 link). Actual throughput varies, depending in part on the Packet Payload size implemented by the motherboard.

Approximate Throughput (Gbits per Second)			
Lane Width	Payload size (bytes)		
	16	128	256
x1	1.7	1.7	2.0
x4	6.8	7.0	7.8
x8	13.7	14.0	15.7
x16	27.4	28.0	31.4

Also referred to as "PCI-Express Gen 1" or "PCIe Gen 1".

Actual throughput on most computers is approximately 190 MByte/sec. for PCI-Express 1.1 x1 cards, approximately 777 MByte/sec. for PCI-Express 1.1 x4 cards, and approximately 1600 MByte/sec. for PCI-Express 1.1 x8 cards.

The PCI-Express Interface specification allows operating a card using a lower lane width in a slot supporting a higher lane width, such as using a x1 card in a x4 slot, resulting in x1 bandwidth. However, the higher lane width slot need not support all lower lane bandwidths; for example, typical computers (circa 2008) with x16 slots might operate a x4 card but only provide x1 bandwidth, not the desired x4 bandwidth.

The PIXCI® A110, D3XE, E1, E1DB, EB1, EB1-PoCL, EL1 (Rev. 6 and earlier), EL1DB (Rev. 6 and earlier), ELS2, SI1, SI2, SV7, and SV8 are PCI-Express 1.1 x1 cards. The PIXCI® A310, E4, E4DB, and SI4 are PCI-Express 1.1 x4 cards. The PIXCI® E8, E8CAM, and E8DB are PCI-Express 1.1 x8 cards.

PCI-Express 2.0 Interface

A four wire serial interface capable of a raw bidirectional data rate of 5.0 GBits per second (x1 link), 20 GBits per second (x4 link), 40 GBits per second (x8 link), or 80 GBits per second (x16 link). Actual throughput varies, depending in part on the Packet Payload size implemented by the motherboard.

Also referred to as "PCI-Express Gen 2" or "PCIe Gen 2".

Actual throughput on most computers is approximately 448 MByte/sec. for PCI-Express 2.0 x1 cards, and approximately 1011 MByte/sec. for PCI-Express 2.0 x4 cards.

The PCI-Express Interface specification allows operating a card using a lower lane width in a slot supporting a higher lane width, such as using a x1 card in a x4 slot, resulting in x1 bandwidth. The specification also allows operating a card designed for PCI-Express 1.x in a slot supporting PCI-Express 2.0, and vice versa, resulting in the lower of the two bandwidths.

The PIXCI® E4G2-2F, E4G2-4B, E4G2-F2B, e104x4-2f, e104x4-4b, e104x4-f2b, EL1 (Rev. 7 and later), and EL1DB (Rev. 7 and later) are PCI-Express 2.0 x4 cards. The PIXCI® EB1G2 and EB1G2-PoCL PCI-Express 2.0 x1 cards. The PIXCI® E4TX2-2F, E4TX2-4B, E4TX2-F2B, and miniH2x4F are PCI-Express 2.0 x4 devices. The PIXCI® miniH2B and miniH2F are PCI-Express 2.0 x1 cards or M.2 E-Key/M-Key PCIe x1 gen2 cards. The PIXCI® miniH2x4F is a M.2 M-Key PCIe x4 gen2 card.

PCI Express mini Interface

The PIXCI® EB1mini is a PCI Express mini card, using the PCIExpress x1 interface. The PIXCI® miniH2B and miniH2F are PCI Express mini cards, using the PCIExpress x1 Gen 2 interface.

PCX (.PCX)

An image file format specified by Zsoft for saving S/VGA graphics.

Photosite

The light sensitive cells that compose a solid state imaging sensor.

Pixel

Short for picture element. The fundamental unit of digital imaging. The smallest unit of an image with homogeneous intensity and color. The numeric representation of an intensity and color. Sometimes used interchangeably with "photosite" to refer to the light sensitive cells that compose a solid state imaging sensor.

Pixel Binning

To combine pixel values, typically by summation, creating a smaller image. Binning by a factor of ×2 horizontally and vertically yields an image with ¼ the number of pixels, with pixel at coordinates (x,y) in the binned image corresponding to the sum of pixels at (x×2+0,y×2+0), (x×2+0,y×2+1), (x×2+1,y×2+0), and (x×2+1,y×2+1) in the original or potential image. Contrast to "Pixel"Subsampling""."

Pixel Clock

An oscillator, timing circuit, or externally provided signal which is used to sample (i.e. partition) a video signal scan line into pixels. For analog signals, the scan line can be sampled more or less often, with a larger or smaller pixel clock frequency, to provide higher or lower resolution; cameras outputting analog video typically do not provide a pixel clock signal along with the analog scan line. For digital signals, the scan line must be sampled at a precise frequency and phase; cameras outputting digital signals typically provide a pixel clock signal to control sampling of the digital scan line.

Separately, a pixel clock is used to control the timing and readout within cameras using digital sensors. For some cameras the pixel clock frequency is adjustable; a higher or lower pixel clock frequency provides faster or slower frame rates with corresponding side effects, such as shorter or longer exposure limits, greater or lesser levels of fixed pattern noise, photo response non-uniformity, and random noise. For cameras with an adjustable pixel clock outputting digital signals, a higher or lower pixel clock frequency also affects the maximum length of the electrical cable connecting the camera and frame grabber.

Pixel Subsampling (Decimation)

To retrieve or utilize fewer pixels than are otherwise available, creating a smaller image. Subsampling by a factor of ×2 horizontally and vertically yields an image with ¼ the number of pixels, with pixel at coordinates (x,y) in the subsampled image corresponding to pixel (x×2,y×2) in the original or potential image. Contrast to "Pixel Binning".

Pixie

One component value of a pixel. A monochrome pixel contains one pixie, a color pixel typically contains three or four pixies. For example, an RGB pixel is composed of green, red, and blue pixies.

PoCL (POCL)

Power over Camera Link. An enhancement to the Camera Link specification that allows providing power to the camera (12V 4W maximum in Base mode, 12V 8W maximum in other modes) over the Camera Link cable. A PoCL compliant Camera Link cable is required. The PIXCI® EB1-PoCL, E4 (Rev. 4 & later), E4DB (Rev. 4 & later), E8, and E8DB are PoCL compliant cards. The PIXCI® E4TX2-2F, E4TX2-4B, and E4TX2-F2B are PoCL compliant devices.

PNG (.PNG)

The Portable Network Graphics file format. A file format for the lossless, portable, storage of images.

Polling

Technique used to determine when a device requires attention, by having the processor continuously test the device's status. Contrast to "Interrupt".

Portable Map (.PBM/.PGM/.PPM)

The Portable Bit Map (.PBM), Portable Gray Map (.PGM), and Portable Pixel Map (.PPM) file formats for saving black&white, grey level, or RGB color images, respectively. A common, uncompressed, file format as it is not company or product specific. Does not have any limitation as to image size, number of images in one file, or maximum file size.

PRNU

Photo Response Non Uniformity. A camera or sensor's variation in gain from pixel to pixel. The pattern of variation is typically unique to each camera or sensor. Some cameras correct PRNU within the camera, other cameras expect PRNU to be corrected outside of the camera. See also "FPN".

Progressive Scan
A camera in which all scan lines of the imaging sensor are exposed at the same time and output in order. Contrast to "Interlace".

Pseudo-color
A technique that assigns a color to each grey level of a monochrome image, helping visualize patterns of intensities.

Raster
A sequence of scan lines which constitute a field or frame of video.

Rec. 709
The CIE Rec. 709 is a video standard intended for use with HDTV.

Region of Interest
See "ROI".

Resolution - Depth
Measure of the number of bits, grey levels and colors, which compose each pixel.

Resolution - Spatial
Measure of the number of pixels, horizontally and vertically, that compose an image.

Resolution - Temporal
Measure of the number of images that compose an image sequence. Implies a period of time, at a fixed time interval per image, or implies a time interval per image, for a fixed period of time.

RGB Color
Color space composed of three components: red, green, and blue. The "natural" color space for video hardware, as most video monitors use red, green, and blue phosphors or filters, and most video cameras use red, green, and blue filters. RGB color, by itself, is not colorimetric calibrated; the perceived intensity of a given RGB value varies on different hardware. Often abbreviated to "RGB".

ROI
Region of Interest. An area of an image subject to modification or analysis. See "AOI".

Rolling Shutter
A mechanism within some CCD or CMOS sensors in which each line or column of photosites are exposed at different, or overlapping times. Has the same effect as a mechanical slit shutter; an opaque material containing a transparent slit which is moved across the sensor in a direction orthogonal to the length of the slit. A rolling shutter is best used to image stationary, or slowly moving objects; an image of a rapidly moving object - particularly an object moving parallel to the movement of the slit - will be distorted.

Contrast to

Global Shutter

RS-170
EIA standard for broadcast, monochrome, analog video which defines voltage levels, blanking times and sync pulses. 525 lines, 30 frames per second.

RS-232
(1) EIA standard for single-ended signalling of binary data, (2) EIA standard for interpreting a binary data stream as bytes, (3) EIA standard for communication of data and status between two devices using a group of RS-232 signals, and (4) EIA standard for the physical connectors used for RS-232 communication cables. The RS-232 connection between a computer and modem, or between a computer and an RS-232 controlled camera, involves all of the above specifications.

RS-330
EIA standard for non-broadcast, monochrome, analog video which defines voltage levels, blanking times, and sync pulses. 525 lines, 30 frames per second. Compared to RS-170, has optional formats for sync pulses.

RS-343

An EIA standard for high-resolution, non-broadcast, analog, monochrome video which defines voltage levels, blanking times and width of sync pulses. The RS-343 standard covers a range of different resolutions and frame rates.

RS-422
: EIA standard for differential signalling format for binary data. Capable of higher speeds over greater distance as compared to RS-232.

RS-644
: EIA standard for differential signalling format for binary data, also known as LVDS. Capable of higher speeds over greater distance as compared to RS-422.

Saturated
: The combination of lighting, aperture, and camera sensitivity is such that the pixel value is at its maximum and remains at the maximum value after the light intensity is reduced by an amount which would normally cause a drop in pixel value.

Saturation
: The degree of vividness, strength, or purity of a color. The degree to which a color has not been weakened by mixture with white.

Scan Line
: The (almost) horizontal line scanned by the electron beam in a CRT-based video monitor, and the corresponding line scanned by a vidicon-based (or similar) video camera. For cameras with digital sensors that serialize pixel data, a scan line is a sequence of pixel values, typically from a horizontal row, of sensor's photosites.

  However, many digital cameras may serialize the light sensor's photosites in other than left-to-right and top-to-bottom order. For example, a camera might output the left-most pixel of a row followed by the middle pixel of a row, continue with each pair of neighboring pixels within the row, and continue in the same fashion with each row. Or a camera might output a pixel of the top row, a pixel of the bottom row, continue with each pair of neighboring pixels within those rows, and continue with each pair of rows inward toward the middle. The number of possible serialization order permutations is quite large. With such cameras, the term "Scan Line" may either refer to pixel values from one line of the sensor, or to a "line" of values output by the camera during one "Line Valid".

Scroll
: To move the viewed area of text or image up and down through the vertically larger text or image. See also Pan.

Serration Pulses
: Synchronization pulses used in some analog video signals which occur within vertical sync at twice the normal horizontal scan rate to ensure correct 2:1 interlacing.

Shutter (Period)
: The duration of time that a sensor's photosites are sensitive to, and integrating the intensity of, light so as to affect the image intensity.

  Some cameras may have a mechanical shutter or electronic shutter (e.g. LCD) mechanism passing light for a "Shutter (Period)", separate from the sensor's integration control. The sensor's integration control (if any) may then be distinguished as "Exposure (Period)".

Snap
: To capture a single video field or frame and store it in a frame buffer.

sRGB Color
: A calibrated colorimetric RGB color space intended for use on the Internet.

SOG
: Sync on Green. For component analog video using one analog video signal, such as RS-170 or RS-343, for each of the red, green, and blue intensities; "Sync on Green" specifies that composite sync is present (from the signal source's point of view), or expected (from the monitor's, recorder's, or frame grabber's point of view), on the green signal.

SVGA
: A type of graphics display for IBM compatible computers, providing 800×600 resolution. Often used in the generic sense to describe any SVGA or better graphic display system for IBM compatible computers. Also spelled as "S/VGA".

S-Video
: A variation of the NTSC or PAL video format, in which the luminance and chrominance are separate analog signals, providing higher quality images.

SWIR
: Short-wavelength infrared.

SXGA
: A type of graphics display for IBM compatible computers, providing 1280×1024 resolution. Often SVGA or S/VGA is used in a generic sense to include SXGA.

TARGA (.TGA)
: A file format specified by TrueVision for saving digital images.

TDI
: Time Delay Integration. A variant of Line Scan, whereby a stack of one-dimensional sensing arrays are aligned with and synchronized to the object being imaged such that the stored charge in the stack of arrays moves in synchronization to the object.

Threshold
: Image processing operation which transforms a grey level or color image into a two-toned, or binary image, by comparing each pixel against a threshold value.

TIFF (.TIF)
: The Tagged Image File Format. An industry standard file format used to save digital images. A widely used file format as it is not company or product specific.

TTL
: Specifically: Transistor-Transistor-Logic. Generally: Single-ended signalling format for binary data using levels of 0.0 and +5.0 volts (nominal). TTL is intended for high speed signalling between integrated circuits on the same or adjacent boards, although may be used at slower speeds over several feet.

Triggered (Video) Mode
: See "Controlled (Video) Mode".

White Balance
: Corrections to a color image, or color video, so that a whitish object appears white. The color balance is affected by the color temperature of the illumination (e.g. sunlight versus fluorescent versus incandescent), and also affected by the display monitor.

USB
: Universal Serial Bus. A standard for a relatively low performance serial data bus, operating at speeds of 12 megabits per second, with a maximum cable length of 5 meters (although several devices may be daisy-chained with several 5 meter cables).

UXGA
: A type of graphics display for IBM compatible computers, providing 1600×1200 resolution. Often SVGA or S/VGA is used in a generic sense to include UXGA.

VGA
: A type of graphics display for IBM compatible computers, providing 640×480 resolution.

Vertical Blanking
: The portion of the analog video signal when brightness is suppressed at the end of a field, during which the electron beam retraces from the bottom to the top of the CRT-based video monitor.

  By analogy, the term may be used with digital video signals as a synonym for the complement of "Frame Valid".

Vertical Sync
: The portion of the analog video signal, within vertical blanking, which synchronizes hardware with the top/bottom of each frame.

  By analogy, the term may be used with digital video signals as a synonym for the complement of "Frame Valid".

Video
: A representation of a visual scene, or a sequence of visual scenes, in an electrical or other format suitable for transmission, storage, retrieval, modification or display.

Video Camera
: An instrument in which light is admitted through a lens, forming an image of external objects on a surface placed at the focus of the lens, and producing an electrical or other signal corresponding to the image formed.

Video Format
: Specifications which define the characteristics of video signals.

  For analog video, the specifications include voltage levels, blanking times, width of sync pulses, lines per frame, and frames per second. Examples of common standard analog video formats are: NTSC, CCIR, PAL, RS-170, RS-330, and RS-343.

  For digital video, the Camera Link specification provides part of the video format, such as the signals used and their relationship; additional specifications are provided by individual cameras using the Camera Link standard, such as resolution, bit depth, pixel clock frequency, and frame rate.

  A "Video Format (File)" is also used as a synonym for "Video Setup (File)".

Video Sampling
: The process of obtaining digital data from an analog video signal.

Video Setup (File)
: A collection of parameters used to configure specific capture hardware and software for a desired "Video Format" and camera.

VIF (.VIF)
: The Video Frame File format used by EPIX® imaging software for raw video to disk files. The internal format is dependent on the characteristics of the specific PIXCI® frame grabber and camera used to capture the video. The VIF format is not intended for exporting of images or video to other applications; after recording a video to disk sequence the VIF file is typically resaved in TIFF, AVI, or other industry standard format.

YCrCb Color
: Color space where the Y component represents the brightness signal and the Cr and Cb components represent color difference signals. "4:2:2 YCrCb" indicates that Y is sampled at twice the rate of Cr and Cb.

YUYV, YVYU, UYVY, VYUY Color
: Color space where the Y component represents the brightness signal and the V and U components represent red and blue color difference signals, respectively. The four variations differ only in the order of the components. Similar to "4:2:2 YCrCb"; Y is sampled at twice the rate of U and V.

YUY2 Color
: Same as "YUYV Color".

Zoom
: To magnify an image in order to observe more detail.

12. Certification and Warranty

12.1. Certification and Testing

The PIXCI® E1, E1DB, E4, E4DB, E8, E8DB, EL1, and EL1DB frame grabbers have been tested per EMC directive 89/336/EEC and have met the following test requirements:

- EN 50081-1/01.92,
- EN 55022/08.94 class B
- EN 61000-4-2/03.95
- ENV 50204/03.95

These tests are more commonly known as the "CE" test. The testing was performed to class B which has a more restrictive emission limit than the FCC class B limit.

If you find that the computer system in which the PIXCI® frame grabber is installed is causing interference with other devices, try increasing the distance between the devices, reorienting (turning) the devices, or using additional shielding on the computer system (such as placing covers on the computer and installing metal shields in unused slots or over unused drive slots).

It may be that the camera connected to the PIXCI® frame grabber is the source of radiation. To determine if the camera is the source of interference, remove power to the camera or reorient the camera. If a shielded camera cable is not being used, use a shielded cable. If the camera is the source of interference, contact the camera manufacturer.

12.2. Limited Warranty

EPIX, Inc. warrants to the original purchaser of the PIXCI® frame grabber that the PIXCI® frame grabber shall be in good working order for a period of one year from the date of shipment from EPIX, Inc. Should this product fail to be in good working order at any time during this one year warranty period, EPIX, Inc. will, at its option, repair or replace this product at no additional charge except as set forth below. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. All replaced parts and products become the property of EPIX, Inc. This limited warranty does not cover damage to the product resulting from accident, disaster, lightning, misuse, abuse, improper packaging, shipping damage, hot plugging, hot removal, installation of the frame grabber into a powered PCI Express slot, removal of the frame grabber from a powered PCI Express slot, installation into any slot other than an x1, x4, x8, or x16 PCI Express slot, connection to external equipment, such as a camera, that is operational while being connected to the frame grabber, or unauthorized modification of the frame grabber.
Limited warranty service may be obtained by delivering the product during the one year warranty period to an EPIX, Inc. distributor or to EPIX, Inc. and providing proof of the purchase date. Insure the product or assume the risk of loss or damage in transit. Prepay shipping charges to EPIX, Inc. or to the distributor. Use the original shipping container, or the equivalent, and static dissipative packaging material.
EPIX, Inc. hereby disclaims all other express and implied warranties for this product, including the warranties of merchantability and fitness for a particular purpose. Some states do not allow the exclusion of implied warranties, so the above limitations may not apply to you.
If this product is not in good working order as warranted above, your sole remedy shall be repair or replacement as provided above. In no event will EPIX, Inc. be liable to you for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use of or inability to use such product, even if EPIX, Inc. or an authorized EPIX, Inc. distributor has been advised of the possibility of such damages, or for any claim by any other party.

12.3. Life Support

EPIX® imaging products are not authorized for use as critical components in life support devices or systems without the express written approval of the president of EPIX, Inc.

13. Footnotes

[1]
See the "Intel Chipset 4 GB System Memory Support" white paper by Intel Corp.

[2]
See the "Intel Chipset 4 GB System Memory Support" white paper by Intel Corp.

[3]
Depending upon the user's environment setup, you may have to enter "./anypgm.bin" instead of "anypgm.bin" to execute a program from the current directory.

[4]
Assuming use of the installation procedure's default options.

[5]
See the "Intel Chipset 4 GB System Memory Support" white paper by Intel Corp.

[6]
See the "Intel Chipset 4 GB System Memory Support" white paper by Intel Corp.

[7]
The identification code is provided on a card enclosed with the CD and is also shown on the packing list. The card and the identification code may be required as proof of purchase for future software upgrades. Keep the card in a safe place!!

[8]
XCAP-Plus, XCAP-Std, and XCAP-Ltd also require an authorization key to activate all features.

[9]
The required "XCAP Sourcery" TWAIN driver is a separate software product and is not included with XCAP.

[10]
The required "XCAP Sourcery" Image-Pro driver is a separate software product and is not included with XCAP.

[11]
The Linux' "lspci" command lists PCI/PCIe cards regardless of whether a suitable driver was installed.

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