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USER'S MANUAL

PIXCI® SV4
Revision 5.0

7 March 2000

For use with:
PIXCI® SV4 Rev. 0.0 thru 1.0

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1. Installation

Installation of the XCAP software should be performed prior to installation of the PIXCI® SV4 imaging board. Install XCAP software by following the instructions in the XCAP Software Installation chapter in this manual. After installation of the software, follow the instructions below to install the PIXCISV4 imaging board.

The PIXCI® SV4 imaging board, for the PCI bus, is packed in a static dissipative bag. Please keep the bag and box in which the board was shipped should the need arise to return the board. Prior to opening the bag, place the bag near the PC into which the board will be installed.

1. Remove power or turn off the PC power switch.
2. Remove the cover from the PC (if one is used with the PC) into which the PIXCI® SV4 imaging board is to be installed.
3. Select a vacant PCI bus slot and remove the metal bracket and screw covering the back panel slot with which it is aligned. Consult the reference manual for the PC if there is any doubt about which slot is a PCI bus slot.
4. A static free area for installation is adviseable. Use of a wrist strap that is connected to the PC or to the static free area is suggested. Since walking across carpet will generate static electricity, keep your feet stationary while removing the PIXCI® SV4 imaging board from the antistatic bag. Hold the bag and touch the PC at the same time, or place the bag on the PC chassis and touch the chassis to dissipate the static charge that may have been created while transporting the board to the PC.
5. Remove the PIXCI® SV4 imaging board from the antistatic bag and push it into the PCI bus connector. This can require up to 15 pounds of force. Do not use too much force as the board may not be inserted into the connector correctly, and the result can be damage to the connector or the board.
6. Replace the screw to secure the PIXCI® SV4 imaging board in the slot.
7. Remove power from the video source to be connected to the PIXCI® SV4.
8. Connect the video source to either the S-Video input connector (for S-Video sources) or to one of the two BNC connectors (for NTSC or PAL sources).
9. Apply power to the PC and to the video source.
10. Power up the camera, PC, and monitor(s).
11. Operate XCAP by following the instructions in in the XCAP Software Guide chapter in this manual.
12. Check for display of the video source on the VGA monitor by clicking on the Capture and then the Snap menu in the View window or by using the shortcut menu.
13. The XCAP software defaults to the S-Video input connector for the video source. The video input source can be selected by clicking on the desired connector of the bracket view of the board in the *Capture & Adjust*, window. The selected video input connector is highlighted in red. If a video input is selected that does not have a video timing source connected, a blue image will be displayed.
14. If it is not possible to display an image from the video source, consult the chapter "In Case of Trouble" in this manual.
15. Replace the PC's cover (if one is used).

Caution: Turn the power to the PC and the video source off prior to connecting video sources to the PIXCI® SV4.

1.1. Memory, Motherboard, and VGA

The size and the number of images that can be stored in DRAM on the motherboard is a function of the amount of DRAM that is not used by software. EPIX' XCAP requires at least one megabyte of free DRAM for image storage. If more free DRAM is available, it can be used for image sequence storage.

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The PIXCI® SV4 imaging board can capture and store full resolution color images to DRAM on a burst mode PCI motherboard provided that other devices do not compete for PCI bus bandwidth. The data transfer capabilities of the motherboard may limit the size of the image that the PIXCI® SV4 imaging board can transfer to memory on the motherboard. Some PCI motherboards do not support burst mode on the PCI bus. Some PCI motherboards must have their configuration ROM set to enable PCI bus burst mode. PCI bus transfers from other devices will compete for data transfer time with images to be transferred from the PIXCI® SV4 imaging board to memory on the motherboard. ISA bus transfers will also compete for data transfer time with images to be transferred from the PIXCI® SV4 imaging board to memory on the motherboard. If a PC or motherboard has not yet been selected, contact EPIX for suggested motherboards.

The capabilities of the S/VGA board may limit the number of images that can be displayed per second, the number of colors that can be displayed, or the size of the image that can be displayed. An AGP bus VGA board is preferred and at least a PCI bus S/VGA board is recommended to display images from the PIXCI® SV4 imaging board. If an S/VGA board has not yet been selected, contact EPIX for suggested S/VGA boards.

EPIX can provide a complete imaging system including camera, cables, power supply, and computer with the PIXCI imaging board and XCAP software installed.

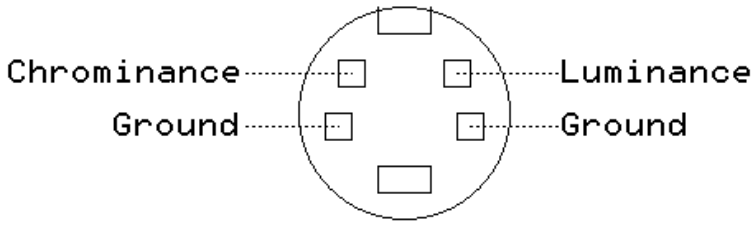
---

2. Connectors

The PIXCI® SV4 imaging board has four connectors which are accessible thru the bracket that mounts the board to the computer chassis. From the top of the bracket to the bottom, the connectors are: Y/C, BNC1, BNC2, and DSUB. Silkscreen labels identify each connector on the PIXCI® SV4 imaging board.

2.1. The PIXCI® SV4 Imaging Board Video Signal Descriptions

YC, is the S-Video signal input connector. The "Y" signal level is 0 to 1V terminated with 75Ohm to ground. The "C" signal level is 0 to 0.714V terminated with 75Ohm to ground. The Y and C inputs have low pass filters in the video path.



S-Video Connector

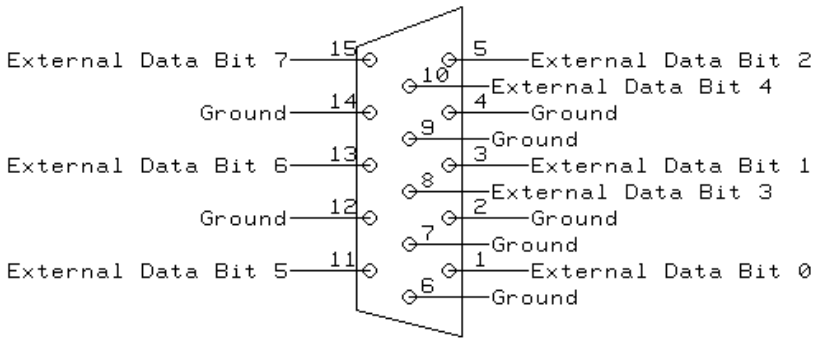
BNC1 is an analog video input connector. The analog video input signal level should be 1 volt peak to peak with the video portion positive and the sync tips negative. The minimum composite video input signal that can be amplified to provide 0 thru 255 grey levels is 0.4 volts peak to peak. The maximum composite video input signal that can be amplified to provide 0 thru 255 grey levels is 2.5 volts peak to peak. The input is terminated in 75Ohm to ground. The BNC1 video input has a low pass filter in the video path.

BNC2, is identical to BNC1.

2.2. DB15 Connector

The connector is a female 15 pin D-Subminiature connector (AMP PN 748390-5). Eight pins are used for external inputs and outputs. Seven pins are connected to ground. The signal levels are TTL. Each signal has a 1K ohm pull-up resistor to +5 volts. EPIX' XCAP software treats bits 0 thru 3 as inputs and bits 4 thru 7 as outputs.

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DB15 Connector

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3. Software Installation

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

While XCAP is easy to install, like most manufacturers of PC software, we recommend as a precaution that a hard disk backup be performed before installing XCAP.

3.1. For Windows 95 - Windows 98 - Windows ME

1. Install Files:
   a. If XCAP is provided on diskette(s):
      i. Insert XCAP diskette #1 into the A: or B: drive.
      ii. Execute the SETUP program, from a command prompt, or via the Windows "Start", "Run":

```
    > A:SETUP
or
    > B:SETUP
```

      iii. Follow the installation program's directions, such as to select an installation directory, and insert additional diskettes (depending upon version) as instructed.
   b. If XCAP is provided on a compact disk (CD):
      i. If your PC 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". Click "OK".
      iii. Follow the installation program's directions, such as to select an installation directory.
   c. If XCAP is provided via the internet:
      i. Download:

```
ftp.epixinc.com/software/xcap_v21/XCAPWI.EXE
```

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

```
    > XCAPWI.EXE
```

      iii. Follow the installation program's directions, such as to select an installation directory.
      iv. Delete the downloaded .EXE file from your PC's hard drive.
   d. 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. One file, PCITIPS.TXT, contains the *PC Configuration Tips*, which provides tips for resolving hardware and software conflicts.
2. Create Shortcut - Drag & Drop (optional):
   a. From the program group created by the installation program, click and drag the icon for XCAP over to the desktop and drop.

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3. Create Shortcut - Manual (optional):
   a. Right click on the Desktop.[1]
   b. Select "New".
   c. Select "Shortcut".
   d. Set:

```
Command Line:   InstallDir \ XCAPWXX
Name:           XCAP
```

   replacing "InstallDir" with the name of the installation directory chosen above. Select "OK".
4. Install Authorization Key (for XCAP-Plus and XCAP-Std):
   a. XCAP-Plus and XCAP-Std, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

      The printer port authorization key is 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 printer port 1, 2, or 3. 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 which 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 approximately the size of a small finger (6.0×1.6×0.8 cm), having a USB standard 4 pin connector at one end. If provided, connect the authorization key to a USB port.

      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 or XCAP-Std will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

   b. Run the authorization key utility program provided with XCAP by "Start", "Run":

```
> C:\XCAP\HLDINST -install
```

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

```
> CHDIR C:\XCAP
```

      and execute:

```
 HLDINST  -install
```

      to run the authorization key utility program.
   d. For USB port authorization keys, in some versions of Windows 95 and 98, it is also necessary to:

```
Start
Settings
Control Panel
Add New Hardware
...
```

   e. Note that support for the USB port authorization key under Windows 95 requires OSR2 or later with the USB supplement.
5. Install PIXCI® Imaging Board Driver:
   a. Under Windows 95/98/ME, the Windows' Device Manager must be used for initial installation of the PIXCI® driver.

      If the PIXCI® imaging board was not yet installed, the first time Windows starts after installation Windows will notice the new device and inquire.

      The first time Windows 95 starts after installation of the PIXCI® imaging board, a pop-up window titled "New Hardware Found" with messages "PCI Multimedia Device" and "Select which driver you want to install for your new hardware" will appear. Select the "Driver from disk provided by hardware manufacturer" option and click "OK". A pop-up window with the message "Insert the manufacturer's installation disk ..." and "Copy manufacturer's files from ..." will appear. Click "Browse", select path and file DRIVERS\WIN95\EPIXXCW5.INF (EPIXXC32.INF for version 2.0 and earlier) within the chosen installation directory, such as C:\XCAP\DRIVERS\WIN95\EPIXXCW5.INF, and click "OK" and "OK". Do not accept the offer to "Reboot"; a full shutdown and reboot is required. Some later releases of Windows 95 behave similar to Windows 98; the inquiries and responses may instead follow the steps below.

      The first time Windows 98 starts after installation of the PIXCI® imaging board, a pop-up window with the message "New PCI Multimedia Device" will flash by. Next a pop-up window with the message "The wizard searches for new driver for PCI Multimedia Video Device" will appear. Click "Next". Select "Search for the best driver for your device". Click "Next". A pop-up window with the message "Windows will search for new driver ..." and "Specify

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Location" will appear. Enter path DRIVERS\WIN95 within the chosen installation directory, such as C:\XCAP \DRIVERS\WIN95, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP \DRIVERS\WIN95\EPIXXCW5.INF (EPIXXC32.INF for version 2.0 and earlier). Click "Next" and "Finish".

The first time Windows ME starts after installation of the PIXCI® imaging board, a pop-up window with the message "New PCI Multimedia Video Device" will flash by. Next a pop-up window with the message "Windows has found the following new hardware:" will appear. Select "Specify the location of the driver (Advanced)". Click "Next". Select "Search for the best driver for your device". Check the box for: "Specify a location". Enter path DRIVERS\WINME within the chosen installation directory, such as C:\XCAP\DRIVERS\WINME, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WINME\EPIXXCW5.INF (EPIXXC32.INF for version 2.0 and earlier). Click "Next" and "Finish".

If the PIXCI® imaging board was already installed under Windows 95 or 98, and "Cancel" was clicked when Windows started and announced the presence of new "PCI Multimedia Hardware", then instruct Windows to load the appropriate driver. Click "Start", "Control Panel", "System", "Device Manager", and "Other Devices". Select "PCI MultiMedia Video Device" (which appears if a PIXCI® imaging board driver was never installed), or "PIXCI(R) Video Capture Board" (which appears if a PIXCI® imaging board driver was previously installed). Click "Driver", "Change Driver", and "Other". Select "PCI MultiMedia Video Device" or "PIXCI(R) Video Capture Board". Click "Have Disk", select DRIVERS\WIN95 within the chosen installation directory, such as C:\XCAP\DRIVERS\WIN95, and click "OK".

If the PIXCI® imaging board was already installed under Windows ME, and "Cancel" was clicked when Windows started and announced the presence of new "PCI Multimedia Hardware", then instruct Windows to load the appropriate driver. Click "Start", "Settings", "Control Panel", "System", if System is not listed, click on "view all Control Panel options", "Device Manager", and "Other Devices". Select "PCI MultiMedia Video Device" (which appears if a PIXCI® imaging board driver was never installed), or "PIXCI(R) Video Capture Board" (which appears if a PIXCI® imaging board driver was previously installed). Click on the "Properties" button. Click on the "Driver" Tab, and the click on "Change Driver", or "Update Driver". Next a pop-up window with the message "This wizard searches for updated drivers for:" followed by "PCI MultiMedia Video Device" (which appears if a PIXCI® imaging board driver was never installed), or "PIXCI(R) Video Capture Board" (which appears if a PIXCI® imaging board driver was previously installed). Select "Specify the location of the driver (Advanced)". Click "Next". Select "Search for the best driver for your device". Check the box for: "Specify a location". Enter path DRIVERS\WINME within the chosen installation directory, such as C:\XCAP\DRIVERS\WINME, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WINME\EPIXXCW5.INF (EPIXXC32.INF for version 2.0 and earlier). Click "Next" and "Finish".

Note that the "quick reboot" offered by (some versions of the) Device Manager does not properly install the PIXCI® board's driver; a full shutdown and reboot is required. The shutdown and reboot can be delayed until after the installation is completed.

6. Set Frame Buffer Memory Size (optional):
   a. By default, 4 megabytes of frame buffer memory is allocated.
   b. Under Windows 95/98/ME, frame buffer memory must be allocated during Windows' initialization, as specified in the Windows' SYSTEM.INI file. If additional frame buffer memory is desired, then at the end of the Windows' SYSTEM.INI file, add a section:

```
[EPIX_XC]
PIXCI=-IM <memorysize>
```

   replacing the "<memorysize>" with the desired memory size in Kbytes. Windows must be rebooted for the new specification to take effect.

   Windows 95/98/ME limits the maximum amount of allocatable frame buffer memory, dependent upon what other devices are installed, the total PC memory size, and other factors.

   Less than the requested amount of frame buffer memory may be provided by Windows. If no memory could be allocated, the PIXCI® imaging board will not be usable; reporting "Can't allocate frame buffer memory". Otherwise, within XCAP, the amount of frame buffer memory can be checked under *PIXCI®*, *PIXCI® Open/Close*.

7. Configure S/VGA:
   a. A "High Color (16 bit or 65536 Color)", "True Color (24 bit or 16777216 Color)", or "True Color (32 bit)" setting for the display adapter (S/VGA) is required for proper display of images and overlay graphics. The "True Color (24 bit or 16777216 Color)" or "True Color (32 bit)" is suggested for higher quality, and quicker, display of images and overlay graphics. This may be checked and/or modified via Windows "Start", "Control Panel", "Display", "Settings".
   b. In Windows 95, under "Control Panel", "Display", "Plus!", the "Show window contents while dragging" must be disabled (this feature is not present in older versions of Windows 95). Or in Windows 98/ME, under "Control Panel", "Display", "Effects", the "Show window contents while dragging" must be disabled.
   c. After changing the settings a full shutdown and CTRL+ALT+DEL reboot should be used. The quick restart offered

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by older versions of Windows 95, and the dynamic VGA reconfiguration performed by newer versions of Windows 95, may not re-initialize all devices properly.

8. Reboot Windows.
9. XCAP is now ready to run, clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

3.2. Windows 95 - Windows 98 - Windows ME - Esoterica

3.2.1. Windows 95/98/ME - Manual Installation

Use of EPIXXCW5.INF (EPIXXC32.VXD for version 2.0 and earlier), above, provides automatic installation of EPIXXCW5.VXD (EPIXXC32.VXD for version 2.0 and earlier) in most circumstances. The following information allows manual installation, correcting problems, or integration with an OEM's procedures.

1. The EPIXXCW5.VXD (EPIXXC32.VXD for version 2.0 and earlier) must be copied to the Windows SYSTEM directory, typically:

```
C:\WINDOWS\SYSTEM
```

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

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Class\Unknown\0000
```

   replacing the \0000, if such an entry already exists, with the next available sequential number. This entry must contain:

```
DevLoader=      "epixxc32.vxd"                      (for version 2.0-)
DevLoader=      "epixxcw5.vxd"                      (for version 2.1+)
DriverDesc=     "PIXCI(R) PCI Video Capture Board"  (optional)
InfSection=     "Unknown"
StaticVxD=      "epixxc32.vxd"                      (for version 2.0-)
StaticVxD=      "epixxcw5.vxd"                      (for version 2.1+)
```


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3. Using the Registry Editor, edit the existing entry for PIXCI® SV2 or PIXCI® SV3:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_8086&DEV_1223\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_8086&DEV_1223&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® SV4:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_109E&DEV_0350\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_109E&DEV_0350&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entries for PIXCI® SV5:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_109E&DEV_036E\BUS_**&DEV_**&FUNC_**
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_109E&DEV_0878\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_109E&DEV_036E&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_109E&DEV_0878&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® D, PIXCI® D24, or PIXCI® D32:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_10E8&DEV_80D6\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_10E8&DEV_80D6&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® A:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_10E8&DEV_82B1\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_10E8&DEV_82B1&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® D2X:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D200\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D200&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® D2X:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D201\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D201&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® CL3SD:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D300\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D300&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® CL1:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D100\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D100&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

or the existing entry for PIXCI® D3X:

```
(Win 95)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D300\BUS_**&DEV_**&FUNC_**
(Win 98)    HKEY_LOCAL_MACHINE\Enum\PCI\VEN_165A&DEV_D300&SUBSYS_00000000&REV_**\BUS_**&DEV_**&FUNC_**
```

where the **'s may be any digits (assigned and created by Windows after detection of the PIXCI® imaging board). This entry must contain:

```
Class=          "Unknown"
ConfigFlags=    00 00 00 00
DeviceDesc=     "PIXCI(R) PCI Video Capture Board"    (optional)
Driver=         "Unknown\0000"                       (substitute 0000)
Mfg=            "EPIX, Inc."                         (optional)
```

where the "0000" is replaced by the sequential number used in the previous step.

4. Reboot Windows.

3.2.2. Windows 95/98 - Forcible Frame Buffer Memory Allocation

As described above, frame buffer memory allocated by EPIXXCW5.VXD (EPIXXC32.VXD for version 2.0 and earlier) during Windows startup is limited to a small percentage of total PC memory.

A larger frame buffer memory can often be obtained by reserving memory before Windows starts:

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1. In C:\CONFIG.SYS[2], add a line:

```
DEVICE=C:\XCAP\DRIVERS\WIN95\EPIXXC.SYS -IM <framebuffermemorysize>
```

   or

```
DEVICE=C:\XCAP\DRIVERS\WIN95\EPIXXC.SYS -OS <reservememorysize>
```

   after DEVICE=HIMEM.SYS, replacing "<framebuffermemorysize>" with the desired frame buffer memory size, in Kbytes. Alternately, the second form reserves "<reservememorysize>" Kbytes, for Windows and allocates (almost) all of the remaining memory for use as frame buffer memory.
2. Edit the Windows' SYSTEM.INI file, add a section:

```
[EPIX_XC]
PIXCI=-IM 0
```

   so that EPIXXCW5.VXD (EPIXXC32.VXD for version 2.0 and earlier) doesn't reserve and waste additional frame buffer memory.
3. Reboot Windows.

This technique allows most of the PC's memory to be reserved as frame buffer memory (e.g. typically all but 8 or 16 megabytes, as required by Windows). However, the memory is unavailable to Windows, even when the PIXCI® imaging board's driver is not open.

If the specified amount of frame buffer memory could not be allocated, EPIXXC.SYS will attempt to allocate smaller amounts. If no memory can be allocated EPIXXC.SYS, will display an error message during Windows startup, and XCAP will not run, stating "Can't allocate frame buffer memory".

This alternate frame buffer allocation method is not available under Windows ME.

3.2.3. Windows ME - Forcible Frame Buffer Memory Allocation

As described above, frame buffer memory allocated by EPIXXCW5.VXD during Windows startup is limited to a small percentage of total PC memory.

A larger frame buffer memory can be obtained by limiting the amount of memory recognized by Windows ME, and then instructing EPIXXCW5.VXD to explicitly use a section of memory without allocating it from Windows:

1. Restrict Windows to use no more than a set amount of memory: Edit the Windows' SYSTEM.INI file, add or modify the MaxPhysPage entry, specifying the maximum amount of memory to be used by Windows in units of 4096 pages, expressed in hexadecimal:

```
[386Enh]
MaxPhysPage=4000    ;; 64 Mbytes in 4096 byte pages, in hexadecimal
```

2. Edit the Windows' SYSTEM.INI file, add a section and entry:

```
[EPIX_XC]
PIXCI= -IA <image_memory_adrs_in_kbyte>
       -IM <size_of_image_memory_in_kbyte>
       -MB 16384
```

   In practice, all three fields are on the same line. Be certain that the -IA address is equal to (or above) the specified /MaxPhysPage limit - including exact base2 to base10 conversions! (i.e. for MaxPhysPage=4000 or 64 Mbyte, the smallest legal value of -IA is 65536, not 64000!). Likewise, be certain that the -IA plus -IM values do not exceed the amount of memory available!
3. Reboot.

For example, for a PC with 256 megabyte of memory, allocating 192 Mbyte for Windows and the remainder for frame buffer memory, use:

```
MaxPhysPage=C000
```

and

```
PIXCI = -IA 196608 -IM 65536 -MB 16384
```

3.2.4. Windows 95/98/ME - Authorization Key - Manual Installation

Use of HLDINST.EXE, above, provides automatic installation of the printer port authorization key's driver, needed under Windows 95/98/ME, for XCAP-Plus and XCAP-Std (but not needed for XCAP-Lite). The following information allows manual

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installation, correcting problems, or integration with an OEM's procedures for the printer port version of authorization keys.

1. The file HARDLOCK.VXD must be copied to the Windows SYSTEM directory, typically:

```
C:\WINDOWS\SYSTEM
```

   or placed in the same directory as XCAP, typically:

```
C:\XCAP
```

Normally, all LPT ports are scanned for the authorization key. Should other hardware use, or overlap, one of the LPT I/O port addresses, the search may be restricted to specific I/O ports. In AUTOEXEC.BAT, specifying:

```
SET HL_SEARCH=378p
SET HL_SEARCH=278p,378p
```

forces only the I/O port addresses listed (in hexadecimal) to be searched. Note that setting HL_SEARCH from a DOS box has no effect, as the setting is not "carried back" from DOS into the Windows 95/98/ME environment.

3.3. For Windows NT

XCAP requires Windows NT Version 4 with Service Pack 3 or later. You must be logged on an Administrator, or have equivalent privileges, to complete the installation procedure.

1. Install Files:
   a. If XCAP is provided on diskette(s):
      i. Insert XCAP diskette #1 into the A: or B: drive.
      ii. Execute the SETUP program, from a command prompt, or via the Windows "Start", "Run":

```
    > A:SETUP
or
    > B:SETUP
```

      iii. Follow the installation program's directions, such as to select an installation directory, and insert additional diskettes (depending upon version) as instructed.
   b. If XCAP is provided on a compact disk (CD):
      i. If your PC 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". Click "OK".
      iii. Follow the installation program's directions, such as to select an installation directory.
   c. If XCAP is provided via the internet:
      i. Download:

```
ftp.epixinc.com/software/xcap_v21/XCAPWI.EXE
```

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

```
    > XCAPWI.EXE
```

      iii. Follow the installation program's directions, such as to select an installation directory.
      iv. Delete the downloaded .EXE file from your PC's hard drive.
   d. 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. One file, PCITIPS.TXT, contains the *PC Configuration Tips*, which provides tips for resolving hardware and software conflicts.
2. Create Shortcut - Drag & Drop (optional):
   a. From the program group created by the installation program, click and drag the icon for XCAP over to the desktop and drop.
3. Create Shortcut - Manual (optional):
   a. Right click on the Desktop.[3]
   b. Select "New".
   c. Select "Shortcut".
   d. Set:

```
Command Line:   InstallDir \ XCAPWXX
Name:           XCAP
```


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replacing "InstallDir" with the name of the installation directory chosen above. Select "OK".

4. Install Authorization Key (for XCAP-Plus and XCAP-Std):
   a. XCAP-Plus and XCAP-Std, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

      The printer port authorization key is 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 printer port 1, 2, or 3. 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 which 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 approximately the size of a small finger (6.0×1.6×0.8 cm), having a USB standard 4 pin connector at one end. If provided, connect the authorization key to a USB port.

      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 or XCAP-Std will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

   b. Run the authorization key utility program provided with XCAP by "Start", "Run":

      ```
      > C:\XCAP\HLDINST -install
      ```

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

      ```
      > CHDIR C:\XCAP
      ```

      and execute:

      ```
       HLDINST  -install
      ```

      to run the authorization key utility program.
5. Install PIXCI® Imaging Board Driver:
   a. If the PIXCI® imaging board's driver was not loaded when the PC was powered up (as described under *Hardware Installation*), instruct Windows to load the appropriate driver: Click "Start", "Programs", and "Windows NT Explorer". Within the chosen installation directory, such as C:\XCAP, find and highlight file DRIVERS\WINNT \EPIXXCWT.INF (EPIXXCNT.INF for version 2.0 and earlier). From the menu bar, select "File" and "Install".
6. Configure S/VGA:
   a. A "High Color (16 bit or 65536 Color)", "True Color (24 bit or 16777216 Color)", or "True Color (32 bit)" setting for the display adapter (S/VGA) is required for proper display of images and overlay graphics. The "True Color (24 bit or 16777216 Color)" or "True Color (32 bit)" is suggested for higher quality, and quicker, display of images and overlay graphics. This may be checked and/or modified via Windows "Start", "Settings", "Control Panel", "Display", "Settings".
   b. Under "Start", "Settings", "Control Panel", "Display", "Effects", the "Show window contents while dragging" must be disabled.
7. Reboot Windows.
8. XCAP is now ready to run, clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

3.4. Windows NT Esoterica

3.4.1. Windows NT - Manual Installation

Use of EPIXXCWT.INF (EPIXXCNT.INF for version 2.0 and earlier), above, provides automatic installation of EPIXXCWT.SYS (EPIXXCNT.SYS for version 2.0 and earlier) in most circumstances. The following information allows manual installation, correcting problems, or integration with an OEM's procedures.

1. The EPIXXCWT.SYS (EPIXXCNT.SYS for version 2.0 and earlier) 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\EPIXXCWT  (version 2.1+)
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCNT  (version 2.0-)
   ```

   This entry must contain:

   ```
   ErrorControl  =  0x00000001
   ```


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

and may, as described below, also contain:

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

Create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCWT  (version 2.1+)
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCNT  (version 2.0-)
```

This entry must contain:

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

3. Shut down and restart Windows.

3.4.2. Windows NT - Frame Buffer Memory Allocation

Under Windows NT, 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 4 megabytes is used. Windows must be rebooted for the new specification to take effect.

Windows NT limits the maximum amount of allocatable frame buffer memory, dependent upon what other devices are installed, the total PC memory size, and other factors. Using the Control Panel's Device Manager to select Boot or System priority startup for EPIXXCWT.SYS (EPIXXCNT.SYS for version 2.0 and earlier) allows more frame buffer memory to be allocated than selection of Automatic startup.

Less than the requested amount of frame buffer memory may be provided by Windows. If no memory could be allocated, XCAP will not run, 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 NT - Forcible Frame Buffer Memory Allocation

As described above, frame buffer memory allocated by EPIXXCWT.SYS (EPIXXCNT.SYS for version 2.0 and earlier) during Windows startup may be limited to a small percentage of total PC memory.

A larger frame buffer memory can be obtained by limiting the amount of memory recognized by Windows NT, and then instructing EPIXXCWT.SYS (EPIXXCNT.SYS for version 2.0 and earlier) to explicitly use a section of memory without allocating it from Windows NT:

1. Edit C:\BOOT.INI, restricting Windows NT to use no more than a set amount of memory: by copying an existing configuration line, adding /MAXMEM=XX (where XX is in Mbytes) and changing the prompt name, such as changing:

```
[operating systems]
multi(0)disk(0)rdisk(0)partition(7)\WINNT="Windows NT V 4.00"
```

to

```
[operating systems]
multi(0)disk(0)rdisk(0)partition(7)\WINNT="Windows NT V 4.00 [NT=64M PIXCI=256M]"  /MAXMEM=64
multi(0)disk(0)rdisk(0)partition(7)\WINNT="Windows NT V 4.00"
```

Do not copy this new line as shown above; the first portion of the line must be copied from an existing configuration line in your C:\BOOT.INI file. The text between quotes appears as a boot selection prompt, use of "[NT=64M PIXCI=256M]" is a suggested reminder, but not required.

Also in C:\BOOT.INI, change the timeout selection to be greater than 0:

```
[boot loader]
timeout=30
```

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

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Keeping the original configuration line, as a boot selection option, is highly recommended as a backup.

2. Edit the registry entry:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCWT  (version 2.1+)
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCNT  (version 2.0-)
```

   On the "PIXCI" field add:

```
-IA <image_memory_adrs_in_kbyte>
-IM <size_of_image_memory_in_kbyte>
-MB 8192
```

   In practice, all three fields are on the same line. Be certain that the -IA address is equal to (or above) the specified /MAXMEM limit - including exact base2 to base10 conversions! (i.e. for /MAXMEM=64, the smallest legal value of -IA is 65536, not 64000!). Likewise, be certain that the -IA plus -IM values do not exceed the amount of memory available!
3. Reboot, using the newly added boot selection.

For example, for a PC with 1 gigabyte of memory, allocating 256 Mbyte for Windows and the remainder for frame buffer memory, use:

```
/MAXMEM=256
```

in C:\BOOT.INI, 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 NT - Authorization Key - Manual Installation

Use of HLDINST.EXE, above, provides automatic installation of the printer port authorization key's driver, needed under Windows NT, for XCAP-Plus and XCAP-Std (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. The file HLVDD.DLL must copied to the Windows SYSTEM directory, typically:

```
C:\WINNT\SYSTEM
```

   or placed in the same directory as XCAP, typically:

```
C:\XCAP
```

3. 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
```

4. Shut down and restart Windows for the new registry entries to take effect.
5. 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
```


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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.

3.5. For Windows 2000

1. Install Files:
   a. If XCAP is provided on diskette(s):
      i. Insert XCAP diskette #1 into the A: or B: drive.
      ii. Execute the SETUP program, from a command prompt, or via the Windows "Start", "Run":

```
    > A:SETUP
or
    > B:SETUP
```

      iii. Follow the installation program's directions, such as to select an installation directory, and insert additional diskettes (depending upon version) as instructed.
   b. If XCAP is provided on a compact disk (CD):
      i. If your PC 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". Click "OK".
      iii. Follow the installation program's directions, such as to select an installation directory.
   c. If XCAP is provided via the internet:
      i. Download:

```
ftp.epixinc.com/software/xcap_v21/XCAPWI.EXE
```

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

```
    > XCAPWI.EXE
```

      iii. Follow the installation program's directions, such as to select an installation directory.
      iv. Delete the downloaded .EXE file from your PC's hard drive.
   d. 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. One file, PCITIPS.TXT, contains the *PC Configuration Tips*, which provides tips for resolving hardware and software conflicts.
2. Create Shortcut - Drag & Drop (optional):
   a. From the program group created by the installation program, click and drag the icon for XCAP over to the desktop and drop.
3. Create Shortcut - Manual (optional):
   a. Right click on the Desktop.[4]
   b. Select "New".
   c. Select "Shortcut".
   d. Set:

```
Command Line:   InstallDir \ XCAPWXX
Name:           XCAP
```

   replacing "InstallDir" with the name of the installation directory chosen above. Select "OK".
4. Install Authorization Key (for XCAP-Plus and XCAP-Std):
   a. XCAP-Plus and XCAP-Std, but not XCAP-Lite, are provided with either a printer port authorization key or a USB authorization key.

   The printer port authorization key is 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 printer port 1, 2, or 3. 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 which happens to use the same style connector; the authorization key will not function, might be permanently damaged, and

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the warranty will be void!

The USB port authorization key is approximately the size of a small finger (6.0×1.6×0.8 cm), having a USB standard 4 pin connector at one end. If provided, connect the authorization key to a USB port.

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 or XCAP-Std will behave similar to the XCAP-Lite version; selected image processing and analysis tools will not be operational.

b. Run the authorization key utility program provided with XCAP by "Start", "Run":

```
> C:\XCAP\HLDINST -install
```

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

```
> CHDIR C:\XCAP
```

and execute:

```
 HLDINST  -install
```

to run the authorization key utility program.

5. Install PIXCI® Imaging Board Driver:
   a. Under Windows 2000, the Windows' Device Manager must be used for initial installation of the PIXCI® driver.

   If the PIXCI® imaging board was not yet installed, the first time Windows starts after installation Windows will notice the new device and inquire.

   The first time Windows 2000 starts after installation of the PIXCI® imaging board, a pop-up window with the message "Multimedia Video Controller" will flash by. Next a pop-up window with the message "Welcome to the Found New Hardware Wizard" will appear. Click "Next". Select "Search for the best driver for your device". Click "Next". Check the box for: "Specify a location". Enter path DRIVERS\WIN2K within the chosen installation directory, such as C:\XCAP\DRIVERS\WIN2K, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WIN2K\EPIXXCW2.INF. Click "Next". A pop-up window will report that a "Digital Signature was not found". Click "Yes". A pop-up window with the message "Completing the Found New Hardware Wizard" will state that "This device is not configured correctly. (Code 1)"; this error indicates that the newly installed driver will be functional only after a reboot. Click "Finish" and reboot Windows.

   If the PIXCI® imaging board was already installed under Windows 2000, and "Cancel" was clicked when Windows started and announced the presence of a new "Multimedia Video Controller", then instruct Windows to load the appropriate driver. Click "Start", "Settings", "Control Panel", "System" (if "System" is not listed, click on "view all Control Panel options"), "Device Manager", and "Other Devices" or "Imaging Devices". Select "PCI MultiMedia Video Device" (which appears if a PIXCI® imaging board driver was never installed), or "PIXCI(R) Video Capture Board" (which appears if a PIXCI® imaging board driver was previously installed). Double-click on the entry to bring up the "Properties" window. Click the "Driver" tab, and then click "Change Driver", or "Update Driver". A pop-up "Welcome" window will appear, click "Next". A pop-up window with the messages "This wizard searches for updated drivers for:" and "PCI MultiMedia Video Device" or "PIXCI(R) Video Capture Board" will appear. Select "Search for a suitable driver for my device (recommended)". Click "Next". Check the box for: "Specify a location". Enter path DRIVERS\WIN2K within the chosen installation directory, such as C:\XCAP\DRIVERS\WIN2K, and click "Next". A pop-up window will report that a driver was found, namely C:\XCAP\DRIVERS\WIN2K \EPIXXCW2.INF. Click "Next". A pop-up window will appear stating that a "Digital Signature was not found". Click "Yes". A pop-up window with the message "Completing the Found New Hardware Wizard" will appear and may state that "This device is not configured correctly. (Code 1)"; this error indicates that the newly installed driver will be functional only after a reboot. Click "Finish" and reboot Windows.

6. Configure S/VGA:
   a. A "High Color (16 bit or 65536 Color)", "True Color (24 bit or 16777216 Color)", or "True Color (32 bit)" setting for the display adapter (S/VGA) is required for proper display of images and overlay graphics. The "True Color (24 bit or 16777216 Color)" or "True Color (32 bit)" is suggested for higher quality, and quicker, display of images and overlay graphics. This may be checked and/or modified via Windows "Start", "Settings", "Control Panel", "Display", "Settings".
   b. Under "Start", "Settings", "Control Panel", "Display", "Effects", the "Show window contents while dragging" must be disabled.
7. Reboot Windows.
8. XCAP is now ready to run, clicking "Start", "Programs", "XCAP Imaging", and finally "XCAP for Windows".

3.6. Windows 2000 Esoterica

3.6.1. Windows 2000 - Manual Installation

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Use of EPIXXCW2.INF (EPIXXCNT.INF for version 2.0 and earlier), above, provides automatic installation of EPIXXCW2.SYS (EPIXXCNT.SYS for version 2.0 and earlier) in most circumstances. The following information allows manual installation, correcting problems, or integration with an OEM's procedures.

1. The EPIXXCW2.SYS (EPIXXCNT.SYS for version 2.0 and earlier) 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\EPIXXCW2  (version 2.1+)
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EPIXXCNT  (version 2.0-)
```

   This entry must contain:

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

   and may, as described below, also contain:

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

   Create an entry such as:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCW2  (version 2.1+)
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\EventLog\System\EPIXXCNT  (version 2.0-)
```

   This entry must contain:

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

3. Shut down and restart Windows.

Under Windows 2000, the Windows NT driver EPIXXCWT.SYS can be, and was previously, used instead of EPIXXCW2.SYS. In contrast to EPIXXCWT.SYS, the EPIXXCW2.SYS is Plug & Play compatible.

3.6.2. Windows 2000/XP - Frame Buffer Memory Allocation

Under Windows 2000/XP, 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 4 megabytes is used. Windows must be rebooted for the new specification to take effect.

Windows 2000/XP limits the maximum amount of allocatable frame buffer memory, dependent upon what other devices are installed, the total PC memory size, and other factors.

Less than the requested amount of frame buffer memory may be provided by Windows. If no memory could be allocated, XCAP will not run, 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.

3.6.3. Windows 2000/XP - Forcible Frame Buffer Memory Allocation

As described above, frame buffer memory allocated by EPIXXCW2.SYS during Windows startup may be limited to a small percentage of total PC memory.

A larger frame buffer memory can be obtained by limiting the amount of memory recognized by Windows 2000/XP, and then instructing EPIXXCW2.SYS to explicitly use a section of memory without allocating it from Windows 2000/XP:

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1. Edit C:\BOOT.INI, restricting Windows 2000/XP to use no more than a set amount of memory: by copying an existing configuration line, adding /MAXMEM=XX (where XX is in Mbytes) and changing the prompt name, such as changing:

```
[operating systems]
multi(0)disk(0)rdisk(0)partition(7)\WINNT="Windows 2000"
```

   to

```
[operating systems]
multi(0)disk(0)rdisk(0)partition(7)\WINNT="Windows 2000 [NT=64M PIXCI=256M]"  /MAXMEM=64
multi(0)disk(0)rdisk(0)partition(7)\WINNT="Windows 2000"
```

   Do not copy this new line as shown above; the first portion of the line must be copied from an existing configuration line in your C:\BOOT.INI file. The text between quotes appears as a boot selection prompt, use of "[NT=64M PIXCI=256M]" is a suggested reminder, but not required.

   Also in C:\BOOT.INI, change the timeout selection to be greater than 0:

```
[boot loader]
timeout=30
```

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

   Keeping the original configuration line, as a boot selection option, is highly recommended as a backup.

2. Edit the registry entry:

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

   On the "PIXCI" field add:

```
-IA <image_memory_adrs_in_kbyte>
-IM <size_of_image_memory_in_kbyte>
-MB 8192
```

   In practice, all three fields are on the same line. Be certain that the -IA address is equal to (or above) the specified /MAXMEM limit - including exact base2 to base10 conversions! (i.e. for /MAXMEM=64, the smallest legal value of -IA is 65536, not 64000!). Likewise, be certain that the -IA plus -IM values do not exceed the amount of memory available!
3. Reboot, using the newly added boot selection.

For example, for a PC with 1 gigabyte of memory, allocating 256 Mbyte for Windows and the remainder for frame buffer memory, use:

```
/MAXMEM=256
```

in C:\BOOT.INI, 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.

3.6.4. Windows 2000/XP - Authorization Key - Manual Installation

Use of HLDINST.EXE, above, provides automatic installation of the printer port authorization key's driver, needed under Windows 2000/XP, for XCAP-Plus and XCAP-Std (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"
```


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```
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.

---

4. Getting Started

This chapter will guide the user through the initial steps common to most applications using the PIXCI imaging board: capturing, viewing, examining, and saving images. This guide isn't intended to discuss every feature of every window in XCAP, just the most important features to "get up and running".

By following the previous instructions, at this point:

a. The PIXCI imaging board has been installed.
b. The camera has been connected to the PIXCI imaging board.
c. The XCAP software has been installed.
d. For XCAP-Plus or XCAP-Std, but not XCAP-Lite, the authorization key has been installed on the printer port.
e. The PIXCI driver for Windows 95/98 or Windows NT, has been installed.
f. The S/VGA has been set for 16 bits (minimum required), or 24 or 32 bits (preferred), per pixel.
g. The PC has been rebooted (Ctrl+Alt+Del) so that the installed driver and the modified S/VGA settings (if any) have taken effect.

The following instructions are intended to be used while operating the PC; pictures of the S/VGA are intentionally not shown, in favor of focusing the reader's attention on the real S/VGA screen.

4.1. Start XCAP

Start XCAP by clicking:

```
Start (on the Windows Taskbar)
XCAP Imaging
```

and then clicking:

```
XCAP for Windows
```

The XCAP Main Window now appears.

4.2. Open PIXCI Imaging Board

In the XCAP Main Window, click:

```
PIXCI
PIXCI Open/Close
```

A pop-up window appears.

Clicking:

```
Open
```

opens the PIXCI imaging board for use, removes the Open/Close pop-up window, creates a PIXCI Image Viewer window

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showing the first PIXCI frame buffer, creates an Adjust window with commonly used 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 imaging board, and features independent of the PIXCI imaging board, 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 where cursor coordinates and other information is displayed.
3. The PIXCI® Shortcut Toolbar, with shortcuts for the most commonly needed features relating to the PIXCI® imaging board and its frame buffers.
4. An Adjust window, with commonly used video capture adjustments.

If XCAP has already been installed, it may have been configured with one or more variations, such as, (a) Eliminate the Main Window, automatically opening and displaying the PIXCI® Image Viewer, (b) Configure the Shortcuts and/or Adjust features to be attached to the The PIXCI® Image Viewer window, rather than detached into their own windows, (c) Select whether the Shortcuts and/or Adjust features appear automatically, or only when

```
Capture
Adjustments
```

or

```
Capture
Shortcuts
```

are clicked, or (d) Remove the status bar, increasing the screen area available for image display. These variations allow custom configuration of XCAP, but don't affect the functionality of the Shortcuts or Adjustments features.

4.3. PIXCI® SV2, SV3, SV4, SV5 Video Configuration

The PIXCI® SV2, SV3, SV4, and SV5 default to the NTSC video format for S-Video, using the S-Video input, capturing full video resolution. These defaults can be adjusted as follows.

4.3.1. Video Format

From the Main window, click:

```
PIXCI®
PIXCI® Video Setup
Format
```

Select an alternate video format, and click:

```
OK
```

4.3.2. Video Resolution

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 Main Window, click:

```
PIXCI®
PIXCI® Video Setup
Resolution
```

Modify:

```
Data Pixels per Line
Data Lines per Field


Frame Buffer: 2 Fields      (i.e. interlace)
Frame Buffer: 1 Field
```

as per your application's needs. The:

```
Image Buffers in Memory
```

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

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```
OK
```

4.3.3. Input Selection

To select one of the video input connectors on the imaging board's bracket, from the PIXCI® Image Viewer, click:

```
Capture
Adjustments
```

The video input connector may be selected numerically with:

```
Video Input (0 is the top most connector, 1 the next)
```

Alternately, a specific connector on the picture of the imaging board's bracket may be clicked.

4.3.4. Saving the Video Configuration

The selections under the Main Window:

```
PIXCI® Video Setup
```

and under the PIXCI® Image Viewer:

```
Adjustments
```

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

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

You may choose:

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

to use the previous video setup, or choose:

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

to start anew with the default video format, resolution, and video input.

4.4. Capturing Images

Once the PIXCI® imaging board is opened for use, images may be captured from the PIXCI® Image Viewer, 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, continuously updating the image shown on the S/VGA.

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

```
Capture
UnLive
```

A *Live* followed immediately by *Unlive* has the same effect as *Snap*.

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
```

or sometimes shortened to:

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```
Current 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 which 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, in the top row, at the fifth and sixth from the left. The Shortcuts also allow changing the current frame buffer; in the top row, the four icons at the left switch to the first frame buffer, the next frame buffer (e.g. current buffer +1), the previous frame buffer (e.g. current buffer -1), and the last frame buffer, respectively.

4.5. Examining Images

4.5.1. Altering How the Image is Displayed

The PIXCI Image Viewer can be moved and resized, using standard Windows 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 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 the exact pixels, from the PIXCI® Image Viewer, click:

```
View
Display
Resize: None (1 to 1)
```

Each image pixel is now displayed as exactly one S/VGA pixel. Of course, depending upon the image resolution, S/VGA 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).

Note that when:

```
Resize: None (1 to 1)
```

is selected, 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
```

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:

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```
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 line (column) of the image which is shown 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. Saving Images

To save an image, from the PIXCI Image Viewer, click:

```
File
Save Image
```

Choose a file format, such as:

```
TIFF
JPEG/JFIF
BMP
PCX
Targa (TGA)
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 JPGE/JFIF is also a commonly used image file format and provides high, but lossy, compression. 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.

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 File Dialog, click

```
Accept
```

to accept the filename selected by browsing, and click

```
OK
```

to save the image.

---

5. XCAP Software Guide

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XCAP is a family of sophisticated, interactive, imaging programs specifically designed to support the PIXCI series of imaging boards, but also able to process and analyze images from other imaging sources. Several versions of XCAP are available: XCAP-Std, XCAP-Plus, XCAP-Lite, and XCAP-Demo. All versions share the same user interface and menu structure, but selected features in XCAP-Std, XCAP-Lite, and XCAP-Demo are not operational. XCAP is distributed on CD, diskette(s), or downloadable from the EPIX, Inc. website. After installation, a 12 character identification code[5] is entered to configure XCAP as either XCAP-Std, XCAP-Plus,[6], or XCAP-Lite; or, lacking a valid code, configured as XCAP-Demo 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 imaging board, 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 imaging boards can be loaded, examined, processed, analyzed, measured, printed, annotated, and saved.

XCAP-Std also allows loading and analyzing a pre-existing image or image sequence with size, pixel depth, and color space independent of the PIXCI imaging board's configuration; XCAP-Std can be used with pre-existing images even when the PIXCI imaging board 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-Lite is a basic version of XCAP-Std. XCAP-Lite provides similar image acquisition and PIXCI imaging board 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 imaging board is present and opened for use.

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

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

The XCAP programs are organized into two major types of windows, the Image Viewer Window and the Main Window.

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 imaging board'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 zoomed and unzoomed, 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 imaging board for use. Video setup for the PIXCI imaging board, such as modifying the video resolution or color space, are also in the Main Window; these features destroy and re-create the PIXCI imaging board'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, BMP, 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 imaging board's frame buffers. After creation and loading, the new image (sequence) is displayed, processed, and analyzed in 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 *Image File Info* displays information about a specified TIFF or BMP 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.

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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 version does 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 imaging board's frame buffers. After creation, the new image is displayed in an The Image Viewer Window, as described below.

Underneath *New Image* are listed all existing image windows, whether for PIXCI imaging board frame buffers, or for independent image buffers. (The image window for PIXCI imaging board frame buffers appears only after the PIXCI imaging board has been opened for use, see below). An image window which has been closed and 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 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. Features activated with keys, or clicking icons are not currently recorded; such features can also activated by other means, which are 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 version does not support recording scripts, creating user-defined tool bars, or the remote control feature. The XCAP-Lite version can play scripts previously created with XCAP.

5.1.4. Main Window - Utility

The main window's *Utility* provides an assortment of features which are of secondary importance; features which 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 version allows use of the *Black Board* for computing values (similar to a spreadsheet), but does 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.

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The *Program Setup* shows information about the installed XCAP components, such as their revision level, and sets various configuration options. For versions of XCAP which 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 S/VGA display adapter's features, as reported by Windows. 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* allows recording and playing short audio "clips".

The *RS-232 Control* allows "raw" communication with a camera or other device connected via the computer's RS-232 port. The *RS-232 Control* 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 imaging board 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 not available under Windows NT.

The *Screen Capture* allows capturing the current S/VGA screen graphics, 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.

5.1.5. Main Window - PIXCI®

The main window's *PIXCI®* allows initiating access to the PIXCI imaging board and provides configuration options. Actual operation of the PIXCI imaging board 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 imaging board. Once open, the model (and submodel, as appropriate) of the PIXCI imaging board is available via the *Board Info* button. After opening, the contents of the PIXCI image board's frame buffer(s) are displayed in The Image Viewer Window, along with a tool bar of PIXCI® Image Viewer - Capture - Shortcuts and a status bar of PIXCI® 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 example, for PIXCI SV2, SV3, SV4, and SV5 models, the *PIXCI® Video Setup* allows selecting NTSC, RS-170, S-VIDEO, CCIR, or PAL, allows selecting the video window size and capture resolution, and selecting other video acquisition characteristics. For other models, such as the PIXCI® D, fewer options may be provided, as the PIXCI® D models are camera specific.

The current video setup is automatically saved when access to the PIXCI imaging board is closed, and reloaded when the PIXCI image board is later opened. The *PIXCI® Save Video Setup* and *PIXCI® Load 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 XCIP program or the XCOBJ library.

The *PIXCI® Status* shows the PIXCI imaging board's current status, such as the state of the TTL trigger input(s) and output(s), the number of elapsed video fields, the board's model and submodel, and configured image memory size.

The *PIXCI® Serial Peek & Poke* allows "raw" communication with a camera connected to the serial port on selected models of the PIXCI® imaging board. XCAP may also provide more convenient, camera-specific "smart" controls, provided after a camera-specific imaging board is opened, via the Capture - Adjustments.

The *PIXCI® Connections* provides, as appropriate for the specific model of PIXCI imaging board, 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® imaging boards. The *PIXCI® Camera Info* also allows viewing a non-operational Capture - Adjustments window (i.e. the "Control Panel", which provides integrated control of both imaging board and any supported camera).

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The *PIXCI® TWAIN Sourcery* 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® imaging board, while XCAP provides imaging board, camera controls, and, optionally, image preprocessing.[7] (The XCAP-Lite version does 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* 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® imaging board, while XCAP provides imaging board, camera controls, and, optionally, image preprocessing.[8]

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 imaging board'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 or AVI format image file with multiple images. The XCAP-Lite version does not support loading or saving of image buffer sequences in a single operation; however multiple uses of *Load Image* or *Save Image* can load or save each image buffer of a sequence.

The *E-Mail Image* allows directly e-mail'ing 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, Windows* and *Print, PXIPL* allow printing the image; the former printing via Windows and supporting a wide variety of printers, the latter printing via the PXIPL library and supporting only the most popular printers, but providing precise control of print options. The XCAP-Lite version does not allow printing via the PXIPL library.

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

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

The *Copy to Black Board* allows copying the image's pixel values into the Black Board. The XCAP-Lite version does not provide *Copy to Black Board*.

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 imaging board's frame buffer(s) does not provide a *Close & Dispose of Image*; an image viewer window is available whenever the PIXCI imaging board 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.

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

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The *Full Screen* allows displaying the image in the full S/VGA screen, with little or no window "frame" around the image. A mouse click, anywhere on the S/VGA, restores the previous mode. The XCAP-Lite version does not provide the *Full Screen* feature.

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 *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 *Misc Options*.

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 that there is a one to one relationship between an image pixel and a displayed S/VGA pixel and is 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. For the image viewer window associated with the PIXCI imaging board'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.

The *Misc Options* 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.

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.

The *Pixel Peek & Poke* allows numeric display and modification of the pixel value at the image cursor.

The *Pixel Plot* displays a two dimensional graph of pixels values along a selected image line or column, all image lines, or for image sequences, a vector. 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 does not provide a graph of all image lines, 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 version does 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)."

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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. 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 *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 single image normalizations. 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 *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 which 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 *Warp* allows "rubber-sheet" transformations governed by a list of initial and final fiducial locations. The *Sequence Warp* does the same on each image of a sequence. The *Src+Dst Warp* 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 *Pair Arithmetic* provides pixel arithmetic, such as summation, between one image buffer and another. The *Src+Dst Arithmetic* does the same with distinct pair of source and destination images.

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

The *Sequence Average* 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

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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 version only provides 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 the image's histogram.

The *Mass & Moments* computes and displays various moments of the 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 overlayed 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 overlayed 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 overlayed 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 overlayed 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 which 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 to subpixel accuracy, and displays the position of the edges 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 version does not provide the *Intensity Calibration*, *Spatial Calibration*, *Histogram*, *Mass & Moments*, *Radial Mass Plot*, *Ruler*, *Protractor*, *Cartesian Reticle*, *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

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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 overlayed 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 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 as the "input focus" (e.g. Windows has highlighted that window's title bar). 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. Zoom, scroll, and pan.
h. Peek at numeric pixel values.
i. Two dimensional plot of line or column of pixel values.
j. Histogram of pixel values.

The first four shortcuts appear only for The Image Viewer Windows 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

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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 image board's frame buffer(s) has *Capture* which provides for capturing images from the PIXCI imaging board and other features associated with the PIXCI imaging board. 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 *Adjustments* allows setting common adjustments, as suitable for the model of the PIXCI imaging board in use. For example, for PIXCI® SV2, SV3, SV4 and SV5 models, the *Adjustments* allows selecting the video input connection and adjusting the gain, black level, hue, and saturation. Less frequently used, and more esoteric, adjustments may be found under *PIXCI® Video Setup*, described above. A duplicate *Adjustments* is provided under Image Viewer - View.

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

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 *GIO Event Capture* provides single or sequence image capture, each image triggered in conjunction with the imaging board's general purpose (previously 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 captured in response to an event. Events include mouse clicks, time of day, and the imaging board's general purpose (previously 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. former starts the entire sequence upon a single event (trigger), When recording at subvideo rates, 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 Memory Buffers* 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, or the time stamp feature, or the event (trigger) option of the *Video to Frame Buffers* or *Video to Memory Buffers* features.

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* 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 version does 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 version does 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 imaging board can, (a) Capture continuously into the specified frame buffer, however the image shown on the S/VGA may contain portions from different video frames, (b) Snap, display to the S/VGA, and repeat, however the image display rate will be slower, or (c) Alternate capturing into the specified frame buffer and the last frame buffer (dual buffering). On host computers

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with insufficient PCI bandwidth to simultaneously capture into host computer memory and display from host computer memory to the S/VGA, option (b) reduces the required bandwidth by approximately half.

5.2.11. PIXCI® Image Viewer - Capture - Shortcuts

A tool bar of icons provides shortcuts for accessing often used features of the PIXCI imaging board, 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 as the "input focus" (e.g. Windows has highlighted that window's title bar). 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. Zoom, scroll, and pan.
j. Peek at numeric pixel values.
k. Two dimensional plot of line or column of pixel values.
l. Histogram of pixel values.
m. Sequence acquire.
n. Sequence display.

The shortcuts may either be attached and part of PIXCI® 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 buttons. Left clicking a button allows incrementing or decrementing the numeric value. Right clicking 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 applied when the buttons are left clicked.
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 frequency's period in milliseconds or microseconds.
viii. Selecting units for display of memory sizes, such as bytes, kilobytes, megabytes, or gigabytes.
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 field in which to view or enter a number.
xii. Providing a field in which an entered mathematical expression is evaluated to a numeric value.
xiii. 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 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.

Editing of numeric and text fields follows (one of the many) Windows 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

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highlighted text, and the left/right arrow keys cancel the highlight mode.

5.4. Road Map - Main Window

```
Main Window


    File
        Load New Image
        Load New Image Sequence
            TIFF
            JPEG/JFIF
            BMP
            Multimedia
        Image File Info
        TWAIN Select Source
        TWAIN New Acquire
        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
        RS-232 Control
        Screen Capture
        I/O Port Peek & Poke
        Program Setup
        Windows Info
        Window Style
        Java Info
        Devices
            Volpi intralux dc-1100
            Illumination Technologies 3900


    PIXCI®
        PIXCI® Open/Close
            Board Info
            Driver Assistant
        PIXCI® Video Setup
            Format  (dependent on imaging board)
            Resolution
            Sync
            Custom


        PIXCI® Save Video Setup
        PIXCI® Load Video Setup
        PIXCI® TWAIN Sourcery
        PIXCI® Image-Pro Sourcery
        PIXCI® Status
        PIXCI® Serial Peek & Poke
        PIXCI® Connections
        PIXCI® Camera Info


    Help
        About
        License
        XCAP Release Notes
        XCAP Reference Manual
        PC Configuration Tips
```

5.5. Road Map - PIXCI Image Viewer Window

```
PIXCI Image Viewer Window


    File
```


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```
    Save Image
        TIFF
        JPEG/JFIF
        BMP
        PCX
        Targa
        X/Y Binary
        X/Y ASCII


    Load Image
        TIFF
        JPEG/JFIF
        BMP
        X/Y Binary
        X/Y ASCII


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


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


    E-Mail Image
    Save Frame Buffer Memory
    Load Frame Buffer Memory
    Print, Windows
    Print, PXIPL
    Duplicate Image
    Copy to Black Board
    Attributes
    Close Viewer

View
    Shortcuts
    Adjustments
    Status 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
    Misc. Options
    Launch 2nd Viewer


Examine
    Pixel Peek
    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]
```

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```
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
    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


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


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
    Deflicker: Average Line Pairs
    Deflicker: Filter Singularity


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]
```


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```
        X, Y Shift
        Flip
        Skew Left/Right
        Skew Up/Down
        Rotate


    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


    Threshold [Sequence Threshold] [Src+Dst Threshold]
    Threshold, Adaptive [Sequence Threshold, Adaptive] [Src+Dst Threshold, Adaptive]
    Warp [Sequence Warp] [Src+Dst Warp]
    Copy & Resize
    Pair Arithmetic [Src+Dst Pair Arithmetic]
        Add: Dist+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 [Src+Dst Pair Normalization]
        Contrast Modify & Match
        Background Correction, Subtractive
        Background Correction, Ratio
        Spot Mask Correction


    Sequence Average
        Average Sequence
        Integrate Sequence
    Difference Sequence
    Tile Sequence


Measure
    Intensity Calibration
    Spatial Calibration
    Histogram
    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
```


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```
        Line
        Parallel Lines
        Path Curve
        Polyline
        Rectangle
        Window
        Annulus
        Annulus Arc
        Bezier Region
        Elliptical Annulus
        Elliptical Annulus Arc
        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 Memory Buffers - Single Sequence
            Video to Memory Buffers - Single Sequence w. Event Start
            Video to Memory Buffers - Single Sequence w. Event per Image
            Video to Memory Buffers - Continuous Sequence
            Video to Memory Buffers - Continuous Sequence w. Event Stop
            Video to Memory Buffers - 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
        GIO Event Capture


        Waterfall Display
        Video to Disk
        RGB Merge
        Quad Pixel Merge
        Frame Average
        Live Options


    Help
        Vis-a-Vis
```

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
```


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```
        Window Style
        Java Info


    PIXCI®
        PIXCI® Open/Close
        PIXCI® TWAIN Sourcery
        PIXCI® Image-Pro Sourcery
        PIXCI® Connections
        PIXCI® Video Setup


    Help
        XCAP Release Notes
        XCAP Reference Manual
        PC 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-Lite	XCAP-Demo
File -				
- Load New Image	Yes	Yes	Yes (u)	No
- Load New Image Sequence	Yes	Yes	No	No
- Image File Info	Yes	Yes	Yes	Yes
- TWAIN Select Source	Yes	Yes	No	No
- TWAIN New Acquire	Yes	Yes	No	No
Images -				
- New Image	Yes	Yes	Yes	Yes
Scripts -				
- Record	Yes	Yes	No	No
- Play	Yes	Yes	Yes	No
- Remote Control	Yes	Yes	No	No
- Load Tool Bar	Yes	Yes	No	No
Utility -				
- Black Board	Yes	Yes	No	No
- Message Log	Yes	Yes	Yes	Yes
- Audio Clip	Yes	Yes	Yes	No
- RS-232 Control	Yes	Yes	Yes	Yes
- Screen Capture	Yes	Yes	No	No
- I/O Port Peek & Poke	Yes (w)	Yes (w)	Yes (w)	Yes (w)
- Volpi intralux dc-1100	Yes	Yes	Yes	Yes
- Illumination Tech. 3900	Yes	Yes	Yes	Yes
PIXCI® -				
- Open/Close -				
- Single Board	Yes	Yes	Yes	No

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- Multiple Identical Boards	Yes	Yes	Yes	No
- Multiple Different Boards	Yes	Yes	No	No
- Driver Assistant	Yes	Yes	Yes	No
- Video Setup	Yes	Yes	Yes	No
- Save Video Setup	Yes	Yes	Yes	No
- Load Video Setup	Yes	Yes	Yes	No
- TWAIN Sourcery	Yes	Yes	Yes	No
- Image-Pro Sourcery	Yes	Yes	Yes	No
- Status	Yes	Yes	Yes	No
- Serial Peek & Poke	Yes	Yes	Yes	No
- Connections	Yes	Yes	Yes	Yes
- Camera Info	Yes	Yes	Yes	Yes
Help -				
- XCAP Release Notes	Yes	Yes	Yes	Yes
- XCAP Reference Manual	Yes	Yes	Yes	Yes
- PC Configuration Tips	Yes	Yes	Yes	Yes
File -				
- Save Image	Yes	Yes	Yes	No
- Load Image	Yes	Yes	Yes (u)	No
- Save Image Sequence	Yes	Yes	No	No
- Load Image Sequence	Yes	Yes	No	No
- E-Mail Image	Yes	Yes	No	No
- Print, Windows	Yes	Yes	Yes	No
- Print, PXIPL	Yes	Yes	No	No
- Duplicate Image	Yes	Yes	No	No
- Copy to Black Board	Yes	Yes	No	No
View -				
- Full Screen	Yes	Yes	No	No
- Palette	Yes	Yes	Yes (a)	Yes (a)
- Sequence Play	Yes	Yes	Yes	Yes
- Sequence Thumbnails	Yes	Yes	Yes	Yes
- Cursor	Yes	Yes	Yes	Yes
- Zoom, Pan, Scroll	Yes	Yes	Yes	Yes
- Launch 2nd Viewer	Yes	Yes	Yes	Yes
Examine				
- Pixel Peek	Yes	Yes	Yes (b)	Yes (b)
- Pixel Peek & Poke	Yes	Yes	Yes	Yes
- Pixel Plot Row	Yes	Yes	Yes (p)	Yes (p)
- Pixel Plot Column	Yes	Yes	Yes (p)	Yes (p)
- Pixel Plot Buffer	Yes	Yes	Yes (p)	Yes (p)
- Pixel Plot All Rows	Yes	Yes	No	No

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- Pixel Plot 3D	Yes	Yes	Yes	Yes
- SMPTE VITC	Yes	Yes	Yes	No
Modify -				
- Patterns	Yes	Yes	Yes	Yes
- Set	Yes	Yes	Yes (c)	Yes (c)
- Arithmetic	Yes	Yes	No	No
- Binning	Yes	Yes	No	No
- Contrast Modification	Yes	Yes	No	No
- Convolution	Yes	Yes	No	No
- Correlation Map	Yes	Yes	No	No
- Edge Detection	Yes	Yes	No	No
- FFT	Yes	Yes	No	No
- Interlace & Flicker	Yes	Yes	No	No
- Morphology	Yes	Yes	No	No
- Noise Generator	Yes	Yes	No	No
- Normalization	Yes	Yes	No	No
- Rotation & Shift	Yes	Yes	No	No
- Spatial Filtering	Yes	Yes	No	No
- Threshold	Yes	Yes	No	No
- Threshold, Adaptive	Yes	Yes	No	No
- Warp	Yes	Yes	No	No
- Copy & Resize	Yes	Yes	No	No
- Pair Arithmetic	Yes	Yes	No	No
- Pair Normalization	Yes	Yes	No	No
- Sequence Average	Yes	Yes	No	No
- Difference Sequence	Yes	Yes	No	No
- Tile Sequence	Yes	Yes	No	No
Measure -				
- Intensity Calibration	Yes	Yes	No	No
- Spatial Calibration	Yes	Yes	No	No
- Histogram	Yes	Yes	No	No
- Mass & Moments	Yes	Yes	No	No
- Line Profile	Yes	Yes	Yes (p,d,f)	Yes (p,d,f)
- Radial Mass Plot	Yes	Yes	No	No
- Ruler	Yes	Yes	Yes (d)	Yes (d)
- Protractor	Yes	Yes	No	No
- Cartesian Reticle	Yes	Yes	Yes (d)	Yes (d)
- Polar Reticle	Yes	Yes	No	No
- Dist. & Angle Crosshairs	Yes	Yes	No	No
- Shape Analysis	Yes	Yes	No	No
- Blob Analysis	Yes	Yes	No	No
- Particle Tracking	Yes	Yes	No	No

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- SubPixel Edger	Yes	Yes	No	No
- Ellipse Fitter	Yes	Yes	No	No
- Correlation Finder	Yes	Yes	No	No
Draw -				
- Arrow	Yes	Yes	Yes	Yes
- Text	Yes	Yes	No	No
- Point	Yes	Yes	No	No
- Points	Yes	Yes	No	No
- Bezier Curve	Yes	Yes	No	No
- Circle	Yes	Yes	No	No
- Circle Arc	Yes	Yes	No	No
- Ellipse	Yes	Yes	No	No
- Ellipse Arc	Yes	Yes	No	No
- Line	Yes	Yes	Yes	Yes
- Parallel Lines	Yes	Yes	No	No
- Path Curve	Yes	Yes	No	No
- Polyline	Yes	Yes	No	No
- Rectangle	Yes	Yes	No	No
- Window	Yes	Yes	Yes	Yes
- Annulus	Yes	Yes	No	No
- Annulus Arc	Yes	Yes	No	No
- Bezier Region	Yes	Yes	No	No
- Elliptical Annulus	Yes	Yes	No	No
- Elliptical Annulus Arc	Yes	Yes	No	No
- Path Enclosed	Yes	Yes	No	No
- Polygon	Yes	Yes	No	No
- Rectangular Frame	Yes	Yes	No	No
- Graphic Manager	Yes	Yes	Yes	Yes
- Image Overlay	Yes	Yes	No	No
- Paint Brush	Yes	Yes	No	No
- Paint Fill	Yes	Yes	No	No
Capture -				
- Snap	Yes	Yes	Yes	No
- Live	Yes (l)	Yes (l)	Yes (l)	No
- First Buffer	Yes	Yes	Yes	No
- Next Buffer	Yes (m)	Yes (m)	Yes (m)	No
- Previous Buffer	Yes (m)	Yes (m)	Yes (m)	No
- Last Buffer	Yes (m)	Yes (m)	Yes (m)	No
- Adjustments	Yes	Yes	Yes (e)	No
- Shortcuts	Yes	Yes	Yes	No
- GIO Event Capture Single	Yes	Yes	Yes	No
- GIO Event Capture Sequence	Yes	Yes	No	No

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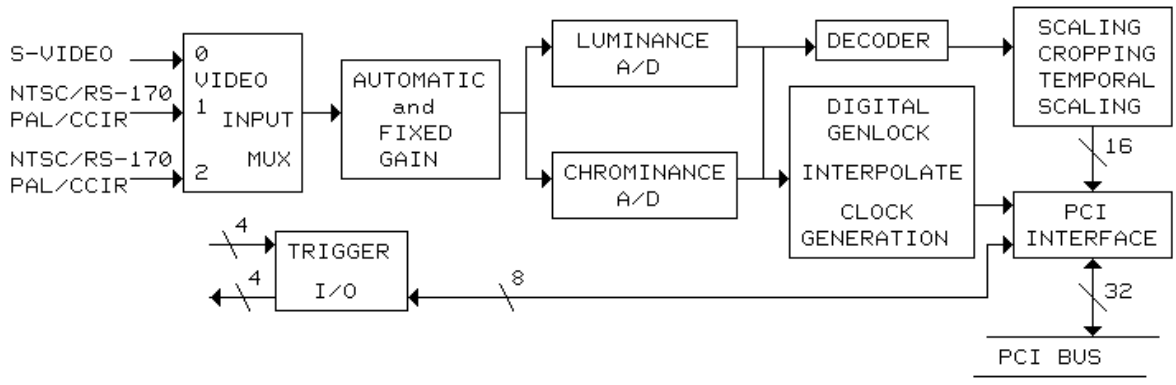
- Waterfall Display	Yes	Yes	Yes	No
- RGB Merge	Yes	Yes	No	No
- Quad Pixel Merge	Yes	No	No	No
- Frame Average	Yes	Yes	No	No
Sequence Capture (Single Sequence and Continuous Sequence) -				
- to Frame Buffers	Yes	Yes	Yes (g)	No
- to Frame Buffers at Event	Yes	Yes	No	No
- to Memory Buffers	Yes	Yes	Yes (g)	No
- to Memory Buffers at Event	Yes	Yes	No	No
- to Disk File	Yes	Yes	No	No
- to Disk File at Event	Yes	Yes	No	No
- to Image Files	Yes	Yes	No	No
- to Image Files at Event	Yes	Yes	No	No
- to StreamStor	Yes	No	No	No

Notes: For XCAP-Lite, the PIXCI imaging board is assumed installed and open for use. For XCAP-Demo, images can't be loaded or captured; a "synthetic" image can be created for viewing. (a) The View, Palette feature does not include save, load, import, or export. (b) The Examine, Pixel Peek feature does not include save. (c) The Modify, Set feature does not include non-rectangular regions. (d) The Measure features do not include calibration. (e) The Capture, Adjustments do not include save, load, or export. For color cameras with Bayer output, the white balance software feature allows creating a single set of customized settings. (f) The Line Profile is limited to straight lines. (g) The Sequence Capture to Frame Buffers does not include the strobe feature. The Sequence Capture does not include the time stamping feature. (l) Subject to the camera's mode being consistent with continuous capture; cameras in a "single shot trigger" mode only use the Snap feature. (m) Subject to the image resolution versus frame buffer memory size. (p) All plotting features do not include statistics, save, or export options. (u) For XCAP-Lite, images may not be loaded directly from an Internet URL. (w) I/O Port Peek & Poke feature available only under Windows 95, 98, and ME.

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6. Architecture, Applications, and Features

6.1. Architecture



Block Diagram of the PIXCI® SV4 imaging board

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6.1.1. Video Input Mux

The multiplexer selects the video source for the Automatic and Fixed Gain from the S-Video input connector (mux 0), from the BNC1 connector (mux 1), or from the BNC2 connector (mux 2). The multiplexer is designed to be switched during vertical blanking.

6.1.2. Automatic and Fixed Gain

The PIXCI® SV4 is configured for Fixed Gain by providing a fixed reference voltage for the A-D converters. Optionally, it can be modified to provide automatic gain for the A-D converters. Automatic gain automatically compensates for reduced amplitude in the analog signal input by adjusting the reference voltage for the A-D converters. Automatic gain, hue, brightness, saturation, and contrast adjustments can be programmed from 0% to more than 200%. The automatic gain control adjusts the video reference level for the A-D converters until the back porch of the Y video input is equal to a programmable value, nominally 0x38. Three other values may be selected for non-standard sync height to video, they are: 0x30, 0x34, and 0x3C.

6.1.3. Luminance A/D

Provides analog to digital conversion of NTSC, RS-170, CCIR, PAL, and the luminance (Y) component of S-Video sources. A programmable prefilter is used for horizontal luminance scaling to reduce aliasing artifacts. The luminance gain can be selected from values of 0% to 236.57%. The luminance and chrominance A-D converters run at 28.636363 MHz for NTSC video formats and 35.46895 MHz for PAL video formats. Digitizing the video signals at twice the typical sampling rate provides low noise digitization. The video inputs only need to be band limited to 14 MHz instead of the 7 MHz limit that would be required at the typical sampling rate. The chrominance and luminance inputs from the S-Video connector and each BNC input connector have low pass filters in the video input. The inputs to the A/D converters are AC coupled.

6.1.4. Chrominance A/D

Provides analog to digital conversion of the color (C) component of S-Video. A chroma comb filter may be enabled or disabled by software. The chrominance U component gain can be selected from values of 0% to 201.18%. The chrominance V component gain can be selected from values of 0% to 283.89%. The hue can be selected from values of -89.3 degrees to +90 degrees.

6.1.5. Decoder

The decoder separates the Y/C components and generates the U/V color difference signals. The PIXCI® SV4 imaging board converts analog video inputs from standard video sources such as S-Video, NTSC, RS-170, PAL, and CCIR to YCrCb in a 4:2:2 format.

6.1.6. Digital Genlock

The digital genlock circuit is used for precise digitization. It interpolates lines with lengths less than or greater than the programmed number of pixels. It generates the pixel clock for transferring image data to the PCI bus interface. The digital genlock circuit automatically recognizes unstable signals (for example, from a VCR) and adapts its locking mechanism to accommodate the source.

6.1.7. Scaling, Cropping

Interpolation is used to scale images down to 1/14 of their original size. Independent horizontal and vertical down scaling of the video input can be selected from ratios of 1:1 to 1:14. For horizontal scaling, 32 phase interpolation is used to accurately determine the value of a pixel. For vertical scaling, an 8 phase interpolation filter is used with a 768 pixel line store.

The window of video to be captured may be cropped in single pixel increments, then scaled in ratios from 1:1 to 1:14, down to as few as 4 pixels by 1 line of image data. Horizontal and vertical scaling is performed in real-time by interpolation, providing an accurate representation of the original image. Either frames or fields of video can be selected.

Some of the possible video formats are:
640 by 480 for NTSC square pixels,
720 by 480 for NTSC CCIR 601,
720 by 576 for PAL CCIR 601, and
768 by 576 for PAL square pixels.

6.1.8. Temporal Scaling

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Image sequences may be captured at full or reduced frame rates. Temporal decimation can reduce the frame rate down to one image per second.

6.1.9. Trigger I/O

Four input and four output TTL triggers can be used for synchronization with external events. The trigger signals are controlled by the host CPU.

For applications requiring asynchronous reset of the camera, it should be noted that PIXCI® SV4 requires two vertical sync intervals prior to digitizing the video correctly.

6.1.10. PCI Interface

The PIXCI® SV4 imaging board is designed to use the 132 Mbytes/second, burst mode transfer rate of the PCI bus. As a bus master, the PIXCI® SV4 imaging board sends image data to the PCI bus; it does not wait for the computer's CPU to read images from the board into PC memory.

Each PCI bus data cycle can move two pixels (32 bits). If burst mode is not used, the transfer can take several PCI bus cycles. If burst mode is used, two pixels can be transferred on each PCI bus data cycle. When digitizing full resolution video formats and scaling or cropping is not being performed to reduce the number of pixels to be transferred to the PCI bus, burst mode is required to avoid loosing pixels. The PCI bus can only achieve 132 MB/S data transfer rates by using burst mode. If burst mode is not supported or is disabled; only scaled, cropped, or reduced resolution images can be transferred on the PCI bus.

Image sequences may be captured at full or reduced frame rates, onto the PCI bus, for storage in the host computer's memory, or can be passed to other devices on the PCI bus such as disk controllers or S/VGA adapters.

6.1.11. Display

Image display is not a function of the PIXCI® SV4 imaging board, however it is discussed here since many applications require image display. The PIXCI® SV4 imaging board relies on an S/VGA board for image display. Depending on the VGA adapter, 24 bit RGB color images, 16 bit S-Video color images, or 8 bit monochrome images may be displayed. The full, scaled, or cropped image may be placed anywhere on the VGA screen.

Color or monochrome image data can be passed across the PCI bus directly to the S/VGA for live video-in-a-window display, depending on the S/VGA adapter. With a fast processor, fast PCI bus, and fast S/VGA adapter, 30 frame per second color image data may be displayed. Some S/VGA adapters provide graphics overlay on the live video.

6.2. Applications

- Automated Inspection
- Motion Analysis
- Metalurgical Analysis
- Biological Analysis
- Microscopy
- Medical Image Archival
- Robotics
- Laser Beam Analysis
- Object Tracking
- Multimedia
- Print Quality Inspection

6.3. Features

- Composite/S-Video/NTSC/RS-170/CCIR/PAL to YCrCb (4:2:2).
- Square Pixel and CCIR601 Resolution for NTSC and PAL Formats.
- Chroma Comb Filtering.
- Programmable Horizontal Scaling and Vertical Scaling.
- Programmable Cropping.
- Vertical Scaling Line Store.
- Programmable Temporal Decimation for Reduced Frame Rate.
- Programmable Hue, Brightness, Saturation, and Contrast.
- Double Frequency Oversampling A-D Converters.

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- Three Video Input Mux.
- NTSC/PAL Auto Detect.
- Automatic Gain Control.
- PCI Bus Master with Burst Mode for 132 MB/S Transfers.
- Packed or Planar Format.
- 512 Pixel Buffer to PCI Bus.
- Real-Time Digitization to PCI Bus and/or S/VGA Memory.
- Real-Time Digitization to Motherboard Memory.
- 4 Input Triggers and 4 Output Triggers.
- Plug 'N Play Operation.
- Extensive Image Processing Programmer's Libraries.

The PIXCI® SV4 imaging board, for the PCI bus, is designed to take advantage of the power of the host computer. Applications which were once restricted by limited memory or processing power can now be easily accomplished with the PIXCI® SV4 imaging board and a compatible PCI computer.

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7. Specifications

7.0.1. Video Input:

- Color or Monochrome Video Acquisition: S-Video, NTSC, PAL, RS-170, CCIR
- Minimum Voltage Input: 0.5 Volts
- Maximum Voltage Input: 2.0 Volts
- Resolution-Pixels:
  752x480: S-Video, NTSC, RS-170
  922x580: CCIR
  768x580: S-Video, PAL
- Resolution-Depth
  8 bit: RS-170, CCIR
  YUV [4:2:2]: NTSC, PAL
  YCrCb: S-Video
- Capture/Display Rate
  30 fps: S-Video, NTSC, RS-170
  25 fps: S-Video, PAL, CCIR

7.0.2. Bus Requirements

- 32 bit, 33 MHz PCI slot.
- 0.55 Amps @ +5 Volts
- 4.913 inches by 3.350 inches (short slot).

7.0.3. Transfer Rates

- Requires a burst mode PCI motherboard for full resolution image capture to motherboard DRAM. Contact EPIX for suggested motherboards.

7.0.4. Display - DOS

- Via Standard VGA: limited to 4 bits (16 gray levels), non real-time display.
- Via Super VGA: 8 bit, 256 gray level display. Color display via adapters supporting 24 bit RGB or Y/C video. S/VGA adapters must be VESA 1.0 compatible. Contact EPIX for suggested S/VGA adapters.

7.0.5. Display - Windows

- Display resolution as per installed VGA device driver.
- A DCI compatible S/VGA adapter is required for real-time display.

7.0.6. Connections

- 4 Pin DIN Receptacle: S-Video Input
- 2 BNC Jacks: Composite Video Input

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- DB15 Receptacle: TTL I/O Triggers
- Cables optionally available.

Specifications subject to change without notice.

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8. Software and Related Manuals

Extensive software is available as a ready-to-run programs or as programmer libraries for DOS or Windows NT/98/95. The software provides control for the capturing of images and image sequences, triggered capture, scaling, cropping, image processing, measurement, analysis, and display.

8.0.1. XCAP^{tm}

A powerful, interactive, ready-to-run program for Windows 2000/NT/98/95. XCAP has an extensive set of image processing functions. Features include image sequence capture, triggered capture, display, processing, printing, archiving, analysis, and calibrated measurement. Processing of images with up to 16 bits per pixel is supported. XCAP is available in four versions and is described in the chapter "XCAP"Software"Guide."

8.0.2. XCOBJ^{tm}

The royalty free XCOBJ Library empowers C/C++ and Windows programmers to control the PIXCI series of imaging boards. XCOBJ supports all versions and options of the PIXCI series.
Up to eight PIXCI imaging boards, of the same version and with the same options, can be operated selectively or simultaneously; allowing parallel control for multi-camera vision of a single event or object, or selective control for capturing multiple, independent, events or objects.
Through the unique flexibility of XCOBJ and the PIXCI imaging boards, single frames or video sequences of standard or nonstandard video sources can be captured, analyzed, displayed, and archived.
XCOBJ provides high level services, allowing programmers to concentrate on the imaging application, rather than focusing on board level programming and I/O ports. For virtually all applications, board level programming can be ignored!
XCOBJ automatically recognizes different versions and options of the PIXCI imaging cards, providing consistent access to features, and hiding hardware details and differences. Fundamental services, such as setting resolution, capturing, and accessing image data, are compatible with C libraries for other EPIX imaging board families; allowing easy porting and reuse of application programs.
The XCOBJ C/C++ libraries of object code allow embedding PIXCI control into user-written applications. Under Windows, the XCOBJ DLL also enables access from existing Windows applications which support "hooks" into DLLs.

8.0.3. PXIPL^{tm}

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9. In Case of Trouble

9.1. Software Problems - XCAP Error Messages

After XCAP is started and prior to the display of the first menu, the software checks for the presence of required BIOS software, the presence of the PIXCI® SV4 imaging board, and performs other tests. If any of the software checks fail, an error message will be displayed. Consult the XCAP manual for a description of the error messages and suggested remedies.

If error messages about "FIFO Overflow" are displayed, check the PC's setup menu to see if PCI burst mode is enabled. If burst mode is not enabled, the number of pixels per line may be limited to 200 pixels or less.

9.2. Hardware Problems

Some problems do not cause software error messages. Some problems may prevent the computer from powering up. Some problems may prevent the software from accessing the PIXCI® SV4 imaging board. These types of problems can be due to:

Power Supply	Insufficient power for the boards installed.
Touching Boards	One board's components are touching another board.

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Defective Cable(s)	Video input cable or DB15 cable has an open or short.
Video Input	Defective or incompatible video source.
Defective PIXCI SV4 imaging board	Defective integrated circuit, bad solder joint, physical damage, or static damage.
Motherboard	No PCI burst mode or no PCI BIOS. Defective PCI connector. PCI slot is not bus master capable.
S/VGA	S/VGA board is too slow, has insufficient memory, or is not an AGP or PCI board.

9.2.1. Power Supply Problems

The PC power supply usually has a printed rating of power available for the four standard PC voltages. The PIXCI® SV4 imaging board uses 500 milliamps from the +5 volt supply and 200 milliamps from the +12 volt supply. If other devices and the PIXCI® SV4 imaging board use more power than the power supply can provide, the power supply will shut down. In marginal situations, this may not happen until an operation is performed that requires additional power, such as increasing the number of pixels per line. Try removing non-essential boards from the system.

9.2.2. Touching Boards

If the components of one board touch those of another, damage to one or both boards can occur. Move one of the touching boards at least one slot away from the other.

9.2.3. Defective Cable

If a video input cable or DB15 cable is broken or shorted, the input or output will not be connected properly.

- Try another cable.
- Test the video or DB15 cable for shorts or opens with an ohmmeter.
- Test the video cable by connecting the video source directly to a monitor.

9.2.4. Video Input

If the video source is defective or incompatible, a blue image will be captured.

- Connect the video source directly to a monitor or oscilloscope and observe the signal.
- If the video signal is present, but is not digitized correctly, the camera lens may be closed or the cap may be covering the lens.
- The XCAP software may have a different video input connector selected than the video input connector with the desired video source. Check the video input mux software selection.

9.2.5. Motherboard

- If the motherboard does not support PCI burst mode, does not have a PCI BIOS, or the PIXCI® SV4 imaging board does not operate correctly, try another motherboard. Call EPIX for a list of suggested motherboards.
- The PCI bus connector on the motherboard may be defective. Try another PCI bus slot or another motherboard.
- The PCI bus slot may not support a PCI master. Try another PCI bus slot or another motherboard.

9.2.6. S/VGA Board

If the S/VGA board has insufficient memory, is not a PCI board, does not support PCI burst mode, or the XCAP software does

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not operate correctly, try another S/VGA board. Call EPIX for a list of suggested S/VGA boards.

9.3. If All Else Fails

If none of the above suggestions have solved the problem, call your distributor (if you purchased the board thru a distributor), or FAX or e-mail EPIX for technical support. In the FAX or e-mail, include error messages that were displayed, describe symptoms observed, and steps taken to attempt to solve the problem. It is helpful to call from a phone near the computer with the PIXCI® SV4 imaging board installed.

The PIXCI® SV4 imaging board can be damaged during shipment. If damage is visible, check the shipping container for damage, and notify the freight carrier.

If the board must be returned for test or repair, call EPIX for a Return Materials Authorization (RMA) number. Be prepared to describe the problem that has been encountered and what steps have been taken to attempt to correct it. Please include a written description of symptoms, error messages, and steps taken to attempt to solve the problem with the packing list for the material returned.

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10. Hardware Revision Description

10.1. PIXCI® SV4

Changes from PIXCI SV3:

1. Added input/output buffer to prevent latchup of Bt848 when external equipment is powered up prior to Bt848.
2. Changed to surface mount voltage regulator and crystal oscillators.

Changes from PIXCI SV2:

1. Added second BNC connector. Video encoder now handles 3 video inputs.
2. Added video input low pass filters for each of the BNC inputs. These filters are identical to the filter on the S-Video input.
3. Added 1K ohm pullup resistors for the 8 trigger input, strobe outputs. These signals are open collector with high impedance pullup resistors.

Changes from PIXCI SV:

1. Added artwork to incorporate engineering changes that were added as wires or etch cuts.

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11. Certification and Warranty

11.1. Certification and Testing

The PIXCI SV4 imaging board has been tested per EMC directive 89/336/EEC and has 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 test 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 SV4 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).

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It may be that the camera connected to the PIXCI SV4 is the source of radiation. To determine if the camera is the source of interference, remove power to 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.

11.2. Limited Warranty

EPIX, Inc. warrants to the original purchaser of the PIXCI SV4 board that the PIXCI SV4 board 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 include service to repair damage to the product resulting from accident, disaster, misuse, abuse, or non-EPIX, Inc. modification of the product.
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.
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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.

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12. Footnotes

[1]
If modifying a previously installed XCAP: Right click the XCAP icon, select "Properties", select "Program", and modify the "Name" or "Command Line" as needed.

[2]
If the PC is configured with a selective boot option (i.e. so as to boot Windows or boot old DOS), be sure to modify the correct CONFIG.SYS.

[3]
If modifying a previously installed XCAP: Right click the XCAP icon, select "Properties", select "Program", and modify the "Name" or "Command Line" as needed.

[4]
If modifying a previously installed XCAP: Right click the XCAP icon, select "Properties", select "Program", and modify the "Name" or "Command Line" as needed.

[5]
The identification code is provided on a card enclosed with the CD or diskette(s), 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!!

[6]
XCAP-Std and XCAP-Plus also require an authorization key to activate all features.

[7]
The required "XCAP Sourcery" TWAIN driver is a separate software product and is not included with XCAP.

[8]
The required "XCAP Sourcery" Image-Pro driver is a separate software product and is not included with XCAP.

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