

Xtium-CLHS PX4™

User's Manual

Edition 1.00

sensors | cameras | **frame grabbers** | processors | software | vision solutions



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www.teledynedalsa.com

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About Teledyne DALSA

Teledyne DALSA is an international high performance semiconductor and electronics company that designs, develops, manufactures, and markets digital imaging products and solutions, in addition to providing wafer foundry services.

Teledyne DALSA Digital Imaging offers the widest range of machine vision components in the world. From industry-leading image sensors through powerful and sophisticated cameras, frame grabbers, vision processors and software to easy-to-use vision appliances and custom vision modules.

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Overview

Product Part Numbers

Xtium-CLHS PX4 Board

Item	Product Number
Xtium-CLHS PX4	OR-Y4S0-XPX70
For OEM clients, this manual in printed form, is available on request	OC-Y4HM-PUSR0

Table 1: Xtium-CLHS PX4 Board Product Numbers

Xtium-CLHS PX4 Software

Item	Product Number
Sapera LT version 7.50 or later for full feature support (required but sold separately) <ol style="list-style-type: none">1. Sapera LT: Provides everything needed to build imaging application2. Current Sapera compliant board hardware drivers3. Sapera documentation: (compiled HTML help, Adobe Acrobat® (PDF)	OC-SL00-0000000
(optional) Sapera Processing Imaging Development Library includes over 600 optimized image-processing routines.	Contact Sales at Teledyne DALSA

Table 2: Xtium-CLHS PX4 Software Product Numbers

Optional Xtium-CLHS PX4 Cables & Accessories

Item	Product Number
DH40-27S cable assembly to blunt end: 6 ft cable I/O 27 pin Hirose connector to blunt end. This cable assembly connects to J1.	OR-YXCC-27BE2M0
Cable set to connect to J4 Internal I/O Signals connector (J4: 26-pin SHF-113-01-L-D-RA)	see suggested cables
Cable assembly to connect to J5 (Board Sync) Connecting 2 boards Connection 3 or 4 boards	OR-YXCC-BSYNC20 OR-YXCC-BSYNC40
Power interface cable required when supplying power to J1	OR-YXCC-PWRY00
CX4 Cable:	Contact Sales at Teledyne DALSA

Table 3: Xtium-CLHS PX4 Cables & Accessories

About the Xtium-CLHS PX4 Frame Grabber



Series Key Features

- Compliant with Camera Link HS (CLHS) specification version 1.0 (M-Protocol) (visit <http://www.visiononline.org/vision-standards.cfm> for details on industry standards)
- The specification defines a device discovery methodology that can be automated and which provides plug and play capability
- Camera Link HS cameras implement GenICam and associated GenCP, thus resulting in ease of use for Teledyne DALSA or third party cameras
- Uses a PCIe x4 Gen2 slot to maximize transfers to host computer buffers
- Acquire from Monochrome CLHS cameras, both area scan and linescan
- Acquire from RGB CLHS cameras, both area scan and linescan (contact sales at Teledyne DALSA for availability)
- Output lookup tables (contact sales at Teledyne DALSA for availability)
- Vertical and Horizontal Flip supported on board
- External Input Triggers and Shaft Encoder inputs, along with Strobe outputs
- Supports Data Forwarding Mode, where camera image data is automatically transferred to one or more Xtium-CLHS boards (each installed in a separate computer), allowing distributed processing of the acquisition.
- Supports Multi-board Sync for trigger events, to simultaneously acquire from multiple cameras.
- Supports a number of acquisition events in compliance with "Teledyne DALSA's Trigger to Image Reliability"
- RoHS compliant

See "Technical Specifications" on page 52 for detailed information.

User Programmable Configurations

Use the Xtium-CLHS PX4 firmware loader function in the Teledyne DALSA Device manager utility to select firmware for one of the supported modes. Firmware selection is made either during driver installation or manually later on (see "Firmware Update: Manual Mode" on page 12). Currently there is only one firmware version available:

- **Camera Link HS camera** (*installation default*):
Support for 1 Camera Link HS camera, 8/10/12/14/16 bits per pixel, monochrome.

ACUPlus: Acquisition Control Unit

ACUPlus consists of a grab controller, one pixel packer, and one time base generator.

ACUPlus acquires variable frame sizes up to 64KB per horizontal line and up to 16 million lines per frame. ACUPlus can also capture an infinite number of lines from a line scan camera without losing a single line of data.

DTE: Intelligent Data Transfer Engine

The Xtium-CLHS PX4 intelligent Data Transfer Engine ensures fast image data transfers between the board and the host computer with zero CPU usage. The DTE provides a high degree of data integrity during continuous image acquisition in a non-real time operating system like Windows. DTE consists of intelligent DMA units with auto-loading Scatter-Gather tables.

PCI Express x4 Gen2 Interface

The Xtium-CLHS PX4 is a universal PCI Express x4 Gen2 board, compliant with the PCI Express 2.0 specification. The Xtium-CLHS PX4 board achieves transfer rates up to 1.8Gbytes/sec. to host memory. Note that performance can be lower depending on PC and/or programmed configuration.

The Xtium-CLHS PX4 board occupies one PCI Express x4 Gen2 expansion slot and one chassis opening.

Important:

- To obtain the maximum transfer rate to host memory, make sure the Xtium-CLHS PX4 is in a computer with a Gen2 slot. The board will work in a Gen1 slot, but only with half the possible transfer performance.
- If the computer only has a PCI Express x16 slot, test directly or review the computer documentation to know if the Xtium-CLHS PX4 is supported. Computer motherboards may only support x16 graphic video board products in x16 slots.

Advanced Controls Overview

Visual Indicators

Xtium-CLHS PX4 features 2 LED indicators to facilitate system installation and setup (see Status LEDs Functional Description). These indicators provide visual feedback on the board status and camera status.

External Event Synchronization

Trigger inputs and strobe signals precisely synchronize image captures with external events.

Camera Link HS Communication Port

A single Sopera LT Acquisition Device provides access to the Camera Link HS camera configuration via the board device driver. The communication port presents a seamless interface to access GenICam camera features.

Quadrature Shaft Encoder

An important feature for web scanning applications, the Quadrature Shaft Encoder inputs allow synchronized line captures from external web encoders (see [J1- I/O Connector](#)). The Xtium-CLHS PX4 provides a RS-422 input that supports a tick rate of up to 5 MHz.

Development Software Overview

Sapera++ LT Library

Sapera++ LT is a powerful development library for image acquisition and control. Sapera++ LT provides a single API across all current and future Teledyne DALSA hardware. Sapera++ LT delivers a comprehensive feature set including program portability, versatile camera controls, flexible display functionality and management, plus easy to use application development wizards. Applications are developed using either C++ or .NET frameworks.

Sapera++ LT comes bundled with CamExpert, an easy to use camera configuration utility to create new, or modify existing camera configuration files.

Sapera Processing Library

Sapera Processing is a comprehensive set of C++ classes or .NET classes for image processing and analysis. Sapera Processing offers highly optimized tools for image processing, blob analysis, search (pattern recognition), OCR and barcode decoding.

Installing Xtium-CLHS PX4

Warning! (Grounding Instructions)

Static electricity can damage electronic components. Please discharge any static electrical charge by touching a grounded surface, such as the metal computer chassis, before performing any hardware installation. If you do not feel comfortable performing the installation, please consult a qualified computer technician.



Important: Never remove or install any hardware component with the computer power on. Disconnect the power cord from the computer to disable the power standby mode. This prevents the case where some computers unexpectedly power up when a board is installed.

Installation

The installation sequence is as follows:

- Install the board hardware into an available PCI Express x4 Gen2 slot.
- Turn on the computer.
- Install the Sopera LT Development Library or only its 'runtime library'.
- Install the Xtium-CLHS PX4 Sopera board driver.
- Update the board firmware if required.
- Reboot the computer.
- Connect a CLHS camera and test.

Hardware Installation

- Turn the computer off, disconnect the power cord (disables power standby mode), and open the computer chassis to allow access to the expansion slot area.
- Install the Xtium-CLHS PX4 into a free PCI Express x4 Gen2 expansion slot (or an available x8 slot). Note that some computer's x16 slot may support boards such as the Xtium-CLHS PX4, not just display adapters.
- Connect a spare power supply connector to [J7](#) when DC power is required on the external signals connector [J1/J4](#). See Power Cable Assembly OR-YXCC-PWRY00 for information about an adapter for older computers.
- Close the computer chassis and turn the computer on.
- Logon to the workstation as administrator or with an account that has administrator privileges.
- Windows will find the Xtium-CLHS PX4 and start its **Found New Hardware Wizard**. Click on the **Cancel** button to close the Wizard.
- [Connect a CLHS camera](#) to J3 after installing Sopera as described below. Test with [CamExpert](#).

Multi-board Data Forwarding Hardware Setup

- For distributed processing applications, see Data Forwarding Setup for information about data forwarding cabling with one to six Xtium-CLHS boards.

Multi-board Sync & I/O Setup

- For multi-board sync applications, see J5: Multi-Board Sync / Bi-directional General I/Os for information on using two to four Xtium-CLHS boards in one computer.

Sapera LT Library & Xtium-CLHS PX4 Driver Installation

- Insert the Teledyne DALSA Sapera Essential CD-ROM. If **AUTORUN** is enabled on your computer, the installation menu is presented.
- If **AUTORUN** is not enabled, use Windows Explorer and browse to the root directory of the CD-ROM. Execute *autorun.exe* to start the installation menu.
- From the CD Browser menu, select the *Software Installation* menu to install the required Sapera components. Select the Xtium-CLHS PX4 Driver and required Sapera LT package. Click the Next button to cycle through the various board product families.
- If the installation of Sapera and Board Drivers is not done through the CD Browse applet, make sure Sapera LT is installed before Teledyne DALSA board drivers.
- The installation program may prompt to reboot the computer. It is not necessary to reboot the computer between the installation of Sapera LT and the board driver. Simply reboot once all the software and board drivers are installed.
- During the late stages of the installation, the Xtium-CLHS PX4 firmware loader application starts. This is described in detail in the following section.
- If Windows displays any unexpected message concerning the board, power off the system and verify the Xtium-CLHS PX4 is installed in the slot properly. You should also note the board's status LED color and compare it to the defined LED states as described in Status LEDs Functional Description.

Refer to *Sapera LT User's Manual* for additional details about Sapera LT.

Xtium-CLHS PX4 Firmware Loader

The Device Manager-Firmware Loader program automatically executes at the end of the driver installation and on every subsequent reboot of the computer. It will determine if the Xtium-CLHS PX4 requires a firmware update. If firmware is required, a dialog displays. This dialog also allows the user to load alternative firmware if available for the Xtium-CLHS PX4.

Important: In the rare case of firmware loader errors please see "Recovering from a Firmware Update Error" on page 25.

Firmware Update: Automatic Mode

Click **Automatic** to update the Xtium-CLHS PX4 firmware. The **Xtium-CLHS PX4** currently supports one firmware configuration.

See "User Programmable Configurations" on page 7 for details on all supported modes, selected via a manual update of alternative firmware.

With multiple Xtium-CLHS PX4 boards in the system, all are updated with new firmware. If any installed Xtium-CLHS PX4 board installed in a system already has the correct firmware version, an update is not required. In the following screen shot a single Xtium-CLHS PX4 board is installed and ready for a firmware upgrade.

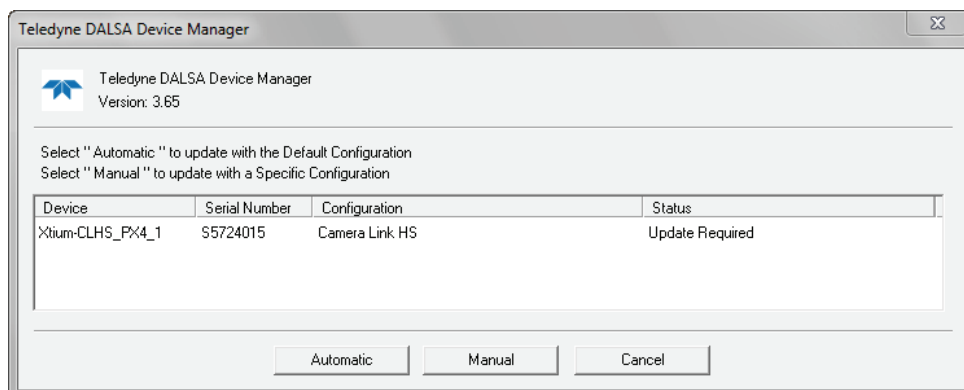


Figure 1: Automatic Firmware Update

Firmware Update: Manual Mode

Select **Manual** mode to load firmware other than the default version or when, in the case of multiple Xtium-CLHS PX4 boards in the same system, if each requires different firmware.

The following figure shows the Device Manager manual firmware screen. Displayed is information on all installed Xtium-CLHS PX4 boards, their serial numbers, and their firmware components.

Do a manual firmware update as follows:

- Select the Xtium-CLHS PX4 to update via the board selection box (if there are multiple boards in the system).
- From the Configuration field drop menu select the firmware version required (typical required or offered to support different CLHS cameras).
- Click on the Start Update button.
- Observe the firmware update progress in the message output window.
- Close the Device manager program when the device reset complete message is shown.

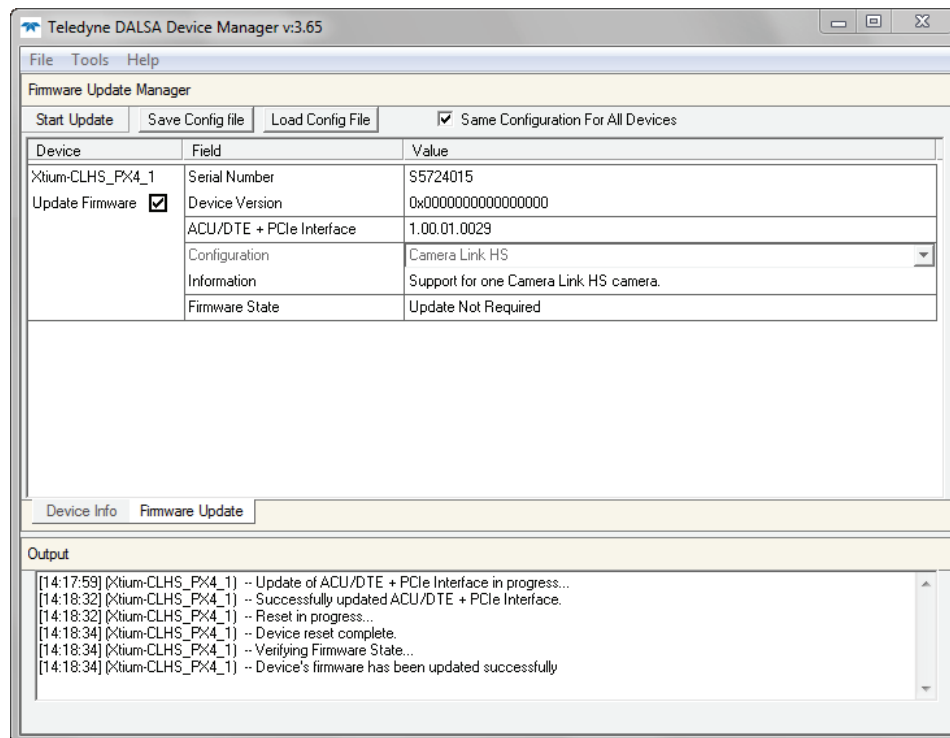


Figure 2: Manual Firmware Update

Executing the Firmware Loader from the Start Menu

If required, the Xtium-CLHS PX4 Firmware Loader program is executed via the Windows Start Menu shortcut **Start • Programs • Teledyne DALSA • Xtium-CLHS PX4 Driver • Firmware Update**. A firmware change after installation would be required to select a different configuration mode. See "User Programmable Configurations" on page 7.

Requirements for a Silent Install

Both Sapera LT and the Xtium-CLHS PX4 driver installations share the same installer technology. When the installations of Teledyne DALSA products are embedded within a third party's product installation, the mode can either have user interaction or be completely silent. The following installation mode descriptions apply to both Sapera and the hardware driver.



Note: You must reboot after the installation of Sapera LT. However, to streamline the installation process, Sapera LT can be installed without rebooting before installing the board hardware device drivers. The installations then complete with a single final system reboot.

Perform Teledyne DALSA embedded installations in either of these two ways:

- **Normal Mode**
The default mode is interactive. This is identical to running the setup.exe program manually from Windows (either run from Windows Explorer or the Windows command line).
- **Silent Mode**
This mode requires no user interaction. A preconfigured "response" file provides the user input. The installer displays nothing.

Silent Mode Installation

A Silent Mode installation is recommended when integrating Teledyne DALSA products into your software installation. The silent installation mode allows the device driver installation to proceed without the need for mouse clicks or other input from a user.

Preparing a Silent Mode Installation requires two steps:

- Prepare the response file, which emulates a user.
- Invoke the device driver installer with command options to use the prepared response file.

Creating a Response File

Create the installer response file by performing a device driver installation with a command line switch "-r". The response file is automatically named `setup.iss` and is saved in the `\windows` folder. If a specific directory is desired, the switch `-f1` is used.

As an example, to save a response file in the same directory as the installation executable of the Xtium-CLHS PX4, the command line would be:

```
Xtium-CLHS_PX4_1.00.00.0000 -r -f1".\setup.iss"
```

Running a Silent Mode Installation

A device driver silent installation, whether done alone or within a larger software installation requires the device driver executable and the generated response file `setup.iss`.

Execute the device driver installer with the following command line:

```
Xtium-CLHS_PX4_1.00.00.0000 -s -f1".\setup.iss"
```

Where the `-s` switch specifies the silent mode and the `-f1` switch specifies the location of the response file. In this example, the switch `-f1".\setup.iss"` specifies that the `setup.iss` file be in the same folder as the device driver installer.



Note: On Windows 7 and 8, the Windows Security dialog box will appear unless one has already notified Windows to 'Always trust software from "Teledyne DALSA Inc."' during a previous installation of a driver.

Silent Mode Uninstall

Similar to a silent installation, a response file must be prepared first as follows.

Creating a Response File

The installer response file is created by performing a device driver un-installation with a command line switch "-r". The response file is automatically named `setup_uninstall.iss` which is saved in the \windows folder. If a specific directory is desired, the switch "-f1" is used.

As an example, to save a response file in the same directory as the installation executable of the Xtium-CLHS PX4, the command line would be:

```
Xtium-CLHS_PX4_1.00.00.0000 -r -f1".\setup_uninstall.iss"
```

Running a Silent Mode Uninstall

Similar to the device driver silent mode installation, the un-installation requires the device driver executable and the generated response file `setup.iss`.

Execute the device driver installer with the following command line:

```
Xtium-CLHS_PX4_1.00.00.0000 -s -f1".\setup_uninstall.iss"
```

Where the `-s` switch specifies the silent mode and the `-f1` switch specifies the location of the response file. In this example, the switch `-f1".\setup_uninstall.iss"` specifies that the `setup_uninstall.iss` file be in the same folder as the device driver installer.

Silent Mode Installation Return Code

A silent mode installation creates a file "corinstall.ini" in the Windows directory. A section called [SetupResult] contains the 'status' of the installation. A value of **1** indicates that the installation has started and a value of **2** indicates that the installation has terminated.

A silent mode installation also creates a log file "setup.log" which by default is created in the same directory and with the same name (except for the extension) as the response file. The /f2 option enables you to specify an alternative log file location and file name, as in `Setup.exe /s /f2"C:\Setup.log"`.

The "setup.log" file contains three sections. The first section, [InstallShield Silent], identifies the version of InstallShield used in the silent installation. It also identifies the file as a log file. The second section, [Application], identifies the installed application name, version, and the company name. The third section, [ResponseResult], contains the 'ResultCode' indicating whether the silent installation succeeded. A value of **0** means the installation was successful.

Installation Setup with CorAppLauncher.exe

The installation setup can be run with the CorAppLauncher.exe tool provided with the driver.

- Install the board driver and get CorAppLauncher.exe from the \bin directory of the installation.
- When running the installation, CorAppLauncher.exe will return only when the installation is finished.
- When run from within a batch file, obtain the installation exit code from the ERRORLEVEL value.
- The arguments to CorAppLauncher.exe are
 - l: Launch application
 - f: Application to launch. Specify a fully qualified path.

As an example:

- `CorAppLauncher -l -f"c:\driver_install\Xtium-CLHS_PX4_1.00.00.0000.exe"`
- `IF %ERRORLEVEL% NEQ 0 goto launch error`

Note: There is a 32-bit and 64-bit version of CorAppLauncher.exe. When installing the driver, only the version related to the OS is installed. However, the 32-bit version is usable on either 32-bit or 64-bit Windows.

Custom Driver Installation using install.ini

Customize the driver installation by parameters defined in the file "install.ini".

By using this file, the user can:

- Select the user default configuration.
- Select different configurations for systems with multiple boards.
- Assign a standard Serial COM port to board.

Creating the install.ini File

- Install the driver in the target computer. All Xtium-CLHS PX4 boards required in the system must be installed.
- Configure each board's acquisition firmware using the Teledyne DALSA Device Manager tool (see Device Manager – Board Viewer).
- When each board setup is complete, using the Teledyne DALSA Device Manager tool, click on the **Save Config File** button. This will create the "install.ini" file.

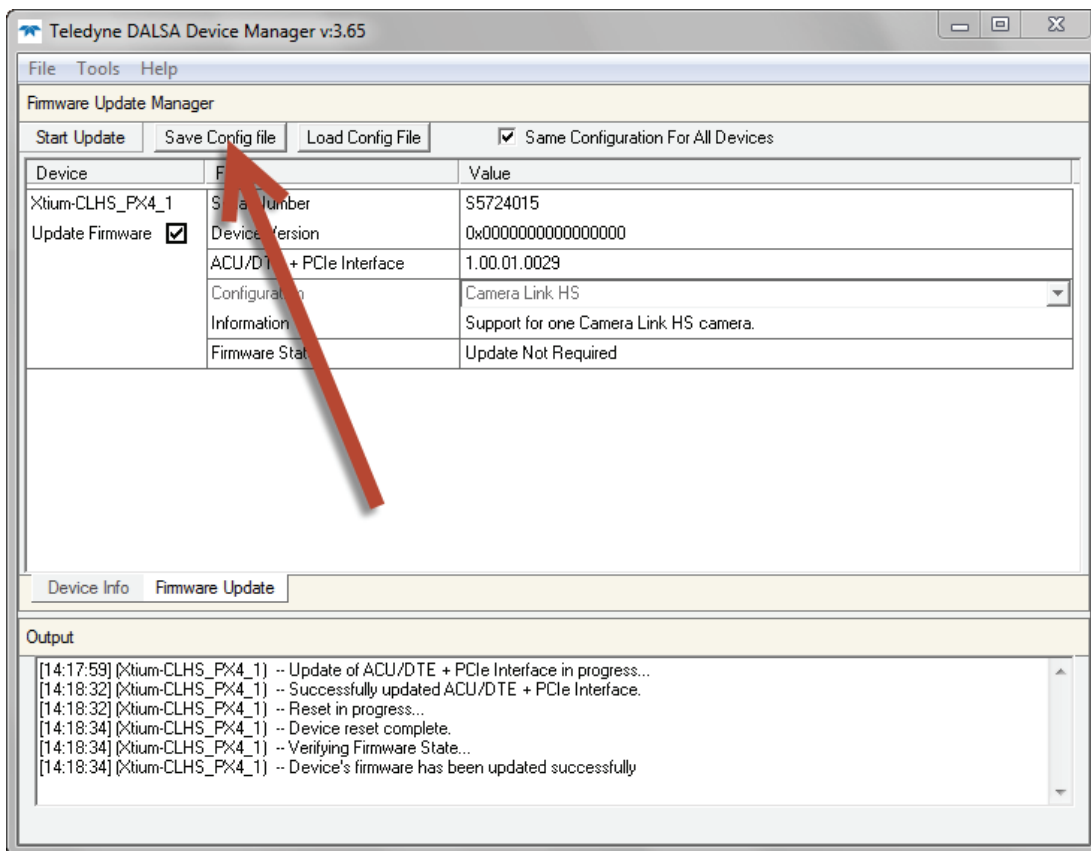


Figure 3: Create an install.ini File

Run the Installation using install.ini

Copy the install.ini file into the same directory as the setup installation file. Run the setup installation as normal. The installation will automatically check for an install.ini file and if found, use the configuration defined in it.

Upgrading Sapera or Board Driver

When installing a new version of Sapera or a Teledyne DALSA acquisition board driver in a computer with a previous installation, the current version **must** be un-installed first. Described below are two upgrade situations. Note that if the board is installed in a different slot, the new hardware wizard opens. Answer as instructed in section "Installation" on page 10.

Board Driver Upgrade Only

Minor upgrades to acquisition board drivers are distributed as ZIP files available in the Teledyne DALSA web site www.teledynedalsa.com/mv/support. Board driver revisions are also available on the next release of the Sapera Essential CD-ROM.

Often minor board driver upgrades do not require a new revision of Sapera. To confirm that the current Sapera version will work with the new board driver:

- Check the new board driver ReadMe file before installing, for information on the minimum Sapera version required.
- If the ReadMe file does not specify the Sapera version required, contact Teledyne DALSA Technical Support (see "Technical Support" on page 76).

To upgrade the board driver only:

- Logon the computer as an administrator or with an account that has administrator privileges.
- In **Windows XP**, from the start menu select **Start • Settings • Control Panel • Add or Remove Programs**. Select the Teledyne DALSA Xcelera board driver and click **Remove**.
- **Windows XP only:**
 - When the driver un-install is complete, reboot the computer.
 - Logon the computer as an administrator again.
- In **Windows 7**, from the start menu select **Start • Settings • Control Panel • Programs and Features**. Double-Click the Teledyne DALSA Xcelera board driver and click **Remove**.
- In **Windows 8**, just type Control Panel while in the start screen, or click the arrow in the lower left side to bring up the all applications window. Select Programs and Features, then double-click the Teledyne DALSA Xcelera board driver and click **Remove**.
- Install the new board driver. Run **Setup.exe** if installing manually from a downloaded driver file.
- If the new driver is on a Sapera Essential CD-ROM follow the installation procedure described in Sapera LT Library & Xtium-CLHS PX4 Driver Installation.
- **Important:** You cannot install a Teledyne DALSA board driver without Sapera LT installed on the computer.

Upgrading both Sapera and Board Driver

When upgrading both Sapera and the acquisition board driver, follow the procedure described below.

- Logon the computer as an administrator or with an account that has administrator privileges.
- In **Windows XP**, from the start menu select **Start • Settings • Control Panel • Add or Remove Programs**. Select the Teledyne DALSA Xcelera board driver and click **Remove**. Follow by also removing the older version of Sapera LT.
- In **Windows 7**, from the start menu select **Start • Settings • Control Panel • Programs and Features**. Double-click the Teledyne DALSA Xcelera board driver and click **Remove**. Follow by also removing the older version of Sapera LT.
- In **Windows 8**, just type Control Panel while in the start screen, or click the arrow in the lower left side to bring up the all applications window. Select Programs and Features, then double-click the Teledyne DALSA Xcelera board driver and click **Remove**. Follow by also removing the older version of Sapera LT.

- Reboot the computer and logon the computer as an administrator again.
- Install the new versions of Sapera and the board driver as if this was a first time installation. See "Sapera LT Library & Xtium-CLHS PX4 Driver Installation" on page 11 for installation procedures.

Displaying Xtium-CLHS PX4 Board Information

The Device Manager program also displays information about the Xtium-CLHS PX4 boards installed in the system. To view board information run the program via the Windows Start Menu shortcut **Start • Programs • Teledyne DALSA • Xtium-CLHS PX4 Device Driver • Device Manager**.

Device Manager – Board Viewer

The following screen image shows the Device Manager program with the Information/Firmware tab active. The left window displays all Teledyne DALSA boards in the system and their individual device components. The right window displays the information stored in the selected board device. This example screen shows the Xtium-CLHS PX4 board information.

Generate the Xtium-CLHS PX4 device manager report file (BoardInfo.txt) by clicking **File • Save Device Info**. Teledyne DALSA Technical Support may request this report to aid in troubleshooting installation or operational problems.

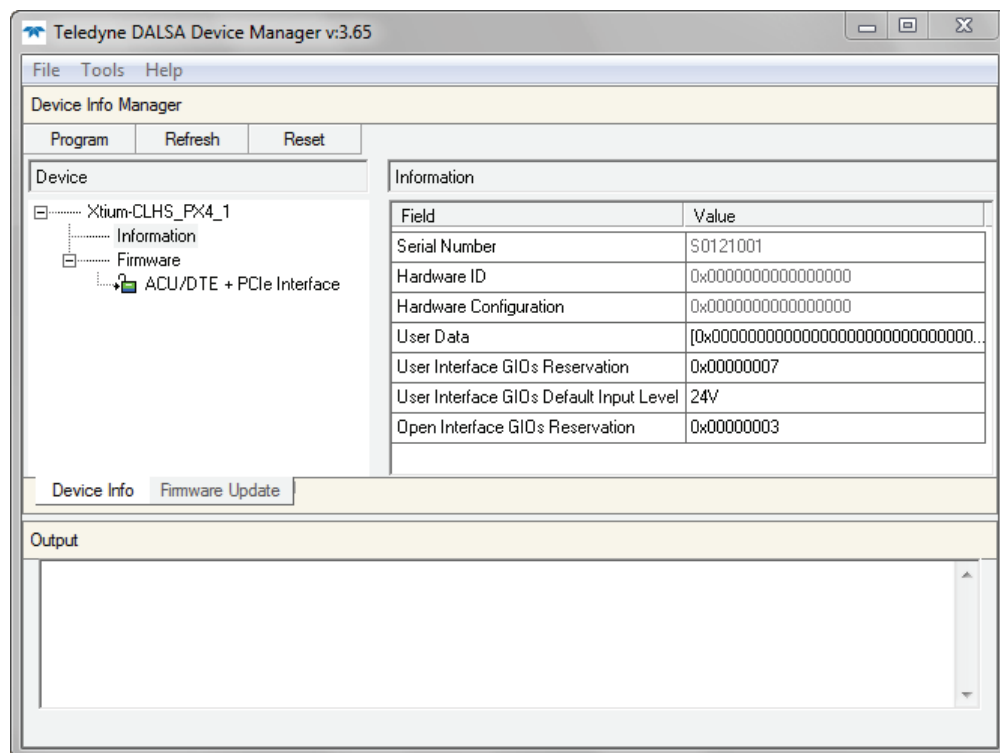


Figure 4: Board Information via Device Manager

Information Field Description

- **Serial Number** [Read-Only]: Displays the board Serial Number.
- **Hardware ID** [Read-Only]: This field identifies future hardware changes affecting the operation of the board.
- **Hardware Configuration** [Read-Only]: This field states the presence or absence of optional components.
- **User Data** [Read/Write]: This is a 64 byte general purpose user storage area. For information on how to read/write this field at the application level, contact Teledyne DALSA Technical Support.

- **User Interface GIOs Reservation** [Read/Write]: Use this field to reserve User Interface GIOs for use by the acquisition module. By default, boards are shipped with User Interface General Inputs 1 & 2 reserved for External Triggers and User Interface General Output 1 reserved for Strobe Output.

Click on the 'Value' field to open the dialog box show below. Disable any GIO reservations that are not required. Click the OK button to update the value field.

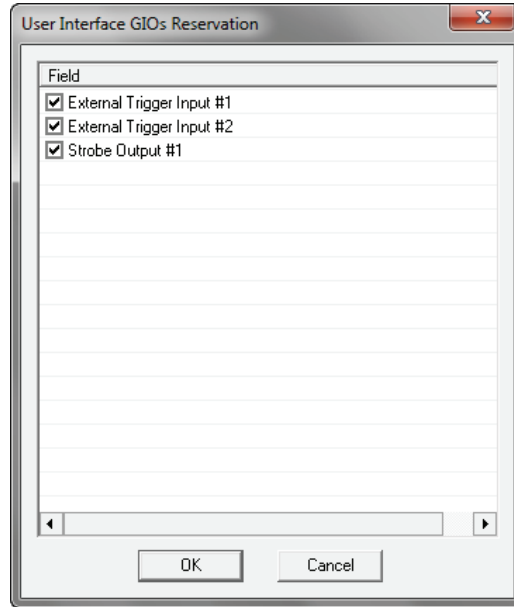


Figure 5: User Interface GIOs Reservation

- **User Interface GIOs Default Input Level** [Read/Write]: Use this field to select the default input level of the User Interface GIOs. By default, boards are shipped with inputs set for 24V signaling. Note that the input level can also be modified at the application level.

Click on the 'Value' field to open the drop selection box show below. Select the input signal level detection required.

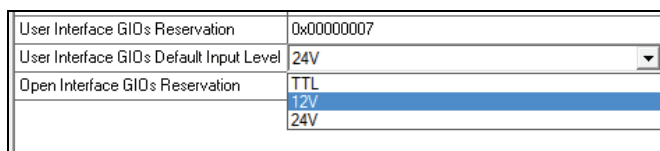


Figure 6: GIOs Default Input Level

- **Open Interface GIOs Reservation** [Read/Write]: Use this field to reserve Open Interface GIOs for use by the acquisition module. By default, boards are shipped with Open Interface GIOs 1 & 2 reserved for Board Sync 1 & 2.

Click on the 'Value' field to open the dialog box show below. Disable any GIO reservations that are not required. Click the OK button to update the value field.

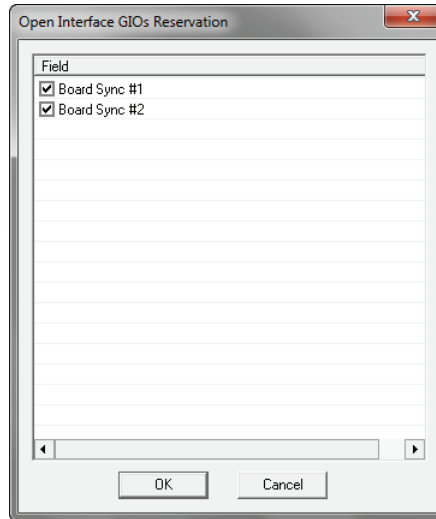


Figure 7: Open Interface GIOs Reservation

Configuring Sopera

Viewing Installed Sopera Servers

The Sopera configuration program (**Start • Programs • Teledyne DALSA • Sopera LT • Sopera Configuration**) allows the user to see all available Sopera servers for the installed Sopera-compatible boards. The **System** entry represents the system server. It corresponds to the host machine (your computer) and is the only server that should always be present.

Increasing Contiguous Memory for Sopera Resources

The **Contiguous Memory** section lets the user specify the total amount of contiguous memory (a block of physical memory, occupying consecutive addresses) reserved for the resources needed for **Sopera buffers** allocation and **Sopera messaging**. For both items, the **Requested** value dialog box shows the 'CorMem' driver default memory setting while the **Allocated** value displays the amount of contiguous memory allocated successfully. The default values will generally satisfy the needs of most applications.

The **Sopera buffers** value determines the total amount of contiguous memory reserved at boot time for the allocation of dynamic resources used for frame buffer management such as scatter-gather list, DMA descriptor tables plus other kernel needs. Adjust this value higher if your application generates any out-of-memory error while allocating host frame buffers or when connecting the buffers via a transfer object. You can approximate the worst-case scenario amount of contiguous memory required as follows:

- Calculate the total amount of host memory used for one frame buffer
[number of pixels per line • number of lines • (2 - if buffer is 10/12/14 or 16 bits)].
- Provide 200 bytes per frame buffer for Sopera buffer resources.
- Provide 64 bytes per frame buffer for metadata. Memory for this data is reserved in chunks of 64kB blocks.

- Provide 48 bytes per frame buffer for buffer management. Memory for this data is reserved in chunks of 64kB blocks.
- For each frame buffer DMA table, allocate 24 bytes + 8 bytes for each 4kB of buffer. For example, for a 120x50x8 image: $120 \times 50 = 6000 = 1.46 \text{ 4kB blocks} \rightarrow$ roundup to 2 4kB blocks. Therefore $24 \text{ bytes} + (2 * 8 \text{ bytes}) = 40 \text{ bytes}$ for DMA tables per frame buffer. Memory for this data is reserved in chunks of 64kB blocks. If vertical flipping is enabled, one must add 16 bytes per line per buffer. For example, for an image 4080x3072 image: $16 \text{ bytes} * 3072 = 49152 \text{ bytes}$.
- Note that Sapera LT reserves the 1st 5MB for its own resources, which includes the 200 bytes per frame buffer mentioned above.
- Test for any memory error when allocating host buffers. Simply use the Buffer menu of the Sapera Grab demo program (see "Grab Demo Overview" on page 33) to allocate the number of host buffers required for your acquisition source. Feel free to test the maximum limit of host buffers possible on your host system – the Sapera Grab demo will not crash when the requested number of host frame buffers is not allocated.
- The following calculation is an example of the amount of contiguous memory to reserve beyond 5MB with 80,000 buffers of 2048x1024x8:
 - a) $(80000 * 64 \text{ bytes})$
 - b) $(80000 * 48 \text{ bytes})$
 - c) $(80000 * (24 + (((2048 * 1024) / 4 \text{ kB}) * 8))) = 323 \text{ MB}$
 - d) Total = a (rounded up to nearest 64kB) + b (rounded up to nearest 64kB) + c (rounded up to nearest 64kB).

Host Computer Frame Buffer Memory Limitations

When planning a Sapera application and its host frame buffers used, plus other Sapera memory resources, do not forget the Windows operating system memory needs.

A Sapera application using the preferred *scatter gather buffers* could consume most of the remaining system memory, with a large allocation of frame buffers. If using frame buffers allocated as a *single contiguous memory block*, Windows will limit the allocation dependent on the installed system memory. Use the Buffer menu of the Sapera Grab demo program to allocate host buffer memory until an error message signals the limit allowed by the operating system used.

Contiguous Memory for Sapera Messaging

The current value for **Sapera messaging** determines the total amount of contiguous memory reserved at boot time for messages allocation. This memory space stores arguments when a Sapera function is called. Increase this value if you are using functions with large arguments, such as arrays and experience any memory errors.

Troubleshooting Problems

Overview

The Xtium-CLHS PX4 (and the Xtium family of products) is tested by Teledyne DALSA in a variety of computers. Although unlikely, installation problems may occur due to the constant changing nature of computer equipment and operating systems. This section describes what the user can verify to determine the problem or the checks to make before contacting Teledyne DALSA Technical Support.

If you require help and need to contact Teledyne DALSA Technical Support, make detailed notes on your installation and/or test results for our technical support to review. See ["Technical Support" on page 76](#) for contact information.

Problem Type Summary

Xtium-CLHS PX4 problems are either installation types where the board hardware is not recognized on the PCIe bus (i.e. trained), or function errors due to camera connections or bandwidth issues. The following links jump to various topics in this troubleshooting section.

First Step: Check the Status LED

Status LED D1 should be **GREEN** or flashing **GREEN** just after boot up. If it remains flashing **RED**, the board firmware did not load correctly. If LED D1 is **BLUE** or flashing **BLUE**, the board is running from the safe mode load.

CLHS Link status is indicated by LED D3 – above the camera connector. The status colors displayed follow industry specifications for Camera Link HS.

The complete status LED descriptions are available in the technical reference section (see ["Status LEDs Functional Description" on page 58](#)).

Possible Installation Problems

- **Hardware PCI bus conflict:** When a new installation produces PCI bus error messages or the board driver does not install, it is important to verify that there are no conflicts with other PCI or system devices already installed. Use the Teledyne DALSA PCI Diagnostic tool as described in ["Checking for PCI Bus Conflicts" on page 22](#). Also verify the installation via the ["Windows Device Manager" on page 24](#).
- **BSOD (blue screen) following a board reset:** After programming the board with different firmware, the computer displays the BSOD when the board is reset (see ["BSOD \(blue screen\) Following a Board Reset" on page 24](#)).
- **Verify Sopera and Board drivers:** If there are errors when running applications, confirm that all Sopera and board drivers are running. See ["Sopera and Hardware Windows Drivers" on page 24](#) for details. In addition, Teledyne DALSA technical support will ask for the log file of messages by Teledyne DALSA drivers. Follow the instructions describe in ["Teledyne DALSA Log Viewer" on page 25](#).
- **Firmware update error:** There was an error during the Xtium-CLHS PX4 firmware update procedure. The user can usually easily corrects this. Follow the instructions ["Recovering from a Firmware Update Error" on page 25](#).
- Installation went well but the board doesn't work or stopped working. Review these steps described in ["Symptoms: CamExpert Detects no Boards" on page 26](#).

Possible Functional Problems

- **Driver Information:** Use the Teledyne DALSA device manager program to view information about the installed Xtium-CLHS PX4 board and driver. See "Driver Information via the Device Manager Program" on page 25.
- **On-Board Image Memory Requirements:** The Xtium-CLHS PX4 on-board memory can provide two frame buffers large enough for most imaging situations. See "On-board Image Memory Requirements for Acquisitions" on page 26 for details on the on board memory and possible limitations.

Sometimes the problem symptoms are not the result of an installation issue but due to other system issues. Review the sections described below for solutions to various Xtium-CLHS PX4 functional problems.

- "Symptoms: Xtium-CLHS PX4 Does Not Grab" on page 26
- "Symptoms: Card grabs black" on page 27
- "Symptoms: Card acquisition bandwidth is less than expected" on page 28

Troubleshooting Procedures

The following sections provide information and solutions to possible Xtium-CLHS PX4 installation and functional problems. The previous section of this manual summarizes these topics.

Checking for PCI Bus Conflicts

One of the first items to check when there is a problem with any PCI board is to examine the system PCI configuration and ensure that there are no conflicts with other PCI or system devices. The *PCI Diagnostic* program (**cpcidiag.exe**) allows examination of the PCI configuration registers and can save this information to a text file. Run the program via the Windows Start Menu shortcut **Start • Programs • Teledyne DALSA • Sapera LT • Tools • PCI Diagnostics**.

As shown in the following screen image, use the first drop menu to select the PCI device to examine. Select the device from Teledyne DALSA. Note the bus and slot number of the installed board (this will be unique for each system unless systems are setup identically). Click on the **Diagnostic** button to view an analysis of the system PCI configuration space.

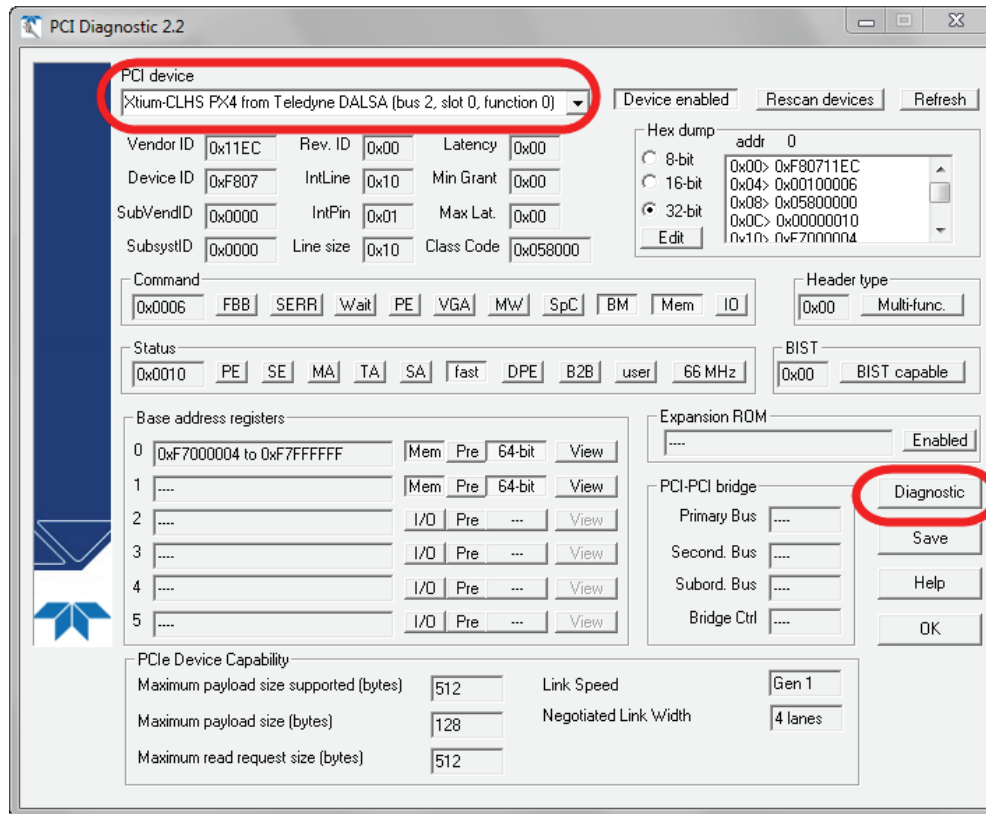


Figure 8: PCI Diagnostic Program

Clicking on the **Diagnostic** button opens a new window with the diagnostic report. From the PCI Bus Number drop menu, select the bus number that the Xtium-CLHS PX4 is installed in—in this example the slot is bus 2.

The window now shows the I/O and memory ranges used by each device on the selected PCI bus. The information display box will detail any PCI conflicts. If there is a problem, click on the **Save** button. A file named '**pcidiag.txt**' is created (in the Sapera\bin directory) with a dump of the PCI configuration registers. Email this file when requested by the Teledyne DALSA Technical Support group along with a full description of your computer.

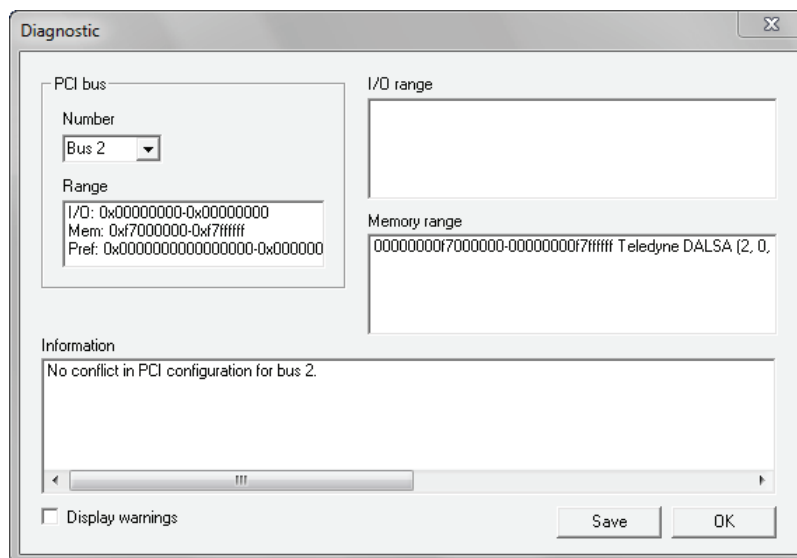


Figure 9: PCI Diagnostic Program – PCI bus info

Windows Device Manager

An alternative method to confirm the installation of the Xtium-CLHS PX4 board and driver is to use the Windows Device manager tool. Use the Start Menu shortcut **Start • Control Panel • System • Device Manager**. As shown in the following screen images, look for *Xtium-CLHS PX4* board under “Imaging Devices”. Double-click and look at the device status. You should see “This device is working properly.” Go to “Resources” tab and make certain that the device has an interrupt assigned to it, without conflicts.

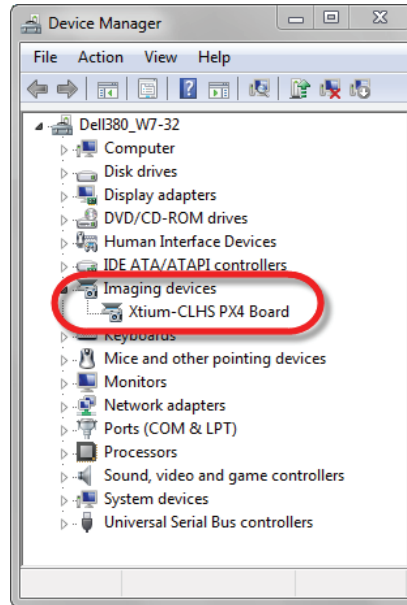


Figure 10: Using Windows Device Manager

BSOD (blue screen) Following a Board Reset

There are cases where a PC will falsely report a hardware malfunction when the Xtium-CLHS PX4 board is reset. Ensure that you are using Sapera LT 7.50 or later.

Sapera and Hardware Windows Drivers

Any problem seen after installation, such as an error message running CamExpert, first make certain the appropriate Teledyne DALSA drivers have started successfully during the boot sequence. Example, click on the **Start • Programs • Accessories • System Tools • System Information • Software Environment** and click on **System Drivers**. Make certain the following drivers have started for the **Xtium-CLHS PX4**.

Device	Description	Type	Started
CorXtiumCLHSPX4	Xtium-CLHS PX4 messaging	Kernel Driver	Yes
CorLog	Sapera Log viewer	Kernel Driver	Yes
CorMem	Sapera Memory manager	Kernel Driver	Yes
CorPci	Sapera PCI configuration	Kernel Driver	Yes
CorSerial	Sapera Serial Port manager	Kernel Driver	Yes

Table 4: Xtium-CLHS PX4 Device Drivers

Teledyne DALSA Technical Support may request that you check the status of these drivers as part of the troubleshooting process.

Recovering from a Firmware Update Error

This procedure is required if any failure occurred while updating the Xtium-CLHS PX4 firmware on installation or during a manual firmware upgrade. If on the case the board has corrupted firmware, any Sopera application such as CamExpert or the grab demo program will not find an installed board to control.

Possible reasons for firmware loading errors or corruption are:

- Computer system mains power failure or deep brown-out
- PCI bus or checksum errors
- PCI bus timeout conditions due to other devices
- User forcing a partial firmware upload using an invalid firmware source file

When the Xtium-CLHS PX4 firmware is corrupted, the board will automatically run from the Safe load after a PC reset.

Solution: Update the board using the standard method described in section Firmware Update: Automatic Mode.

Driver Information via the Device Manager Program

The Device Manager program provides a convenient method of collecting information about the installed Xtium-CLHS PX4. System information such as operating system, computer CPU, system memory, PCI configuration space, plus Xtium-CLHS PX4 firmware information is displayed or written to a text file (default file name – BoardInfo.txt). Note that this program also manually uploads firmware to the Xtium-CLHS PX4 (described elsewhere in this manual).

Execute the program via the Windows Start Menu shortcut

Start • Programs • Teledyne DALSA • Xtium-CLHS PX4 Device Driver • Device Manager.

If the Device Manager Program does not run, it will exit with a board was not found message.

Possible reasons for an error are:

- Board is not in the computer
- Board driver did not start or was terminated
- PCI conflict after some other device was installed

Information Window

Click to highlight one of the board components and its information shows in the right hand window, as described below.

- Select **Information** to display identification and information stored in the Xtium-CLHS PX4 firmware.
- Select **Firmware** to display version information for the firmware components.
- Select one of the firmware components to load *custom* firmware when supplied by Teledyne DALSA engineering for a future feature.
- Click on **File • Save Device Info** to save all information to a text file. Email this file when requested by Technical Support.

Teledyne DALSA Log Viewer

The third step in the verification process is to save in a text file the information collected by the Log Viewer program. Run the program via the Windows Start Menu shortcut

Start • Programs • Teledyne DALSA • Sopera LT • Tools • Log Viewer.

The Log Viewer lists information about the installed Teledyne DALSA drivers. Click on File • Save and you will be prompted for a text file name to save the Log Viewer contents. Email this text file to Teledyne DALSA Technical Support when requested or as part of your initial contact email.

On-board Image Memory Requirements for Acquisitions

The Xtium-CLHS PX4 by default will allocate the maximum number of buffers that can fit in on-board memory based on the size of the acquired image before cropping, to a maximum of 65535 buffers. Note that an application can change the default number of on-board frame buffers using the Sapera LT API. Usually two buffers will ensure that the acquired video frame is complete and not corrupted in cases where the image transfer to host system memory may be interrupted and delayed by other host system processes. That is, there is no interruption to the image acquisition of one buffer by any delays in transfer of the other buffer (which contains the previously acquired video frame) to system memory.

If allocation for the requested number of buffers fails, the driver will reduce the number of on-board frame buffers requested until they can all fit.

- For area scan cameras, a minimum of 2 on-board frame buffers is needed for proper operation.
- For line scan cameras, if there is not enough memory for 2 on-board buffers, the driver will reduce the size such that it allocates two partial buffers. This mode is dependent on reading out the image data to the host computer faster than the incoming acquisition.

The maximum number of buffers that can fit in on-board memory can be calculated as follows: (Total On-Board memory / (Buffer Size in Bytes + 256 Bytes used to store the DMA)).

For example, assuming 512MB of on-board memory and acquiring 1024 x 1024 x 8 bit images, the number of on-board buffers would be:

$512 \text{ MB} / [(1024 \times 1024) + 256] = 511.875 \Rightarrow 511 \text{ on-board buffers.}$

Symptoms: CamExpert Detects no Boards

- When starting CamExpert, with no Teledyne DALSA board detected, CamExpert will start in offline mode. There is no error message and CamExpert is functional for creating or modifying a camera configuration file. If CamExpert should have detected an installed board frame grabber, troubleshoot the installation problem as described below.

Troubleshooting Procedure

When CamExpert detects no installed Teledyne DALSA board, there could be a hardware problem, a system bus problem, a kernel driver problem, or a software installation problem.

- Make certain that the card is properly seated in PCIe slot.
- Perform all installation checks described in this section before contacting Technical Support.
- Try the board in a different PCIe slot if available.

Symptoms: Xtium-CLHS PX4 Does Not Grab

Sapera CamExpert does start but you do not see an image and the frame rate displayed is 0.

- Verify the camera has power.
- Verify the Camera Link HS cable is connected to the camera.
- Verify the camera and timing parameters with the camera in free run mode.
- Verify you can grab with the camera in free run mode.
- Make certain that you provide an external trigger if the camera configuration file requires one. Use the software trigger feature of CamExpert if you do not have a trigger source.
- Make certain that the camera configuration is the required mode. This must match the camera configuration file. Refer to your camera datasheet.
- Try to snap one frame instead of continuous grab.
- Perform all installation checks described in this section before contacting Technical Support.

Symptoms: Card grabs black

You are able to use Sopera CamExpert, the displayed frame rate is as expected, but the display is always black.

- Set your camera to manual exposure mode and set the exposure to a longer period, plus open the lens iris.
- Try to snap one frame instead of continuous grab.
- Make certain that the input LUT is not programmed to output all '0's.
- A PCIe transfer issue sometimes causes this problem. No PCIe transfer takes place, so the frame rate is above 0 but nevertheless no image is displayed in CamExpert.
- Make certain that BUS MASTER bit in the PCIe configuration space is activated. Look in PCI Diagnostics for **BM** button under "Command" group. Make certain that the **BM** button is activated.

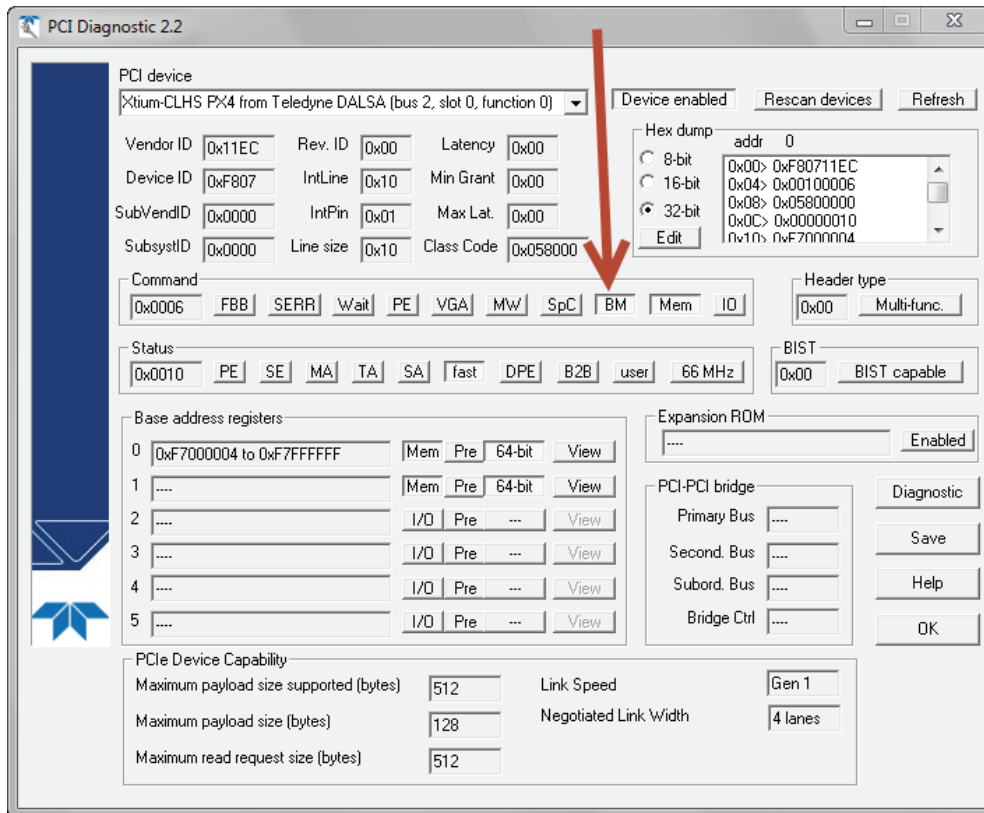


Figure 11: PCI Diagnostic – checking the BUS Master bit

- Perform all installation checks described in this section before contacting Technical Support.

Symptoms: Card acquisition bandwidth is less than expected

The Xtium-CLHS PX4 acquisition bandwidth is less than expected.

- Review the system for problems or conflicts with other expansion boards or drivers.
- Remove other PCI Express, PCI-32 or PCI-64 boards and check acquisition bandwidth again. Engineering has seen this case where other PCI boards in some systems cause limitations in transfers. Each system, with its combination of system motherboard and PCI boards, will be unique and must be tested for bandwidth limitations affecting the imaging application.
- Is the Xtium-CLHS PX4 installed in a PCI Express x16 slot?
Note that some computer's x16 slot may only support non x16 boards at x1 or not at all. Check the computer documentation or test an Xtium-CLHS PX4 installation. The speed at which the board is running can be viewed using the Diagnostic Tool provided with the driver.
- Is the Xtium-CLHS PX4 installed in a PCI Express Gen1 slot?
Some older computers only have PCIe Gen1 slots. The Generation at which the board is running can be viewed using the Diagnostic Tool provided with the driver.

CamExpert Quick Start

Interfacing CLHS Cameras with CamExpert

CamExpert is the camera-interfacing tool for Teledyne DALSA frame grabber boards supported by the Sopera library. CamExpert generates the Sopera camera configuration file (*yourcamera.ccf*) based on timing and control parameters entered. For backward compatibility with previous versions of Sopera, CamExpert also reads and writes the *.cca and *.cvi camera parameter files.

Every Sopera demo program starts with a dialog window to select a camera configuration file. Even when using the Xtium-CLHS PX4 with common video signals, a camera file is required. Therefore, CamExpert is typically the first Sopera application run after an installation. Obviously existing .ccf files can be copied to any new board installations when similar cameras are used.

CamExpert Example with a Monochrome Camera

The image below shows CamExpert controlling the Xtium-CLHS PX4. As an example, the CLHS camera has its control Lane 1 connected along with 3 additional Lanes for data.

After the camera is identified (as per the CLHS device discovery protocol), the timing parameters are displayed and the user can test by clicking on *Grab*. Descriptions of the CamExpert sections follow the image.

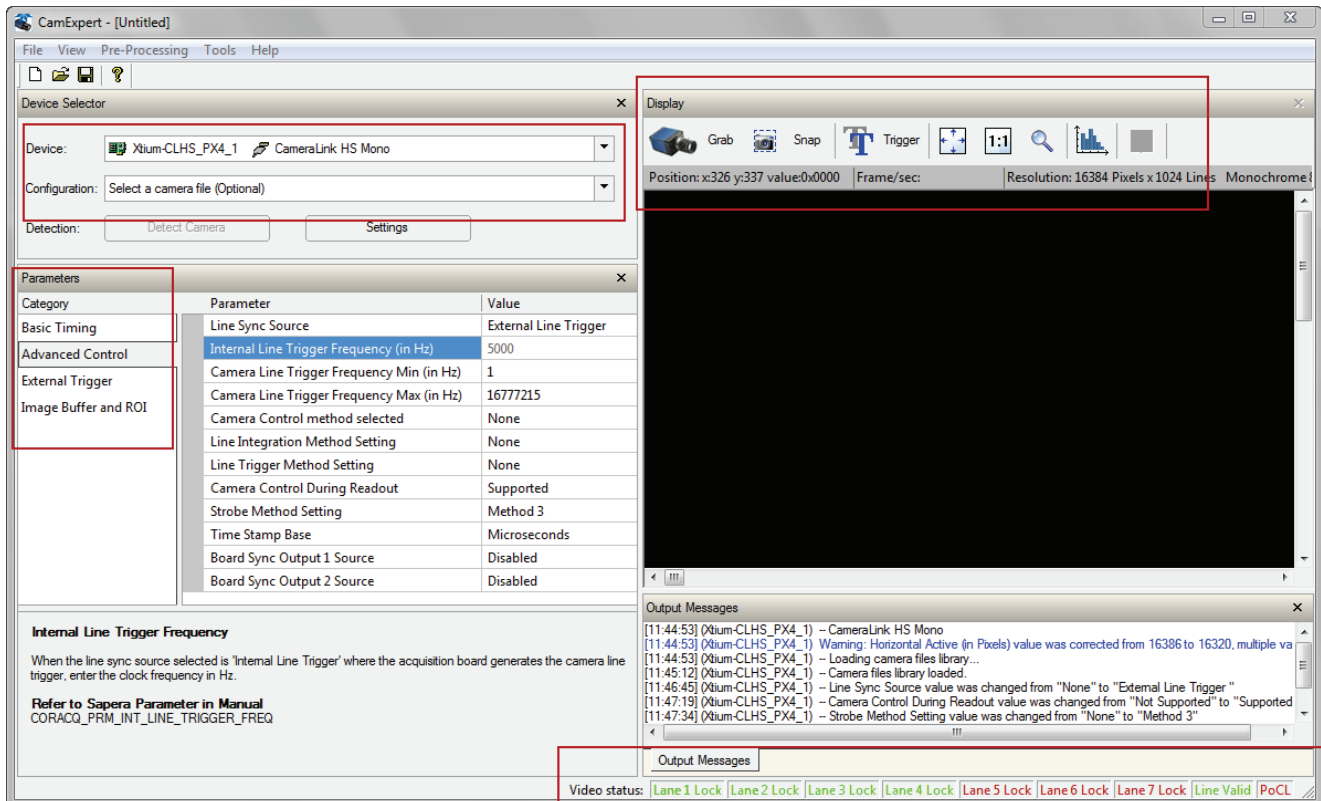
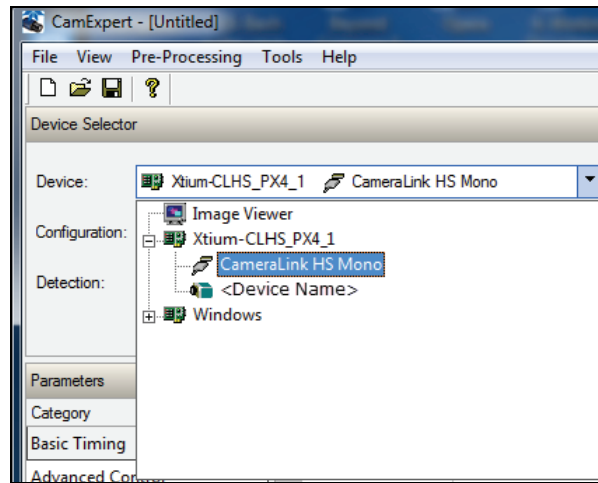


Figure 12: CamExpert Program

CamExpert groups camera features into functional categories. The features shown depend on the frame grabber used and what camera is connected. The values are either the camera defaults or the last stored value when the camera was used. The general descriptions below are not specific to a particular camera.

- **Device Selector:** Two drop menus allow selection of which device and which saved configuration to use.
 - **Device:** Select which acquisition device to control and configure a camera file. Required in cases where there are multiple boards in a system and when one board supports multiple acquisition types. Note in this example, the installed Xtium-CLHS PX4 has firmware to support a monochrome Camera Link HS camera.



- **Configuration:** Select the timing for a specific camera model included with the Sapera installation or a standard video standard. The *User's* subsection is where user created camera files are stored.
- **Parameter Groups:** Select a function category and change parameter values as required. Descriptions for the camera parameters change dependent on the camera.
 - **Basic Timing:** Provides or change static camera parameters.
 - **Advanced Controls:** Advanced parameters used to select various integration methods, frame trigger type, Camera Link HS controls, etc.
 - **External Trigger:** Parameters to configure the external trigger characteristics.
 - **Image Buffer and ROI:** Allows control of the host buffer dimension and format.
- **Display:** An important component of CamExpert is its live acquisition display window, which allows immediate verification of timing or control parameters without the need to run a separate acquisition program. **Grab** starts continuous acquisition (button then toggles to **Freeze** to stop). **Snap** is a single frame grab. **Trigger** is a software trigger to emulate an external source.
- **Output Messages and Video Status Bar:** Events and errors are logged for review. Camera connection status is displayed where green indicates connected signals present.

The CamExpert tool is described more fully in the Sapera Getting started and Sapera Introduction manuals.

CamExpert Demonstration and Test Tools

The CamExpert utility also includes a number of demonstration features, which make CamExpert the primary tool to configure, test and calibrate your camera and imaging setup. Display tools include, image pixel value readout, image zoom, and line profiler.

Functional tools include support for either hardware based or software Bayer filter camera decoding with auto white balance calibration.

Camera Types & Files

The Xtium-CLHS PX4 supports digital area scan or line scan cameras using the Camera Link HS interface standard. Browse our web site [<http://www.teledynedalsa.com/imaging/>] for the latest information on Teledyne DALSA Camera Link HS cameras.

Camera Files Distributed with Sopera

The Sopera distribution includes camera files for a selection of Xtium-CLHS PX4 supported cameras. Using the Sopera CamExpert program, you may use the camera files (CCA) provided to generate a camera configuration file (CCF) that describes the desired camera and frame grabber configuration..

Teledyne DALSA continually updates a camera application library composed of application information and prepared camera files. Camera files are ASCII text, readable with Windows Notepad on any computer without having Sopera installed.

Overview of Sopera Acquisition Parameter Files (*.ccf or *.cca/*.cvi)

Concepts and Differences between the Parameter Files

There are two components to the legacy Sopera acquisition parameter file set: CCA files (also called cam-files) and CVI files (also called VIC files, i.e. video input conditioning). The files store video-signal parameters (CCA) and video conditioning parameters (CVI), which in turn simplifies programming the frame-grabber acquisition hardware for the camera in use. **Sopera LT 5.0** introduces a new camera configuration file (**CCF**) that combines the CCA and CVI files into one file.

Typically, a camera application will use a CCF file per camera operating mode (or one CCA file in conjunction with several CVI files, where each CVI file defines a specific camera-operating mode). An application can also have multiple CCA/CCF files to support different image format modes supported by the camera or sensor (such as image binning or variable ROI).

CCF File Details

A file using the ".CCF" extension, (Camera Configuration files), is the camera (CCA) and frame grabber (CVI) parameters grouped into one file for easier configuration file management. This is the default Camera Configuration file used with Sopera LT 5.0 and the CamExpert utility.

CCA File Details

Teledyne DALSA distributes camera files using the legacy ".CCA" extension, (CAMERA files), which contain all parameters describing the camera video signal characteristics and operation modes (what the camera outputs). The Sopera parameter groups within the file are:

- Video format and pixel definition
- Video resolution (pixel rate, pixels per line, lines per frame)
- Synchronization source and timing
- Channels/Taps configuration
- Supported camera modes and related parameters
- External signal assignment

CVI File Details

Legacy files using the “.CVI” extension contain all operating parameters related to the frame grabber board - what the frame grabber can actually do with camera controls or incoming video. The Sopera parameter groups within the file are:

- Activate and set any supported camera control mode or control variable.
- Define the integration mode and duration.
- Define the strobe output control.
- Allocate the frame grabber transfer ROI, the host video buffer size and buffer type (RGB888, RGB101010, MONO8, and MONO16).
- Configuration of line/frame trigger parameters such as source (internal via the frame grabber /external via some outside event), electrical format (TTL, RS-422, OPTO-isolated), and signal active edge or level characterization.

Saving a Camera File

Use CamExpert to save a camera file (*.ccf) usable with any Sopera demo program or user application. An example would be a camera file, which sets up parameters for a free running camera (i.e. internal trigger) with exposure settings for a good image with common lighting conditions.

When CamExpert is setup as required, click on **File•Save As** to save the new .ccf file. The dialog that opens allows adding details such as camera information, mode of operation, and a file name for the .ccf file.

Camera Interfacing Check List

Before interfacing a camera from scratch with CamExpert:

- Confirm that Teledyne DALSA has not already published an application note with camera files [www.teledynedalsa.com].
- Confirm that the correct version or board revision of Xtium-CLHS PX4 is used. Confirm that the required firmware is loaded into the Xtium-CLHS PX4.
- Confirm that Sopera does not already have a .cca file for your camera installed on your hard disk. If there is a .cca file supplied with Sopera, then use CamExpert to generate the .ccf file with default parameter values matching the frame grabber capabilities.
- Check if the Sopera installation has a similar type of camera file. A similar .cca file can be loaded into CamExpert and modified to match timing and operating parameters for your camera, and lastly save them as Camera Configuration file (.ccf).
- Finally, if there is no file for your camera, run CamExpert after installing Sopera and the acquisition board driver, select the board acquisition server, and manually enter the camera parameters.

Sapera Demo Applications

Grab Demo Overview

Program	Start•Programs•DALSA•Sapera LT•Demos•Frame Grabbers•Grab Demo
Program file	...\\...\\Sapera\\Demos\\Classes\\vc\\GrabDemo\\Release\\GrabDemo.exe
Workspace	...\\...\\Sapera\\Demos\\Classes\\vc\\SapDemos.dsw
.NET Solution	...\\...\\Sapera\\Demos\\Classes\\vc\\SapDemos_2003.sln ...\\...\\Sapera\\Demos\\Classes\\vc\\SapDemos_2005.sln ...\\...\\Sapera\\Demos\\Classes\\vc\\SapDemos_2008.sln ...\\...\\Sapera\\Demos\\Classes\\vc\\SapDemos_2010.sln
Description	This program demonstrates the basic acquisition functions included in the Sapera library. The program either allows you to acquire images, in continuous or in one-time mode, while adjusting the acquisition parameters. The program code may be extracted for use within your own application.
Remarks	This demo is built using Visual C++ 6.0. It is based on Sapera C++ classes. See the Sapera User's and Reference manuals for more information.

Table 5: Grab Demo Workspace Details

Using the Grab Demo

Server Selection

Run the grab demo from the start menu:

Start•Programs•Sapera LT•Demos•Frame Grabbers•Grab Demo.

The demo program first displays the acquisition configuration menu. The first drop menu displayed permits selecting from any installed Sapera acquisition servers (installed Teledyne DALSA acquisition hardware using Sapera drivers). The second drop menu permits selecting from the available input devices present on the selected server.

CCF File Selection

Use the acquisition configuration menu to select the required camera configuration file for the connected camera. Sapera camera files contain timing parameters and video conditioning parameters. The default folder for camera configuration files is the same used by the CamExpert utility to save user generated or modified camera files.

Use the Sapera CamExpert utility program to generate the camera configuration file based on timing and control parameters entered. The CamExpert live acquisition window allows immediate verification of those parameters. CamExpert reads both Sapera *.cca and *.cvi for backward compatibility with the original Sapera camera files.

Grab Demo Main Window

The Grab Demo program provides basic acquisition control for the selected frame grabber. The loaded camera file (.ccf) defines the Frame buffer defaults.

Refer to the Sapera LT User's Manual (OC-SAPM-USER), in section "Demos and Examples – Acquiring with Grab Demo", for more information on the Grab Demo and others provided with Sapera LT.

Xtium-CLHS PX4 Reference

Block Diagram

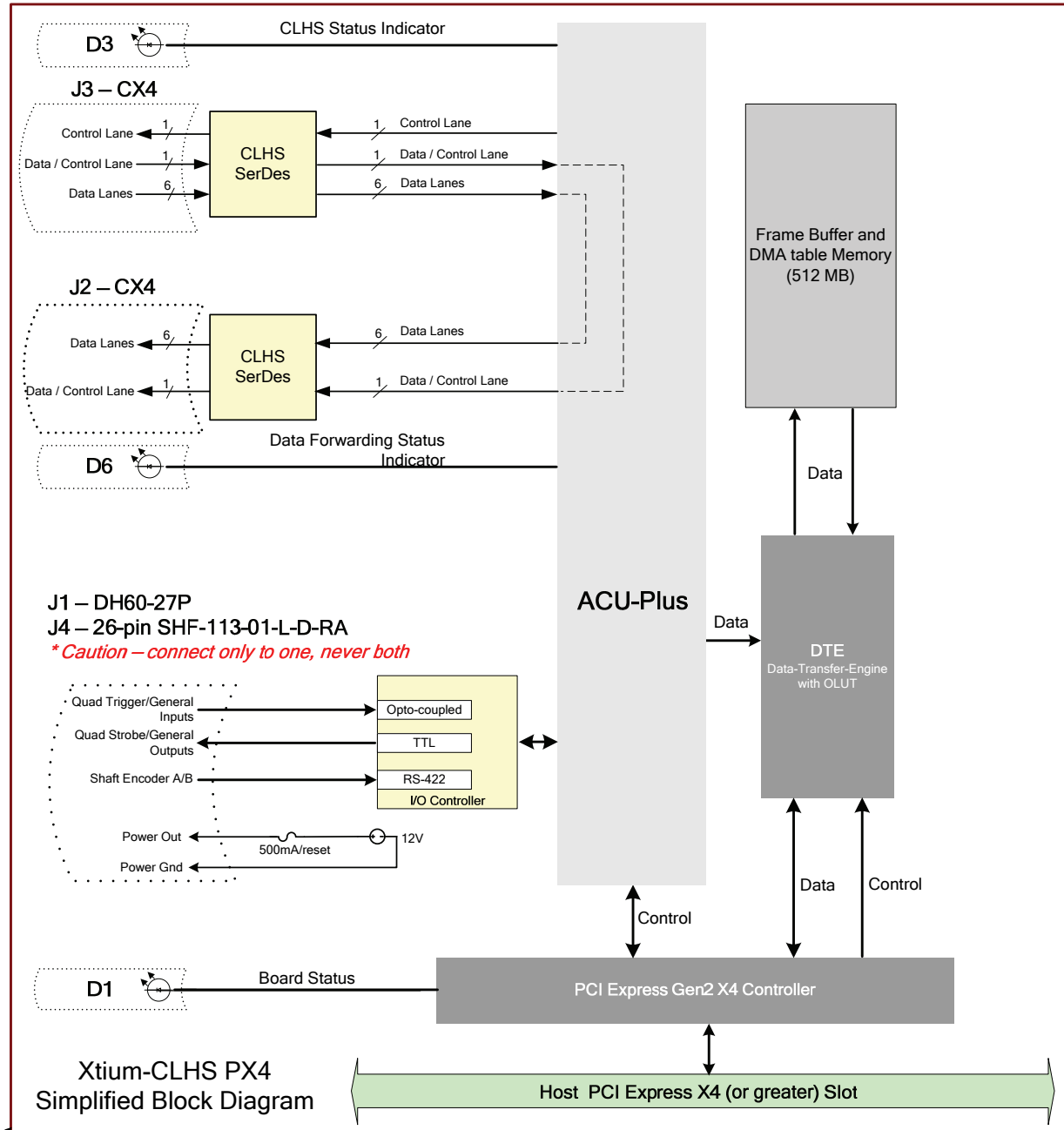


Figure 13: Xtium-CLHS PX4 Block Diagram

Xtium-CLHS Flow Diagram

The following diagram represents the sequence in which the camera data acquired is processed through the Xtium-CLHS.

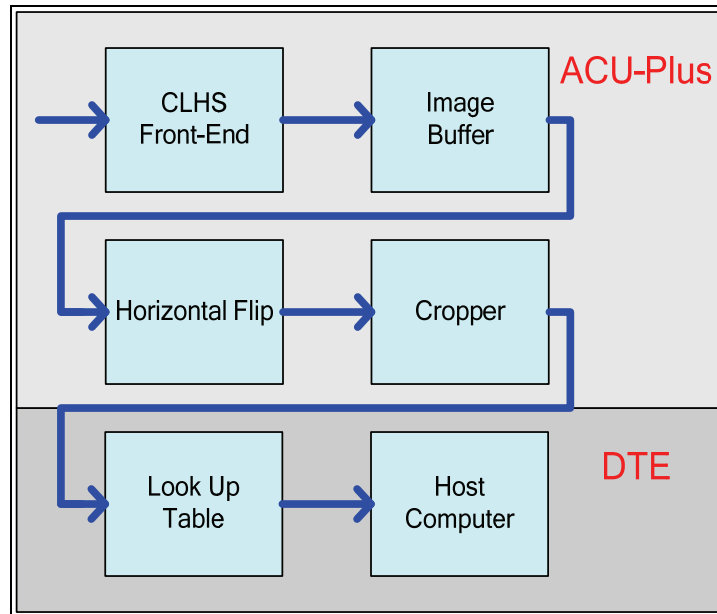


Figure 14: Xtium-CLHS Flow Diagram

- **Camera Link HS Front End:** Extracts the video data packets from the Camera Link HS port.
- **Image Buffer:** Stores the video data using the model of video frames.
- **Horizontal Flip:** If present, performs the line data flip process.
- **Cropper:** Crops the resulting image when used, using a 4-byte resolution.
- **Lookup Tables:** Apply lookup table transformation to the data going to host memory.
- **Host DMA:** Transfers the data from frame grabber into the host buffer memory. This module will also perform the vertical flip if enabled.

CLHS Camera Implementation

The following figure defines the Xtium CLHS PX4 camera interface as per the *Camera Link HS (CLHS) specification version 1.0*. The key parameters are:

- A single camera connector (J3) which is a copper hardwired interface with a thumbscrew locking mechanism – not an optical interface.
- Supports the M-Protocol definition of the Physical and Data Link Layer.
- There is one command channel to/from the camera.
- Supports single connector cameras which have 1 to 7 data Lanes.

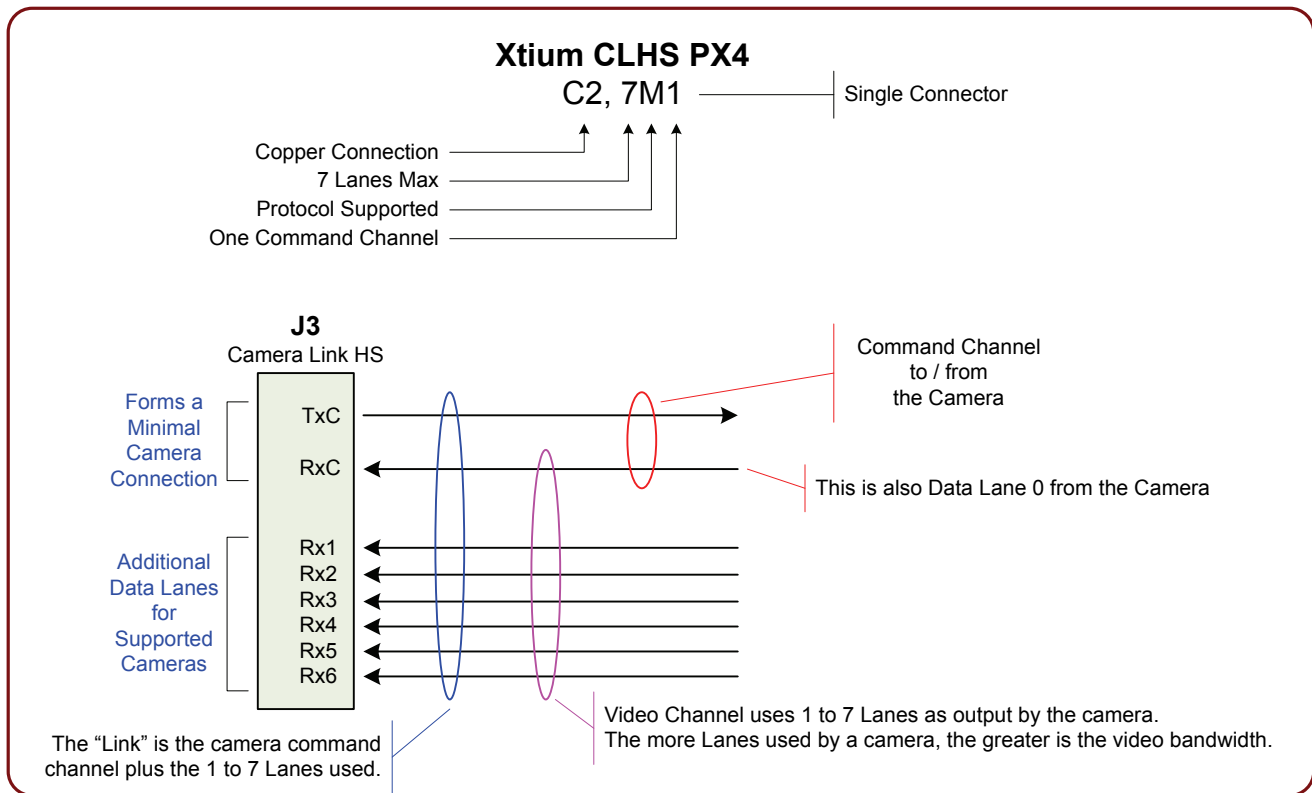


Figure 15: CLHS Camera Interface

Line Trigger Source Selection for Line scan Applications

Line scan imaging applications require some form of external event trigger to synchronize line scan camera exposures to the moving object. This synchronization signal is either an external trigger source (one exposure per trigger event) or a shaft encoder source composed of a single or dual phase (also known as a quadrature) signal.

The Xtium-CLHS PX4 shaft encoder inputs provide additional functionality with pulse drop, pulse multiply, and pulse direction support.

The following table describes the line-trigger source types supported by the Xtium-CLHS PX4. Refer to the Spera Acquisition Parameters Reference Manual (OC-SAPM-APR00) for descriptions of the Spera parameters.

CORACQ_PRM_EXT_LINE_TRIGGER_SOURCE – Parameter Values Specific to the Xtium-CLHS PX4

PRM Value	Input used as: External Line Trigger	Input used as: External Shaft Encoder
	<i>if</i> CORACQ_PRM_EXT_LINE_TRIGGER_ENABLE = <i>true</i>	<i>if</i> CORACQ_PRM_SHAFT_ENCODER_ENABLE = <i>true</i>
0	From Shaft Encoder Phase A	From Shaft Encoder Phase A & B
1	From Shaft Encoder Phase A	From Shaft Encoder Phase A
2	From Shaft Encoder Phase B	From Shaft Encoder Phase B
3	n/a	From Shaft Encoder Phase A & B
4	From Board Sync #1	n/a
5	From Board Sync #2	n/a

Table 6: CORACQ_PRM_EXT_LINE_TRIGGER_SOURCE – Parameter Values

CVI/CCF File Parameters Used

- External Line Trigger Source = parameter value
- External Line Trigger Enable = true/false
- Shaft Encoder Enable = true/false

Shaft Encoder Interface Timing

Dual Balanced Shaft Encoder RS-422 Inputs:

- Input Phase A: Connector J1/J4: Pin 3 (Phase A +) & Pin 2 (Phase A -)
- Input Phase B: Connector J1/J4: Pin 6 (Phase B+) & Pin 5 (Phase B-)
- See J1: External I/O Signals Connector (Female DH60-27P) for complete connector signal details)

Web inspection systems with variable web speeds typically provide one or two synchronization signals from a web mounted encoder to coordinate trigger signals. These trigger signals are used by the acquisition linescan camera. The Xtium-CLHS PX4 supports single or dual phase shaft encoder signals. Dual encoder signals are typically 90 degrees out of phase relative to each other and provide greater web motion resolution.

Example using any Encoder Input with Pulse-drop Counter

When enabled, the triggered camera acquires one scan line for each shaft encoder pulse-edge. To optimize the web application, a second Sopera parameter defines the number of triggers to skip between valid acquisition triggers. The figure below depicts a system where a valid camera trigger is any pulse edge from either shaft encoder signal. After a trigger, the two following triggers are ignored (as defined by the Sopera pulse drop parameter).

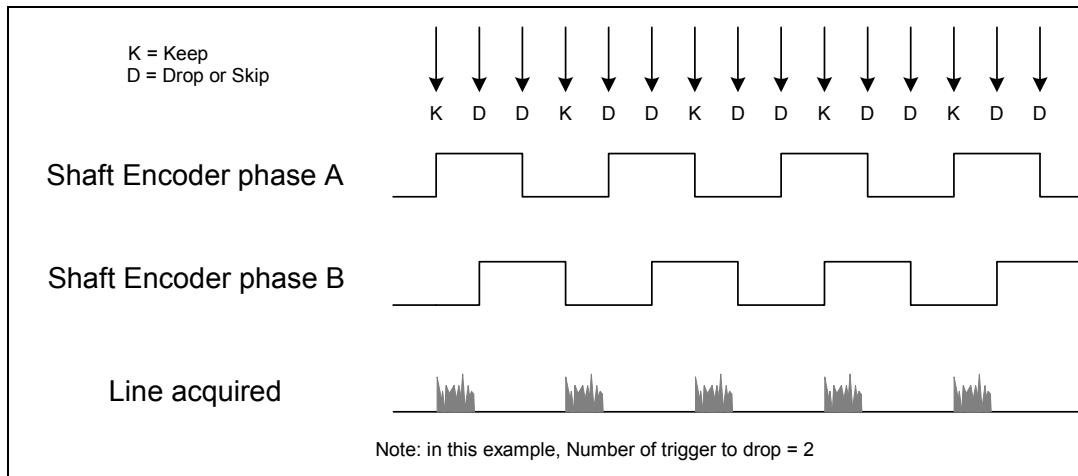


Figure 16: Encoder Input with Pulse-drop Counter

Example using Sequential Encoder Input

Support of a dual phase encoder should consider the direction of motion of one phase signal to the other. Such a case might exist where system vibrations and/or conveyor backlash can cause the encoder to briefly travel backwards. The acquisition device must in those cases count the reverse steps and subtract the forward steps such that only pulses after the reverse count reaches zero are considered. By using the event "Shaft Encoder Reverse Counter Overflow", an application can monitor an overflow of this counter.

The example figure below shows shaft encoder signals with high jitter. If the acquisition is triggered when phase B follows phase A, with jitter present phase B may precede phase A. Use of the *Shaft Encoder Direction* parameter will prevent false trigger conditions.

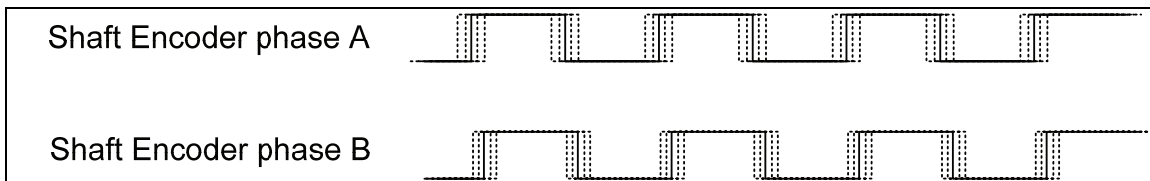


Figure 17: Using Shaft Encoder Direction Parameter



Note: Modify camera file parameters easily with the Sapera CamExpert program.

CVI/CCF File Parameters Used

Shaft Encoder Enable = X, where:

- If X = 1, Shaft Encoder is enabled
- If X = 0, Shaft Encoder is disabled

Shaft Encoder Pulse Drop = X, where:

- X = number of trigger pulses ignored between valid triggers

Shaft Encoder Pulse Multiply = X, where:

- X = number of trigger pulses generated for each shaft encoder pulses

Shaft Encoder Pulse Drop/Multiply Order = X, where:

- If X = 1, the drop operation will be done first, followed by the multiplier operation
- If X = 0 or 2, the multiplier operation will be done first, followed by the drop operation

Shaft Encoder Direction = X, where:

- X = 0, Ignore direction
- X = 1, Forward steps are detected by pulse order A/B (forward motion)
- X = 2, Forward steps are detected by pulse order B/A (reverse motion)



Note: For information on camera configuration files, see the Sopera Acquisition Parameters Reference Manual (OC-SAPM-APR00).

Virtual Frame Trigger for Line Scan Cameras

When using line scan cameras, a frame buffer is allocated in host system memory to store captured video lines. To control when a video line is stored as the first line in this “virtual” frame buffer, an external frame trigger signal is used. The Sopera vertical cropping parameter controls the number of lines sequentially grabbed and stored in the virtual frame buffer.

Virtual Frame Trigger Timing Diagram

The following timing diagram shows an example of grabbing 10 video lines from a line scan camera and the use of a virtual frame trigger to define when a video line is stored at the beginning of the virtual frame buffer. The virtual frame trigger signal (generated by some external event) connects to the Xtium-CLHS PX4 trigger input.

- Virtual frame trigger can be TTL, 12V, or 24V industry standard, and be rising or falling edge active, active high or low, or double pulse rising or falling edge.
- In this example, virtual frame trigger control is configured for rising edge trigger.
- Virtual frame trigger connects to the Xtium-CLHS PX4 via the External Trigger Input 1 & 2 inputs.
 - Trigger Input #1 on connector J1: pin 8
 - Trigger Input #2 on connector J1: pin 9
- Camera control signals are active at all times. These continually trigger the camera acquisition in order to avoid corrupted video lines at the beginning of a virtual frame.
- The camera control signals are either timing controls on Xtium-CLHS PX4 shaft encoder inputs, or line triggers generated internally by the Xtium-CLHS PX4.
- The Sopera vertical cropping parameter specifies the number of lines captured.

Synchronization Signals for a 10 Line Virtual Frame

The following timing diagram shows the relationship between External Frame Trigger input, External Shaft Encoder input (one phase used with the second terminated), and camera control output to the camera.

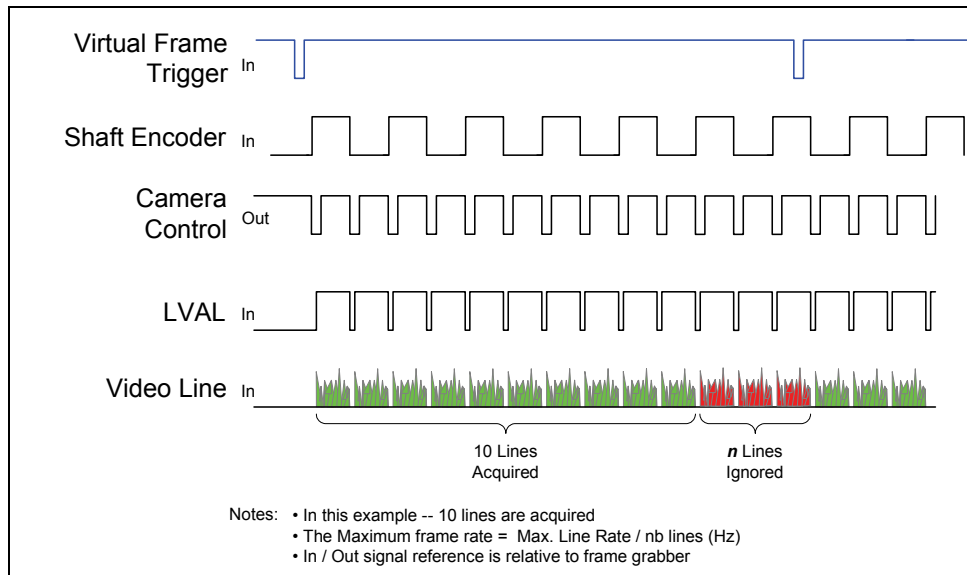


Figure 18: Synchronization Signals for a 10 Line Virtual Frame

CVI File (VIC) Parameters Used

The VIC parameters listed below provide the control functionality for virtual frame reset. Sopera applications load pre-configured CVI files or change VIC parameters during runtime.



Note: Sopera camera file parameters are easily modified by using the CamExpert program.

External Frame Trigger Enable = X, where: (with Virtual Frame Trigger enabled)

- If X = 1, External Frame Trigger is enabled
- If X = 0, External Frame Trigger is disabled

External Frame Trigger Detection = Y, where: (with Virtual Frame Trigger edge select)

- If Y = 1, External Frame Trigger is active low
- If Y = 2, External Frame Trigger is active high
- If Y = 4, External Frame Trigger is active on rising edge
- If Y = 8, External Frame Trigger is active on falling edge
- If Y = 32, External Frame Trigger is dual-input rising edge
- If Y = 64, External Frame Trigger is dual-input falling edge



Note: For dual-input triggers, Trigger Input #1 signals the start of the frame trigger, Trigger Input #2 signals the end of the frame trigger.

External Frame Trigger Level = Z, where: (with Virtual Frame Trigger signal type)

- If Z = 1, External Frame Trigger is a TTL signal
- If Z = 8, External Frame Trigger is a 24V signal
- If Z = 64, External Frame Trigger is a 12V signal



Note: For information on camera configuration files, see the Sopera Acquisition Parameters Reference Manual (OC-SAPM-APR00).

Sapera Acquisition Methods

Sapera acquisition methods define the control and timing of the camera and frame grabber board. Various methods are available, grouped as:

- Camera Trigger Methods (method 3 supported)
- Line Trigger Methods (method 2)
- Line Integration Methods (methods 8, 9 and 10 supported)
- Time Integration Methods (method 10, 11 and 12)
- Strobe Methods (method 1, 3, 4 and 5 supported)

Refer to the Sapera LT Acquisition Parameters Reference manual (OC-SAPM-APR00) for detailed information concerning camera and acquisition control methods.

Trigger to Image Reliability

Trigger-to-image reliability incorporates all stages of image acquisition inside an integrated controller to increase reliability and simplify error recovery. The trigger-to-image reliability model brings together all the requirements for image acquisition to a central management unit. These include signals to control camera timing, on-board frame buffer memory to compensate for PCI bus latency, and comprehensive error notification. If the Xtium-CLHS PX4 detects a problem, the application can take appropriate action to return to normal operation.

The Xtium-CLHS PX4 is designed with a robust ACU (Acquisition and Control Unit). The ACU monitors in real-time, the acquisition state of the input plus the DTE (Data Transfer Engine) which transfers image data from on-board memory into PC memory. In general, these management processes are transparent to end-user applications. With the Xtium-CLHS PX4, applications ensure trigger-to-image reliability by monitoring events and controlling transfer methods as described below:

Supported Events and Transfer Methods

Listed below are the supported acquisition and transfer events. Event monitoring is a major component to the Trigger-to-Image Reliability framework.

Acquisition Events

Acquisition events pertain to the acquisition module. They provide feedback on the image capture phase.

- **External Trigger** (Used/Ignored)
Generated when the external trigger pin is asserted, which indicates the start of the acquisition process. There are two types of external trigger events: 'Used' or 'Ignored'. Following an external trigger, if the event generates a captured image, an External Trigger Used event will be generated (CORACQ_VAL_EVENT_TYPE_EXTERNAL_TRIGGER). If there is no captured image, an External Trigger Ignored event will be generated (CORACQ_VAL_EVENT_TYPE_EXTERNAL_TRIGGER_IGNORED). An external trigger event is ignored if the event rate is higher than the possible frame rate of the camera.
- **Start of Frame**
Event generated during acquisition, with the detection of the start of a video frame by the board acquisition hardware. The Sapera event value is CORACQ_VAL_EVENT_TYPE_START_OF_FRAME.
- **End of Frame**
Event generated during acquisition, with the detection of the end of a video frame by the board acquisition hardware. The Sapera event value is CORACQ_VAL_EVENT_TYPE_END_OF_FRAME.
- **Data Overflow**
The Data Overflow event indicates that there is not enough bandwidth for the acquired data transfer without loss. Data Overflow would occur with limitations of the acquisition module

and should never occur.

The Sapera event value is CORACQ_VAL_EVENT_TYPE_DATA_OVERFLOW.

- **Frame Valid**

Event generated on detection of the start of a video frame by the board acquisition hardware. Acquisition does not need to be active; therefore, this event can verify a valid signal is connected. The Sapera event value is:
CORACQ_VAL_EVENT_TYPE_VERTICAL_SYNC.

- **Link** Lock/Unlock)

Event generated on the transition from locking or not locking, of the required lanes. The Sapera event values are:

CORACQ_VAL_EVENT_TYPE_LINK_LOCK

CORACQ_VAL_EVENT_TYPE_LINK_UNLOCK.

- **Frame Lost**

The Frame Lost event indicates that an acquired image failed to transfer to on-board memory. An example is if there are no free on-board buffers available for the new image. This may be the case if the image transfer from onboard buffers to host PC memory is not sustainable due to bus bandwidth issues or no host buffers are available to receive an image.

The Sapera event value is CORACQ_VAL_EVENT_TYPE_FRAME_LOST.

- **External Line Trigger Too Slow**

Event which indicates that the detected shaft encoder input tick rate is too slow for the device to take into account the specified shaft encoder multiplier value. The Sapera event value is CORACQ_VAL_EVENT_TYPE_EXT_LINE_TRIGGER_TOO_SLOW.

- **Shaft Encoder Reverse Count Overflow**

Event which indicates that the shaft encoder has travelled in the opposite direction expected and that the number of pulses encountered during that travel has exceeded the acquisition device counter. The acquisition device will thus not be able to skip the appropriate number of pulses when the expected direction is detected. The Sapera event value is CORACQ_VAL_EVENT_TYPE_SHAFT_ENCODER_REVERSE_COUNT_OVERFLOW

- **Camera Missed Trigger**

Event which indicates that the camera could not respond to a trigger request as it was busy servicing a previous trigger request. The Sapera event value is CORACQ_VAL_EVENT_TYPE_CAMERA_MISSED_TRIGGER

- **Camera Overrun**

Event which indicates that the camera data and/or video has been corrupted due to insufficient buffer space in the camera. The Sapera event value is CORACQ_VAL_EVENT_TYPE_CAMERA_OVERRUN

Transfer Events

Transfer events are the ones related to the transfer module. Transfer events provide feedback on image transfer from onboard memory frame buffers to PC memory frame buffers.

- **Start of Frame**

Start of Frame event generated when the first image pixel is transferred from on-board memory into PC memory.

The Sapera event value is CORXFER_VAL_EVENT_TYPE_START_OF_FRAME.

- **End of Frame**

End of Frame event generated when the last image pixel is transferred from on-board memory into PC memory.

The Sapera event value is CORXFER_VAL_EVENT_TYPE_END_OF_FRAME.

- **End of Transfer**

End of Transfer event generated at the completion of the last image transfer from on-board memory into PC memory. Issue a stop command to the transfer module to complete a transfer (if transfers are already in progress). If a frame transfer of a fixed number of images is requested, the transfer module will stop transfer automatically. The Sapera event value is CORXFER_VAL_EVENT_TYPE_END_OF_TRANSFER.

Trigger Signal Validity

The ACU ignores external trigger signal noise with its programmable debounce control. Program the debounce parameter for the minimum pulse duration considered as a valid external trigger pulse. For more information see Note 1: General Inputs / External Trigger Inputs Specifications.

Supported Transfer Cycling Methods

The Xtium-CLHS PX4 supports the following transfer modes, which are either synchronous or asynchronous. Note that the Xtium does not make any use of the trash buffer. Images are accumulated in on-board memory in a FIFO type manner. When no memory is available for a new image to be stored, the image is discarded and the CORACQ_VAL_EVENT_TYPE_FRAME_LOST is generated. On-board memory can get filled up if the rate at which the images are acquired is greater than the rate at which the DMA engine can write them to host buffer memory. On-board memory can also get filled-up if there are no more empty buffers available to transfer the on-board images.

When stopping the image acquisition, the event CORXFER_VAL_EVENT_TYPE_END_OF_TRANSFER will occur once all images currently in the on-board memory are transferred to host buffer memory. Note that if the application does not provide enough empty buffers, the Xtium event will not occur and an acquisition abort will be required.

- CORXFER_VAL_CYCLE_MODE_SYNCHRONOUS_WITH_TRASH
Before cycling to the next buffer in the list, the transfer device will check the next buffer's state. If its state is full, the transfer will keep the image in on-board memory until the next buffer's state changes to empty. If the on-board memory gets filled, frame lost events will be generated.
- CORXFER_VAL_CYCLE_MODE_SYNCHRONOUS_NEXT_EMPTY_WITH_TRASH
When starting an acquisition, the buffer list is put in an empty buffer queue list in the exact order they were added to the transfer. Whenever a user sets a buffer to empty, it is added to the empty buffer queue list, so that after cycling once through the original buffer list, the buffers acquired into will follow the order in which they are put empty by the user. So in this mode, the on-board images will be transferred to host buffer memory as long as there are buffers in the empty buffer queue list. If the on-board memory gets filled, the frame lost event will start occurring.
- CORXFER_VAL_CYCLE_MODE_ASYNCHRONOUS
The transfer device cycles through all buffers in the list without concern about the buffer state.

Output LUT Availability



Note: Contact Teledyne DALSA for availability.

Xtium-CLHS PX4 Supported Parameters

The tables below describe the Spera capabilities supported by the Xtium-CLHS PX4. Unless specified, each capability applies to all configuration modes and all acquisition modes.

The information here is subject to change. The application needs to verify capabilities. New board driver releases may change product specifications.

Spera describes the Xtium-CLHS PX4 family as:

- Board Server: Xtium-CLHS_PX4_1
- Acquisition Module: *dependent on firmware used*

Camera Related Capabilities

Capability	Values
CORACQ_CAP_CONNECTOR_TYPE	CORACQ_VAL_CONNECTOR_TYPE_CLHS (0x10)

Table 7: Camera Related Capabilities

Camera Related Parameters

Parameter	Values
CORACQ_PRM_CHANNEL	CORACQ_VAL_CHANNEL_SINGLE (0x1)
CORACQ_PRM_FRAME	CORACQ_VAL_FRAME_PROGRESSIVE (0x2)
CORACQ_PRM_INTERFACE	CORACQ_VAL_INTERFACE_DIGITAL (0x2)
CORACQ_PRM_SCAN	CORACQ_VAL_SCAN_AREA (0x1) CORACQ_VAL_SCAN_LINE (0x2)
CORACQ_PRM_SIGNAL	CORACQ_VAL_SIGNAL_DIFFERENTIAL (0x2)
CORACQ_PRM_VIDEO	CORACQ_VAL_VIDEO_MONO (0x1) CORACQ_VAL_VIDEO_BAYER (0x10)
CORACQ_PRM_PIXEL_DEPTH	8 bits, # LUT = 0, LUT format = CORDATA_FORMAT_MONO8 10 bits, # LUT = 0, LUT format = CORDATA_FORMAT_MONO16 12 bits, # LUT = 0, LUT format = CORDATA_FORMAT_MONO16 14 bits, # LUT = 0, LUT format = CORDATA_FORMAT_MONO16 16 bits, # LUT = 0, LUT format = CORDATA_FORMAT_MONO16
CORACQ_PRM_VIDEO_STD	CORACQ_VAL_VIDEO_STD_NON_STD (0x1)
CORACQ_PRM_FIELD_ORDER	CORACQ_VAL_FIELD_ORDER_NEXT_FIELD (0x4)
CORACQ_PRM_HACTIVE	min = 32 pixel max = 16384 pixel step = 32 pixel
CORACQ_PRM_VACTIVE	min = 1 line max = 16777215 line step = 1 line
CORACQ_PRM_TIME_INTEGRATE_METHOD	CORACQ_VAL_TIME_INTEGRATE_METHOD_10 (0x200) CORACQ_VAL_TIME_INTEGRATE_METHOD_11 (0x400) CORACQ_VAL_TIME_INTEGRATE_METHOD_12 (0x800)
CORACQ_PRM_CAM_TRIGGER_METHOD	CORACQ_VAL_CAM_TRIGGER_METHOD_3 (0x4)
CORACQ_PRM_CAM_NAME	Default Camera Link HS Line Scan Mono
CORACQ_PRM_LINE_INTEGRATE_METHOD	CORACQ_VAL_LINE_INTEGRATE_METHOD_8 (0x80) CORACQ_VAL_LINE_INTEGRATE_METHOD_9 (0x100) CORACQ_VAL_LINE_INTEGRATE_METHOD_10 (0x200)
CORACQ_PRM_LINE_TRIGGER_METHOD	CORACQ_VAL_LINE_TRIGGER_METHOD_2 (0x2)
CORACQ_PRM_LINE_TRIGGER_DELAY	min = 0 nsec max = 4294967295 nsec step = 1 nsec
CORACQ_PRM_CHANNELS_ORDER	CORACQ_VAL_CHANNELS_ORDER_NORMAL (0x1)
CORACQ_PRM_CAM_LINE_TRIGGER_FREQ_MIN	1 Hz

CORACQ_PRM_CAM_LINE_TRIGGER_FREQ_MAX	16777215 Hz
CORACQ_PRM_CAM_TIME_INTEGRATE_DURATION_MIN	1 μ s
CORACQ_PRM_CAM_TIME_INTEGRATE_DURATION_MAX	85899345 μ s
CORACQ_PRM_CAM_IO_CONTROL (*)	
CORACQ_PRM_BAYER_ALIGNMENT	Not available
CORACQ_PRM_CAM_CONTROL_DURING_READOUT	CORACQ_VAL_CAM_CONTROL_DURING_READOUT_INVALID (0x0) CORACQ_VAL_CAM_CONTROL_DURING_READOUT_VALID (0x01) CORACQ_VAL_CAM_CONTROL_DURING_READOUT_IGNORE (0x2)
CORACQ_PRM_DATA_LANES	min = 1 lane, max = 7 lanes, step = 1 lane
CORACQ_PRM_BIT_TRANSFER_RATE	3.125 Gbps

Table 8: Camera Related Parameters

VIC Related Parameters

Parameter	Values
CORACQ_PRM_CAMSEL	CAMSEL_MONO = from 0 to 0
CORACQ_PRM_CROP_LEFT	min = 0 pixel max = 16376 pixel step = 8 pixel
CORACQ_PRM_CROP_TOP	min = 0 line max = 16777215 line step = 1 line
CORACQ_PRM_CROP_WIDTH	min = 8 pixel max = 16384 pixel step = 8 pixel
CORACQ_PRM_CROP_HEIGHT	min = 1 line max = 16777215 line step = 1 line
CORACQ_PRM_DECIMATE_METHOD	CORACQ_VAL_DECIMATE_DISABLE (0x1)
CORACQ_PRM_LUT_ENABLE	Not Available
CORACQ_PRM_LUT_NUMBER	Default = 0
CORACQ_PRM_STROBE_ENABLE	TRUE FALSE
CORACQ_PRM_STROBE_METHOD	CORACQ_VAL_STROBE_METHOD_1 (0x1) CORACQ_VAL_STROBE_METHOD_3 (0x4) CORACQ_VAL_STROBE_METHOD_4 (0x8) CORACQ_VAL_STROBE_METHOD_5 (0x10)
CORACQ_PRM_STROBE_POLARITY	CORACQ_VAL_ACTIVE_LOW (0x1) CORACQ_VAL_ACTIVE_HIGH (0x2)
CORACQ_PRM_STROBE_DURATION	min = 1 μ s max = 85899345 μ s step = 1 μ s
CORACQ_PRM_STROBE_DELAY	min = 0 μ s max = 85899345 μ s step = 1 μ s
CORACQ_PRM_TIME_INTEGRATE_ENABLE	TRUE FALSE
CORACQ_PRM_TIME_INTEGRATE_DURATION	min = 1 μ s max = 85899345 μ s step = 1 μ s
CORACQ_PRM_CAM_TRIGGER_ENABLE	TRUE FALSE
CORACQ_PRM_OUTPUT_FORMAT	CORACQ_VAL_OUTPUT_FORMAT_MONO8 CORACQ_VAL_OUTPUT_FORMAT_MONO16
CORACQ_PRM_EXT_TRIGGER_ENABLE	CORACQ_VAL_EXT_TRIGGER_OFF (0x1) CORACQ_VAL_EXT_TRIGGER_ON (0x8)
CORACQ_PRM_VIC_NAME	Default Camera Link HS Line Scan Mono
CORACQ_PRM_LUT_MAX	0
CORACQ_PRM_EXT_TRIGGER_DETECTION	CORACQ_VAL_ACTIVE_LOW (0x1) CORACQ_VAL_ACTIVE_HIGH (0x2) CORACQ_VAL_RISING_EDGE (0x4) CORACQ_VAL_FALLING_EDGE (0x8)

CORACQ_PRM_LUT_FORMAT	Default = CORDATA_FORMAT_MONO8
CORACQ_PRM_LINE_INTEGRATE_ENABLE	TRUE FALSE
CORACQ_PRM_LINE_INTEGRATE_DURATION	min = 1 nsec max = 4294967295 nsec step = 1 nsec
CORACQ_PRM_LINE_TRIGGER_ENABLE	TRUE FALSE
CORACQ_PRM_EXT_FRAME_TRIGGER_ENABLE	TRUE FALSE
CORACQ_PRM_EXT_FRAME_TRIGGER_DETECTION	CORACQ_VAL_ACTIVE_LOW (0x1) CORACQ_VAL_ACTIVE_HIGH (0x2) CORACQ_VAL_RISING_EDGE (0x4) CORACQ_VAL_FALLING_EDGE (0x8) CORACQ_VAL_DOUBLE_PULSE_RISING_EDGE (0x20) CORACQ_VAL_DOUBLE_PULSE_FALLING_EDGE (0x40)
CORACQ_PRM_EXT_LINE_TRIGGER_ENABLE	TRUE FALSE
CORACQ_PRM_EXT_LINE_TRIGGER_DETECTION	CORACQ_VAL_RISING_EDGE (0x4) CORACQ_VAL_FALLING_EDGE (0x8)
CORACQ_PRM_SNAP_COUNT	Not Available
CORACQ_PRM_INT_LINE_TRIGGER_ENABLE	TRUE FALSE
CORACQ_PRM_INT_LINE_TRIGGER_FREQ	Default = 5000 Hz
CORACQ_PRM_BIT_ORDERING	CORACQ_VAL_BIT_ORDERING_STD (0x1)
CORACQ_PRM_EXT_TRIGGER_LEVEL	CORACQ_VAL_LEVEL_TTL (0x1) CORACQ_VAL_LEVEL_12VOLTS (0x040) CORACQ_VAL_LEVEL_24VOLTS (0x8)
CORACQ_PRM_STROBE_LEVEL	CORACQ_VAL_LEVEL_TTL (0x1)
CORACQ_PRM_EXT_FRAME_TRIGGER_LEVEL	CORACQ_VAL_LEVEL_TTL (0x1) CORACQ_VAL_LEVEL_12VOLTS (0x040) CORACQ_VAL_LEVEL_24VOLTS (0x8)
CORACQ_PRM_EXT_LINE_TRIGGER_LEVEL	CORACQ_VAL_LEVEL_422 (0x2)
CORACQ_PRM_INT_LINE_TRIGGER_FREQ_MIN	8 Hz
CORACQ_PRM_INT_LINE_TRIGGER_FREQ_MAX	500000 Hz
CORACQ_PRM_MASTER_MODE	Not available
CORACQ_PRM_SHAFT_ENCODER_DROP	min = 0 tick max = 254 tick step = 1 tick
CORACQ_PRM_SHAFT_ENCODER_ENABLE	TRUE FALSE
CORACQ_PRM_EXT_TRIGGER_FRAME_COUNT	min = 1 frame max = 262142 frame step = 1 frame Note: Infinite not supported
CORACQ_PRM_INT_FRAME_TRIGGER_ENABLE	TRUE FALSE
CORACQ_PRM_INT_FRAME_TRIGGER_FREQ	min = 1 milli-Hz max = 1000000000 milli-Hz step = 1 milli-Hz
CORACQ_PRM_STROBE_DELAY_2	Not Available
CORACQ_PRM_FRAME_LENGTH	CORACQ_VAL_FRAME_LENGTH_FIX (0x1)
CORACQ_PRM_FLIP	CORACQ_VAL_FLIP_OFF (0x00) CORACQ_VAL_FLIP_HORZ (0x01)
CORACQ_PRM_EXT_TRIGGER_DURATION	min = 0 μ s max = 255 μ s step = 1 μ s
CORACQ_PRM_TIME_INTEGRATE_DELAY	min = 0 μ s max = 85899345 μ s step = 1 μ s
CORACQ_PRM_CAM_TRIGGER_DELAY	min = 0 μ s max = 85899345 μ s step = 1 μ s
CORACQ_PRM_SHAFT_ENCODER_LEVEL	CORACQ_VAL_LEVEL_422 (0x2)

CORACQ_PRM_EXT_FRAME_TRIGGER_SOURCE (*)	min = 0 max = 5 step = 1
CORACQ_PRM_EXT_LINE_TRIGGER_SOURCE (*)	min = 0 max = 5 step = 1
CORACQ_PRM_EXT_TRIGGER_SOURCE (*)	min = 0 max = 5 step = 1
CORACQ_PRM_SHAFT_ENCODER_MULTIPLY	min = 1 max = 32 step = (2 ⁿ)
CORACQ_PRM_EXT_TRIGGER_DELAY	min = 0 max = 16777215 step = 1
CORACQ_PRM_EXT_TRIGGER_DELAY_TIME_BASE	CORACQ_VAL_TIME_BASE_LINE_VALID (0x4) CORACQ_VAL_TIME_BASE_LINE_TRIGGER (0x8) CORACQ_VAL_TIME_BASE_SHAFT_ENCODER (0x40) CORACQ_VAL_TIME_BASE_NS (0x80)
CORACQ_PRM_BAYER_DECODER_ENABLE	Not Available
CORACQ_PRM_EXT_TRIGGER_IGNORE_DELAY	Not Available
CORACQ_PRM_BOARD_SYNC_OUTPUT1_SOURCE (*)	min = 0 max = 2 step = 1
CORACQ_PRM_BOARD_SYNC_OUTPUT2_SOURCE (*)	min = 0 max = 2 step = 1
CORACQ_PRM_EXT_TRIGGER_SOURCE_STR	[0] = Automatic [1] = External Trigger #1 [2] = External Trigger #2 [3] = Board Sync #1 [4] = Board Sync #2 [5] = Software Trigger
CORACQ_PRM_EXT_LINE_TRIGGER_SOURCE_STR	[0] = Automatic [1] = Shaft Encoder Phase A [2] = Shaft Encoder Phase B [3] = Shaft Encoder Phase A & B [4] = Board Sync #1 [5] = Board Sync #2
CORACQ_PRM_VERTICAL_TIMEOUT_DELAY	Not Available
CORACQ_PRM_POCL_ENABLE	TRUE FALSE
CORACQ_PRM_SHAFT_ENCODER_DIRECTION	CORACQ_VAL_SHAFT_ENCODER_DIRECTION_IGNORE (0x00) CORACQ_VAL_SHAFT_ENCODER_DIRECTION_FORWARD (0x01) CORACQ_VAL_SHAFT_ENCODER_DIRECTION_REVERSE (0x02)
CORACQ_PRM_LINE_TRIGGER_AUTO_DELAY	Not Available
CORACQ_PRM_TIME_STAMP_BASE	CORACQ_VAL_TIME_BASE_US (0x1) CORACQ_VAL_TIME_BASE_LINE_VALID (0x4) CORACQ_VAL_TIME_BASE_LINE_TRIGGER (0x8) CORACQ_VAL_TIME_BASE_SHAFT_ENCODER (0x40)
CORACQ_PRM_BOARD_SYNC_OUTPUT1_SOURCE_STR	[0] = Disabled [1] = External Frame Trigger
CORACQ_PRM_BOARD_SYNC_OUTPUT2_SOURCE_STR	[0] = Disabled [1] = External Frame Trigger
CORACQ_PRM_SHAFT_ENCODER_ORDER	CORACQ_VAL_SHAFT_ENCODER_ORDER_AUTO (0x0) CORACQ_VAL_SHAFT_ENCODER_ORDER_DROP_MULTIPLY (0x1) CORACQ_VAL_SHAFT_ENCODER_ORDER_MULTIPLY_DROP (0x2)
CORACQ_PRM_CAM_FRAMES_PER_TRIGGER	Not Available
CORACQ_PRM_LINE_INTEGRATE_TIME_BASE	CORACQ_VAL_TIME_BASE_NS (0x80)

Table 9: VIC Related Parameters

ACQ Related Parameters

Parameter	Values
CORACQ_PRM_LABEL	Camera Link HS Mono
CORACQ_PRM_EVENT_TYPE	CORACQ_VAL_EVENT_TYPE_START_OF_FRAME CORACQ_VAL_EVENT_TYPE_END_OF_FRAME CORACQ_VAL_EVENT_TYPE_EXTERNAL_TRIGGER CORACQ_VAL_EVENT_TYPE_VERTICAL_SYNC CORACQ_VAL_EVENT_TYPE_FRAME_LOST CORACQ_VAL_EVENT_TYPE_DATA_OVERFLOW CORACQ_VAL_EVENT_TYPE_EXTERNAL_TRIGGER_IGNORED CORACQ_VAL_EVENT_TYPE_EXT_LINE_TRIGGER_TOO_SLOW CORACQ_VAL_EVENT_TYPE_SHAFT_ENCODER_REVERSE_COUNT_OVERFLOW
CORACQ_PRM_EVENT_TYPE_EX	CORACQ_VAL_EVENT_TYPE_LINK_LOCK CORACQ_VAL_EVENT_TYPE_LINK_UNLOCK CORACQ_VAL_EVENT_TYPE_CAMERA_MISSED_TRIGGER CORACQ_VAL_EVENT_TYPE_CAMERA_OVERRUN
CORACQ_PRM_SIGNAL_STATUS	CORACQ_VAL_SIGNAL_HSYNC_PRESENT CORACQ_VAL_SIGNAL_VSYNC_PRESENT CORACQ_VAL_SIGNAL_POWER_PRESENT CORACQ_VAL_SIGNAL_POCL_ACTIVE CORACQ_VAL_SIGNAL_LINK_LOCK CORACQ_VAL_SIGNAL_LANE1_LOCK CORACQ_VAL_SIGNAL_LANE2_LOCK CORACQ_VAL_SIGNAL_LANE3_LOCK CORACQ_VAL_SIGNAL_LANE4_LOCK CORACQ_VAL_SIGNAL_LANE5_LOCK CORACQ_VAL_SIGNAL_LANE6_LOCK CORACQ_VAL_SIGNAL_LANE7_LOCK
CORACQ_PRM_FLAT_FIELD_ENABLE	Not Available
CORACQ_PRM_TIME_STAMP	Available
CORACQ_CAP_SERIAL_PORT_INDEX	Not Available

Table 10: Acquisition Related Parameters

Sapera Servers and Resources

A Sapera Server is an abstract representation of a physical device like a frame-grabber or camera. When using the SapAcquisition or SapAcqDevice constructors, the location parameter specifies the server to use to create the object. Use the Sapera Configuration utility to find the names and indices of all Sapera servers in your system.

In Sapera LT all frame grabbers are configured using the SapAcquisition class. All CLHS cameras are GenCP compliant and are configured in Sapera LT using the SapAcqDevice class.



Note: Currently, CLHS cameras do not have their own server, therefore it is available under the Xtium_CLHS server. For example, in CamExpert the Xtium server displays both the frame grabber and camera resources.

The following table describes the Xtium-CLHS PX4 board

Servers	Resources			
Name	Type	Name	Index	Description
Xtium-CLHS_PX4_1	Acquisition	Camera Link HS Mono	0	CLHS Monochrome Camera
	Acquisition Device	<Device Name>	1	CLHS Monochrome Camera

Table 11: Xtium-CLHS PX4 - Servers and Resources

Windows Embedded 7 Installation

Windows Embedded 7 is not officially supported by Teledyne DALSA due to the number of possible configurations. However, Sapera LT and other Teledyne DALSA products should function properly on the Windows Embedded 7 platform provided that the required components are installed.

Teledyne DALSA provides answer files (.xml) for use during Windows Embedded 7 installation that install all necessary components for running Sapera LT 32-bit or 64-bit versions (SDK or Runtime), Sapera Processing 32-bit or 64-bit versions (SDK or Runtime), and Teledyne DALSA framegrabbers.

For each platform (32 or 64-bit), the answer file provided is:

- **SaperaFrameGrabbers.xml:**

Configuration for Sapera LT, Sapera Processing and Teledyne DALSA framegrabbers

The file is located in the following directory dependent on the platform used:

```
<Install Directory>\Sapera\Install\Win7_Embedded\Win32  
<Install Directory>\Sapera\Install\Win7_Embedded\Win64
```

The OS footprint for these configurations is less than 1 GB. Alternatively, the Windows Thin Client configuration template provided by Microsoft in the Windows Embedded 7 installation also provides the necessary dependencies for Sapera LT, and Teledyne DALSA framegrabbers (with an OS footprint of approximately 1.5 GB).

If you are installing other applications on the Windows Embedded 7 platform, it is recommended that you verify which components are required, and if necessary, create a corresponding "Answer File".

For more information on performing dependency analysis to enable your application on Windows Embedded 7, refer to the Microsoft Windows Embedded 7 documentation.

Technical Specifications

Xtium-CLHS PX4 Board Specifications

Digital Video Input & Controls

Input Type	Camera Link HS Specifications Rev 1.0 compliant
Common Pixel Formats	Camera Link HS for 8, 10, 12, 14 and 16-bit mono
Scanning	Area scan and Line scan
Resolution	<p>Horizontal Minimum: 8 Pixels per lane (8-bits/pixel)</p> <p>Horizontal Maximum: 8-bits/pixel x 16k Pixels/line 16-bits/pixel x 8k Pixels/line</p> <p>Vertical Minimum: 1 line</p> <p>Vertical Maximum: up to 16,000,000 lines—for area scan sensors infinite line count—for linescan sensors</p>
<i>note: these are Xtium-CLHS PX4 maximums, not Camera Link HS specifications</i>	
Bit Transfer Rate	3.125 Gbps
Image Buffer	Available with 512 MB
Bandwidth to Host System	Approximately 1.7GB/s (maximum obtained is dependent on firmware loaded and PC characteristics)
Controls	<p>Compliant with Teledyne DALSA Trigger-to-Image Reliability framework</p> <p>Comprehensive event notifications</p> <p>Timing control logic for camera triggers and strobe signals</p> <p>4 opto-coupled general inputs where 2 are shared Trigger inputs (TTL/12V/24V)</p> <p>Trigger inputs are programmable as active high or low (edge or level trigger, at maximum input frequency of 100 KHz)</p> <p>External trigger latency less than 100 nsec</p> <p>4 TTL general Outputs where 1 is shared as Strobe Output</p> <p>Quadrature (phase A & B) shaft encoder inputs for external web synchronization: RS-422 input maximum frequency is 5 MHz</p> <p>Supports camera Data Forwarding up to 5 additional boards</p> <p>Supports multi-camera synchronization of 2 to 4 boards</p> <p>I/O available on a DH60-27P connector (J1) and on 26-pin SHF-113-01-L-D-RA (J4)</p>
Processing	<p>Output Lookup Table Contact Teledyne DALSA for availability.</p> <p>Bayer Mosaic Filter Contact Teledyne DALSA for availability.</p>
<i>Dependant on user loaded firmware configuration</i>	

Table 12: Board Specifications

Host System Requirements

Xtium-CLHS PX4 Dimensions

Approximately 4 in. (10 cm) wide by 4 in. (10 cm) high

General System Requirements for the Xtium-CLHS PX4

- PCI Express Gen2 x4 slot compatible; (will work in Gen1 x4 slot with reduced bandwidth to host)
- On some computers the Xtium-CLHS PX4 may function installed in a x16 slot. The computer documentation or direct testing by the user is required.
- Xtium-CLHS PX4 operates correctly when installed in a multi-processor system (including Hyper-Threading multi-core processors).

Operating System Support

Windows XP, Windows 7 and Windows 8, each in either 32-bit or 64-bit

Environment

Ambient Temperature:	10° to 50°C (operation) -40° to 75°C (storage)
Relative Humidity:	5% to 90% non-condensing (operating) 0% to 95% (storage)
MTBF @40°C	36.4 years

Table 13: Environment Specifications



Note: Ensure adequate airflow for proper functioning of the board across the entire temperature range of 10 – 50°C . We recommend airflow measuring 80 LFM (linear feet per minute) across the surface of the board.

Power Requirements while grabbing

+3.3V:	1A
+12V:	0.33A

Table 14: Power Specifications

EMI Certifications



EC & FCC DECLARATION OF CONFORMITY

We : Teledyne DALSA inc.
7075 Place Robert-Joncas, Suite 142,
St. Laurent, Quebec, Canada, H4M 2Z2

Declare under sole legal responsibility that the following products conform to the protection requirements of council directive 2004/108/EC on the approximation of the laws of member states relating to electromagnetic compatibility:

Xtium-CLHS PX4

The products to which this declaration relates are in conformity with the following relevant harmonized standards, the reference numbers of which have been published in the Official Journal of the European Communities:

EN55022 (CISPR22:2008)
EN61000-3-2:2005, A1:2008, A2:2009
EN61000-3-3:2008
EN61000-4-2:2008
EN61000-4-3:2006, A1:2007, A2:2010
EN61000-4-4:2012
EN61000-4-5:2005
EN61000-4-6:2008
EN61000-4-8:2009
EN61000-4-11:2004

Further declare under our sole legal responsibility that the product listed conforms to the code of federal regulations CFR 47 part 15 (2012), subpart B, for a class A product.

St. Laurent, Canada
Location

2014-07-17
Date



Eric Carey, ing.
Director,
Research and Development

Figure 19: EMI Certifications

Connector and Switch Locations

Xtium-CLHS PX4 Board Layout Drawing

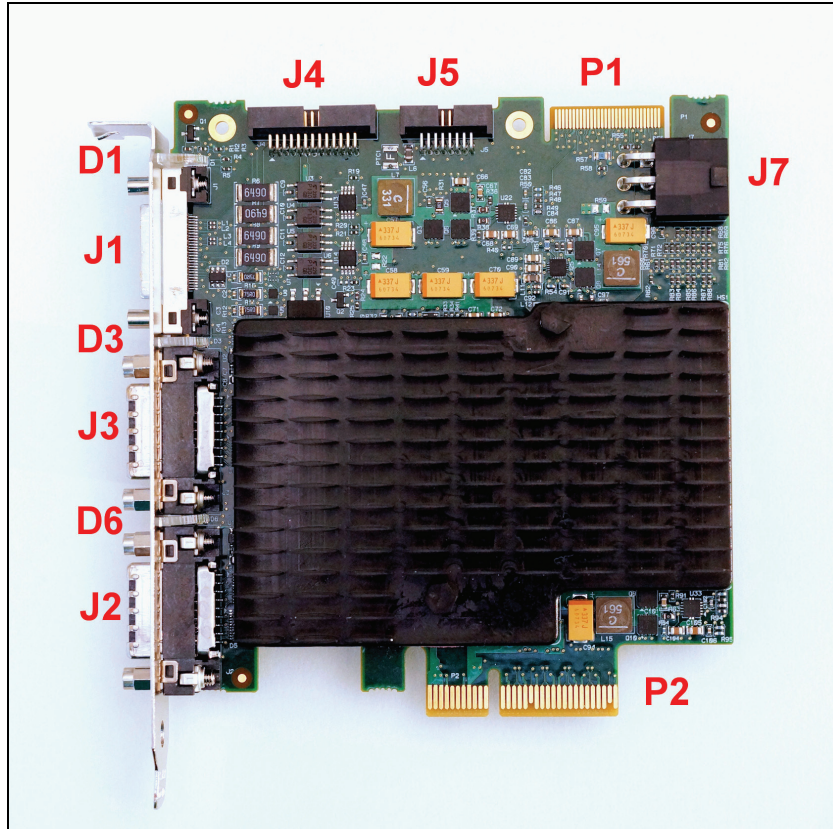


Figure 20: Board Layout

Connector / LED Description List

The following table lists components on the Xtium-CLHS PX4 board. Detailed information concerning the connectors/LEDs follows this summary table.

Location	Description	Location	Description
J1	External I/O Signals connector (DH60-27P)	J5	Multi Board Sync
D1	Boot-up/PCIe Status LED (refer to text)	J7	PC power to J1
J3	Camera Link HS Input Connector	P2	PCIe x4 computer bus connector (Gen2 compliant slot preferred)
D3	Camera Link HS status LED	P1	Reserved
J4	Internal I/O Signals connector (26-pin SHF-113-01-L-D-RA)	J2	Camera Link HS Output Connector (used for Data Forwarding)
D6	Data Forwarding status LED		

Table 15: Board Connector List

Connector and Switch Specifications

Xtium-CLHS PX4 End Bracket Detail

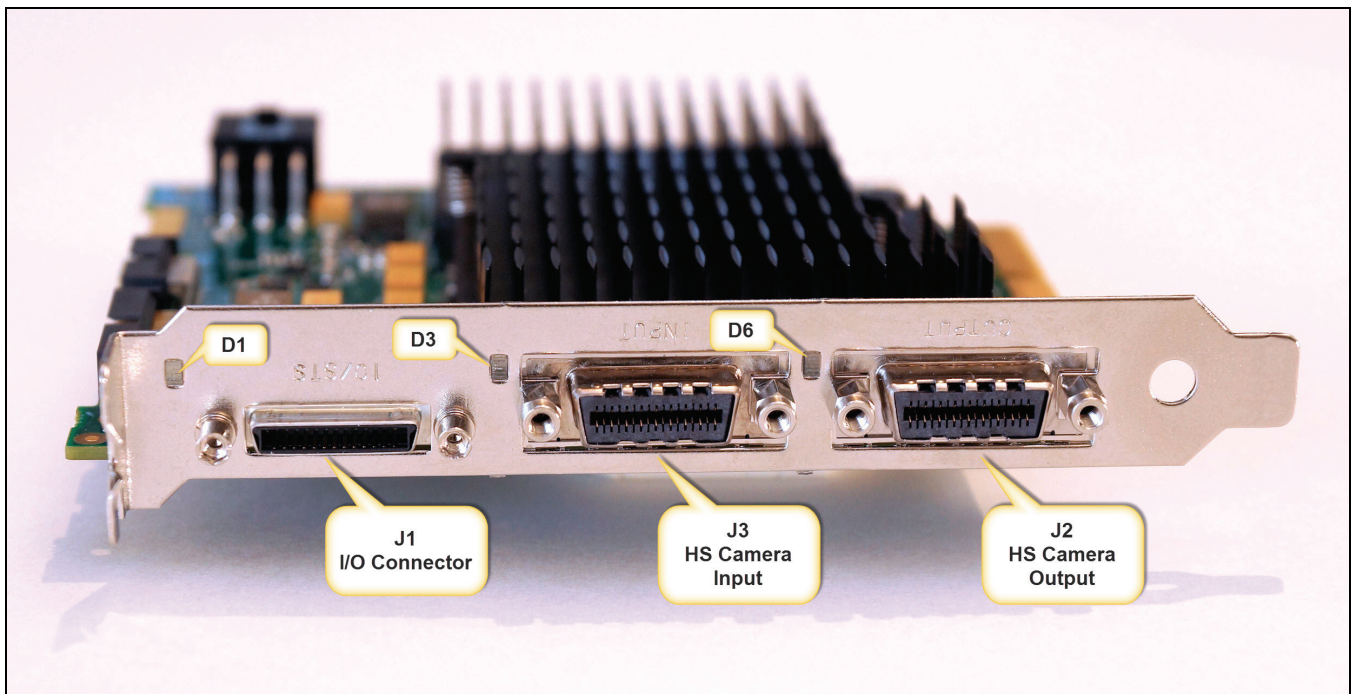
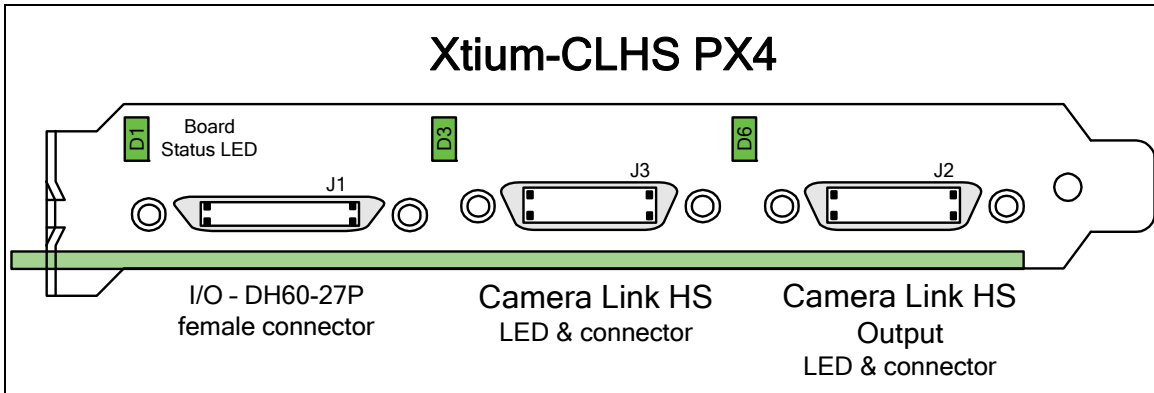


Figure 21: End Bracket Details

The hardware installation process is completed with the connection of a supported camera to the Xtium-CLHS PX4 board using a Camera Link HS cable (see "Camera Link HS Cables" on page 71).

- The Xtium-CLHS PX4 board supports one Camera Link HS camera output.
- Connect the camera to the J3 connector with a Camera Link HS cable.

Data Forwarding Setup

Distributed processing of high bandwidth image data is easily configured by inter-connecting multiple Xtium-CLHS boards. The following description and block diagram shows the simple physical setup. The user has total control to the actual distributed processing task divisions and algorithms.

- Connect a camera to **J3** of the first Xtium-CLHS board installed in the first PC. This board is defined as the "Data Forwarding Master".
- Using a second Camera Link HS cable, connect **J2** of the Data Forwarding Master Xtium-CLHS board to **J3** of second Xtium-CLHS installed in a separate computer or the same as the first Xtium if it can manage the processing. This second board is defined as the "Data Forwarding Slave #1".
- Camera Link HS cables used to interconnect Xtium-CLHS boards could be up to 15 meters.
- Optionally, the **J2** connector of the Data Forwarding Slave #1 Xtium-CLHS board can connect to **J3** of a third Xtium-CLHS ("Data Forwarding Slave #2").
- The number of Data Forwarding Slave boards should not exceed 5, for a total of 6 boards. The Xtium CLHS boards can either have separate computers or share computers dependent on the distributed processing requirements.
- The Xtium-CLHS driver will automatically detect whether a board is connected to a camera (becoming the Data Forwarding Master) or is connected to forwarded data (becoming a Data Forwarding Slave).
- Each Data Forwarding Slave board has full control of the camera data portion transferred to the host computer for processing.

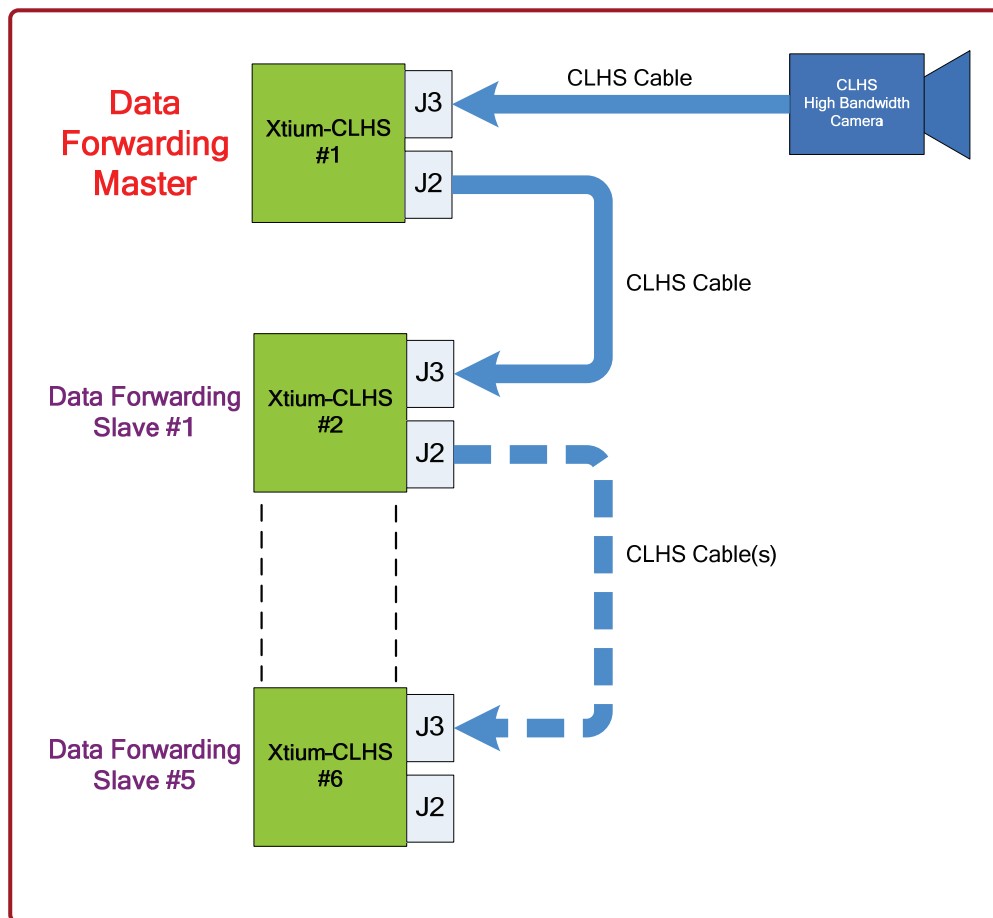


Figure 22: Data Forwarding Block Diagram

Status LEDs Functional Descriptions

Three LED indicators, mounted on the board bracket, provide information on board and connection status as per the tables below.

D1: Boot-up/PCIe Status LED — Provides general board status information

D3: Camera Link HS status LED — Indicates data status for J3 when connected to a camera or when receiving forwarded data from another Xtium-CLHS system.

D6: Camera Link HS Forwarded Data status LED — Indicates connection status when the data forwarding connector J2 is connected to another Xtium-CLHS.

D1: Boot-up/PCIe Status LED

Color	State	Description
Red	Solid	FPGA firmware not loaded
Green	Solid	Normal FPGA firmware loaded, Gen2 speed, link width x4
Green	Flashing	Normal FPGA firmware loaded, Gen1 speed, link width x4
Yellow	Solid	Normal FPGA firmware loaded, Gen2 speed, link width not x4
Yellow	Flashing	Normal FPGA firmware loaded, Gen1 speed, link width not x4
Blue	Solid	Safe FPGA firmware loaded, Gen2 speed
Blue	Flashing	Safe FPGA firmware loaded, Gen1 speed
Red	Flashing	PCIe Training Issue – Board will not be detected by computer

Table 16: D1 Boot-up/PCIe Status LED

D3: Camera Link HS Status LED (when a camera is connected)

The Xtium-CLHS PX4 implements the mandatory LED states defined by the Camera Link HS Specification v1.0 RC5. The first column – Priority, defines the signaling order when multiple events are reported simultaneously.

This LED status table reflects activity on input connector J3 when a camera is connected (i.e. the Xtium is the Data Forwarding Master).

Priority	LED State	State Name	Description
A	Off	NON_OP	Device not powered and/or waiting for software; No Hardware or the LED was commanded to the off state.
3	Constant Orange	FAR_END_RESET	The device at the Far End is holding this device in reset preventing any communication.
4	Flashing Orange	SYSTEM_INCOMPATIBILITY	The devices have established communication and determined that they are not interoperable.
5	Flashing Green	LOOKING_FOR_LINK	Hardware is fine, but connection not established or recently broken.
8	Constant Green	LINK_GOOD	Link established and data transfer may take place.

Table 17: Camera Link HS Status LED: J3 connected to output of a camera

D3: Camera Link HS Status LED (as Data Forwarding receiver)

When the Xtium-CLHS PX4 does not have a camera connected but is used as a Data Forwarding Slave, (i.e. the board receives data on J3 from another Xtium in a separate computer), the LED D3 describes these two additional conditions.

LED Color	State	Description
Green	Flashing	Connection not established on input connector J3
Green	Constant	Link established on input connector J3 and data transfer may take place.

Table 18: Camera Link HS Status LED: J3 connected to data forwarding output of another Xtium-CLHS PX4

D6: Data Forwarding Status LED

D6 defines the connection status for when the Camera Link HS output J2 is forwarding acquisition data to another Xtium-CLHS in a separate computer. Note that the Xtium-CLHS PX4 data forwarding feature is not part of the standard CLHS specifications.

LED Color	State	Description
Off	Constant	Connection not established on input connector J3 of the receiving Xtium-CLHS
Green	Constant	Link established with the receiving Xtium-CLHS and data transfer may take place.

Table 19: Data Forwarding Status LED

J2: Data Forwarding Connector



Note: The Data Forwarding connector on the Xtium-CLHS PX4 has the same specifications as the Camera Link HS camera connector (J3) defined in the AIA document “*Specifications of the Camera Link HS Interface Standard for Digital Cameras and Frame Grabbers*” version 1.0 RC5, ©2012 AIA. Typically there is no need to be concerned with the physical pinout of the connector or cables. Refer to their site www.visiononline.org for additional information.

J3: Camera Link HS Connector



Note: The Camera Link HS camera connector is defined in the AIA document “*Specifications of the Camera Link HS Interface Standard for Digital Cameras and Frame Grabbers*” version 1.0 RC5, ©2012 AIA. Typically there is no need to be concerned with the physical pinout of the connector or cables. Refer to their site www.visiononline.org for additional information.

J1: External I/O Signals Connector (Female DH60-27P)

J4: Internal I/O Signals Connector (26-pin SHF-113-01-L-D-RA)



Warning: J1 and J4 have the same pinout assignment. Signals are routed to both connectors directly from their internal circuitry. Therefore never connect both J1 and J4 to external devices at the same time.

Description	Pin #	Pin #	Description
Ground	1	15	General Input 3
RS-422 Shaft Encoder Phase A (-)	2	16	General Input 4
RS-422 Shaft Encoder Phase A (+) (see note 3)	3	17	Reserved
Ground	4	18	Reserved
RS-422 Shaft Encoder Phase B (-)	5	19	Reserved
RS-422 Shaft Encoder Phase B (+)	6	20	Reserved
General Input Common	7	21	General Output 3
External Trigger Input 1 / General Input 1 (Opto-coupled – see note 1)	8	22	General Output 4
External Trigger Input 2 / General Input 2	9	23	Reserved
Ground	10	24	Reserved
Strobe 1 / General Output 1 (See note 2)	11	25	Reserved
General Output 2	12	26	Reserved
Ground	13	27	Reserved (J1 only)
Power Output 12 Volts, 350mA max (from Aux Power Connector, see J7)	14		

Table 20: DH60-27P/ SHF-113-01-L-D-RA Connector Signals

Note 1: General Inputs / External Trigger Inputs Specifications

Each of the four General Inputs are opto-coupled and able to connect to single ended source signals. General Input 1 and 2 can also act as External Trigger Inputs. See “Board Information” user settings. These inputs generate individual interrupts and are read by the Sapera application. The following figure is typical for each Genera Input.

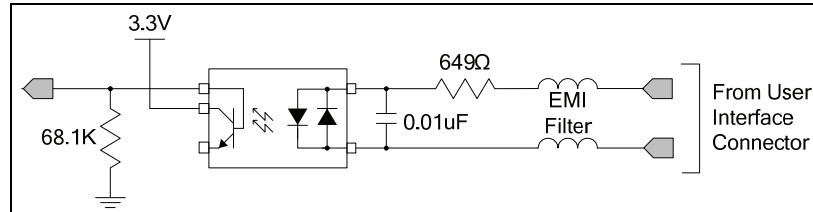


Figure 23: General Inputs Electrical Diagram

Input Details:

- The switch point is software programmable to support TTL, 12V or 24V input signals.
- Maximum input signal frequency is 100 KHz.
- Each input has a 649-ohm series resistor on the opto-coupler input.
- The 0.01uF capacitor provide high frequency noise filtering.
- Maximum input voltage is 26V.

Input Level	Switch Point	Propagation Delay (rising edge signal ↑)	Propagation Delay (falling edge signal ↓)
TTL	1.6V	1.75 μs	5.5 μs
12V	6V	2.6 μs	2.6 μs
24V	12V	1.9 μs	3.1 μs

Table 21: Input Switching Points

For External Trigger usage:

- Input signal is “debounced” to ensure that no voltage glitch is detected as a valid transition. This debounce circuit time constant can be programmed from 1μs to 255μs. Any pulse smaller than the programmed value is blocked and therefore not seen by the board. If no debounce value is specified (value of 0μs), the minimum value of 1μs will be used.
- Refer to Sapera parameters:
CORACQ_PRM_EXT_TRIGGER_SOURCE
CORACQ_PRM_EXT_TRIGGER_ENABLE
CORACQ_PRM_EXT_TRIGGER_LEVEL
CORACQ_PRM_EXT_FRAME_TRIGGER_LEVEL
CORACQ_PRM_EXT_TRIGGER_DETECTION
CORACQ_PRM_EXT_TRIGGER_DURATION
- See also *.cvi file entries:
External Trigger Level, External Frame Trigger Level, External Trigger Enable, External Trigger Detection.
- External Trigger Input 2 used for two pulse external trigger with variable frame length line scan acquisition.

Trigger Signal Total Delay

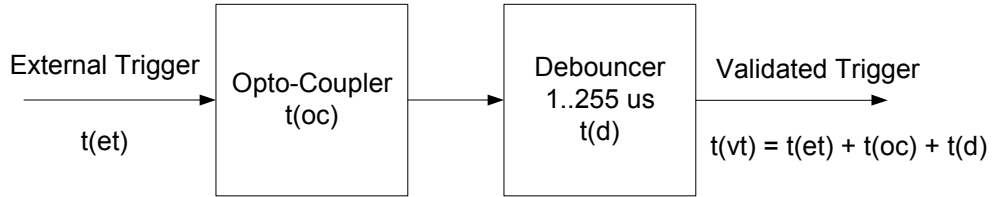


Figure 24: External Trigger Input Validation & Delay

Let	$t(et)$ = time of external trigger in μs $t(oc)$ = time opto-coupler takes to change state (time varies dependent on input voltage) $t(d)$ = user set debounce duration from 1 to 255 μs $t(vt)$ = time of validated trigger in μs
-----	--

Table 22: External Trigger Timing Specifications



Note: Teledyne DALSA recommends using the fastest transition to minimize the time it takes for the opto-coupler to change state.

If the duration of the external trigger is $> t(oc) + t(d)$, then a valid acquisition trigger is detected.

It is possible to emulate an external trigger using the software trigger which is generated by a function call from an application.

Block Diagram: Connecting External Drivers to General Inputs on J1

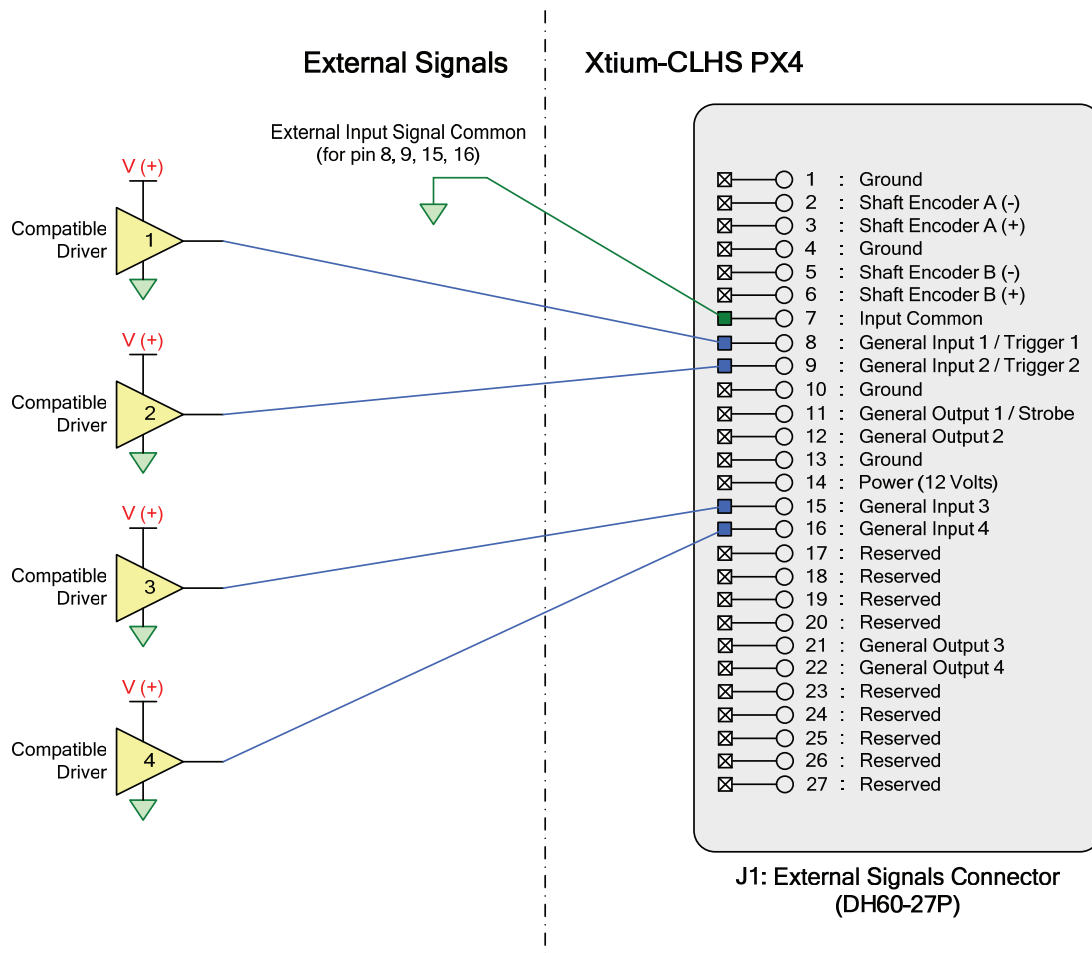


Figure 25: External Signals Connection Diagram

External Driver Electrical Requirements

The Xtium-CLHS allows user selected (software programmable) input switching points to support TTL, 12V or 24V input signals. The following table defines the external signal voltage requirements from the driver circuits connected to the Xtium external inputs.

Input Level	Description	MIN	MAX
TTL	Output Voltage High (V_{OH})	2.4 V	5.5 V
	Output Voltage Low (V_{OL})	0 V	0.8 V
12V	Output Voltage High (V_{OH})	9 V	13.2 V
	Output Voltage Low (V_{OL})	0 V	3 V
24V	Output Voltage High (V_{OH})	18 V	26.4 V
	Output Voltage Low (V_{OL})	0 V	6 V

Note 2: General Outputs /Strobe Output Specifications

Each of the four General Outputs are TTL (3.3V) compatible. General Output 1 also functions as the Strobe Output controlled by Sopera strobe control functions. See "Board Information" user settings. The following figure is typical for each General Output.

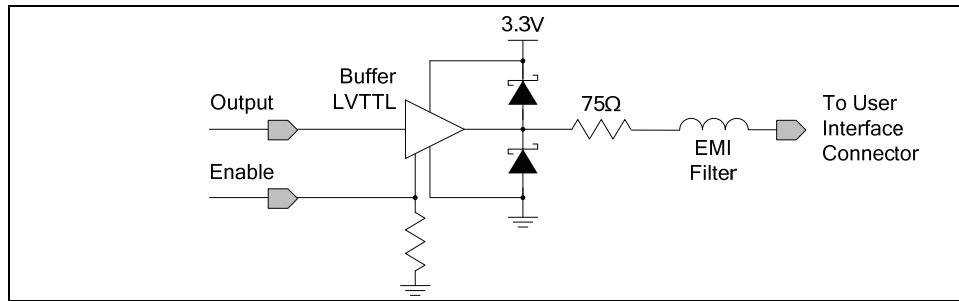


Figure 26: General Outputs Electrical Diagram

Output Details:

- Each output has a 75-ohm series resistor
- The 2 diodes protects the LVTTL buffer against overvoltage
- Each output is a tri-state driver, enabled by software
- Minimum guaranteed output current is +/- 24mA @ 3.3V
- Maximum short circuit output current is 44mA
- Minimum voltage for output level high is 2.4V, while maximum voltage for output low is 0.55V
- Maximum output switching frequency is limited by driver and register access on the PCIe bus.

For Strobe Usage:

- Refer to Sopera Strobe Methods parameters:
CORACQ_PRM_STROBE_ENABLE
CORACQ_PRM_STROBE_POLARITY
CORACQ_PRM_STROBE_LEVEL
CORACQ_PRM_STROBE_METHOD
CORACQ_PRM_STROBE_DELAY
CORACQ_PRM_STROBE_DURATION
- See also *.cvi file entries:
Strobe Enable, Strobe Polarity, Strobe Level, Strobe Method, Strobe Delay, Strobe Duration.

Block Diagram: Connecting External Receivers to the General Outputs

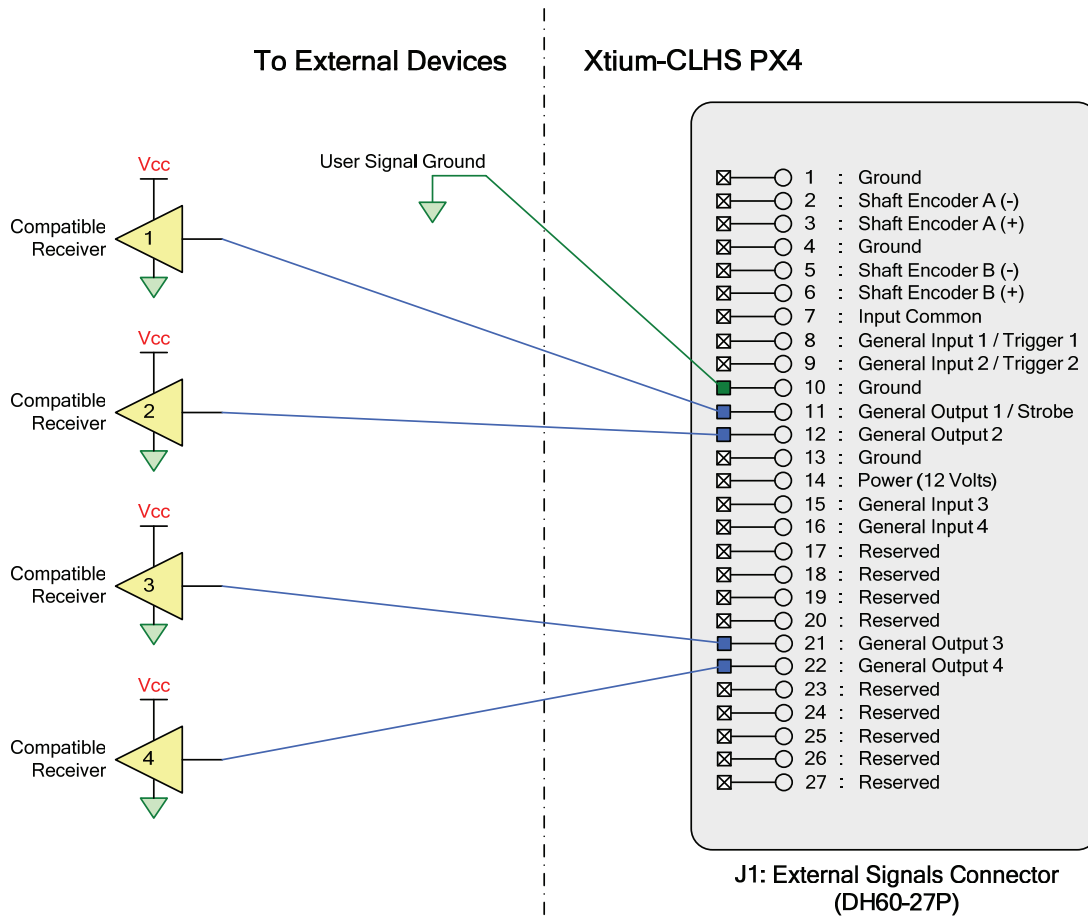


Figure 27: Output Signals Connection Diagram

External Receiver Electrical Requirements

External receiver circuits connected to the Xtium General Outputs must be compatible to TTL signals.

Input Level	Description	MIN	MAX
TTL	Input Voltage High (V_{IH})	2.0 V	-
	Input Voltage Low (V_{IL})	-	0.8 V

Note 3: RS-422 Shaft Encoder Input Specifications

Dual Quadrature Shaft Encoder Inputs (phase A and phase B) connect to differential signals (RS-422) or single ended TTL 5V source signals. The figure below shows the simplified representation of these inputs.

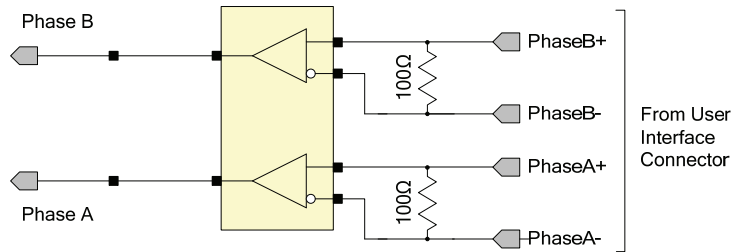


Figure 28: RS-422 Shaft Encoder Input Electrical Diagram

- Maximum input voltage is +/- 7V with a differential voltage level of +/- 200mV.
- All inputs have a 100-ohm differential resistor.
- Maximum input signal frequency is 10 MHz.
- The Xtium-CLHS provides ESD filtering on-board.
- See "Line Trigger Source Selection for Line scan Applications" on page 37 for more information.
- Refer to Sopera parameters:
CORACQ_PRM_SHAFT_ENCODER_ENABLE CORACQ_PRM_SHAFT_ENCODER_DROP
or refer to CORACQ_PRM_EXT_LINE_TRIGGER_ENABLE
CORACQ_PRM_EXT_LINE_TRIGGER_DETECTION
CORACQ_PRM_EXT_LINE_TRIGGER_LEVEL (fixed at RS-422)
CORACQ_PRM_EXT_LINE_TRIGGER_SOURCE
- See also *.cvi file entries:
Shaft Encoder Enable, Shaft Encoder Pulse Drop,
or see External Line Trigger Enable, External Line Trigger Detection, External Line Trigger Level,
External Line Trigger Source.
- For TTL single ended signals, connect a bias voltage to the RS-422 (-) input to ensure correct detection of the logic state of the signal connected to the RS-422 (+) input. See the following section for connection methods.

Example: Connecting to the RS-422 Shaft Encoder Block Diagram

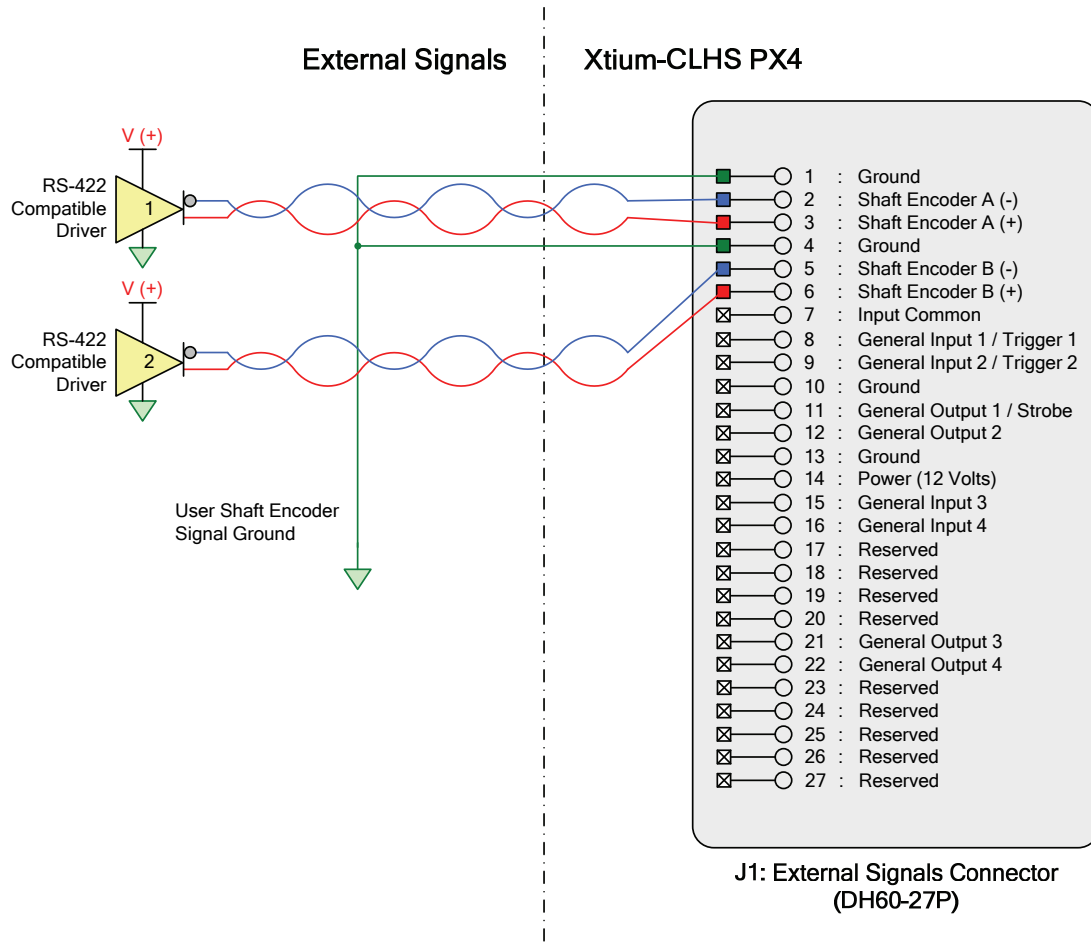


Figure 29: External RS-422 Signals Connection Diagram

- External shaft encoder circuits using RS-422 output drivers must meet the following Xtium-CLHS signal requirements for proper board control:

RS-422 External Driver	MIN	TYP
Differential Output Voltage High (V_{ODH})	2 V	14 V
Differential Output Voltage Low (V_{ODL})	-14 V	-2 V

Example: Connecting a TTL Shaft Encoder to RS-422 Inputs

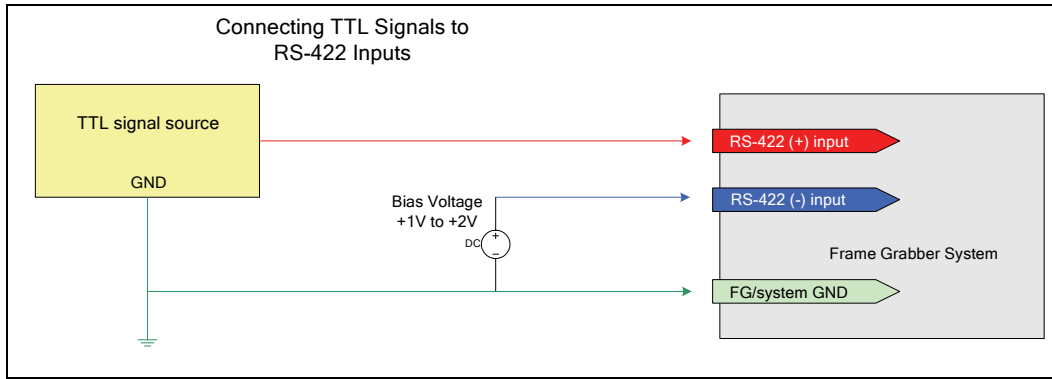


Figure 30: Connecting TTL to RS-422 Shaft Encoder Inputs

- RS-422 (-) input is biased to a DC voltage from +1 to +2 volts.
- This guarantees that the TTL signal connected to the RS-422 (+) input will be detected as a logic high or low relative to the (-) input.
- The TTL shaft encoder ground, the bias voltage ground, and the Xtium-CLHS PX4 computer system ground must be connected together.

Example for Generating a RS-422 (-) Input Bias Source

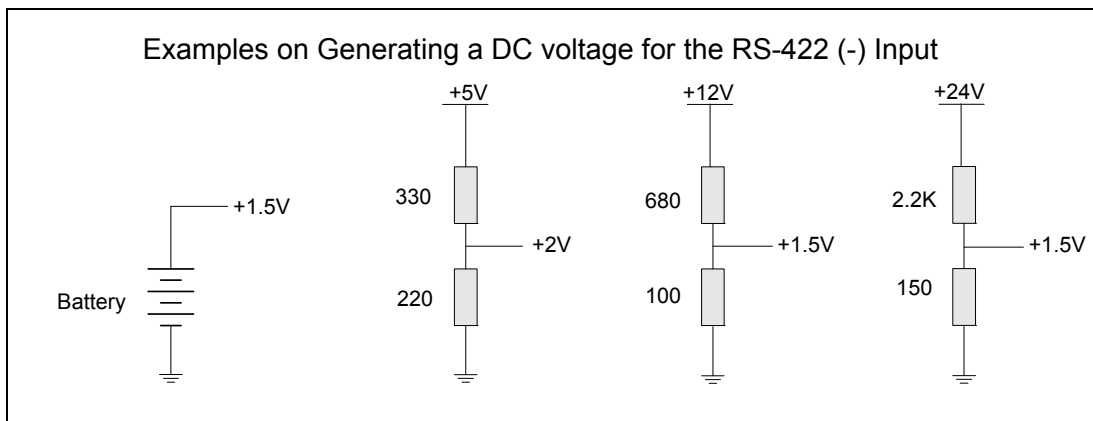


Figure 31: Generating a DC Bias Voltage

- DC voltage for the RS-422 (-) input can be generated by a resistor voltage divider.
- Use a single battery cell if this is more suitable to your system.

J5: Multi-Board Sync / Bi-directional General I/Os

There are 8 bi-directional General I/Os that can be interconnected between multiple boards. These bi-directional I/Os can be read/written by Sopera application. Bi-directional General I/Os no.1 and no.2 also can also act as the multi-board sync I/Os.

The multi-board sync feature permits interconnecting multiple Xtium boards to synchronize acquisitions to one or two triggers or events. The trigger source origin can be either an external signal or a software control signal. The board sending the trigger(s) is the "Sync Master" board, while the one or more boards receiving the control signal(s) "Sync Slaves".

Setup of the boards is either by setting parameters via a Sopera application or by using CamExpert to configure two camera files (.ccf). For testing purposes, two instances of CamExpert (one for each board) can be run on the system where the frame grabbers are installed.

Hardware Preparation

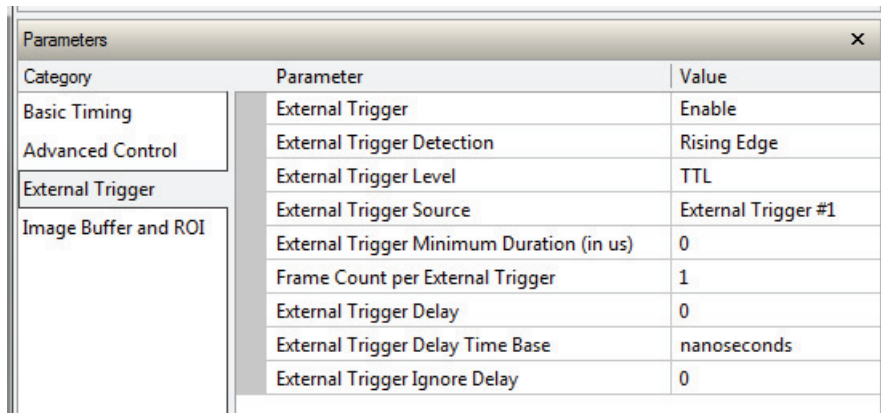
- Interconnect two, three, or four Xtium boards via their J5 connector using the OR-YXCC-BSYNC20 cable (for 2 boards) or the OR-YXCC-BSYNC40 cable (see Board Sync Cable Assembly OR-YXCC-BSYNC40 for 3 or 4 boards).

Configuration via Sopera Application Programming

- Sync Master Board** Software Setup: Choose one Xtium as "Sync Master". The Sopera parameter CORACQ_PRM_BOARD_SYNC_OUTPUT1_SOURCE and/or CORACQ_PRM_BOARD_SYNC_OUTPUT2_SOURCE select the signal(s) to send to the "Sync Slave" boards.
- Other sync master board parameters are set as for any external trigger application, such as External Trigger enable, detection, and level. See Sopera documentation for more details.
- Sync Slave Board** Software Setup: The Sopera parameter CORACQ_PRM_EXT_TRIGGER_SOURCE and/or CORACQ_PRM_EXT_LINE_TRIGGER_SOURCE are set to Board Sync #1 or #2.

Configuration via Sopera CamExpert

- Start the first instance of CamExpert and select one installed **Xtium board** to be the **master**. As shown in the following image, this board is configured to use an external trigger on input #1.



Category	Parameter	Value
Basic Timing	External Trigger	Enable
Advanced Control	External Trigger Detection	Rising Edge
External Trigger	External Trigger Level	TTL
Image Buffer and ROI	External Trigger Source	External Trigger #1
	External Trigger Minimum Duration (in us)	0
	Frame Count per External Trigger	1
	External Trigger Delay	0
	External Trigger Delay Time Base	nanoseconds
	External Trigger Ignore Delay	0

- The **master Xtium board** is also configured to output the external trigger on board sync #1, as shown in the following image.

Parameters		
Category	Parameter	Value
Basic Timing	Internal Frame Trigger	Disabled
Advanced Control	Internal Frame Trigger Frequency (in Hz)	30
External Trigger	Camera Control method selected	Camera Trigger
Image Buffer and ROI	Time Integration Method Setting	None
	Camera Trigger Method Setting	Method 1
	Camera Control During Readout	Not Supported
	Strobe Method Setting	None
	Time Stamp Base	microseconds
	Board Sync Output 1 Source	External Frame Trigger
	Board Sync Output 2 Source	Disabled
	CC1	Not Used
	CC2	Not Used
	CC3	Not Used
	CC4	Not Used

- The **slave Xtium board** is configured to receive its trigger on the board sync signal. As an example the following image shows the Xtium board configured for an external sync on board sync #2.

Parameters		
Category	Parameter	Value
Basic Timing	External Trigger	Enable
Advanced Control	External Trigger Detection	Rising Edge
External Trigger	External Trigger Level	TTL
Image Buffer and ROI	External Trigger Source	Board Sync #2
	External Trigger Minimum Duration (in us)	0
	Frame Count per External Trigger	1
	External Trigger Delay	0
	External Trigger Delay Time Base	nanoseconds
	External Trigger Ignore Delay	0

- **Test Setup:** Start the acquisition on all slave boards. The acquisition process is now waiting for the control signal from the master board. Trigger master board acquisition and the acquisition start signal is sent to each slave board.

J7: Power Connector

DC Power Details



Warning: Never remove or install any hardware component with the computer power on. Never connect a power cable to J7 when the computer is powered on.

- Connect a computer 6-pin PCI Express power connector to J7 to supply DC power to connector J1. Older computers may need a power cable adapter (see Power Cable Assembly OR-YXCC-PWRY00).

Cables & Accessories

The following cables and accessories are available for purchase via third party vendors or Teledyne DALSA. Contact sales for information.

Camera Link HS Cables

In general, a CX4 compliant cable assembly is acceptable for use as a CLHS interface cable with the exception that it must have a thumbscrew type junction shell. This cable assembly is primarily intended as a point-to-point interface of up to 15 meters.

A manufactured CX4 cable shall use the SFF-8470 multi-sourced connector as specified by the published standard "SFF-8470 Specification for Shielded High Speed Serial Multilane Copper Connector (Rev 3.3 April 3, 2006 or later)".

For additional information on cables and their specifications, visit the following web sites and search for "Camera Link HS" cables:

Components Express	http://www.componentsexpress.com/
Nortech Systems	http://www.intercon-1.com/intercon1/

Table 23: Camera Link HS Cable Suppliers

DH40-27S Cable Assembly to Blunt End (OR-YXCC-27BE2Mo, Rev 4)

Cable assembly consists of a 2000 mm (~6 ft) blunt end cable to mate to Xtium external connector **J1**. The wiring color code table follows the cable drawing.

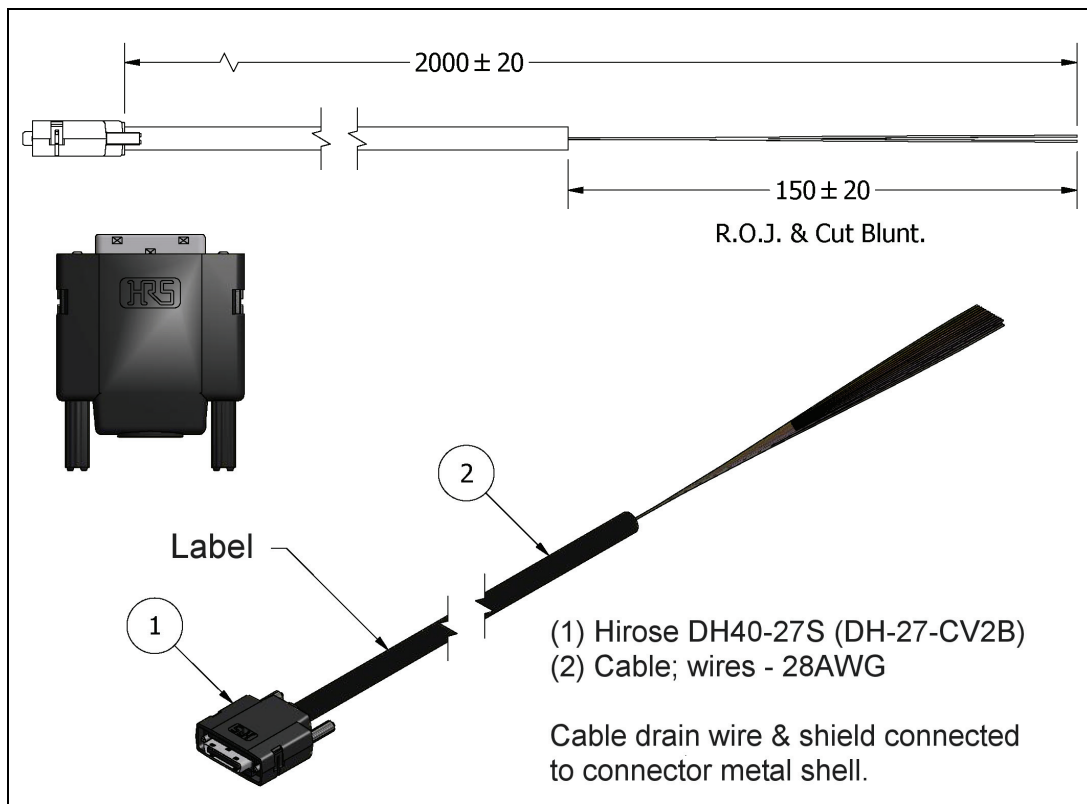


Figure 32: DH60-27P Cable No. OR-YXCC-27BE2M0 Detail

Wire Color Code	No.	No.	Wire Color Code
WHITE - TAN	1	2	BROWN - WHITE
WHITE - BROWN	3	4	TAN - WHITE
WHITE - PINK	5	6	PINK - WHITE
WHITE - ORANGE	7	8	ORANGE - WHITE
WHITE - YELLOW	9	10	YELLOW - WHITE
WHITE - GREEN	11	12	GREEN - WHITE
WHITE - BLUE	13	14	BLUE - WHITE
WHITE - VIOLET	15	16	VIOLET - WHITE
WHITE - GRY	17	18	GRY - WHITE
TAN - BROWN	19	20	BROWN - TAN
TAN - PINK	21	22	PINK - TAN
TAN - ORANGE	23	24	ORANGE - TAN
TAN - YELLOW	25	26	YELLOW - TAN
TAN - GREEN	27		

Note: The first color is the wire base, the second is the wire color stripe

Table 24: OR-YXCC-27BE2M0 Rev 4 Cable Wire Color Codes

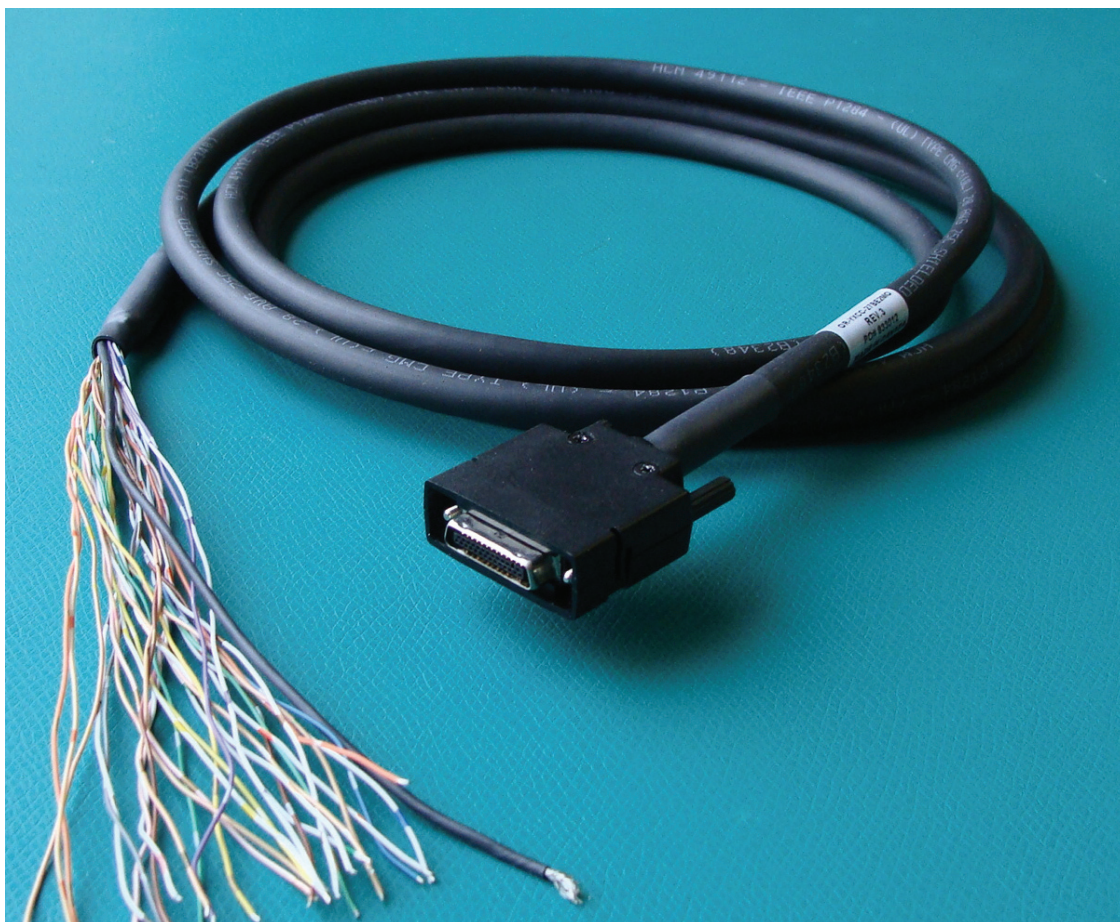


Figure 33: Photo of cable OR-YXCC-27BE2M0

Cable assemblies for I/O connector J4

For use with the internal I/O connector J4, suggested third party cables are available from SAMTEC. Below are two examples:

- Connector to blunt end (FFSD-13-S-xx.xx-01-N)
- Connector to connector (FFSD-13-D-xx.xx-01-N)
- Note: xx.xx denotes length, where 06.00 is a 6 inch (~15 cm) length cable
- URL: http://cloud.samtec.com/catalog_english/FFSD.PDF

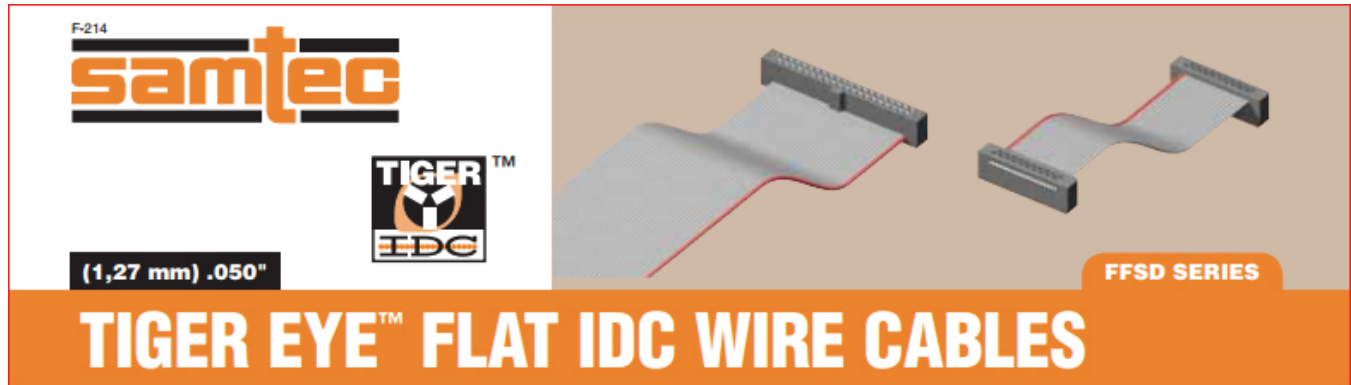


Figure 34: Samtec Cable Series

Board Sync Cable Assembly OR-YXCC-BSYNC40

This cable connects 3 to 4 Xtium boards for the board sync function as described in section J5: Multi-Board Sync / Bi-directional General I/Os. For a shorter 2 board cable, order cable assembly OR-YXCC-BSYNC20.

For a third part source of cables, see http://cloud.samtec.com/catalog_english/FFSD.PDF.

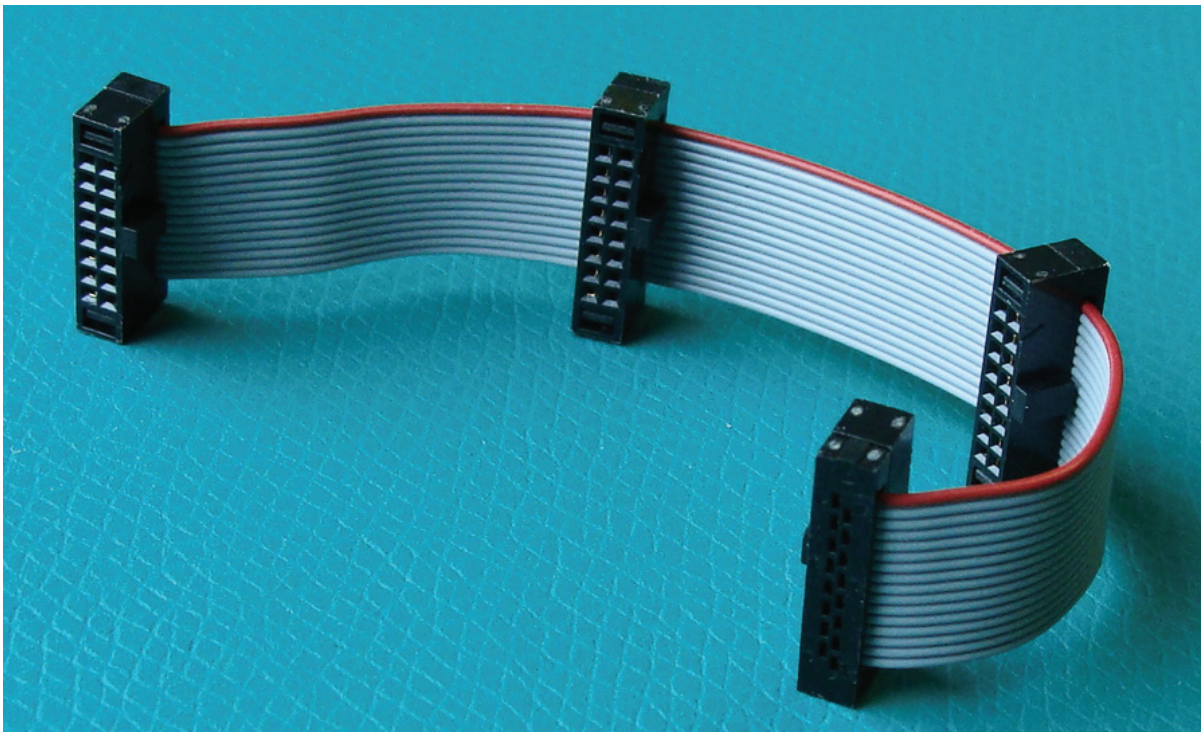


Figure 35: Photo of cable OR-YXCC-BSYNC40

Power Cable Assembly OR-YXCC-PWRY00

When the Xtium-CLHS PX4 supplies power to external devices via the J1 I/O connector, PC power must be connected to the Xtium external power source connector (J7).

Recent computer power supplies provide multiple 6-pin power source connectors for PCI Express video cards, where one is connected to J7 on the Xtium-CLHS. But if the computer is an older model, this power supply adapter converts 2 standard 4-pin large power connectors to a 6-pin power connector.

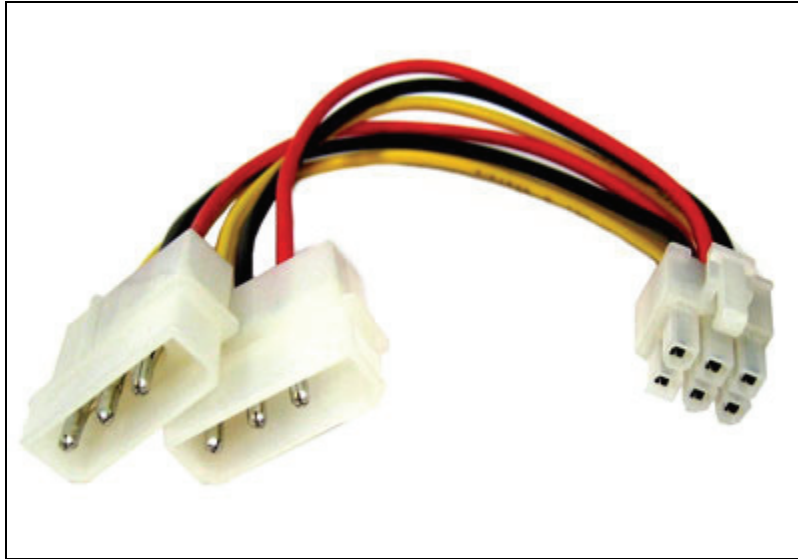


Figure 36: Photo of cable assembly OR-YXCC-PWRY00

This is an industry standard adapter cable which can be purchased from Teledyne DALSA.

Camera Link HS Interface



Camera Link HS Overview



Note: The following text is extracted from the AIA document "*Specifications of the Camera Link HS Interface Standard for Digital Cameras and Frame Grabbers*" version 1.0 RC5, ©2012 AIA. Refer to their site www.visiononline.org for additional information.

Camera Link HS (CLHS) is a global standard defining the communications between a camera and a frame grabber. The CLHS standard offers high performance control functions and scalable data transfer bandwidths between the camera and frame grabber. The data transmission technology employed in CLHS is available from multiple suppliers and has roadmaps to higher bit rates driven by the telecom market. The use of widely used technology guarantees a low component cost and long term supply for machine vision customers.

The packet based protocol used in CLHS is machine vision specific, thus delivering the high image reliability needed in modern machine vision systems. CLHS Messages are defined independent of the physical layer, allowing CLHS to adopt new physical layers as they become available.

Currently CLHS employs simple 8b/10b technology in the M-Protocol and the XAUI-64/66 encoding for the X-Protocol. CLHS supports real time triggers (Pulse) and General Purpose Input/Output (GPIO), using a priority methodology that results in CLHS having the lowest latency and jitter of any packet based protocol. Designed with forward error correction for real time messages, plus CRC and hardware based resend mechanisms for video and command packets, ensure data reliability.

Rights and Trademarks

The AIA, as sponsor of the Camera Link HS committee, owns the U.S. trademark registration for the Camera Link HS logo as a certification mark for the mutual benefit of the industry. Usage of the Camera Link HS logo with any product(s) implies compliancy with the Camera Link HS standard.

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Technical Support

Submit any support question or request via our web site:

Technical support form via our web page:
Support requests for imaging product installations,
Support requests for imaging applications

Camera support information

Product literature and driver updates

<http://www.teledynedalsa.com/mv/support>

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