

Teledyne DALSA • 880 Rue McCaffrey • St-Laurent, Québec, H4T 2C7 • Canada https://www.teledynedalsa.com/en/products/imaging/cameras/falcon4-clhs/

FA-ANHS01-V4: Falcon4-CLHS Application Note

Configuring Falcon4-CLHS and Teledyne DALSA Frame Grabbers

For Falcon4-CLHS models with P/N: FA-Hxxx-xxxxx

Overview

Falcon4-CLHS cameras require a connection to a frame grabber to acquire images. This application note describes how to configure a Falcon4-CLHS with a Teledyne DALSA CLHS Xtium2 series frame grabber.

The Falcon4-CLHS supports the CLHS device discovery methodology providing plugand-play capability. GenICam implementation allows compatibility with Teledyne DALSA or third-party CLHS frame grabbers that support the **CLHS X-Protocol** (CLHS M-Protocol not supported). Teledyne DALSA **Xtium2** series frame grabbers support CLHS X-Protocol.

The Falcon4-CLHS series includes the following models:

- Falcon4-CLHS M4480 (FA-HM00-M4485, FA-HM10-M4485): 7 data lanes.
- Falcon4-CLHS M8200 (FA-HM10-M8205): 7 data lanes.
- Falcon4-CLHS M6200 (FA-HM10-M6205): 7 data lanes.

(Models above supported by Teledyne DALSA **Xtium2-CLHS PX8** (OR-A8S0-PX870) frame grabber.)

- Falcon4-CLHS M2240 (FA-HM10-M2245): 4 data lanes.
- Falcon4-CLHS M4400 (FA-HM11-M4405): 4 data lanes.

(Models supported by Teledyne DALSA **Xtium2-CLHS PX8** (OR-A8S0-PX870) or **Xtium2-CLHS PX8 LC** (OR-A8S0-PX840) frame grabber.)



The maximum sustained bandwidth from a Falcon4-CLHS M4480 camera to an Xtium2-CLHS PX8 is up to ~6.7 GB/s (approximately 505 fps at full resolution / 8-bit). To reach the full camera bandwidth (600 fps), two frame grabbers, using data forwarding, are required. For the other Falcon4 models, a single frame grabber can handle the maximum bandwidth of a camera. Refer to the frame grabber documentation for more information.

Requirements & Installation

Prerequisites

The following table lists the recommended Falcon4-CLHS firmware and software for the camera models.

FALCON4- CLHS Model	Falcon4-CLHS Firmware Design	Software SDK
M2240	Falcon4-CLHS_e2v_11M_STD_Firmware_256.293.cbf	Sapera LT 8.60
M4400	or higher	(or higher)
M4480	Falcon4-CLHS_e2v_11M_STD_Firmware_256.101.cbf or higher	Sapera LT 8.60 (or higher)
M6200	Falcon4-CLHS_e2v_37-67M_STD_Firmware_xx.xx.cbf	Sapera LT 8.70
M8200	or higher	(or higher)

Software

Sapera LT SDK (full version), the image acquisition and control software development kit (SDK) for Teledyne DALSA cameras is available for download from the Teledyne DALSA website:

http://teledynedalsa.com/imaging/support/downloads/sdks/

If the required version is not available, contact your Teledyne DALSA representative.

Sapera LT includes the CamExpert application, which provides a graphical user interface to access camera features for configuration and setup.

Hardware

A frame grabber board such as the Teledyne DALSA Xtium2-CLHS PX8 / PX8 LC is the recommended computer interface.

Falcon4 Model	Teledyne DALSA Frame Grabber	Part Number
M2240	Xtium2 CLHS PX8	OR-A8S0-PX870
M4400	Xtium2 CLHS PX8 LC	OR-A8S0-PX840
M4480 M6200 M8200	Xtium2 CLHS PX8	OR-A8S0-PX870

Follow the installation instructions from the board's User Manual for the computer requirements, installation, and update of the board driver.

The latest board drivers are available from the Teledyne DALSA website:

https://www.teledynedalsa.com/en/support/downloads-center/device-drivers/

Camera Link HS Cables Overview and Resources

The camera uses a Camera Link HS SFF-8470 (CX4) cable; AOC (Active Optical Connectors) cables are recommended due to the high-bandwidth CLHS X-Protocol (C3 copper cables < 2m may work but are not recommended).



Note: CX4 AOC cables are directional; ensure that the connector labelled "Camera" and "FG" are attached accordingly to the camera and frame grabber.

Visit our web site for additional information on the CLHS interface: <u>https://www.teledynedalsa.com/en/learn/knowledge-center/clhs/</u>

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/
FiberStore	https://www.fs.com

Camera Power

Cameras with part number FA-HMxx-xxxx support Power via the Auxiliary Connector (12 to 24 Volt DC). Refer to the <u>Falcon4-CLHS User Manual</u> for cable accessories or mating connector details.





The frame grabber PoCL (Power-over-Cable) powers the electronics in the Active Optical Cable (AOC) module. This frame grabber feature should not be disabled for normal operation.

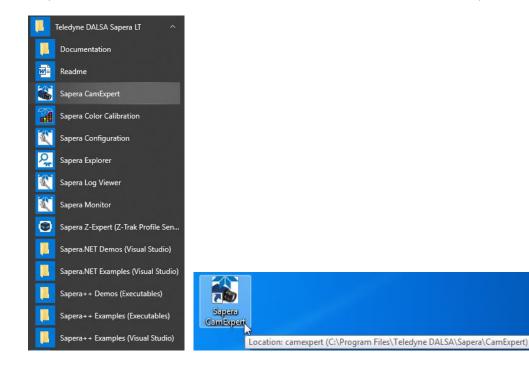
Installation Procedure

The following steps summarize the installation procedure:

- Install the Xtium2-CLHS PX8 (or Xtium2-CLHS PX8 LC) into an available PCI Express x8 Gen3 slot.
- Turn on the computer.
- Download and install the Sapera LT SDK or its runtime library:
 - version 8.60 or newer required for Models M2240, M4480, M4400
 - version 8.70 or newer required for Models M6200, M8200
- Download and install the Xtium2-CLHS PX8 Sapera board driver:
 - version 1.31 or newer required for Models M2240, M4480, M4400
 - version 1.40 or newer required for Models M6200, M8200
- Reboot the computer.
- Connect the Falcon4-CLHS with a CLHS camera cable to the CLHS frame grabber; power the camera using an appropriate power supply.
- The Falcon4-CLHS status LED will indicate power and the Device / Host connection with a steady green color when connected. Refer to the section "Camera Status LED Indicator" in the camera manual for a complete list of Status LED indicators.

Start Sapera CamExpert

The Sapera CamExpert application is included as part of the Sapera LT SDK. It is Teledyne DALSA's camera and frame grabber interfacing tool that allows you to quickly validate hardware setup, change parameter settings, and test image acquisition. It is available from the Windows **Start** menu or desktop shortcut.



Select the Frame Grabber & Camera

If there is only one Teledyne DALSA frame grabber, the **Device** list automatically has the Xtium2-CLHS PX8 selected and the connected Falcon4-CLHS is also automatically detected as shown in the image below.

🏐 CamExper	t (version 8.60.00.2120) - [Untitled]		
File View	Pre-Processing Tools Help		
🗅 🚅 🔒	8		
Device Selecto)r		×
Device:	💵 Xtium2-CLHS_PX8_1 🍃 Camer	aLink HS Mono	
Configuration:	Select a camera file (Optional)		•
CameraLink D	etection: Detect Camera	Settings	
Parameters			×
Category		Parameter	Value
Board		Camera Type	Areascan
Basic Timi	ing	Color Type	Monochrome
Advanced	I Control	Pixel Depth	8
External T	rigger	Data Lanes	7
	ffer and ROI	Horizontal Active (in Pixels)	4480
		Vertical Active (in Lines)	2496
	Camera - Xtium2-CLHS_PX8_1	Data Valid	Disabled
Camera Ir	nformation	CLHS Configuration	None
Camera C	ontrol	PoCL	Enable
Digital IO	Control	PoCL Status	Active
Image For	rmat		

CamExpert indicates the status of the data connections and signal integrity between the camera and frame grabber. The CamExpert Video Status bar, below the **Output Messages** window, displays the connection status flags in green (OK) or red (error). The following screen capture shows that the Data Lane signals are correct and Frame Valid and Line Valid signals are active.

Output Messages
[10:44:37] (Xtium2-CLHS_PX8_1) - CameraLink HS Mono [10:44:37] (Xtium2-CLHS_PX8_1) - Loading camera files library
10:44:41] (Xtium2-CLHS_PX8_1) – Camera files library loaded.
Output Messages
Video status: 10.000 Gb/s Lane 1 Lock Lane 2 Lock Lane 3 Lock Lane 4 Lock Lane 5 Lock Lane 6 Lock Lane 7 Lock Slave Link Lock Frame Valid Line Valid PoCL PoCL 2

If the Camera is Not Automatically Detected

Verify that the camera is properly powered and that the fiber optic cable is connected correctly to the appropriate connectors on the frame grabber and camera; cables are uni-directional and connectors are labelled "Camera" and "F G" (frame grabber).

Upload New Camera Firmware

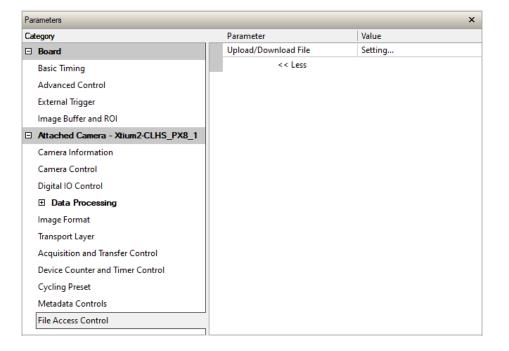
With the Falcon4-CLHS detected the user should upload new firmware if available. Using CamExpert, verify the current camera firmware by selecting the Camera Information category and checking the Firmware Version feature.

Parameters - Visibility: Guru		×
Category	Parameter	Value
Board	Manufacturer Name	Teledyne DALSA
Basic Timing	Device Family Name	FALCON4-CLHS
Advanced Control	Model Name	M4480
	Device Version	1.02 Beta
External Trigger	Manufacturer Part Number	FA-HM00-M4485
Image Buffer and ROI	Manufacturer Info	Standard Design
Attached Camera - Xtium2-CLHS_PX8_1	Firmware Version	256.223
Camera Information	Serial Number	12220499
Camera Control	Device User ID	
Digital IO Control	Temperature	43.5
Data Processing	Input Voltage	23.9
	Device Built-In Self Test Status	Passed
Image Format	Device Built-In Self Test Status All	0
Transport Layer	D.C. L.DICT	n

New firmware versions are available in the <u>file download area of the Teledyne DALSA</u> <u>web site</u>. Download the latest release to the computer used with the Falcon4.

To Upload New Firmware

• Select the File Access Control category and click **Setting**.



• In the File Access Control dialog, from the **Type** list select *Device Firmware* and click **Browse** to select the required firmware file.

File Access Contro		×
Select the type of	file to upload or download from the device.	
File Type Availa	ble	
Туре:	Device Firmware 💌	
File selector:	All Firmware	
Description:	All Firmware - FPGA code, microcode, XML, and Start-up Script	
	ing on the file size and communication speed, the take many minutes, but must not be aborted.	
File path:		
	Browse	
Upload (to Ca	mera) Download (from Camera) Delete	e
	Close	

• Click **Upload (to Camera)** and restart the camera when prompted.



Important: File upload rates are fixed (as per the CLHS standard) at 20 Mb/s. As an example, a firmware file upload process will take about 2¹/₂ minutes.

Verify Basic Acquisition

To verify basic acquisition, the camera can output a test pattern to validate that parameter settings are correctly configured between the camera and frame grabber.

• In the Image Format category, select Test Pattern – *Grey Diagonal Ramp Moving*.

Parameters - Visibility: Guru				×
Category		Parameter	Value	
Board		Pixel Format	Mono 8	
Basic Timing		WidthMax	4480	
Advanced Control		HeightMax	2496	
		Horizontal Offset	0	
External Trigger		Vertical Offset	0	
Image Buffer and ROI		Width	4480	
Attached Camera - Xtium2-CLHS_PX8_1		Height	2496	
Camera Information		Test Pattern	Grey Diagonal Ramp Moving	-
Camera Control		Test Image Value	Grey Horizontal Ramp	~
Digital IO Control		Binning Selector	Grey Vertical Ramp	
Data Processing		Binning Mode	Grey Diagonal Ramp Moving	×
Image Format	- 1	Binning Horizontal	1	
		Binning Vertical	1	
Transport Layer		Multiple ROI Mode	Off	
Acquisition and Transfer Control		ROI Count Vertical	Not Enabled	
Device Counter and Timer Control		ROI Selector	Not Enabled	
Cycling Preset		ROI Offset Y	Not Enabled	
Metadata Controls		ROI Height	Not Enabled	
File Access Control		<< Less		

• (For models M6200 & M8200 only) In the Basic Timing board category, click the Camera Sensor Geometry Setting value, and select 1X-2YE Two Channel Converge as depicted.

amera Sens	or Geometry Setting)
GenlCam	Description		
1X-1Y	One Tap Left to Right	A →	Demo
1X-1Y2	Two Interline Channel, Even A	A → B →	Demo
1X-1Y2	Two Interline Channel, Even B	B → A	Demo
1X-2YE	Two Channel Converge	A →	Demo
		₽ ₽	
2X-1Y	Two Taps Separate Left to Right	A → B →	Demo
3X-1Y	Three Taps Separate Left to Right	A 🔿 B 🔿 C 🔿	Demo
4X-1Y	Four Taps Separate Left to Right		Demo
8X-1Y	Eight Taps Separate Left to Right	And Back Cach Date Each Fack Gack Hade	Demo
10X-1Y	Ten Taps Separate Left to Right	A B B C B D E E F G G H H I J J	Demo
1X2-1Y	Two Taps Interleaved		Demo
1X3-1Y	Three Taps Interleaved	A B C A B C	Demo
2X2-1Y	Four Taps Two Segments Interleaved		Demo

• On the Display toolbar, click **Fit to Screen** to view the complete acquisition in the display window (the actual acquisition data is unmodified).



• Click **Grab** to view the diagonal ramp acquisition.

CamExpert (version 8.60.00.2120) • [Untitled]		
ile View Pre-Processing Tools Help		
0 📽 🖬 💡		
Device Selector		× Daplay
Device: By Xtum2-CLHS_PX8_1 of CameraLin		💌 🗰 freeze 🔛 Sous 🎬 Trayer
Device: Noum2CLHS_PX8_1 of CameraLin	k HS Mono	
Configuration: Select a camera file (Optional)		Frame/sec; 113.0 t/s Resolution: 4450 Pixels x 2496 Lines: Monochrome 8-bit Focus quality (whole image): 37.4
CameraLink Detection: Detect Camera		
arameters		
ategory	Parameter Value	
3 Board	Picel Format Mono 8	
Basic Timing	Pixel Size 8 Bits/Pixe	
Advanced Control	WidthMax 4480	
External Trigger	HeightMax 2496	
Image Buffer and ROI	Horizontal Offset 0	
Attached Camera - Xium2-CLHS_PX8_1	Vertical Offset 0 Width 4480	
Camera Information	Width 4480 Height 2495	
Camera Information	Test Pattern Grey Diag	
	Test Image Value Not Enabl	
Digital ID Control	<< Less	
Image Format		
Transport Layer		
Acquisition and Transfer Control		
File Access Control		
Feature Display Name: Test Pattern		× 1
Feature Display Name: Test Pattern Description: Test Pattern		Buffer (D/3) (VC) 3 (V) (A (VC))
Feature Name: TestImageSelector Type: IEnumeration (SapFeature: TypeEnum)		Output Messages
and the second		(1950-46) (Num2-CLHS, PX8, 1) - Camera files library loaded.
		(955) 48 (Num 2 CLHS (NS, 1) – Canera Net Ibrary loaded. (955) 42 (S (Num 2 CLHS (NS, 1)) – Tair Pattern value was charged from "Off" to "Grey/Degona/Ramp". (955) 42 (S (Num 2 CLHS)) – Start Pattern value was charged from "Off" to "Grey/Degona/Ramp".
Entry Display Name: Off Description: Image is from the camera sensor.		(2) 54.28) - Grab button was clicked. (2) 54-29) - Freeze button was clicked.
Entry Name: Of		10:54 20] - Grab button was clocked.
Parameters		Output Message
and the second s		J

Key features to verify include:

- Data Lanes
- Image Format (pixel depth, pixel format, image height and width)

For example, for frame grabbers, the Basic Timing category includes the Data Lanes and Pixel Depth parameters:

Parameters			×
Category	Parameter	Value	
🗆 Board	Camera Type	Areascan	
Basic Timing	Color Type	Monochrome	
Advanced Control	Pixel Depth	8	-
	Data Lanes	8	
External Trigger	Horizontal Active (in Pixels)	10	
Image Buffer and ROI	Vertical Active (in Lines)	14	
Attached Camera - Xtium2-CLHS	Data Valid	16	

The Image Buffer and ROI categories include the Image Width, Image Height, and Image Buffer format parameters.

Parameters			×
Category	Parameter	Value	
Board	Image Width (in Pixels)	4480	
Basic Timing	Image Height (in Lines)	2496	
Advanced Control	Image Left Offset (in Pixels)	0	
	Image Top Offset (in Lines)	0	
External Trigger	Image Buffer Format	Monochrome 8-bits	-
Image Buffer and ROI	Image Flip	Monochrome 8-bits	~
Attached Camera - Xtium2-CLHS		Monochrome 16-bits Monochrome 8-bit (2 planes)	
Camera Information Camera Control		Monochrome 8-bit (3 planes) Monochrome 8-bit (4 planes)	~

For the Falcon4-CLHS, the Image Format category provides the required feature settings.

Parameters		×
Category	Parameter	Value
🗆 Board	Pixel Format	Mono 8
Basic Timing	WidthMax	4480
Advanced Control	HeightMax	2496
	Horizontal Offset	0
External Trigger	Vertical Offset	0
Image Buffer and ROI	Width	4480
Attached Camera - Xtium2-CLHS_PX8_1	Height	2496
Camera Information	Test Pattern	Grey Diagonal Ramp Moving
Camera Control	Test Image Value	Not Enabled
Digital IO Control	Binning Selector	Mixed
Data Processing	Binning Mode	Average
-	Binning Horizontal	1
Image Format	Binning Vertical	1
Transport Layer	Multiple ROI Mode	Off
Acquisition and Transfer Control	ROI Count Vertical	Not Enabled
Device Counter and Timer Control	ROI Selector	Not Enabled
Cycling Preset	ROI Offset Y	Not Enabled
Metadata Controls	ROI Height	Not Enabled
File Access Control	<< Less	

The Transport Layer category includes the Next CLHS Device Configuration feature, which describes the camera cable and data lanes.

Cate	gory		Parameter	Value
	Board		CLHS Discovery Mode	Discovery Enabled
B	asic Timing		Next CLHS Device Configuration	One Cable Seven Lane
4	dvanced Control		CLHS 64b/66b Receive Error Count	0
			Refresh CLHS 64b/66b Receive Error Count	Press
	xternal Trigger		Reset Receive Error Count	Press
h	Image Buffer and ROI		<< Less	
	Attached Camera - Xtium2-CLHS_PX8_1			
C	Camera Information			
C	Camera Control			
	Camera Control Digital IO Control			
0				
0	igital IO Control			
	Digital IO Control Data Processing			
ם פ וו ד	Digital IO Control El Data Processing mage Format			
ם פי וו ד	Digital IO Control Data Processing mage Format ransport Layer			
ם פ וו ע ע ג	Digital IO Control Data Processing mage Format ransport Layer Acquisition and Transfer Control			

When the imaging setup is validated and working correctly:

- Use CamExpert to explore the Falcon4 camera feature set and the Xtium2-CLHS PX8 / PX8 LC parameter set.
- Use the individual product's User Manuals to explore the capabilities of this imaging system pair.
- Develop your custom imaging application with the Sapera LT API.

Fast Readout Mode

The Fast Readout Mode feature (available in the Camera Control category) determines the sensor readout rate. When enabled, the sensor readout is faster, allowing for a higher maximum frame rate.

Note that the Fast ReadOut Mode feature is only available in the Falcon4-CLHS M4400 and M4480 models.

Category	Parameter	Value
🗆 Board	Device Scan Type	Areascan
Basic Timing	Sensor Color Type	Monochrome
Advanced Control	Input Pixel Size	10 Bits/Pixel
	Sensor Width	4480
External Trigger	Sensor Height	2496
Image Buffer and ROI	Acquisition Frame Rate (in Hz)	100.0
Attached Camera - Xtium2-CLHS_PX8_1	Exposure Mode	Timed
Camera Information	Exposure Alignment	Synchronous
Camera Control	Exposure Delay	9.0
Digital IO Control	Long Exposure Mode	Off
	Exposure Time	2000.0
Image Format	Exposure Time Actual	2000.0
	Shutter Mode	Global
Transport Layer	Gain Selector	Analog
Acquisition and Transfer Control	Gain	1.0
Device Counter and Timer Control	Black Level Selector	Black Level
Cycling Preset	Black Level	0.0
File Access Control	Fast Readout Mode	Off
	<< Less	

The recommended Fast Readout Mode enable state depends on the frame grabber configuration and acquisition scenario:

Frame Grabber Configuration	Fast Readout Mode
Single Xtium2-CLHS PX8 frame grabber Acquiring and SUSTAINING HIGH frame rate capture (for example, 505 fps in full resolution).	Off
Single Xtium2-CLHS PX8 frame grabber Acquiring in short bursts at very high-speed frame rate capture (for example, triggered camera acquisition at maximum frame rate to capture a sequence of a few frames (less than the number of frame grabber image buffers)).	Active
2 Xtium2-CLHS PX8 frame grabbers with data forwarding Acquiring and SUSTAINING frame rate capture (for example, greater than 505 fps in full resolution).	