TELEDYNE DALSA
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Part of the Teledyne Imaging Group

# 03-032-20257-02 Application Note for Camera Cables and Long Distance Solutions

# I. Comparison

| Type | Camera Link | GigE Vision | CoaXPress (CXP6) | Camera Link HS C2 Copper * | Camera Link HS CX4 Active Optical Cable | CLHS SFP+ Fibre Optic Cable * |
|---|---|---|---|---|---|---|
| **Appearance** | | | | | | |
| **Max Length** | 10 to 12 m | 100 m,<br>Can be extended to<br>**300 m**** | 30 m | 15 m<br>5 m ( with 5.0 Gbps) | 100 m | **300 m**** |
| **Bandwidth** | 0.56 Gbps/Lane * | 1 Gbps to 25 Gbps | 6.25 Gbps / Lane | 3.125 and 5.0 Gbps | Up to 8.4 GBps | 10.3125 Gbps |
| **Total Data Throughput** | 850 MBps (with 2 cables – CL Deca Mode) | 117 MBps (1Gbps)<br>292 MBps (2.5Gbps)<br>585 MBps (5Gbps)<br>1100 MBps (10Gbps) | 0.6 GBps(1 lane)<br>1.2 GBps(2 lanes)<br>2.4 GBps(4 lanes) | 2.1 GBps (7 lanes)<br>3.3 GBps (7 lanes) | Up to 8.4 GBps | 1.2 GBps (1 lane)<br>4.8 GBps (4 lanes) |
| **Cable /connector vendor** | Alysium Tech, CEI (Component Express Inc), 3M, … | Alysium Tech, CEI, Intercon1, Hewtech, … | Alysium Tech, CEI, Intercon1, Hewtech … | Alysium Tech, CEI, Intercon1, Hewtech | Alysium Tech, Hewtech, | CEI, Cisco, … |
| **Concept cost** | $$$ for 10m/cable | $ for 10m<br>$$ for 100m | $ for 10/15/20m (1 lanes)<br>$$ for 10/15/20m (4 lanes) | $$$ for 15m/cable | $$$ for 20/30/100m<br>$$$ for 30m<br>$$$ for 100m | $ for module<br>$ for 1m/10m |
| **Camera family Associated** | Piranha CL series, Linea CL series, Nano-CL series, | Linea 1-GigE series, Nano 1-GigE series, Nano 5-GigE series, Genie TS series, Spyder GigE series, | Nano-CXP series | Piranha XL series, Linea (CLHS model), Falcon4, | Piranha XL series, Linea ML series Linea HS series | Linea ML series |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Advantages** | Various camera choices | **Long distance**** Multicast Flexibility Light weight, Low cost | High data rate Power over cable | High data rate, | High bandwidth Immunity to EMI Flexibility Light weight Low cost | **Long distance**** High bandwidth Immunity to EMI Flexibility Light weight Low cost |
| **Teledyne Frame grabber** | Xtium-CL MX4, Xcelera CL series | Not Required | Xtium-CXP PX8 | Xtium-CLHS PX8, Xtium-CLHS PX4 | Xtium2-CLHS PX8 | Xtium2-CLHS FX8 |
| **FG Appearance** | | N/A | | | | |

Note:

- **Gbps** stands for Gigabit per second ( 1 Gbit is equal to 125 megabytes (MB))
- **GBps** stands for Gigabyte per second
- **SFP** stands for Small Form-factor Pluggable transceiver. It is a compact, hot-pluggable optical module transceiver used for data communication applications. SFP modules are commonly available in several different categories.
- **SFP**: 1 to 2.5 Gbps
- **SFP+**: 10 Gbps, etc.
- **C2** is the official CLHS name given to CX4 cable, **SFF-8470** is the specification of the connector.
- Fibre Optic Cables cannot be used with Falcon4
- GigE Vision speeds are vary, depends on interface speed and cable type.

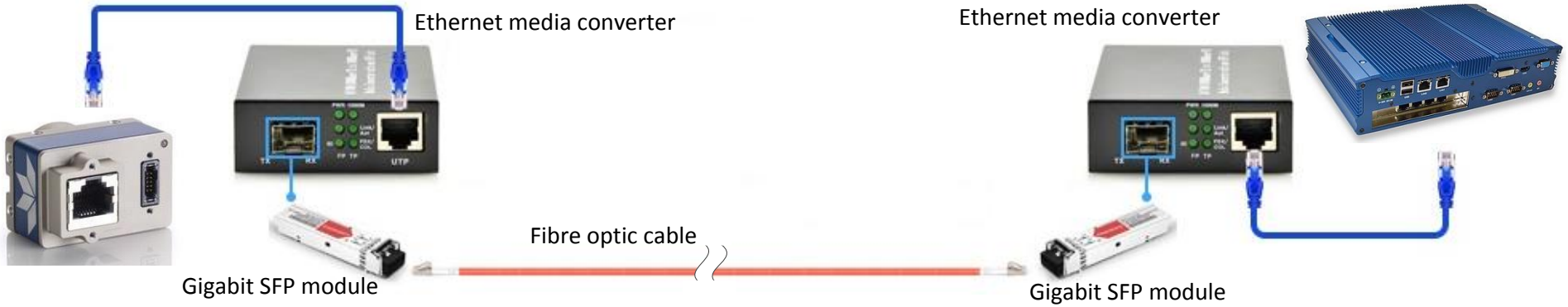
| Interface Speed | Max DATA Bandwidth | Cable Type and Max Distance | Cameras |
|---|---|---|---|
| **1 Gbps GigE Vision** | 117 MBps | Cat5e – 100 m, Cat 6 – 100 m | Linea 1-GigE, Genie Nano1-GigE, Genie TS, Spyder GigE |
| **2.5 Gbps GigE Vision** | 292 MBps | Cat5e – 50 m, Cat 6 -100 m | Nano-5G |
| **5 Gbps GigE Vision** | 585 MBps | Cat5e – 50 m, Cat6 – 75 m, Cat6A – 100 m | Nano-5G |
| **10 Gbps GigE Vision** | 1100 MBps | Cat7 – 100 m, Cat 6A – 50 m, Cat 6 – 35 m | |

# II. Long Cable Solutions**

As you can see from above table, the CLHS SFP+ Fibre Optic Cable or GigE Vision and SFP+ Fibre Optic Cable are the best solutions you can choose from when your application needs cable length beyond 100 meters. There are SFP+ module can achieve 20 kilometers, however, our current standard cameras are designed to achieve up to 300 meters. The following are the details how to use them.

## A. GigE Vision + SFP+ Fibre Optic Cable Solution – Up to 300 meters

A copper Gigabit cable can be extended up to 20,000 meters with two off-the-shelf Gigabit Ethernet media converters and a fibre optic cable. This solution is also a simple and relatively low cost solution.

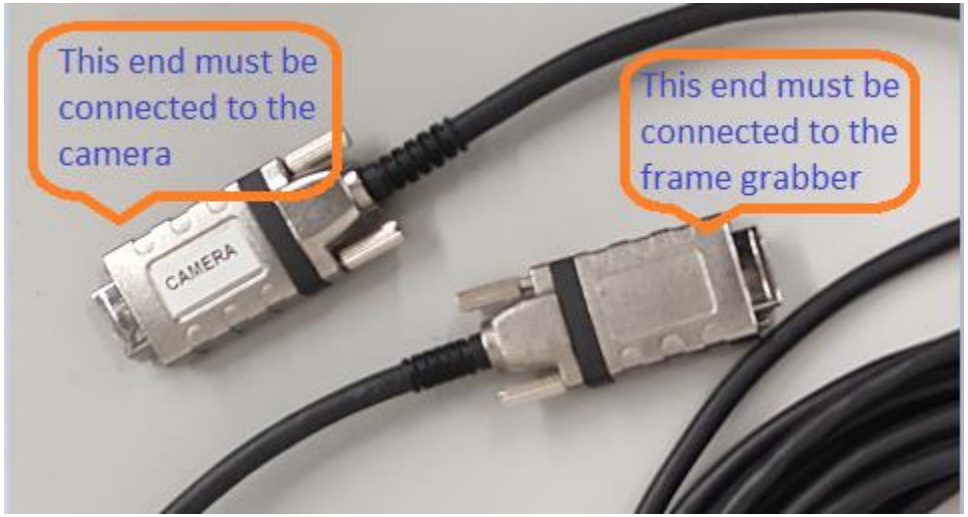



There are many Ethernet media converters on the market users can choose from, in general, the cost is within $$ per piece.

## B. SFP+ Fibre Optic Cable Solution – 300 meters

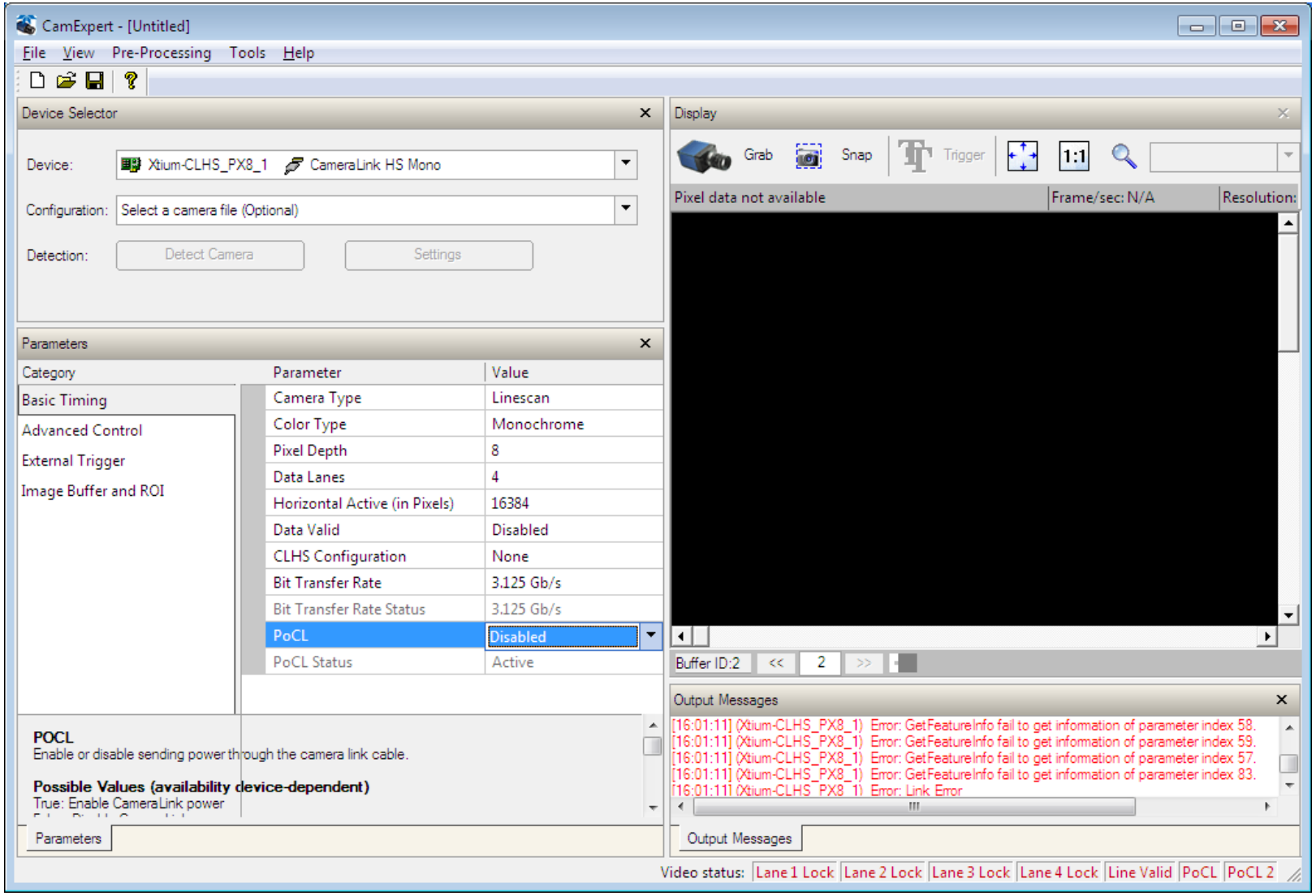
The use of fibre optic cables is quite simple, the following few steps will make it works.

**Step 1** Connect an available camera(Linea CLHS in this example) with a fibre optic cable instead of CX4, and power up.
Please note that the C2 fibre optic cable needs the camera end plugged into the camera.



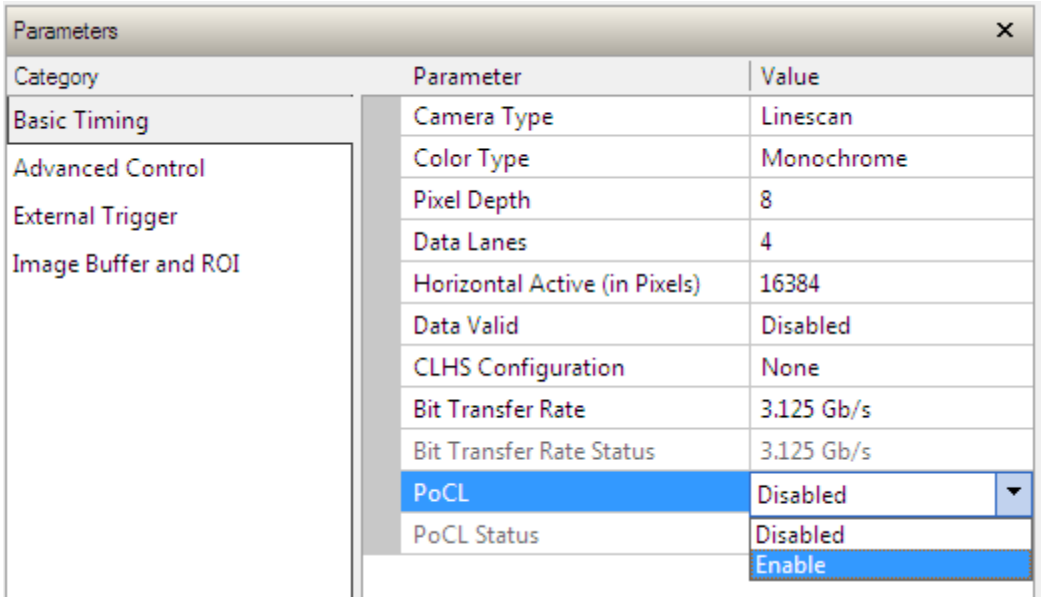

If there is no such mark, and the host PC cannot detect the camera after step 3, you may swap the cable ends and try again. No harm will be done by swapping the ends.

**Step 2** Open the CamExpert and select the right frame grabber.

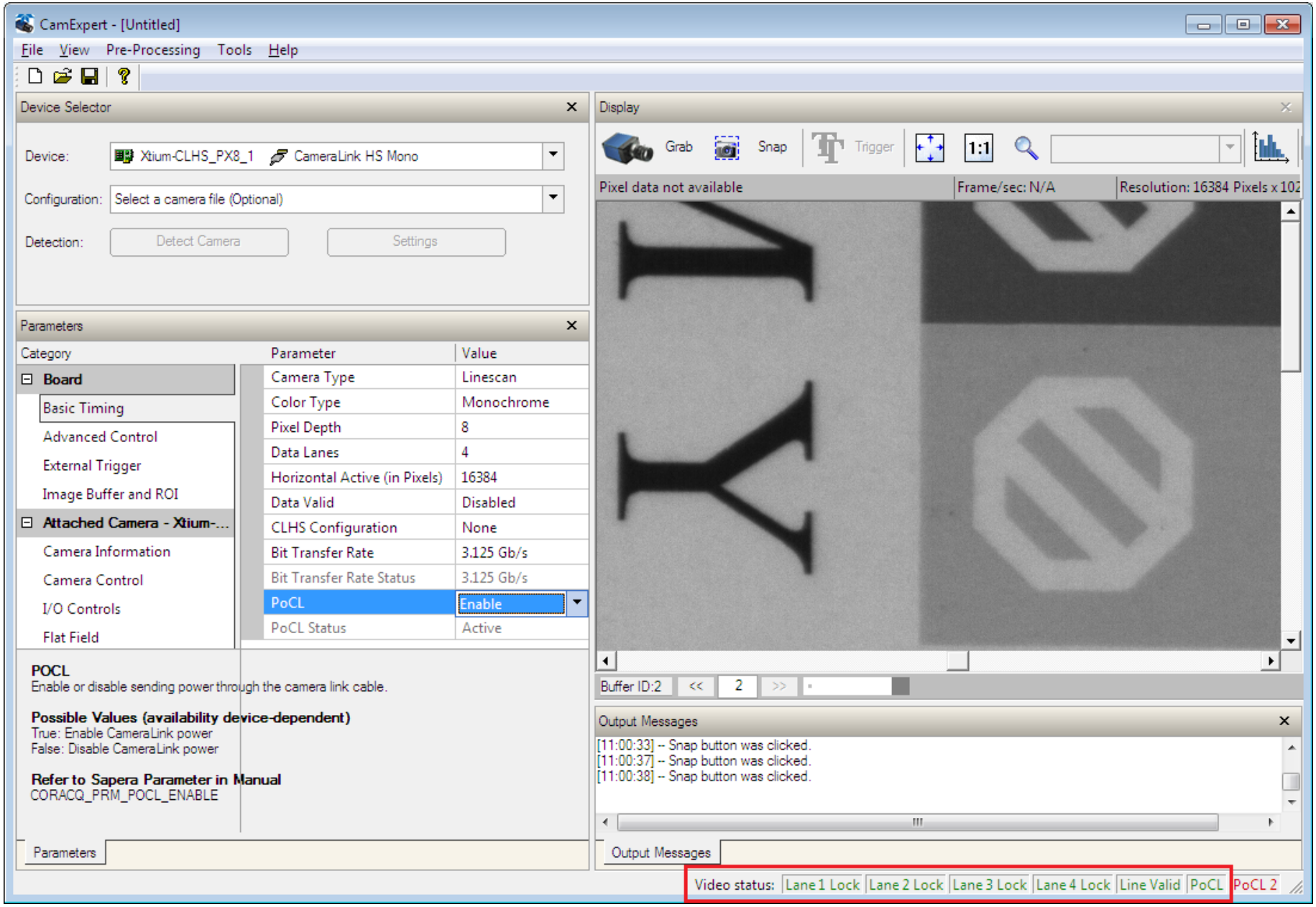



The camera has not been detected at this point.

**Step 3** Select the Enable in the PoCL pulldown menu. This supplies power to the electrical-to-optic signal transmitter.



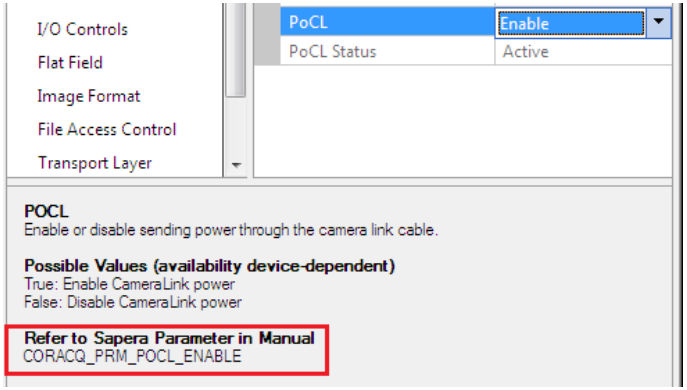

The fibre cable gets activated and the camera should be detected now.


CamExpert - [Untitled]
File View Pre-Processing Tools Help
Device Selector
Device: Xtium-CLHS_PX8_1 CameraLink HS Mono
Configuration: Select a camera file (Optional)
Detection: Detect Camera Settings
Parameters
Category
Parameter
Value
Board
Basic Timing
Advanced Control
External Trigger
Image Buffer and ROI
Attached Camera - Xtium-...
Camera Information
Camera Control
I/O Controls
Flat Field
Camera Type Linescan
Color Type Monochrome
Pixel Depth 8
Data Lanes 4
Horizontal Active (in Pixels) 16384
Data Valid Disabled
CLHS Configuration None
Bit Transfer Rate 3.125 Gb/s
Bit Transfer Rate Status 3.125 Gb/s
PoCL Enable
PoCL Status Active
POCL
Enable or disable sending power through the camera link cable.
Possible Values (availability device-dependent)
True: Enable CameraLink power
False: Disable CameraLink power
Refer to Sapera Parameter in Manual
CORACQ_PRM_POCL_ENABLE
Parameters
Display
Grab Snap Trigger 1:1
Pixel data not available
Frame/sec: N/A
Resolution: 16384 Pixels x 102
Buffer ID:2 << 2 >>
Output Messages
[11:00:33] -- Snap button was clicked.
[11:00:37] -- Snap button was clicked.
[11:00:38] -- Snap button was clicked.
Output Messages
Video status: Lane 1 Lock Lane 2 Lock Lane 3 Lock Lane 4 Lock Line Valid PoCL PoCL 2

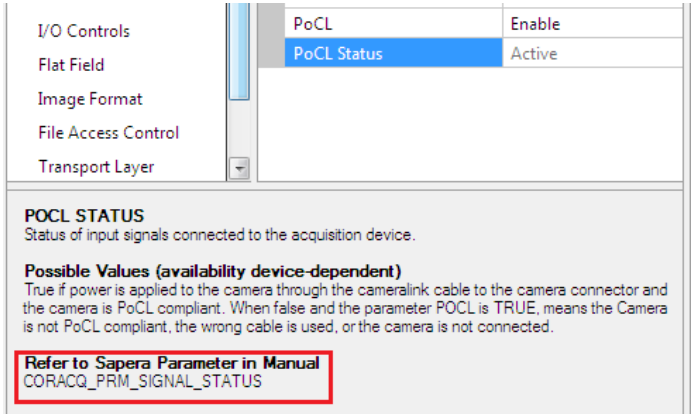
As the camera is detected by the host PC and necessary Lanes, Line Valid are all turned to green color, you can operate the camera like operate with CX4 cables.

These few steps are all you need to activate the fibre cable!

The PoCL in Xtium-CLHS_PX8 is a software trigger. Programmers can find the PoCL function and its status from their function-aid window respectively.

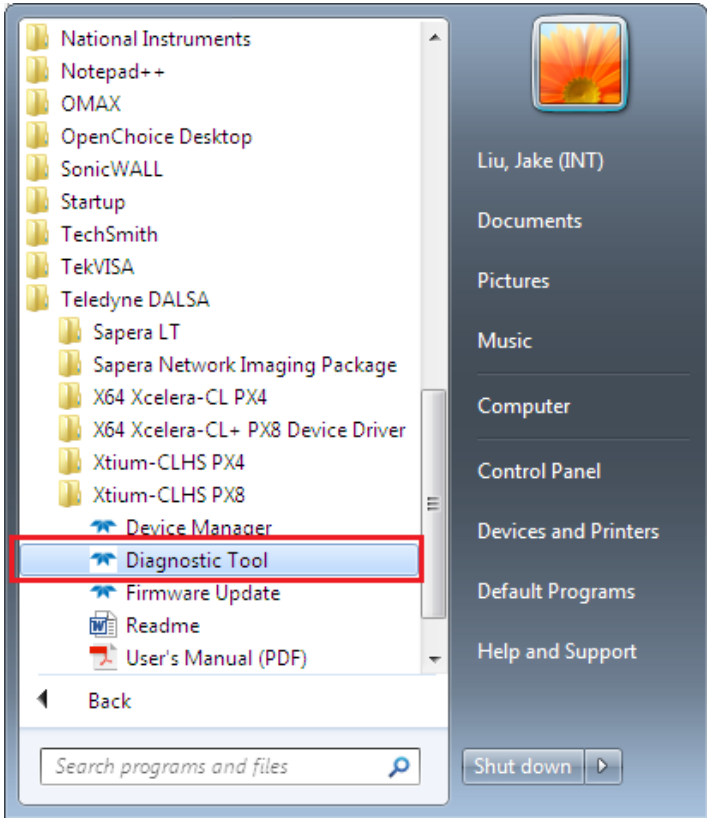



The PoCL status function:

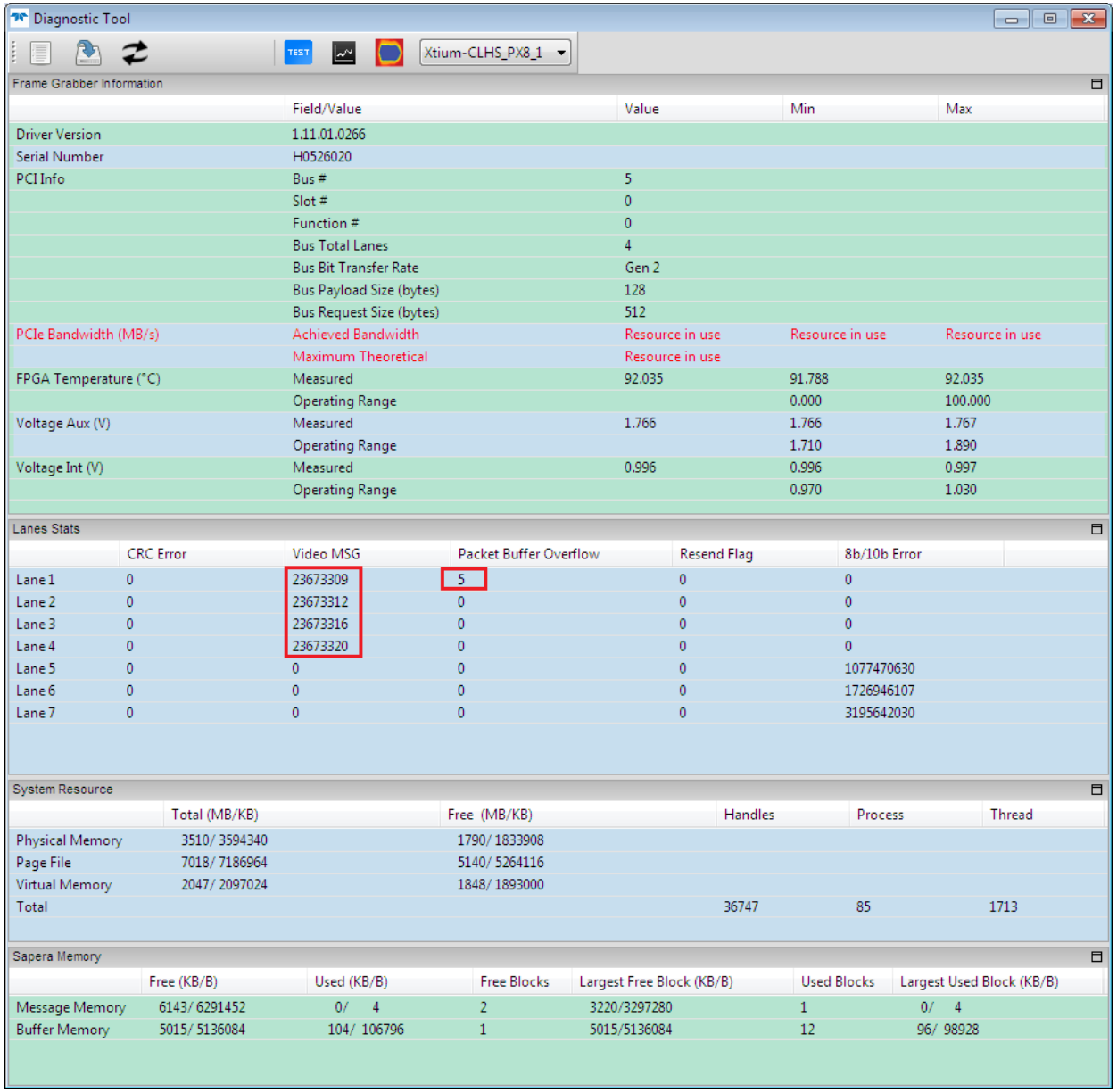


# III. Diagnostic Tools

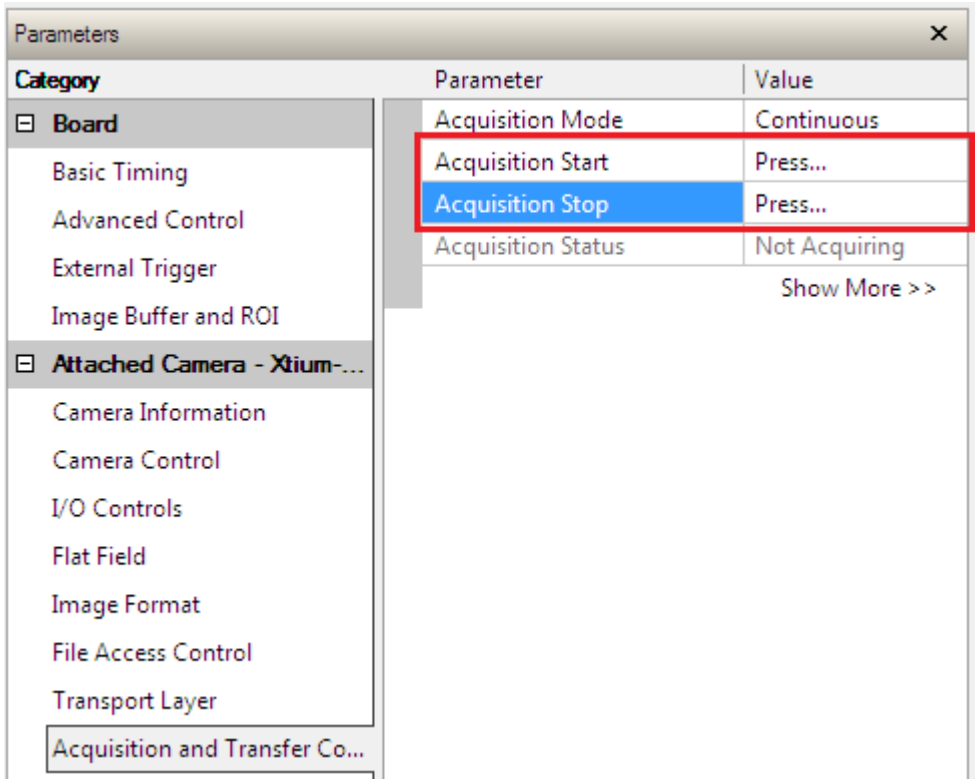
For Teledyne DALSA Nano GigE Vision cameras, there's built in statistic features to monitor communication errors (refers to the Nano User Manual). In case of Teledyne DALSA frame grabber(s), the frame grabber diagnostic tool is a powerful tool for diagnosing communication errors. The program is located under each frame grabber folder.



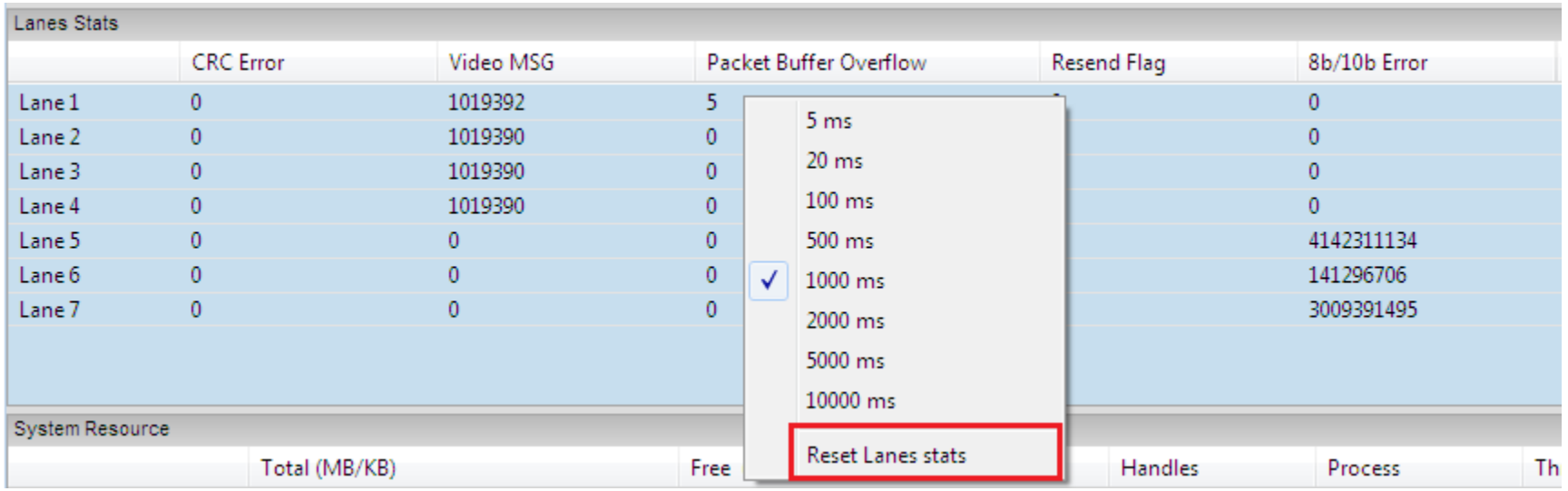

Execute the program, a window shows up with related information.


Diagnostic Tool
Xtium-CLHS_PX8_1
Frame Grabber Information
Field/Value | Value | Min | Max
Driver Version | 1.11.01.0266
Serial Number | H0526020
PCI Info | Bus # | 5
Slot # | 0
Function # | 0
Bus Total Lanes | 4
Bus Bit Transfer Rate | Gen 2
Bus Payload Size (bytes) | 128
Bus Request Size (bytes) | 512
PCIe Bandwidth (MB/s) | Achieved Bandwidth | Resource in use | Resource in use | Resource in use
Maximum Theoretical | Resource in use
FPGA Temperature (°C) | Measured | 92.035 | 91.788 | 92.035
Operating Range | 0.000 | 100.000
Voltage Aux (V) | Measured | 1.766 | 1.766 | 1.767
Operating Range | 1.710 | 1.890
Voltage Int (V) | Measured | 0.996 | 0.996 | 0.997
Operating Range | 0.970 | 1.030
Lanes Stats
CRC Error | Video MSG | Packet Buffer Overflow | Resend Flag | 8b/10b Error
Lane 1 | 0 | 23673309 | 5 | 0 | 0
Lane 2 | 0 | 23673312 | 0 | 0 | 0
Lane 3 | 0 | 23673316 | 0 | 0 | 0
Lane 4 | 0 | 23673320 | 0 | 0 | 0
Lane 5 | 0 | 0 | 0 | 0 | 1077470630
Lane 6 | 0 | 0 | 0 | 0 | 1726946107
Lane 7 | 0 | 0 | 0 | 0 | 3195642030
System Resource
Total (MB/KB) | Free (MB/KB) | Handles | Process | Thread
Physical Memory | 3510/ 3594340 | 1790/ 1833908
Page File | 7018/ 7186964 | 5140/ 5264116
Virtual Memory | 2047/ 2097024 | 1848/ 1893000
Total | 36747 | 85 | 1713
Sapera Memory
Free (KB/B) | Used (KB/B) | Free Blocks | Largest Free Block (KB/B) | Used Blocks | Largest Used Block (KB/B)
Message Memory | 6143/ 6291452 | 0/ 4 | 2 | 3220/3297280 | 1 | 0/ 4
Buffer Memory | 5015/ 5136084 | 104/ 106796 | 1 | 5015/5136084 | 12 | 96/ 98928

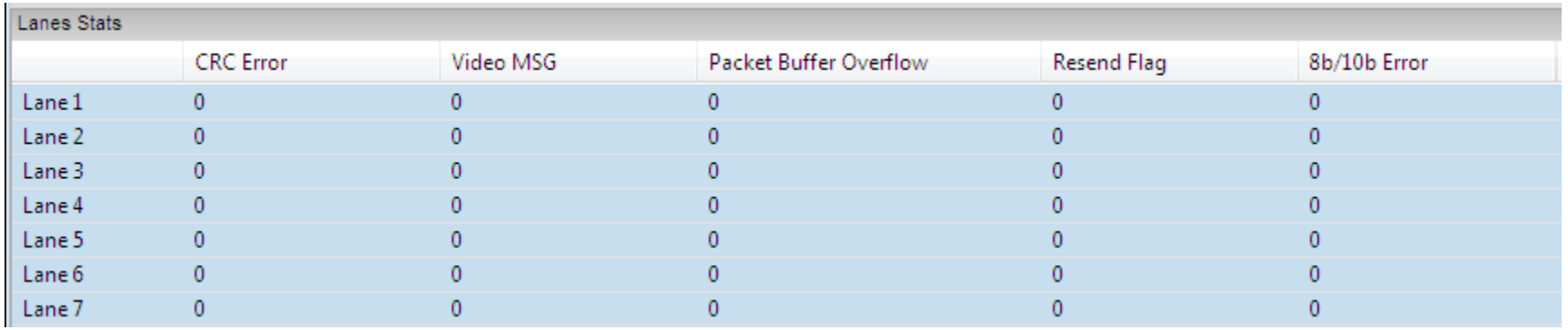
The digit '5' in the red rectangle indicates there are 5 times packet buffer overflow errors happened. It, however, is happened in the initializing stage, can be ignored. Switch to the CamEXpert and Click Press… beside the Acquisition Stop to stop the communication between the camera and the frame grabber.



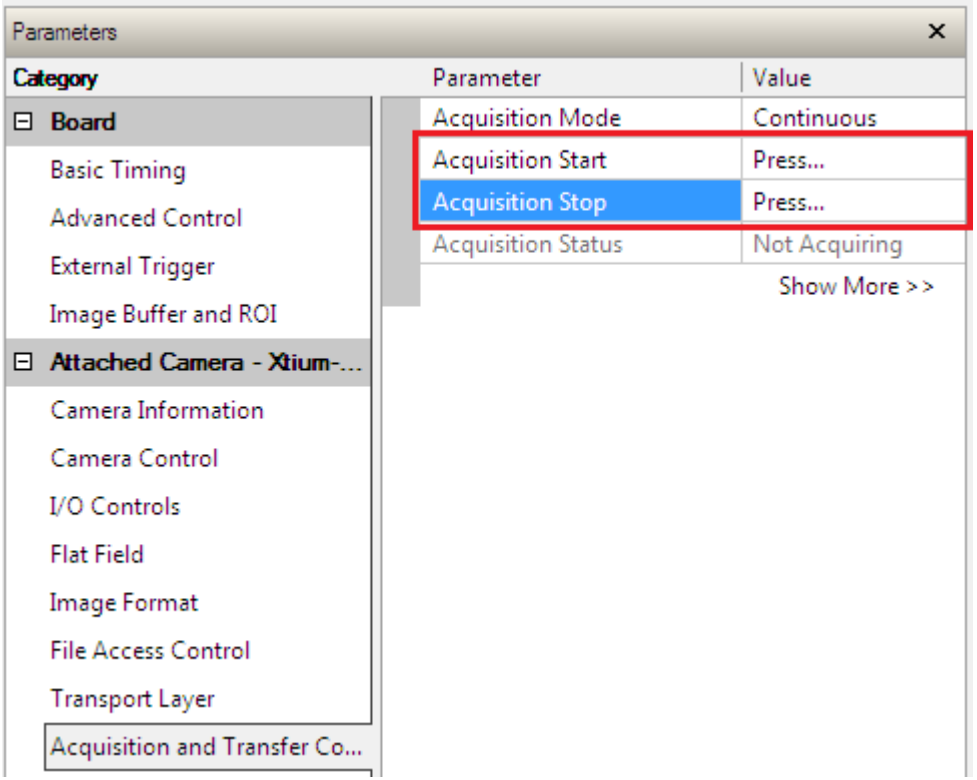

Back to the diagnostic tool, right click anywhere on the Lanes Stats area and select the 'Reset Lanes stats.'




This resets all parameters in the lane part.



Switch to the CamExpert again, click the Press… beside the Acquisition Start.




Back to the tool, you will see Video MSG of those activated lanes are updating and other numbers are remaining in '0' status. The 'Video MSG' shows number of messages have been exchanged between the camera and the frame grabber lane by lane. All the 0s tell you there are no errors have happened.

Lanes Stats

| | CRC Error | Video MSG | Packet Buffer Overflow | Resend Flag | 8b/10b Error |
|---|---|---|---|---|---|
| Lane 1 | 0 | 500936 | 0 | 0 | 0 |
| Lane 2 | 0 | 500936 | 0 | 0 | 0 |
| Lane 3 | 0 | 500936 | 0 | 0 | 0 |
| Lane 4 | 0 | 500936 | 0 | 0 | 0 |
| Lane 5 | 0 | 0 | 0 | 0 | 0 |
| Lane 6 | 0 | 0 | 0 | 0 | 0 |
| Lane 7 | 0 | 0 | 0 | 0 | 0 |

If errors happen, the tool displays the number of errors with numbers lane by lane, refer to following example.

Lanes Stats

| | CRC Error | Video MSG | Packet Buffer Overflow | Resend Flag | 8b/10b Error |
|---|---|---|---|---|---|
| Lane 1 | 0 | 1019392 | 5 | 0 | 0 |
| Lane 2 | 0 | 1019390 | 0 | 0 | 0 |
| Lane 3 | 0 | 1019390 | 0 | 0 | 0 |
| Lane 4 | 0 | 1019390 | 0 | 0 | 0 |
| Lane 5 | 0 | 0 | 0 | 0 | 4142311134 |
| Lane 6 | 0 | 0 | 0 | 0 | 141296706 |
| Lane 7 | 0 | 0 | 0 | 0 | 3009391495 |

As you can see, the diagnostic tool is a helpful tool when you dealing with TDALSA frame grabbers.

**Should you have any questions, please feel free to contact your local TCS (Technical Customer Support) team.**