



Vision Q.400

Image Processing

Version 9.1.0.0 Camera Link Interface



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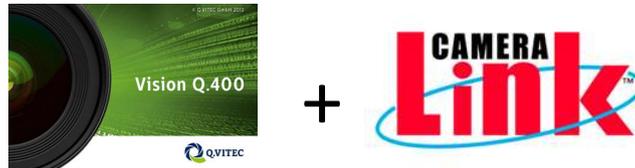
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1 Introduction

This document contains additional information for using Camera Link frame grabbers with Vision Q.400. General information about this interface can be found in the Vision Q.400 Software Manual and the Q.400XD/ Q.400MD Hardware Manual.



Hardware requirements (CL Base, Medium and Medium)

Vision Q.400 V9.1 and above utilizes a Camera Link frame grabber from Silicon Software (microEnable V Series). The frame grabber supports Camera Link base, medium and full matrix or line scan cameras. For this frame grabber customized Hardware Applets running on the FPGA of the grabber can be developed. Aswell, this frame grabber supports Power over Camera Link.



It is not possible to connect a matrix and a line scan camera to one grabber but when using two grabbers (one for the matrix and one for line scan camera) it is possible to mix both camera types in one application.

Software Requirements

The information in this manual belongs to the Camera Link version of Vision Q.400 version 9.1. The following Setups do install this version:

- Setup_Vision_Q400_CameraLink_32Bit_9_1_*.exe
- Setup_Vision_Q400_CameraLink_64Bit_9_1_*.exe.

(The "*" means that this manual is independent from the exact version number of Vision Q.400 version 8 you have installed.)

If you use the simulation version of Vision Q.400 you have to select a "Camera Link" emulation. The following Setups do install the simulation version:

- Setup_Vision_Q400_Simulation_32Bit_9_1_*.exe
- Setup_Vision_Q400_Simulation_32Bit_9_1_*.exe.

In the simulation version, only the values of Camera Link parameters can be read, or set. A "physical" Camera Link camera cannot be connected.

2 Customizing the Vision Q.400 Camera Link Interface

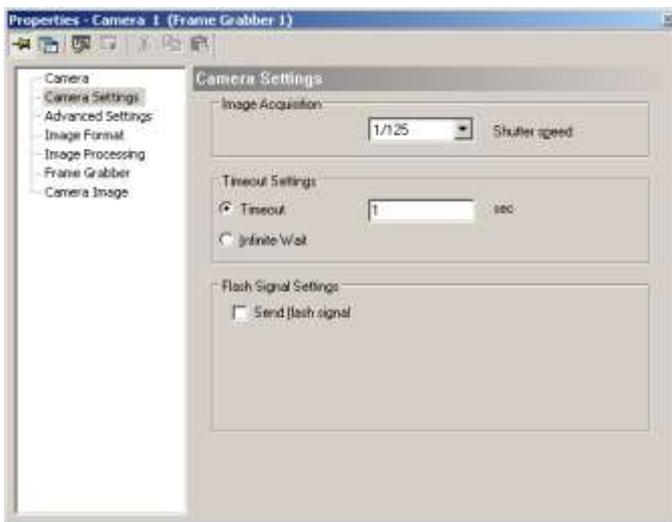
To enable some of the features supported by the Camera Link interface of Vision Q.400, additional settings in the registry path of Vision Q.400 are needed. Additionally a FgalCameras.ini and a *.mcf file can be used to enable features of the Camera Link interface.

Image Grabbing Registry Root

All registry entries used for image grabbing are stored under the so-called Vision Q.400 Image grabbing registry root:

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400\FrameGrabber].
```

To avoid a grabbing error because of a grabbing timeout the Timeout Setting for the grabbing time can be set in the camera property window:



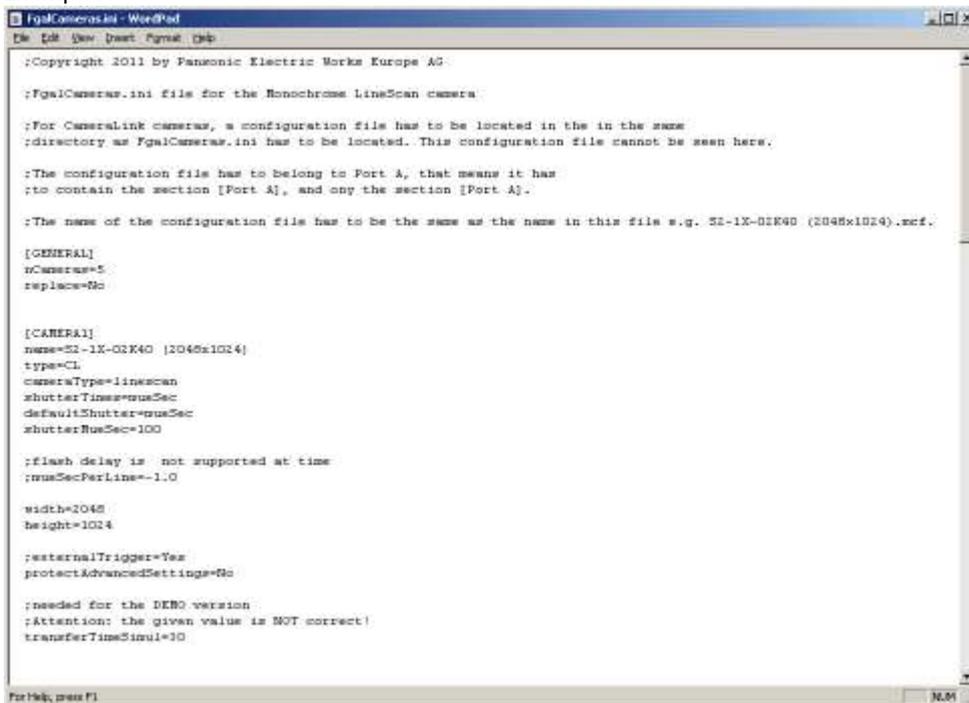
Please be aware that the global Vision Q.400 timeout is 30 seconds. If the image grabbing time could be longer than 30 seconds please change the global timeout setting in the registry:

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400]  
Timeout=3600 [DWORD value in seconds (e.g.3600)]
```

FgalCameras.ini File

The FgalCameras.ini file has to be located in that directory in which the executable file of Vision Q.400 is located. This file contains general information of the connected camera like resolution, or cameraType (matrix or line scan). How to create an FgalCameras.ini file is described in the "CameraFiles.doc" file. After installing a Vision Q.400 demonstration or simulation version, or the full Camera Link version an FgalCameras.ini file is found in the directory mentioned above.

Example:



```

:Copyright 2011 by Panasonic Electric Works Europe AG.
:FgalCameras.ini file for the Monochrome LineScan camera.
:For CameraLink cameras, a configuration file has to be located in the in the same
:directory as FgalCameras.ini has to be located. This configuration file cannot be seen here.
:
:The configuration file has to belong to Port A, that means it has
:to contain the section [Port A], and only the section [Port A].
:
:The name of the configuration file has to be the same as the name in this file e.g. SE-1X-02K40 (2048x1024).mcf.

[GENERAL]
nCamera=5
replace=No

[CAMERA]
name=SE-1X-02K40 (2048x1024)
type=CL
cameraType=lineScan
shutterTime=µsSec
defaultShutter=µsSec
shutterTimeSec=100

:flash delay is not supported at time
:µsSecPerLine=-1.0

width=2048
height=1024

:externalTrigger=Yes
protectAdvancedSettings=No

:needed for the DEBO version
:Attention: the given value is NOT correct!
transferTimeSimul=30
  
```

Camera Parameter File (*.mcf)

Parameter for the applet running on the frame grabber can be adjusted in the *.mcf file. By default Vision Q.400 supports only the standard gray value applet dll's. Further information → [Camera Parameter](#)

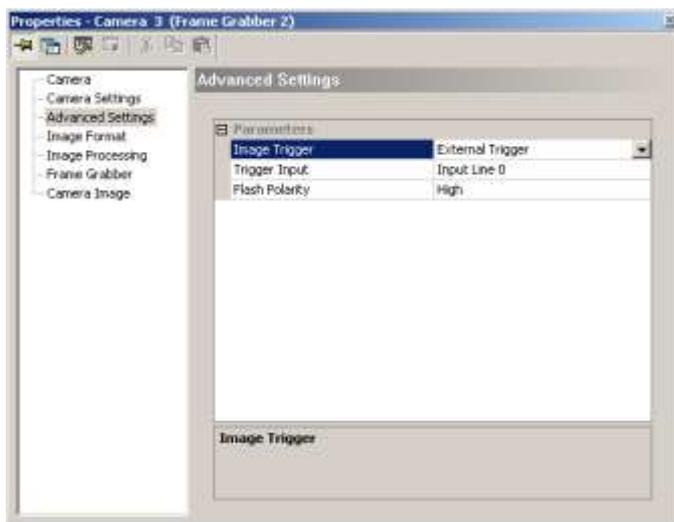
The *.mcf file has to be located, like the FgalCameras.ini file, in that directory in which the executable file of Vision Q.400 is located.

3 External Camera Trigger

By default all cameras are triggered by the Vision Q.400 Software (“Internal Trigger”), but the frame grabber can be enabled to send the camera trigger based on a trigger input at the frame grabber (“External Trigger”). To do so you have to send a trigger signal directly to the frame grabber, this loops it through to the camera.

“Internal Trigger” and “External Trigger” are the so called “Image Trigger” modes. You can select these modes on the “Advanced Settings” property page of each camera.

If the “External Trigger” mode is selected, the input line of the frame grabber, which receives the trigger signal, has to be selected, too.

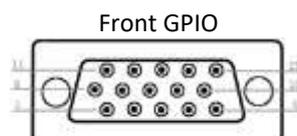


Remarks:

- In the live mode of Vision Q.400 all cameras are internally triggered, even if “External Trigger” is set for a camera.
- Even if “External Trigger” is selected, in the setup mode of Vision Q.400 the “Internal Trigger” is used by default. To use the if “External Trigger” in the setup mode of Vision Q.400, you have to select “Use in Setup Mode”, too.
- To start the execution of an application, a start signal has always to be sent to Vision Q.400, even if “External Trigger” is selected for at least one camera. As an example if one connected camera is triggered externally, you have to send two signals: one to the frame grabber to trigger the camera, and one to Vision Q.400 to start the execution of the application.

Image Trigger via Front GPIO Board

Signal input wiring at the SUB-D15 connector (single use):



- Pin 10 → GPI Voltage IN;
- Pin 15 → GPI GND;
- Pin 11 → Signal 0; Pin 13 → Signal 1
- Pin 8 → Signal 2; Pin 9 → Signal 3

Image Trigger via TTL Trigger Board



microEnable V Series Board

+

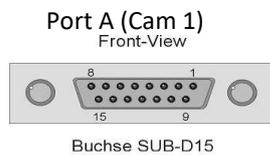
delivered with Trigger Board

+

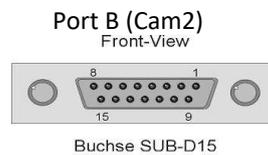
TTLTRIGGER

Signal input wiring at the SUB-D15 connector:

As it is possible to select the input for the trigger signal in the Vision Q.400 software (Input Line 0 to 7) the user can define which physical input of the trigger board should be used. The selection for the input Line 0 in Vision Q.400 refers to Pin 11 of the Port A of the TTL Trigger board. (Line 1 → Pin 12, Port A; Line 2 → Pin 13, Port A; Line 3 → Pin 14, Port A; Line 4 → Pin 11, Port B, Line 5 → Pin 12, Port B; Line 6 → Pin 13, Port B; Line 7 → Pin 14, Port B



Pin 11 → Trigger; Pin 15 → GND



Pin 11 → Trigger; Pin 15 → GND

For electrical specification of the input → [TTLTrigger Board](#)

Image Trigger via Opto Trigger Board



MicroEnable V Series Board

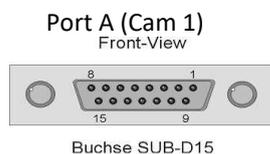
+

delivered with Trigger Board

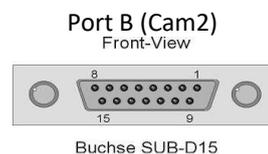
+

OPTOTRIGGERIV

As it is possible to select the input for the trigger signal in the Vision Q.400 software (Input Line 0 to 7) the user can define which physical input of the trigger board should be used. The selection for the input Line 0 in Vision Q.400 refers to Pin 11 of the Port A of the TTL Trigger board. (Line 1 → Pin 12, Port A; Line 2 → Pin 13, Port A; Line 3 → Pin 14, Port A; Line 4 → Pin 11, Port B, Line 5 → Pin 12, Port B; Line 6 → Pin 13, Port B; Line 7 → Pin 14, Port B



Pin 11 → Trigger; Pin 15 → GND

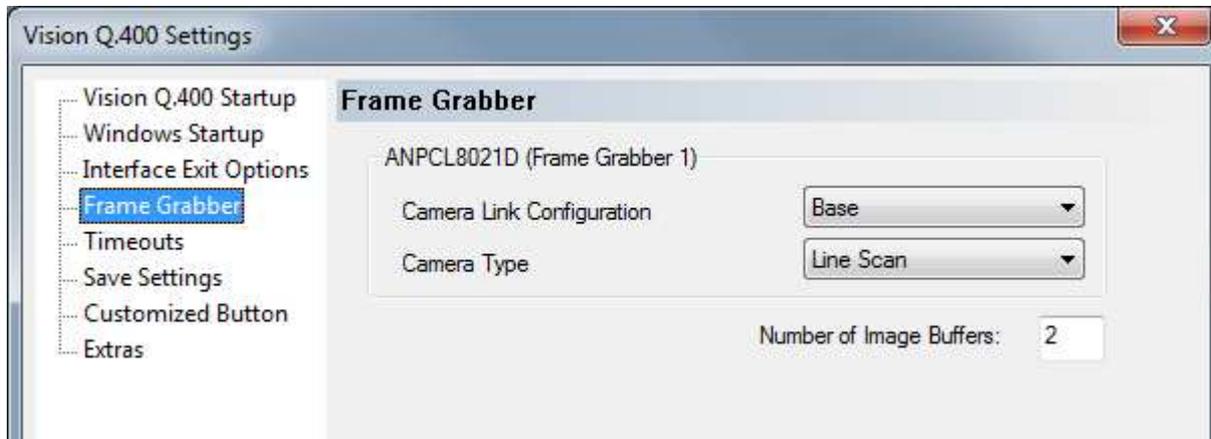


Pin 11 → Trigger; Pin 15 → GND

For electrical specification of the input → [Opto Trigger Board](#)

4 Multi Image Buffers – Sub Images

By default, Vision Q.400 uses only one image buffer for every camera. The number of buffers can be changed in the System Settings->Vision Q.400 Settings->Frame Grabber property page:



The number of buffers is limited to 200.

If more than one image buffer is selected for a camera, a pipelining can be implemented with the help of [external triggering](#): after the first image is grabbed into the first image buffer, Vision Q.400 can process this buffer while the second buffer is filled using external triggering.

Image Buffer

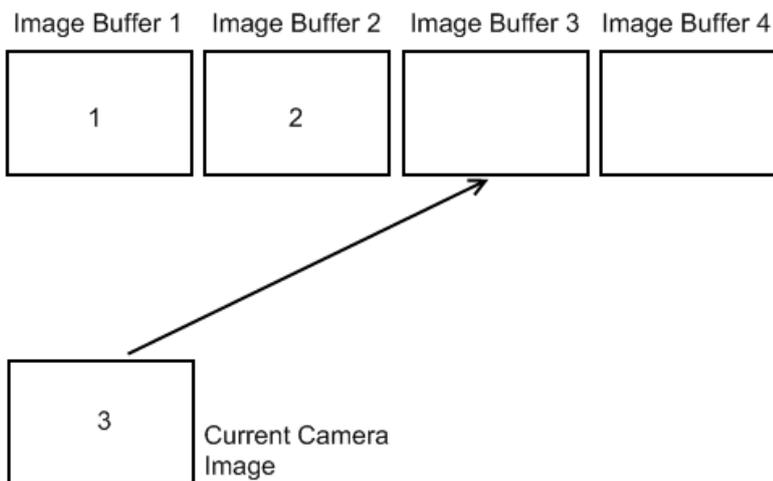
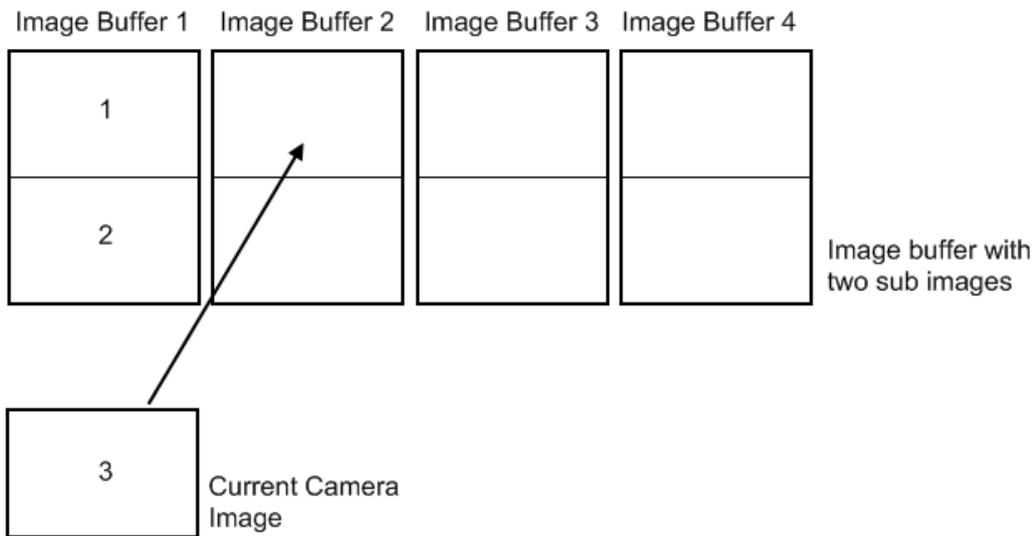


Image Buffer with Sub Images

The feature of “sub images” as described in “CameraFiles.doc”: every image buffer is divided into the sub images.



Registry Settings

By default Vision Q.400 checks if the number of transferred bytes is the number of requested bytes. If not an image grabbing warning is displayed and the not complete grabbed image is cleared.

This behavior should not be changed for matrix cameras.

For line scan cameras this check is not done if the image trigger is gated. But even if the image trigger is not gated, it may be possible that some byte at the end of the image are not transferred, but this is not a bug. To handle these cases, the check can be switched off by the registry setting

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400\FrameGrabber\Board_N\Camera_N]
AvoidCheckTransferLength="Y"
```

where M is the number of the frame grabber, and N is the number of the camera.

If the grabbing of a camera has be stopped and restarted again, a sleep time between start, and stop can be set by the registry entry

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400\FrameGrabber]
SleepOnStopStart=100
```

Where the sleep time is given in milli seconds. (The minimum allowed value is 20.) For details ask your technical support.

5 Vision Q.400 Camera Property Dialog – Advanced Settings

The “Advanced Settings” property page is part of the Vision Q.400 user interface, but not fully described in the official Vision Q.400 documentation.

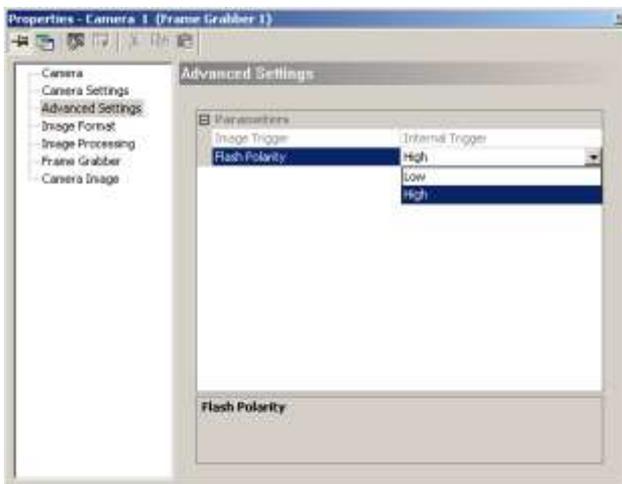
If you have a user defined camera, you can prevent modifications of the advanced settings of the camera. To do so you have to insert

```
[CAMERAn]
protectAdvancedSettings=Yes
```

into the FgalCameras.ini file.

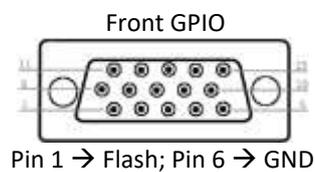
5.1 Flash Signal

The flash signal is output from the frame grabber via the Front GPIO interface or the TTL- or Opto trigger board.



Flash Signal Output via Front GPIO Board

Signal output wiring at the SUB-D15 connector:



Flash Signal Output via TTL Trigger Board



microEnable V Series Board

+



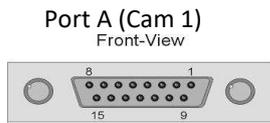
delivered with Trigger Board

+

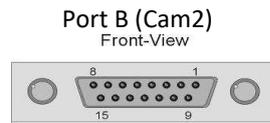


TTLTRIGGER

Signal output wiring at the SUB-D15 connector:



Buchse SUB-D15
Pin 1 → Flash; Pin 6 → GND



Buchse SUB-D15
Pin 1 → Flash; Pin 6 → GND

For electrical specification → [Frame Grabber Extension Boards - Connection and Wiring](#)

Flash Signal Output via Opto Trigger Board



microEnable V Series Board

+



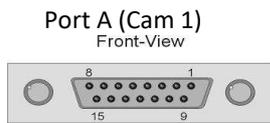
delivered with Trigger Board

+

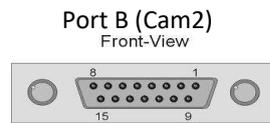


OPTOTRIGGERIV

Signal output wiring at the SUB-D15 connector:



Buchse SUB-D15
Pin 1 → Flash; Pin 6 → GND



Buchse SUB-D15
Pin 1 → Flash; Pin 6 → GND

For electrical specification → [Frame Grabber Extension Boards - Connection and Wiring](#)

5.2 Matrix Cameras

5.2.1 Image Trigger

5.2.1.1 Internal Trigger:

The image trigger signal is sent by the Vision Q.400 software.

5.2.1.2 External Trigger:

The image trigger signal is sent by the frame grabber.

For details see [External Camera Trigger](#).

5.2.1.2.1 Image Trigger Input

Here the input line of the frame grabber is selected, which receives the trigger signal.

5.3 Line Scan Cameras

Additionally to this documentation there is a Line Scan Camera Information Sheet available to get a general overview about the line scan technology.

For line scan cameras, we have to distinguish between line and image trigger. The line trigger starts the grab of one image line, where the image trigger controls which lines are transferred into the image buffer.

5.3.1 Image Trigger

For details of the external trigger modes see [External Camera Trigger](#).

5.3.1.1 Internal Trigger

The image trigger signal is sent by the Vision Q.400 software.

When the camera receives the image trigger signal, it transfers lines until the image buffer is full. (Always a “whole” image is grabbed.)

5.3.1.2 External Trigger:

The image trigger signal is sent by the frame grabber.

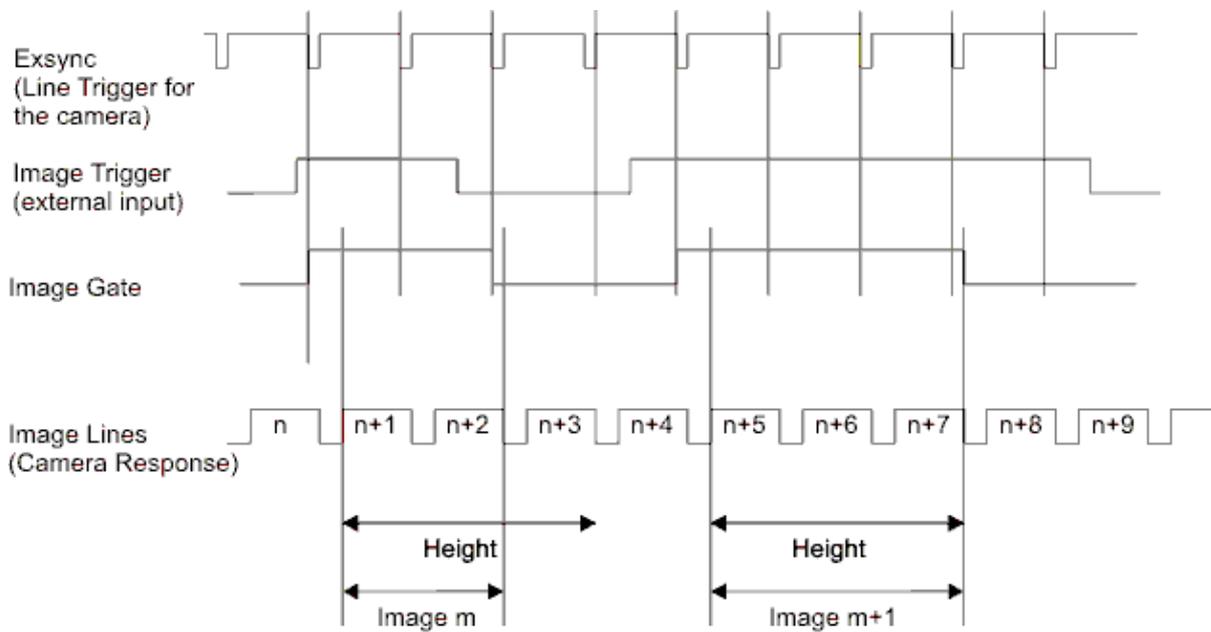
When the image trigger signal received from the frame grabber rises, the camera transfers lines until the image buffer is full. (Always a “whole” image is grabbed.)

5.3.1.3 External Trigger, Gated Single Buffer

The image trigger signal is sent by the frame grabber.

When the image trigger signal received from the frame grabber rises, the camera transfers lines until the image buffer is full, or the image trigger signal goes down. (In the later case only a “part” of the image is grabbed.)

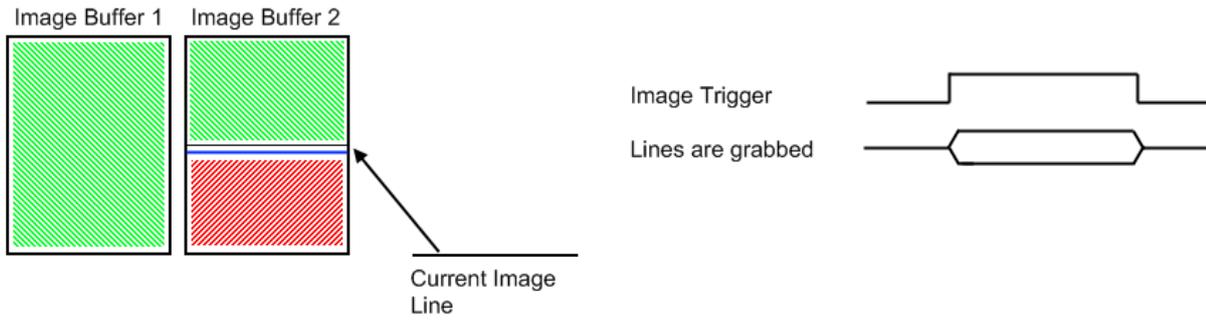
The first transferred line is always written into line 0 of the image buffer.



Height: Number of accepted image lines for a single buffer
 Figure 10: Gated Single buffer

5.3.1.4 External Trigger, Gated Multi Buffer

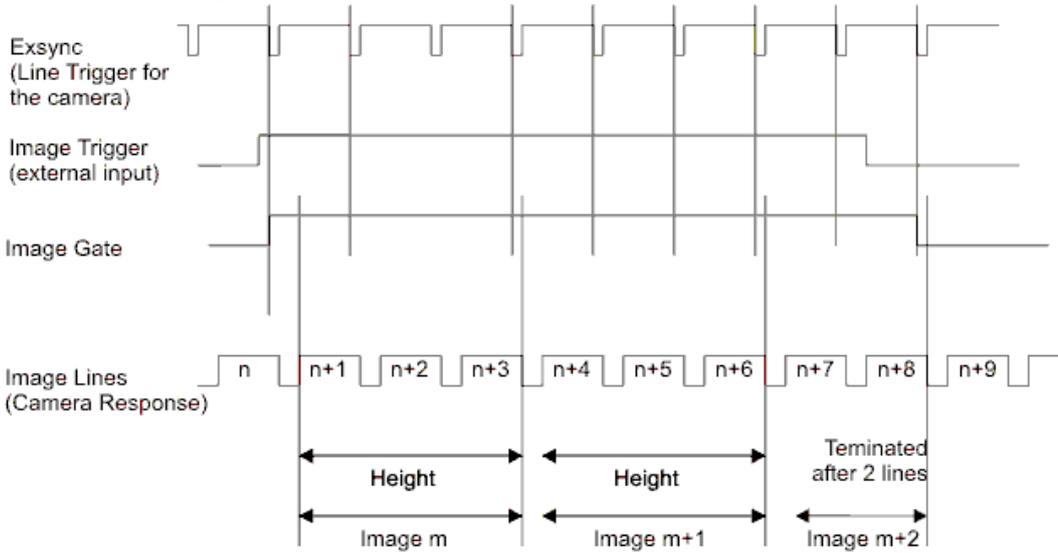
The image trigger signal is sent by the frame grabber. When the image trigger signal received from the frame grabber rises, the camera transfers lines until the image trigger signal goes down. This means that image buffers are filled until the signal goes down. It means too, that, starting with the first image buffer, the image buffers will be overwritten if all image buffers are full and the grab signal does not go down. (A ring buffer is used.)



— Last line, when image trigger is OFF

▨ No valid image data

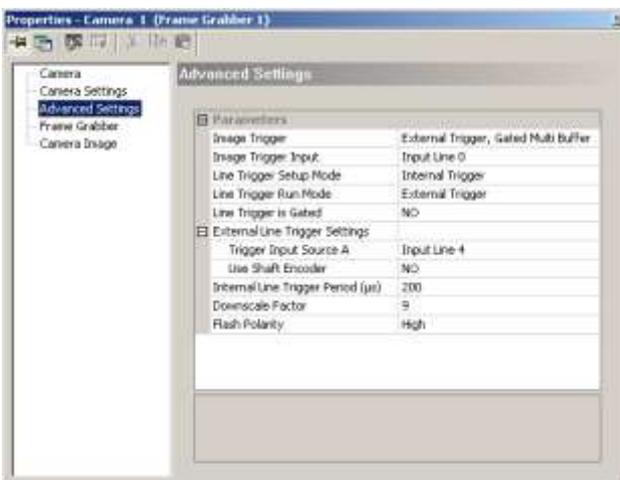
▨ Valid image data



Height: Number of accepted image lines for a single buffer

Figure 9: Image Trigger mode "Gated Multibuffer" interprets the external Trigger Input as a gate for the image acquisition.

However, the Trigger Input is interpreted as a gate and the image terminates with the falling edge. The parameter Height in the FgalCamera.ini file defines the maximum height of an image, thus the image spans across several buffers if the Trigger Input exceeds Height lines. The information whether the Image Gate was still active at the end of the frame, or the image was terminated by a falling Image Gate is available through the image tag (Bit 31 of the Image Tag is 1 if the image is the last image of the acquisition process, Bit 31 is 0 if another image belonging to the same Image Gate follows up).

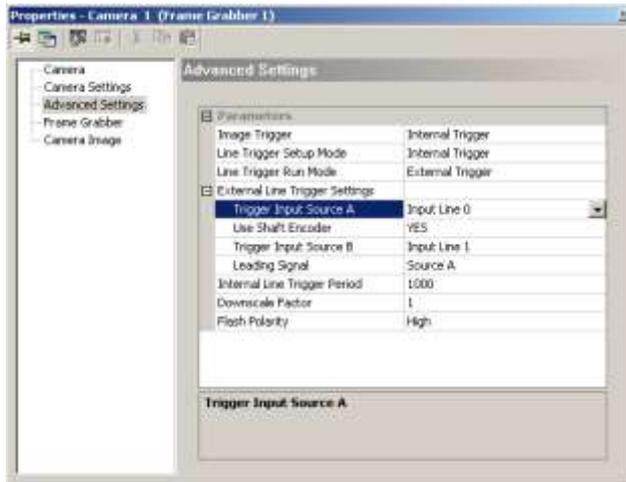


5.3.1.5 Image Trigger Input

Here the input line of the frame grabber is selected, which receives the image trigger signal.

5.3.2 Line Trigger

There are different settings for the line trigger in run mode and in setup mode.



5.3.2.1 Internal Trigger

The line trigger signals are generated by the frame grabber. If "Internal Trigger" is selected, the time grabbing an image is calculated ("Internal Line Trigger Period" * number of image rows). If this time is greater than the grab timeout set in the camera properties property page, the set grab timeout is ignored, and the calculated time is used as grab timeout to avoid an grab timeout.

5.3.2.1.1 Internal Line Trigger Period

The Internal Line Trigger Period is the time distance, in which the frame grabber generates the line trigger signals. This period is given in micro seconds.

5.3.2.2 External Trigger

The line trigger signals are sent to the frame grabber by an external sensor. The frame grabber loops the signal through to the camera

The input line of the frame grabber, which receives the line trigger signals, has to be selected.

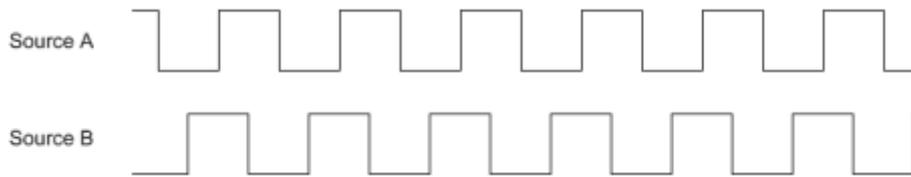
5.3.2.2.1 Trigger Input Source A

Here the input line of the frame grabber is selected, which receives the line trigger signals.

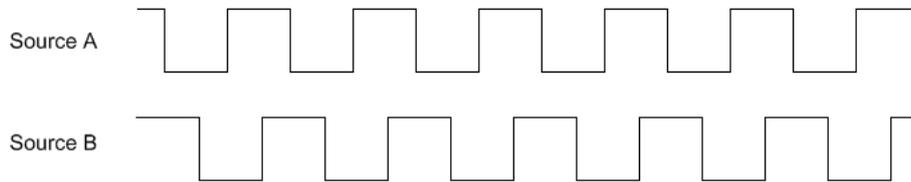
5.3.2.2.2 Use Shaft Encoder

If a shaft encoder is used, the lines are triggered by two signals, which allow distinguishing a direction. If the object is moved against scanning direction the backward lines are counted. After passing the zero line the camera is triggered again and new lines are grabbed.

Direction 1



Direction 2



5.3.2.2.3 Trigger Input Source B

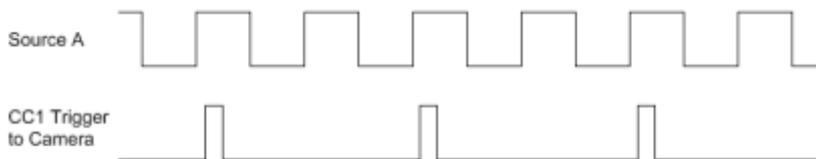
Here the input line of the frame grabber is selected, which receives the second line trigger signals when a shaft encoder is used.

5.3.2.2.4 Leading Signal

When a shaft encoder is used, the leading signal can be selected here. This parameter changes the forward and backward direction of the encoder signals.

5.3.2.2.5 Downscale Factor

The down scale factor of the line trigger signals. E.g. when using the downscale factor two every second encoder signal is ignored and the camera is not triggered.



5.3.3 Line Trigger Gated

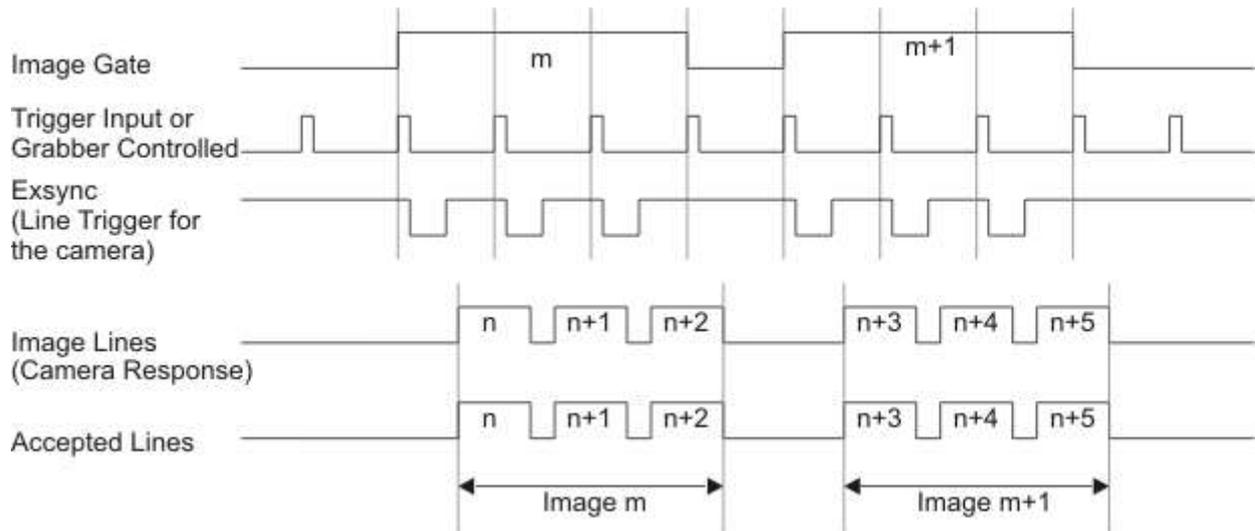


Figure 3: Exsync generation which is gated by the Image Gate

So far the Line Trigger generation was completely independent from the Image Trigger subsystem. However, it is possible to suppress the Exsync generation while no lines are accepted by the Image Trigger, i.e. the Image Gate is low.

The Gated Line Trigger variant is applicable for both Line Trigger modes, thus there are four Line Trigger modes available in total. The "Grabber Controlled" mode becomes the "Gated Grabber Controlled" mode and the "External Trigger" mode becomes the "Gated External Trigger" mode.

6 Installing 3rd Party Cameras in Vision Q.400

By default (means without FgalCameras.ini file) Vision Q.400 supports the following gray value Camera Link cameras

- ANPVC1021,
- ANPVC1040,
- ANPVC1210,
- ANPVC1211,
- ANPVC1510D,
- Sony XCL-160M
- Sony XCL-510M

and the following color Camera Link cameras

- ANPVC2040,
- ANPVC2260,
- Sony XCL-160C
- Sony XCL-510C

By using a FgalCameras.ini file and a camera parameter file (*.mcf file) every eight bit gray value matrix or line scan camera with a Camera Link base or medium interface can be connected to Vision Q.400. For several line scan cameras the FgalCameras.ini file and the *.mcf files can be found in the installation path of Vision Q.400.

6.1 Camera parameter file (*.mcf file)

The first step to use a Non-Standard Camera Link camera is to create a file for the parameter set needed for the camera.

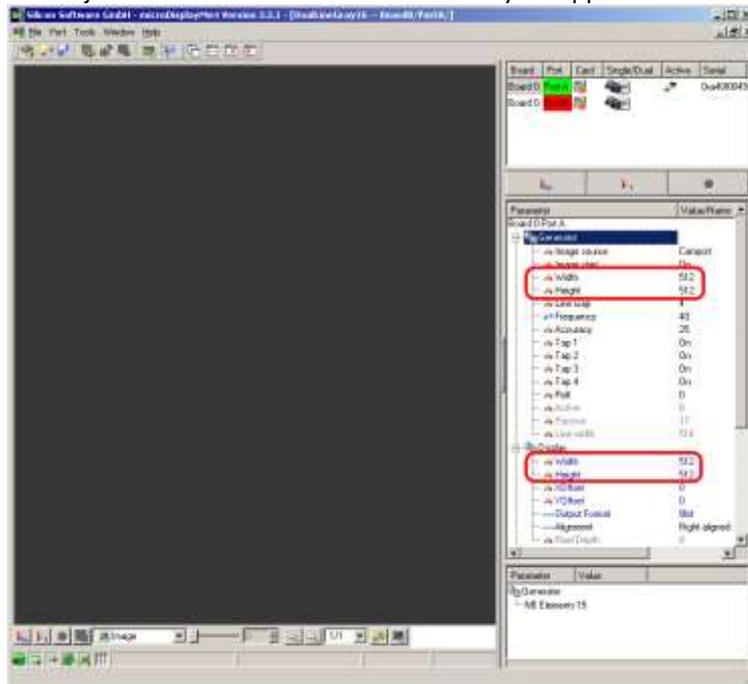
- Start the MicroDisplay.exe program



- Select the Camera Type (Line Scan or Matrix Camera, base or medium)



- Adjust the camera resolution needed for your application



- Adjust the Camera Link Format

Parameter	Value/Name
Board 0 Port A	
Generator	
Display	
CameraLink	
Input Format	8 Bit Single Tap
Use DVAL	Yes
Sensor Readout Correction	
Line Trigger / Exsync	
Image Trigger / Flash	
Software Trigger Control	
CC Signal Mapping	
Digital I/O	
Knee Lookup Table	
Processing	
Image Selector	
Miscellaneous	

- Adjust the sensor readout correction

Parameter	Value/Name
Board 0 Port A	
Generator	
Display	
CameraLink	
Sensor Readout Correction	
Readout mode	SMODE_UNCHA
Line Trigger / Exsync	
Image Trigger / Flash	
Software Trigger Control	
CC Signal Mapping	
Digital I/O	
Knee Lookup Table	
Processing	
Image Selector	
Miscellaneous	

- Adjust the image trigger and in case of a line scan camera the line trigger

Parameter	Value/Name	Parameter	Value/Name
Board 0 Port A		Board 0 Port A	
Generator		Generator	
Display		Display	
CameraLink		CameraLink	
Sensor Readout Correction		Sensor Readout Correction	
Readout mode	SMODE_UNCHA	Readout mode	SMODE_UNCHA
Line Trigger / Exsync		Line Trigger / Exsync	
Image Trigger / Flash		Image Trigger / Flash	
Software Trigger Control		Software Trigger Control	
CC Signal Mapping		CC Signal Mapping	
Digital I/O		Digital I/O	
Knee Lookup Table		Knee Lookup Table	
Processing		Processing	
Image Selector		Image Selector	
Miscellaneous		Miscellaneous	

- Check the camera image

The screenshot shows the 'Silicon Software GmbH - microDisplayMe4 Version 3.5.1 - [DualLineGray16 -- Board0/PortA/]' application. The main window displays a camera image of a black plate with several white circular and rectangular holes. To the right, there is a control panel with a table of board configurations and parameter settings.

Board	Port	Card	Single/Dual	Active	Serial
Board 0	Port A				0xa40f0049
Board 0	Port B				

Parameter	Value/Name
Board 0 Port A	
Generator	
Display	
CameraLink	
Sensor Readout Correction	
Readout mode	SMODE_UNCHA
Line Trigger / Exsync	

Parameter	Value
Image Trigger / Flash	
NB Elements	5

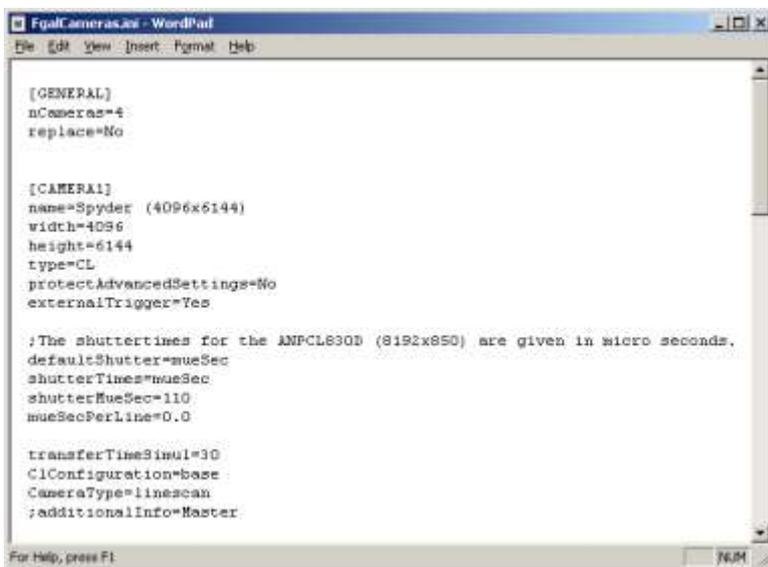
- Save the parameter file in the Vision Q.400 installation path with the name (*) for the camera used in the FgalCameras.ini file and the appendix “_me5” behind the camera name.

(*)(The name for the camera parameter file (*.mcf) is the name of the camera type, which has to fit the following format:

XXXXX (widthxheight)_me5

Where XXXXX is the name of the camera type, and width and height are the image sizes of the camera type. As an example, the name of the camera ANPVC1040 with resolution (636x480), which is supported by default by Vision Q.400, is ANPVC1040 (320x240)_me5 here.)

6.2 Frame Grabber and Camera Ini-File (FgalCameras.ini file)



```
FgalCameras.ini - WordPad
File Edit View Insert Format Help

[GENERAL]
nCameras=4
replace=No

[CAMERA1]
name=Spyder (4096x6144)
width=4096
height=6144
type=CL
protectAdvancedSettings=No
externalTrigger=Yes

;The shuttertimes for the ANPCL830D (8192x850) are given in micro seconds.
defaultShutter=mueSec
shutterTimes=mueSec
shutterHueSec=110
mueSecPerLine=0.0

transferTimeSimul=30
ClConfiguration=base
CameraType=linscan
;additionalInfo=Master

For help, press F1
```

→ Please have a look at the documentation for the camera files (CameraFiles.doc).

7 Virtual Camera Link Cameras

A virtual camera is intended to use only its image memory for image processing: it is never grabbed in, and delivers always a “black” image. In addition, only the width and the height of a virtual camera are used, all other parameters are not used, and cannot be accessed.

7.1 Defining a Virtual Camera

A virtual camera is defined by the registry entry

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400\FrameGrabber\Board_M\Camera_N]
    Virtual=<CameraName>
```

with

Board_M, M = 1..3	Frame grabber number for which a virtual camera is defined.
Camera_N, N = 1..2	Camera number on the frame grabber.
<CameraName>	Name of the camera. This name is either the name of a camera, which is supported by default by Vision Q.400, or the camera has to be defined with the help of the FgalCameras.ini file.

E.g the registry entry

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400\FrameGrabber\Board_1\Camera_1]
    Virtual=ANPVC1040 (640x480)
```

defines a virtual camera for the camera number one on frame grabber number one, which image size is the same as the size of the Camera Link camera ANPVC1040 (640x480), which is supported by default by Vision Q.400

For the demonstration or the simulation version of Vision Q.400 in the above registry entry “Vision Q.400” has to be replaced by “Vision Q.400 DEMO 9.1”.

If the virtual camera is defined with the help of the FgalCameras.ini file, and the definition is intended to be used only for virtual cameras, a camera configuration file is not necessary. In this case, the definition in the FgalCameras.ini file has to contain the entry “isVirtual=Yes”.

On an existing physical frame grabber, a virtual camera can only be defined for a port on which a physical camera is not connected. This means that if a camera is connected to a port, the definition of a virtual camera on this port is ignored.

The Camera Link configuration of a virtual camera (base, medium, or full), and its camera type (matrix, or linescan) has to fit to the Camera Link configuration and the camera type the frame grabber it has to be connected to. It does not matter if this is an existing physical or a virtual (see below) frame grabber. Otherwise the definition of the virtual camera is ignored.

7.2 Defining a Virtual Framegrabber

Virtual frame grabbers can be defined by the registry entry

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400\FrameGrabber\ Board_M]
    Virtual=<Framegrabber Type>
```

With

Board_M, M = 1..3	Frame grabber number of the virtual frame grabber.
< Framegrabber Type >	Type of the virtual frame grabber. Possible Types are: base, base matrix, base linescan, medium, medium matrix, medium linescan, full, full matrix, and full linescan.

The “pure” types define matrix cameras.

E.g the registry entry

```
[HKEY_LOCAL_MACHINE\Software\Q.VITEC\Vision Q.400\FrameGrabber\Board_1]
    Virtual=base
```

defines frame grabber number one as virtual frame grabber for base matrix cameras.

Again in the above registry entry “Vision Q.400” has to be replaced by “Vision Q.400 DEMO 9.1” for the demonstration or the simulation version of Vision Q.400.

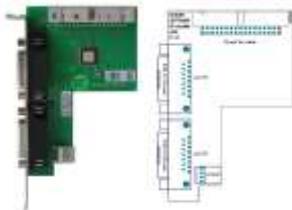
If a physical frame grabber is found, the definition for the virtual frame grabber is ignored for the number of the detected frame grabber. In addition the numbers of virtual frame grabbers has to follow each other. That means that if the virtual frame grabber number two is not defined, but the virtual frame grabber number three, the definition of virtual frame grabber number three is ignored.

To use a virtual camera on a virtual frame grabber, it has to be defined just as for an existing physical frame grabber: virtual cameras are not connected “by default” to virtual frame grabbers.

8 Frame Grabber Extension Boards

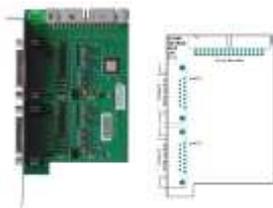
The camera image is transferred from the camera via the Camera Link frame grabber to the RAM memory of the Q.400XD or Q.400MD. The frame grabber is equipped with a Field Programmable Gate Array (FPGA) which controls e.g. the trigger signal to the matrix camera or line trigger to the line scan camera is controlled by the FPGA. Also the backward counting of the line trigger pulses in case of using the setting shaft encoder is done by the FPGA. In case of an external image trigger or to use an encoder for the line trigger of line scan cameras a trigger board has to be connected to the frame grabber. There are two different trigger board types available a TTL board for high speed pulses or shaft encoders (product number: TTLTRIGGERIO) or an opto-isolated trigger board (product number OptoIVTrigger).

TTLTRIGGERIO and connector naming conventions:



Connector	Type	Function
Port A	SUB-D15 female connector	4 output and 4 input signals
Port B	SUB-D15 female connector	4 output and 4 input signals
Flat Cable	34 pin flat cable connector	cable connector to microEnable V frame grabber
Power	Tyco 171826-4	4 Pin Power Input for +5V and +12V from PC

OptoTRIGGERIV and connector naming conventions



Module	Type	Function
Trigger Connector A	SUB-D15 female	Port A Input and Output of up to four signals each
Trigger Connector B	SUB-D15 female	Port B Input and Output of up to four signals each
Flat Cable	34 Pin Flat Cable Connector	Cable connection to <i>microEnable V</i> frame grabber

LED at the Opto trigger board

LED	TYPE
Port A	Check for power on port A
Port B	Check for power on port B
Power	Check for power on board from PC

8.1 Installation of the Extension Boards

Trigger I/O Board

The installation of the Camera Link frame grabber and the TTL (TTLTRIGGERIO) or Opto (OPTOIVTRIGGER) trigger board trigger extension is very easy. You only have to connect the trigger extension with the frame grabber by a flat cable. You need following components:

1. a Camera Link frame grabber (microEnable V Series),
2. a trigger extension
3. a 34-pin flat cable.

Important Note: If there should be more than one frame grabber connected to one TTL or Opto trigger board make sure that the supply voltage of the flat cable is only connected to one frame grabber

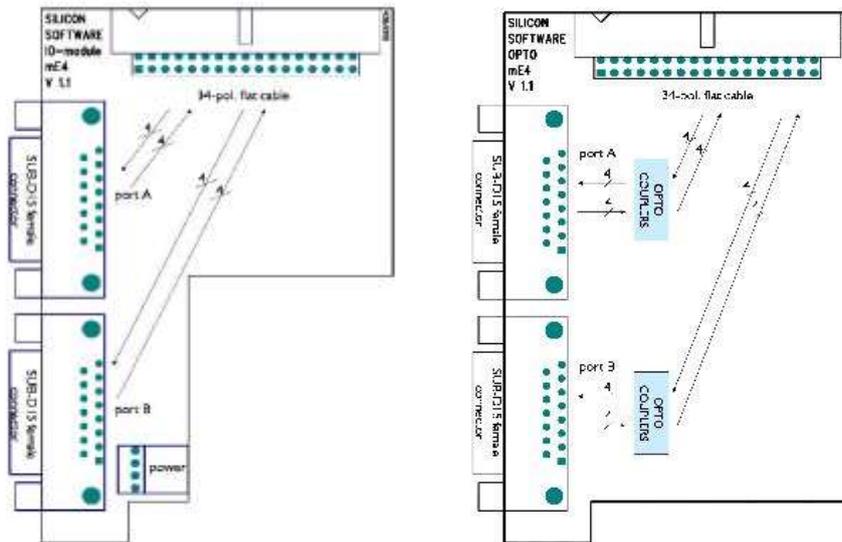
Carry out the installation with the following steps:

1. Switch off the computer.
2. Connect the trigger jack on frame grabber with the flat cable jack on the *TTL or Opto* trigger extension with the 34-pin flat cable. All jacks and cables own a construction shelter. That guarantees a save montage.
3. Install the connected system with frame grabber and *TTL or Opto* trigger extension in two slots of your computer. Pay attention that the frame grabber fits correctly in the slot. Save the position of the frame grabber in the PC chassis by an according screw. Save also the position of the *TTL or Opto* trigger extension in the PC chassis by a screw. The *IO_TTL* trigger extension doesn't need a connection to the motherboard of the computer, so it is possible to use a PCIe, PCI- or an ISA slot.
4. Reboot the computer.

The trigger is ready to use.

8.2 Functional Description of the Frame Grabber Trigger I/O Boards

8.2.1 Overview



TTLTRIGGERIO

OptoTriggerIO

8.2.2 Electrical Environment

The TTL or *Opto* module allows connecting external electronics to the trigger system of the frame grabber.

The *TTL* trigger extension operates internally with LVCMOS33 or LVCMOS25 levels respectively, depending on the attached *microEnable V* frame grabber. All input and output drivers are +5V TTL tolerant.

At the *Opto Trigger* board all signals are electrically isolated using high speed opt couplers. There are three different power / ground systems on the module. One supplies the signals of port A connector, the second the signals of port B connector, and the last the signals of the flat cable connector. There is no electrical connection between all these three power / ground systems.

Each of the three power / ground systems may have a different supply voltage. The voltage range is between 6 and 25.0 Volt. The signal voltage is defined by the supply voltage for both input and outputs.

8.2.3 Input Signals

The *IO_TTL* trigger extension supports eight input signals (four signals per port). These signals are connected to the trigger inputs of the *microEnable V*. They are intended to trigger image or line acquisition. Refer to the *microEnable V* documentation for the functional description of the trigger system.

The polarity of the input signals is NOT inverted.

The *IO-Opto* module supports eight input signals (four signals per port). These signals are connected to four trigger inputs of the *microEnable V* frame grabber. They are intended to trigger image or line acquisition. Refer to the [microEnable V documentation](#) for the functional description of the [trigger system](#).

The input signals are not directly passed to the opto couplers but send to differential comparators. The advantage is that the input accepts low current, voltage driven signals between 6 an 25V. (Input signals have pullup resistors of 4.7 kOhm)

The polarity of the input signals is NOT inverted.

8.2.4 Output Signals

The *IO_TTL* trigger extension supports eight output signals (four signals per port). These signals are connected to the trigger outputs of the *microEnable V*. Refer to the *microEnable V* documentation for the functional description of the trigger system.

The polarity of the output signals is NOT inverted

The *IO-Opto* Module supports eight output signals (four signals per port). These signals are connected to the trigger outputs of the frame grabber.

The opto couplers do not directly connected to the output but buffered by MOSFET transistors. These transistors build an easy to use open collector driver with a 5 mA static current diode as pull up. Note that the power must be delivered by the external power source.

The polarity of the output signals is NOT inverted.

8.2.5 Multiboard Usage

The signals of the flat cable connecting the *microEnable V* frame grabber with the *IO-Opto* module use open collector drivers. It gives the possibility of using several *IO-Opto* (and *IO-TTL*) modules at the same time (inputs are wired-ORed), or several *microEnable V* frame grabbers can use the same *IO-Opto* module (outputs are wired-ORed).

It allows an easy synchronisation of multiple *microEnable V* frame grabbers in a single PC. There is no principle limit in numbers of frame grabbers connected to the *IO-Opto* module. However the usual usage is to support all *microEnable V* frame grabbers in the PC. **Do NOT connect frame grabbers residing in different PCs.**

To connect to several *microEnable V* frame grabbers use a single flat cable with multiple connectors between *IO-Opto* module and frame grabbers.

By sharing the trigger input lines of the *IO-Opto* module all *microEnable V* frame grabbers in the PCs are now accurately synchronized.

The scheme described above is useful if the acquisition is controlled by an external generator. However there are applications where no external source is available or desired. In this case a master frame grabber needs to synchronize all slave frame grabbers.

8.2.6 Power Supply for Cameras

Cameras with a +5V or +12V power supply can be supplied by the *IO_TTL* trigger extension. The power supply is available on both frontal plugs of the trigger extension (SUB-D15) (see pinning in chapter 5).

In order to provide external power you need to plug on a power cable from the PC's power supply to the 4 pin Tyco 171826-4 power connector. This connector is only needed to supply for external power.

If you want to supply the camera with power by the *IO_TTL* trigger extension, you have to use a 4 pin power supply cable (colour code yellow-black-black-red), as it is used on floppy controller in PCs. Plug the 4 pin power connector directly on the trigger extension (see figure in chapter 2.1).

8.2.7 Connection to *microEnable V* frame grabber

The signals of the flat cable connecting the *microEnable V* with the *IO_TTL* trigger extension use open collector drivers. This gives the possibility of using several *IO_TTL* (and *IO_OPTO*) trigger extension at the same time (inputs are wired-ORed), or several *microEnable V* frame grabbers can use the same *IO_TTL* trigger extension (outputs are wired-ORed).

8.2.8 Timing Characteristics of the Opto Trigger board

8.2.8.1 Outputs

	Type	Unit
Delay High / Low Transition (50% - 50%)	240	ns
Fall Time (90% - 10%)	90	ns
Delay Low / High Transition (6 V) (50% - 50%)	140	ns
Rise Time (6 V) (10% - 90%)	50	ns
Delay Low / High Transition (12V) (50% - 50%)	180	ns
Rise Time (12V) (10% - 90%)	100	ns
Delay Low / High Transition (24 V) (50% - 50%)	250	ns
Rise Time (24 V) (10% - 90%)	250	ns
min. Pulse Width	500	ns
max. Frequency (50% duty cycle)	1.0	MHz

Due to the use of a static current diode as pull-up of the output signal there is a static rise time that leads to different low-high transition delays for different voltages. The delay time is measured from/to 50 % signal level.



8.2.8.2 Inputs

	Type	Unit
Delay High / Low Transition	240	ns
Delay Low / High Transition (6 V)	140	ns
Delay Low / High Transition (12V)	180	ns
Delay Low / High Transition (24 V)	250	ns
min. Pulse Width	500	ns
max. Frequency (50% duty cycle)	1.0	MHz
Delay High / Low Transition	240	ns

Output signals generated by an *IO-Opto* module were used as signal source for this measurement. Voltage dependence of low-high transition delay is because of the voltage dependant rise time of the signal.

8.2.9 Electrical Characteristics

8.2.9.1 TTL Trigger Board

	Min	Max	Unit
Circuit speed t PD		10	ns
V input level low	-0.3	0.8	V
V input level high	2	5.5	V
V output level low		0.4	V
V output level high		2.9	V
I output level low		8	mA
I output level high		-4	mA
Temperature range	-40	105	°C

8.2.9.2 Opto Trigger Board

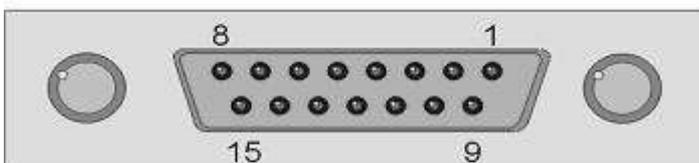
	Min	Type	Max	Unit
Supply Voltage	4.5		25	V
Input Signal Voltage High		>20% Supply Voltage		V
Input Signal Voltage Low		<20% Supply Voltage		V
Input Supply Current			5	mA (per channel)
Output Signal Voltage High		80-90% Supply Voltage		V
Output Signal Voltage Low			0.3	V
Output Current		5		mA (per channel)
Temperature Range	0		70	°C

Important note:

The opto trigger board has been designed with a varistor which opens at an input voltage of 30V to let the onboard surge protector get active to protect the board. At a total supply voltage of 36V the electronic chips will get defective.

8.2.10 Pin Configuration of the SUB-D15 Connector

Front-View



Buchse SUB-D15

There are two SUB-D15 female plugs on the TTL or Opto trigger extension. The upper is called Port A, the lower Port B.

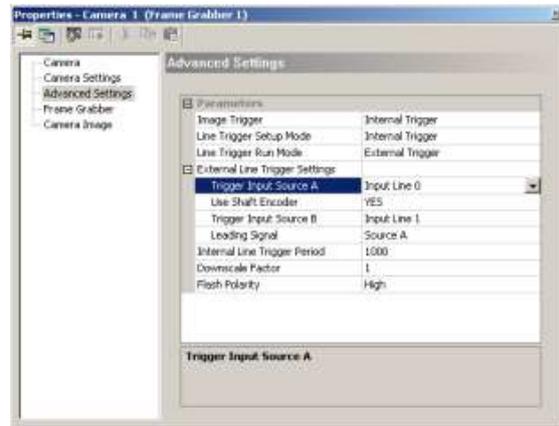
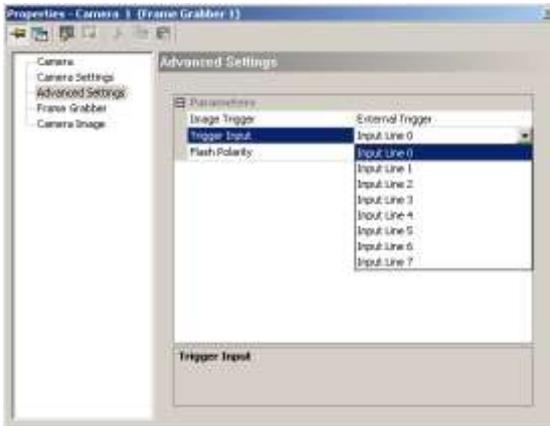
Connector: SUB-D15 female (Port A and B) for the TTL Trigger board

	SUB-D15 Port A	SUB-D15 Port B
Pin #	Signal name	Signal name
1	Trigger Output 0 Port A <i>Flash Signal</i>	Trigger Output 4 Port B <i>Flash Signal</i>
2	Trigger Output 1 Port A For Area Cameras: Image Trigger (Ex Sync) For Line Cameras: Line Trigger (ExSync2)	Trigger Output 5 Port B For Area Cameras: Image Trigger (Ex Sync) For Line Cameras: Line Trigger (ExSync2)
3	Trigger Output 2 Port A For Area Cameras: HD Sync For Line Cameras: Line Trigger (Ex Sync)	Trigger Output 6 Port B For Area Cameras: HD Sync For Line Cameras: Line Trigger (Ex Sync)
4	Trigger Output 3 Port A User Output (DigitalOut Bit#0)	Trigger Output 7 Port B User Output (DigitalOut Bit#0)
5	Nc	Nc
6	GND	GND
7	Nc	Nc
8	+12V (for external devices only)	+12V (for external devices only)
9	+5V (for external devices only)	+5V (for external devices only)
10	Nc	Nc
11	Trigger Input 0 Port A	Trigger Input 4 Port B
12	Trigger Input 1 Port A	Trigger Input 5 Port B
13	Trigger Input 2 Port A	Trigger Input 6 Port B
14	Trigger Input 3 Port A	Trigger Input 7 Port B
15	GND	GND

Connector: SUB-D15 female (Port A and B) Opto trigger Board

Pin #	Signal name	Signal name
1	Trigger Output 0 Port A <i>Flash Signal</i>	Trigger Output 4 Port B <i>Flash Signal</i>
2	Trigger Output 1 Port A For Area Cameras: Image Trigger (Ex Sync) For Line Cameras: Line Trigger (ExSync2)	Trigger Output 5 Port B For Area Cameras: Image Trigger (Ex Sync) For Line Cameras: Line Trigger (ExSync2)
3	Trigger Output 2 Port A For Area Cameras: HD Sync For Line Cameras: Line Trigger (Ex Sync)	Trigger Output 6 Port B For Area Cameras: HD Sync For Line Cameras: Line Trigger (Ex Sync)
4	Trigger Output 3 Port A User Output (DigitalOut Bit#0)	Trigger Output 7 Port B User Output (DigitalOut Bit#0)
5	V_IN (VCC Input)	V_IN (VCC Input)
6	GND	GND
7	Nc	nc
8	Nc	nc
9	Nc	nc
10	V_IN (VCC Input)	V_IN (VCC Input)
11	Trigger Input 0 Port A	Trigger Input 4 Port B
12	Trigger Input 1 Port A	Trigger Input 5 Port B
13	Trigger Input 2 Port A	Trigger Input 6 Port B
14	Trigger Input 3 Port A	Trigger Input 7 Port B
15	GND	GND

Select the input for the external trigger or the shaft encoder in the Vision Q.400 camera properties dialog.



9 Trouble Shooting

9.1 Cameras is Not Detected

Sometimes Vision Q.400 does not detect any cameras for all frame grabbers or for a frame grabber even if a camera (cameras) is (are) connected to the frame grabber(s).

Possible reasons for this are:

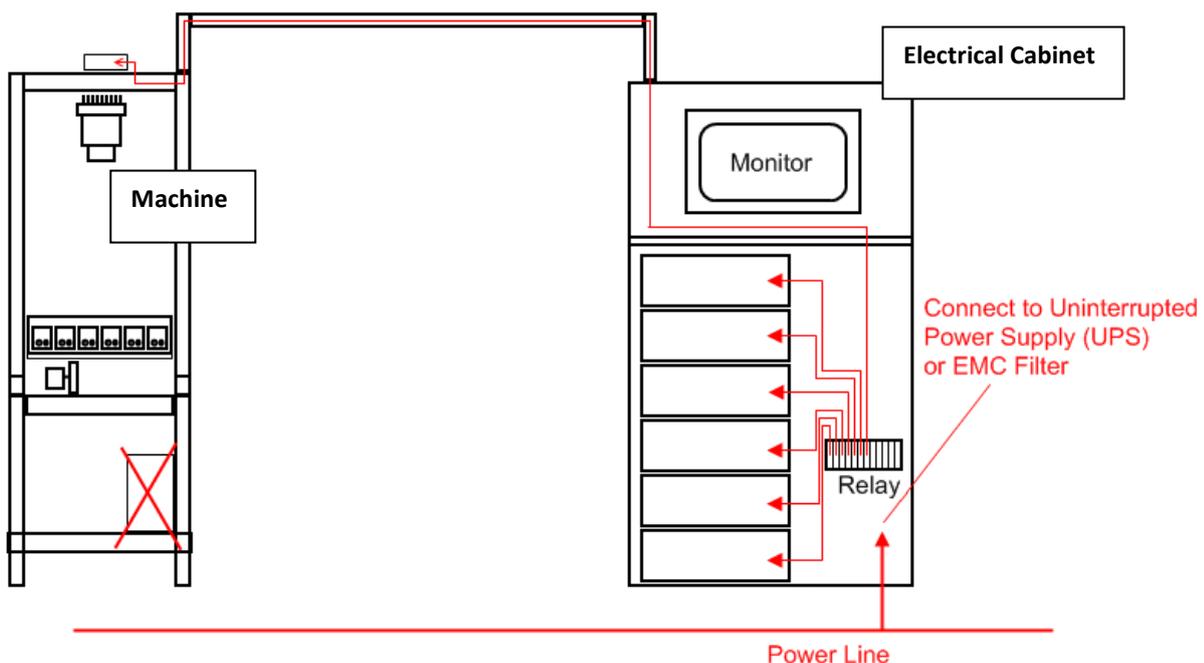
- The Camera Link configuration and/or the camera type, which are selected under the System Settings -> Vision Q.400 Settings... -> Frame Grabber property page for a frame grabber does not fit to any camera type which is currently supported by Vision Q.400.
- User defined cameras should be added to Vision Q.400 with the help of the FgalCameras.ini file: check the FgalCameras.log file if all definitions for the cameras are correct, and if all necessary configuration files are available (see CamerFiles.doc).

9.2 Infrequent Disturbed Images - Electromagnetic compatibility (EMC)

One reason for the success and wide spread usage of the Camera Link interface in the industrial machine vision is the very high data rate. A disadvantage of this digital interface is that if data get lost the image can be heavily disturbed. In many cases these problems occur because of not correct installation of the vision system in the production line which may lead to EMC problems. Some recommendation to avoid such problems:

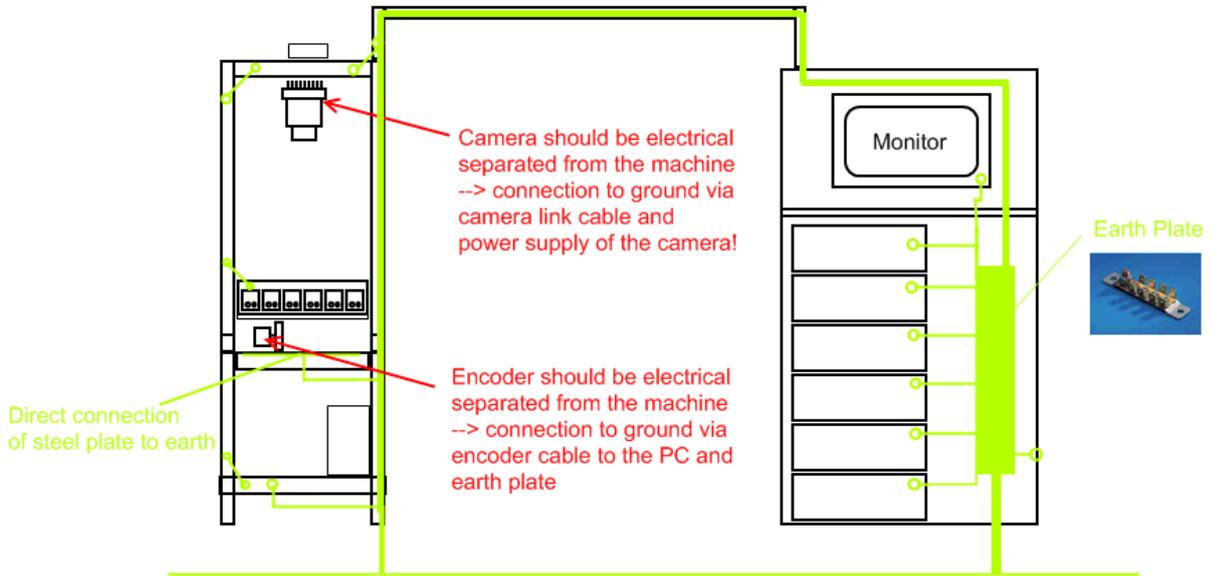
Power Wiring

The external power supply should be connected to a UPS. The UPS also work as net filter to suppress electrical noise. If the power supply fails by the help of the UPS data loss can be avoided.

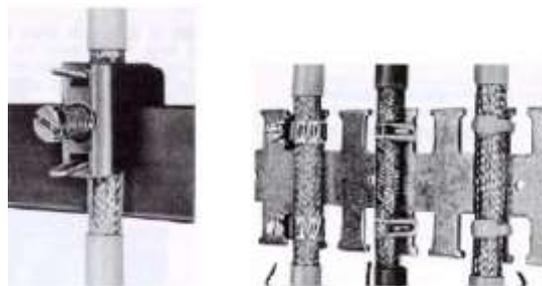
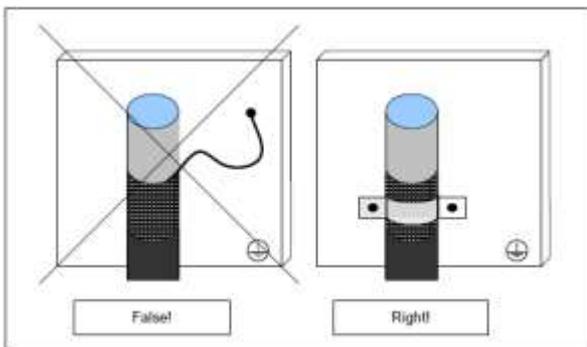


Connection to Earth

If there is a very low resistant of the earth potential the different components can be connected at different points to earth. The steel plate where the paper is moving on should be directly connected to earth because the most electrical charge is generated in this area.

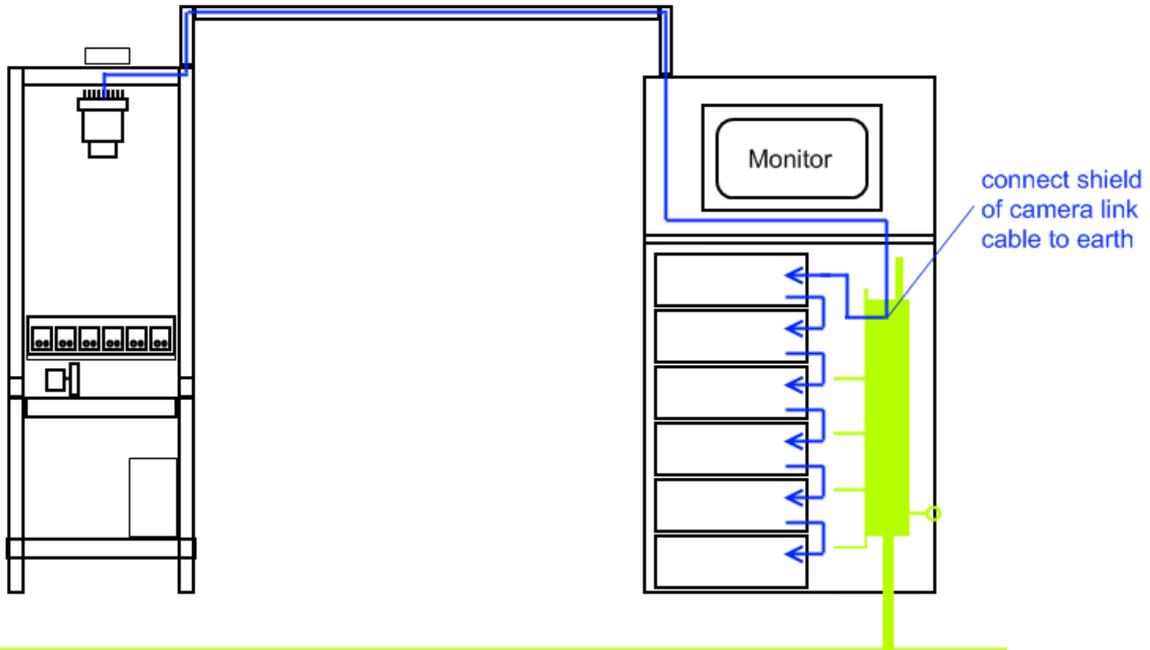


Connection of Shield to Earth



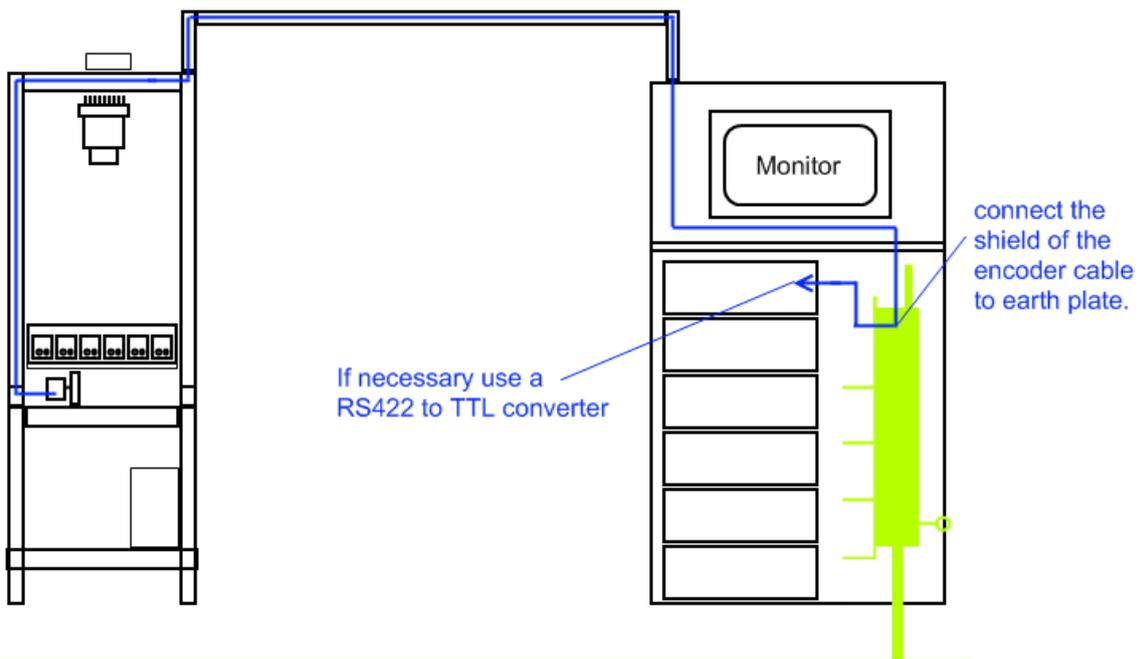
Camera Link Wiring

The shield of the camera link cable should be connected to earth before the camera cable is connected to the master PC.



Connection of the encoder

The shield of the encoder cable should be connected to earth before the encoder cable is connected to the master PC. If necessary also a RS422 to TTL converter can be used.



Important Note:



As the encoder wheel has direct contact to the material in some cases it is strongly recommended to use electroconductive measuring wheels to avoid the build up of electric charge on nonconductive material.

Connection of LED Light

To avoid electrical noise coming from the machine to the cabinet a shielded cable for the light is recommended. Also it is recommended to use a separate 24V power supply to avoid the transfer of electrical noise to the digital IO at the PLC and the PC

