	Subject: VDS CCD4000 C with mvTITAN-DIG	Created	Last change
		28.07.03	20.08.03
Application Note	Project:	Camera adaption	Version 1.0

Overview

Camera VDS CCD 4000C

Running modes

Free running Special settings necessary
Image On Demand

Resolution

Horizontal 2048 Pixel
Vertical 2048/1024 Pixel
Bits per Pixel 12 bpp
Binning
Partial Scan

Timings

Pixel clock 40 MHz
Horizontal 19.5 kHz
Vertical 7.5/15 fps

MATRIX VISION GmbH Frame Grabber

Type	mvTITAN-DIG				
Line Enable by	camera	<input checked="" type="checkbox"/>	Frame Grabber	<input type="checkbox"/>	external <input type="checkbox"/>
Frame Enable by	camera	<input checked="" type="checkbox"/>	Frame Grabber	<input checked="" type="checkbox"/>	external <input type="checkbox"/>
Trigger by	external	<input type="checkbox"/>	Frame Grabber	<input checked="" type="checkbox"/>	
Flash by	camera	<input type="checkbox"/>	Frame Grabber	<input checked="" type="checkbox"/>	external <input type="checkbox"/>

Software

mvAcquireControl
mvIMPACT Go!
Other [e.g. LabView™, Halcon, etc.]

Imprint

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This document requires the general knowledge of the usage and the technical data of the used frame grabber, camera and application.

Information in this document is subject to change without notice and does not represent a commitment on the part of MATRIX VISION GmbH.

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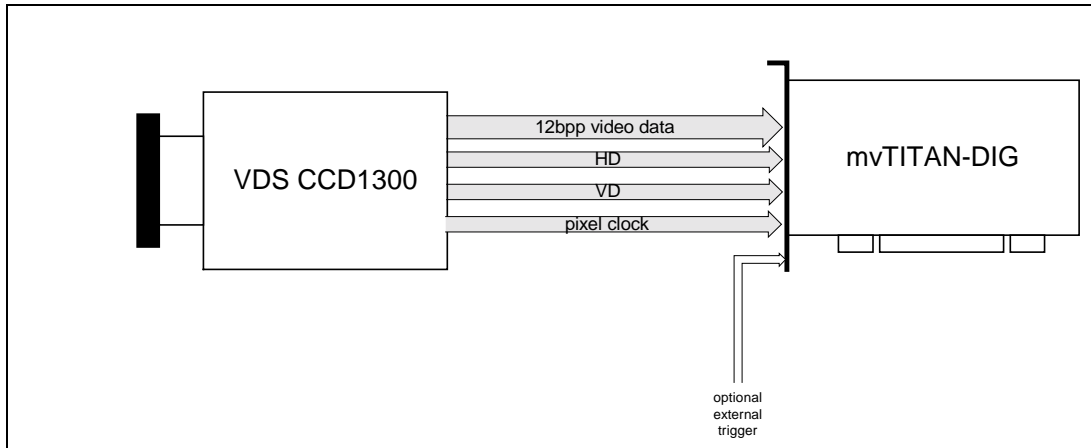
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Free running Mode

Camera runs with its own timing and sends the image data, pixel clock, HD and VD to the mvTITAN-DIG.

mvTITAN-DIG cannot reset the camera in this mode but control the 2xGain and binning mode.

Signal map




Camera settings by hardware

Condition for this mode is to set the camera not to IOD mode by hardware. With the mvTITAN-DIG it isn't possible to switch the IOD mode by a digital output of the mvTITAN-DIG. This must be done in the camera's 15-pin jack. Pin 9 of the 15-pin jack of the camera must be open. You can check the correct setting on the backside of the camera. There are several LEDs. If the camera runs free the LED labeled *IOD* must be dark and the LED labeled *Fout* should be on.

Pin connection

mvTITAN-DIG		Direction	VDS CCD4000 C	
1	Ground	←	16	GND
2	MSB(+)	←	15	D11 (MSB)
3	MSB -1 (+)	←	14	D10
4	MSB -2 (+)	←	13	D9
5	MSB -3 (+)	←	12	D8
6	MSB -4 (+)	←	11	D7
7	MSB -5 (+)	←	10	D6
8	MSB -6 (+)	←	9	D5
9	MSB -7 (+)	←	8	D4
10	MSB -8 (+)	←	7	D3
11	MSB -9 (+)	←	6	D2
13	MSB -10 (+)	←	5	D1
14	MSB -11 (+)	←	4	D0 (LSB)
17	DigOut0 (+)	→	36	TREX +
18	DigOut1 (+)	→	19	Option: 15fps
25	Frame Ena. In (+)	←	3	FEN
26	Line Ena. In (+)	←	2	LEN
29	Pixel Clock In (+)	←	1	PCLK
30	DigOut 2 (+) / Expose (+)	→	18	SV2 +

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35	Ground	←	35	GND
36	MSB (-)	←	34	D11-
37	MSB -1 (-)	←	33	D10-
38	MSB -2 (-)	←	32	D9-
39	MSB -3 (-)	←	31	D8-
40	MSB -4 (-)	←	30	D7-
41	MSB -5 (-)	←	29	D6-
42	MSB -6 (-)	←	28	D5-
43	MSB -7 (-)	←	27	D4-
44	MSB -8 (-)	←	26	D3-
45	MSB -9 (-)	←	25	D2-
47	MSB -10 (-)	←	24	D1-
48	MSB -11 (-)	←	23	D0-
51	DigOut0 (-)	→	17	TREX -
59	Frame Ena. In (-)	←	22	FEN -
60	Line Ena. In (-)	←	21	LEN -
63	Pixel Clock In (-)	←	20	PCLK -

With this pinning it is possible to switch on and of the 2xGain and the binning mode with GPout1 and GPout2.

Recommended cable for this mode from MATRIX VISION GmbH: KS55-0187 05.0 (including camera's power supply by mvTITAN-DIG/P).

Camera definition

Normal mode:

```

/* ----- Vosskühler CCD-4000-C 12Bit ----- */
/* SetInputPitch 2048 */
DefCamType           "CCD4000-C-7_5Hz" VM_DIG12 NONINTERLACED 8 19375 40000
PCLK_EXTERN
DefCamAcquireSetup   "CCD4000-C-7_5Hz" VSCAN INV_SYNC NEXT_FIELD
DefHorizontalUnit     "CCD4000-C-7_5Hz" PIXEL
DefVerticalUnit       "CCD4000-C-7_5Hz" LINES
DefCamHorizontalAcquire "CCD4000-C-7_5Hz" 0L 2048L 1
DefCamVerticalAcquire "CCD4000-C-7_5Hz" 0L 2047L 1

```

Binning mode:

```

/* ----- Vosskühler CCD-4000-C 12Bit ----- */
/* SetInputPitch 2048 */
DefCamType           "CCD4000-C-15Hz" VM_DIG12 NONINTERLACED 15 19375 40000
PCLK_EXTERN
DefCamAcquireSetup   "CCD4000-C-15Hz" VSCAN INV_SYNC NEXT_FIELD
DefHorizontalUnit     "CCD4000-C-15Hz" PIXEL
DefVerticalUnit       "CCD4000-C-15Hz" LINES
DefCamHorizontalAcquire "CCD4000-C-15Hz" 0L 2048L 1
DefCamVerticalAcquire "CCD4000-C-15Hz" 0L 1023L 1

```

Remarks to the mvAcquireControl


In order to open the mvTITAN-DIG properly you should add the command *SetInputPitch* to the used INI-file (in general *grabber.ini*) to tell the mvTITAN-DIG the number of pixel clocks between two HD signals the camera sends.

Example:

```

...
[TITAN]
...
InitBoard

```

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```
...
SetInputPitch 2048
...
```

In the mvAcquireControl you have to choose the camera definition *CCD4000-C*. Activate the option *Grayscale* in register *Acquire* and set it to *12bit*. Be sure the *Shutter Control* in register *Shutter* is deactivated. Otherwise you might get distortions in the acquired images as a result of manually resetting the camera during data transmission.

Using the recommended connection it is possible to activate/deactivate the 2xGain and the binning mode with digital output GPout1 and GPout2. Because the camera wants active high signals it is needed to set these two outputs to high state that the camera runs in normal mode. For doing this switch to register *Signals* and change the *Bit mask* of line *Integration Off* to *'xxxxxxxxxxx1x'*. The *Integration Off* bit mask is set automatically when opening the mvTITAN-DIG. If these outputs are not programmed their state is low.

If you have connected an external trigger signal to the mvTITAN-DIG you can activate the *ext. Trigger* in the register *Trigger*. With this setting the mvTITAN-DIG will acquire and image only after a trigger signal has been detected on the external trigger input of the mvTITAN-DIG.

Onboard color conversion with the mvTITAN-DIG

The onboard Bayer conversion of the mvTITAN-DIG can be used to convert the grayscale images transmitted by the CCD4000 C into color images. However doing this requires some extra settings.

NOTE:

At the moment it is NOT possible to achieve a live real time conversion with the mvTITAN-DIGs onboard processor. The 125MHz CPU of the frame grabber is capable of converting about 8500 lines of 2048 pixels per sec. which gives us about 4 full frames in full resolution.

It doesn't make any sense to operate the CCD4000 in binning mode and doing the conversion! As every 2nd line is transmitted, it is not possible to calculate a color image from this data.


Before the onboard conversion can be used in connection with the CCD4000 C some small modifications to the INI file of the frame grabber have to be made. These modifications are needed to adjust the onboard image data buffers to the converted image data.

After that your INI file should look like this:

```
[TITAN]
...
SetInputBuffer 16 226000
SetOutputBuffer 2 852000
...
InitBoard
...
SetInputPitch 2048
...
```

After that the onboard conversion can be activated on the mvAcquireControls processing tab. By clicking on the *Properties* button another little dialog will appear enabling the user to adjust the gain and the offset of the different color components.



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Remarks to mvIMPACT Go! and mvIMPACT S

Condition for proper images with mvIMPACT Go! and mvIMPACT S is the same as described in *Remarks to mvAcquireControl*, but as mvIMPACT Go! and mvIMPACT S both using a double buffer method for the live preview mode the DMA buffer of the frame grabber has to chosen large enough to store two images in it. In 16 bit it will be about $2 * 8MB = 16MB$, Bayer converted color image will need even 16MB per images. The size after a standard installation is 4MB so you will have to increase the size to at least 16-20MB. In case of Windows NT4.0, Windows 2000 or Windows XP this can be achieved by using the tool `..\windows\matrix\setdma.exe`.

Additionally it is needed to tell mvIMPACT Go! and mvIMPACT S that the acquired images have a resolution of 12bpp. To do this open the menu item *Tools / Options*. Set the entry for *Default bit shift for 16bit images* to 4 (use for 12bit images).

Remarks to programming

In order to open the mvTITAN-DIG properly you should add the command *SetInputPitch* to the used INI-file (in general *grabber.ini*) to tell the mvTITAN-DIG the number of pixel clocks between two HD signals the camera sends.

Example:

```
...
[TITAN]
...
InitBoard
...
SetInputPitch 2048
...
```

Using the VDS CCD4000 C and the mvTITAN-DIG in your own program you have to set at least the video mode to *VM_DIG12* and the color mode to either *COL_GREY* or *COL_GREY16*. With *COL_GREY* you will get the image data as an 8bpp image in the DMA-buffer where the upper 8bit of the 12bit are used. With *COL_GREY16* you will get the 12bit data LSB aligned in the 16bit. To vary the position of the MSB you can use the function *mvSetMSBDataPos()*.

Using the recommended connection it is possible to switch the 2xGain and the binning mode with digital output GPout1 and GPout2. Because the camera expects active high signals it is needed to set these two outputs to high state that the camera runs in normal mode. For doing this you can for example use the command *mvWriteDigIOBit(dev, 1,1)* and *mvWriteDigIOBit(dev, 2,1)*. If these outputs are not programmed their state is low.

When the onboard color conversion shall be used, the functions for doing this are *mvSelBayerMosaikFilter(dev, boEnable)*, *mvSetBayerMosaikCoeff(dev, r, g, b)* and *mvSetBayerMosaikOffset(dev, r, b, g)*.

Apart from that the same modifications have to be made in the INI file of the frame grabber to adjust the image data buffer sizes on the frame grabber to the converted image.

More about programming the mvTITAN-DIG you will find in the mvTITAN-DIG's manual.


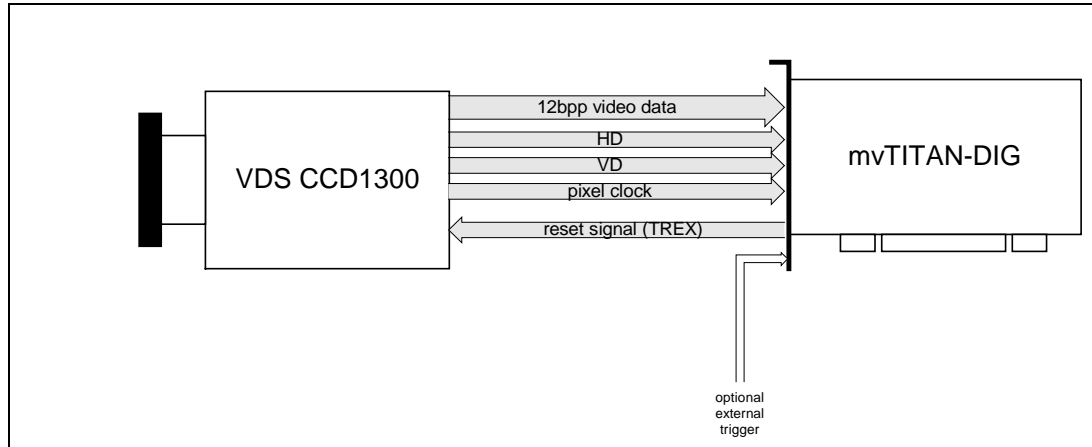
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Image On Demand (IOD) mode

Camera is reset by the mvTITAN-DIG. The camera integrates an image and sends the image and the needed signals for synchronization (pixel clock, HD and VD) to the mvTITAN-DIG. The integration time is nearly equal to the pulse length of the reset signal.
The mvTITAN-DIG can control the 2xGain and binning mode.

Signal map




Camera settings by hardware

Condition for this mode is to set the camera to IOD mode by hardware. With the mvTITAN-DIG it isn't possible to switch the IOD mode by a digital output of the mvTITAN-DIG. This must be done in the camera's 15-pin jack. Pin 9 of the 15-pin jack of the camera must be connected to ground. You can check the correct setting on the backside of the camera. There are several LEDs. If the camera runs in IOD mode the LED labeled *IOD* must be switched on.

The 2x gain and the binning mode can be set by digital outputs of the mvTITAN-DIG. We recommend to use the positive pins of DigOut1 and DigOut2.

Pin connection

mvTITAN-DIG		Direction	VDS CCD4000 C	
1	Ground	←	16	GND
2	MSB(+)	←	15	D11 (MSB)
3	MSB -1 (+)	←	14	D10
4	MSB -2 (+)	←	13	D9
5	MSB -3 (+)	←	12	D8
6	MSB -4 (+)	←	11	D7
7	MSB -5 (+)	←	10	D6
8	MSB -6 (+)	←	9	D5
9	MSB -7 (+)	←	8	D4
10	MSB -8 (+)	←	7	D3
11	MSB -9 (+)	←	6	D2
13	MSB -10 (+)	←	5	D1
14	MSB -11 (+)	←	4	D0 (LSB)
17	DigOut0 (+)	→	36	TRES +
18	DigOut1 (+)	→	19	Option: 15fps
25	Frame Ena. In (+)	←	3	FEN
26	Line Ena. In (+)	←	2	LEN

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29	Pixel Clock In (+)	←	1	PCLK
30	DigOut 2 (+) / Expose (+)	→	18	SV2 +
35	Ground	←	35	GND
36	MSB (-)	←	34	D11-
37	MSB -1 (-)	←	33	D10-
38	MSB -2 (-)	←	32	D9-
39	MSB -3 (-)	←	31	D8-
40	MSB -4 (-)	←	30	D7-
41	MSB -5 (-)	←	29	D6-
42	MSB -6 (-)	←	28	D5-
43	MSB -7 (-)	←	27	D4-
44	MSB -8 (-)	←	26	D3-
45	MSB -9 (-)	←	25	D2-
47	MSB -10 (-)	←	24	D1-
48	MSB -11 (-)	←	23	D0-
51	DigOut0 (-)	→	17	TREX -
59	Frame Ena. In (-)	←	22	FEN -
60	Line Ena. In (-)	←	21	LEN -
63	Pixel Clock In (-)	←	20	PCLK -

With this pinning the needed reset signal is transmitted through the pins DigOut0(+) and DigOut0(-).

Recommended cable for this mode from MATRIX VISION GmbH: KS55-0187 05.0 (including camera's power supply by mvTITAN-DIG/P).

Camera definition

Normal mode:

```

/* ----- Vosskühler CCD-4000-C 12Bit ----- */
/* SetInputPitch 2048 */
DefCamType "CCD4000-C-7_5Hz" VM_DIG12 NONINTERLACED 8 19375 40000
PCLK_EXTERN
DefCamAcquireSetup "CCD4000-C-7_5Hz" VSCAN INV_SYNC NEXT_FIELD
DefHorizontalUnit "CCD4000-C-7_5Hz" PIXEL
DefVerticalUnit "CCD4000-C-7_5Hz" LINES
DefCamHorizontalAcquire "CCD4000-C-7_5Hz" 0L 2048L 1
DefCamVerticalAcquire "CCD4000-C-7_5Hz" 0L 2047L 1

```

Binning mode:

```

/* ----- Vosskühler CCD-4000-C 12Bit ----- */
/* SetInputPitch 2048 */
DefCamType "CCD4000-C-15Hz" VM_DIG12 NONINTERLACED 15 19375 40000
PCLK_EXTERN
DefCamAcquireSetup "CCD4000-C-15Hz" VSCAN INV_SYNC NEXT_FIELD
DefHorizontalUnit "CCD4000-C-15Hz" PIXEL
DefVerticalUnit "CCD4000-C-15Hz" LINES
DefCamHorizontalAcquire "CCD4000-C-15Hz" 0L 2048L 1
DefCamVerticalAcquire "CCD4000-C-15Hz" 0L 1023L 1

```

Remarks to the mvAcquireControl


In order to open the mvTITAN-DIG properly you should add the command *SetInputPitch* to the used INI-file (in general *grabber.ini*) to tell the mvTITAN-DIG the number of pixel clocks between two HD signals the camera sends.

Example:

```

...
[TITAN]
...

```

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```

InitBoard
...
SetInputPitch 2048
...

```

In the mvAcquireControl you have to choose the camera definition *CCD4000-C*. Activate the option *Greyscale* in register *Acquire* and set it to *12bit*.

To set up the reset signal go to register *Shutter* and *enable shutter control*.

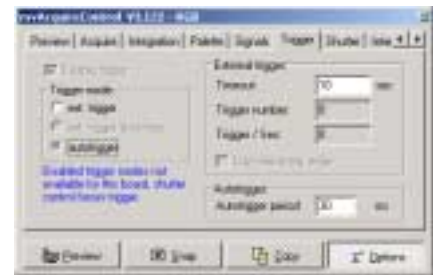
The camera expects an active high signal on the TREX pins. So it is necessary to activate the checkbox *High active*.

Choose the shutter mode *One Trigger Mode*.

The shutter time defines the pulse length of the reset signal and so the integration time in the camera.



For the Shutter control trigger signals are needed. If no *external trigger* is supplied to the mvTITAN-DIG you must use the *autotrigger* mode. This can be done on the *Trigger* tab. The autotrigger is automatically activated when shuttercontrol is enabled.



Using the recommended connection it is possible to switch the 2xGain and the binning mode with digital output GPout1 and GPout2. Because the camera wants active high signals it is needed to set these two outputs to high state that the camera runs in normal mode. For doing this switch to register *Signals* and change the *Bitmask* of line *Integration Off* to *'xxxxxxxxxxxx11x'*. The *Integration Off* bitmask is set automatically when opening the mvTITAN-DIG. If these outputs are not programmed their state is low.

Onboard color conversion with the mvTITAN-DIG

The onboard Bayer conversion of the mvTITAN-DIG can be used to convert the grayscale images transmitted by the CCD4000 C into color images. However doing this requires some extra settings.

NOTE:

At the moment it is NOT possible to achieve a live real time conversion with the mvTITAN-DIGs onboard processor. The 125MHz CPU of the frame grabber is capable of converting about 8500 lines of 2048 pixels per sec. which gives us about 4 full frames in full resolution.

It doesn't make any sense to operate the CCD4000 in binning mode and doing the conversion! As every 2nd line is transmitted, it is not possible to calculate a color image from this data.


Before the onboard conversion can be used in connection with the CCD4000 C some small modifications to the INI file of the frame grabber have to be made. These modifications are needed to adjust the onboard image data buffers to the converted image data.

After that your INI file should look like this:

```

[TITAN]
...
SetInputBuffer 16 226000
SetOutputBuffer 2 852000

```


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```

...
InitBoard
...
SetInputPitch 2048
...

```



After that the onboard conversion can be activated on the mvAcquireControls processing tab. By clicking on the *Properties* button another little dialog will appear enabling the user to adjust the gain and the offset of the different color components.

Remarks to mvIMPACT Go! and mvIMPACT S

Condition for proper images with mvIMPACT Go! and mvIMPACT S is the same as described in *Remarks to mvAcquireControl*, but as mvIMPACT Go! and mvIMPACT S both using a double buffer method for the live preview mode the DMA buffer of the frame grabber has to be chosen large enough to store two images in it. In 16 bit it will be about $2 * 8MB = 16MB$, Bayer converted color image will need even 16MB per images. The size after a standard installation is 4MB so you will have to increase the size to at least 16-20MB. In case of Windows NT4.0, Windows 2000 or Windows XP this can be achieved by using the tool `..\windows\matrix\setdma.exe`.

Additionally it is needed to tell mvIMPACT Go! and mvIMPACT S that the acquired images have a resolution of 12bpp. To do this open the menu item *Tools / Options*. Set the entry for *Default bit shift for 16bit images to 4 (use for 12bit images)*.

Remarks to programming

For opening the mvTITAN-DIG properly add the command *SetInputPitch* to the used INI-file to tell the mvTITAN-DIG the number of pixel clocks between two HD signals the camera sends.

Example:

```


...
[TITAN]
...
InitBoard
...
SetInputPitch 2048
...

```

Using the VDS CCD4000 C and the mvTITAN-DIG in your own program you have to set at least the video mode to *VM_DIG12* and the color mode to either *COL_GREY* or *COL_GREY16*. With *COL_GREY* you will get the image data as an 8bpp image in the DMA-buffer where the upper 8bit of the 12bit are used. With *COL_GREY16* you will get the 12bit data LSB aligned in the 16bit. To vary the position of the MSB you can use the function *mvSetMSBDataPos()*.

To define the needed reset signal and its pulse length use the function *mvDefPulsSeq()*.

Trigger signals are needed for output pulse sequences. You have three possibilities for this trigger signals:

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1. External Trigger: an external trigger signal is connected to the Ext. Trigger input of the mvTITAN-DIG. To activate this input use *mvSelExtTrig(dev,1)*;
2. Auto trigger: the trigger signal is periodically simulated on the mvTITAN-DIG itself, so no external signal must be supplied. Use function *mvSetTriggerPeriode()*; to define the period time of the simulated trigger signal
3. Single software trigger: single trigger signals can be done by software without supplying an external trigger signal with function *mvWriteDigIOBit(dev,15,1)*;

Using the recommended connection it is possible to switch the 2xGain and the binning mode with digital output GPout1 and GPout2. Because the camera expects active high signals it is needed to set these two outputs to high state that the camera runs in normal mode. For doing this you can for example use the command *mvWriteDigIOBit (dev, 1,1)* and *mvWriteDigIOBit (dev, 2,1)*. If these outputs are not programmed their state is low.

When the onboard color conversion shall be used, the functions for doing this are *mvSelBayerMosaikFilter(dev, boEnable)*, *mvSetBayerMosaikCoeff(dev, r, g, b)* and *mvSetBayerMosaikOffset(dev, r, b, g)*.

Apart from that the same modifications have to be made in the INI file of the frame grabber to adjust the image data buffer sizes on the frame grabber to the converted image.

More about programming the mvTITAN-DIG you will find in the mvTITAN-DIG's manual.

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Glossary

Expression	Explanation
VD	Vertical drive, signal is sent to signalize next field (noninterlaced) or frame (interlaced). Also called Frame Enable, VSync or frame start signal.
HD	Horizontal drive, signal is sent to signalize next line. Also called Line Enable, HSync or line start signal.
Bpp	Bits per pixel