

## VITA 1300 Pixel Remapping



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### Application Note Abstract

This application note explains the pixel remapping procedure for VITA 1300 LVDS version.

### Introduction

To read out the image data through the output channels (LVDS), the pixel array is organized in kernels. The kernel size is 8 pixels in x-direction by 1 pixel in y-direction. The below figure indicates how the kernels are organized. The data order of the image data on the output channels depends on the subsampling mode. There are three different scenarios: no sub-sampling, sub-sampling on a monochrome sensor and subsampling on a color sensor.

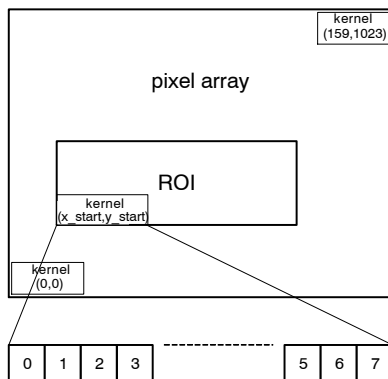


Figure 1. Kernel Organization in Pixel Array

### APPLICATION NOTE

The image data is sent over 4 LVDS channels, operating at 620 Mbps in 10 bit mode and 496 Mbps in 8 bit mode. A synchronization channel and a clock output are foreseen to synchronize the data on the 4 data channels. The 4 data output channels are used to output image data only. The sync channel transmits information about the data sent over the data channels (for instance: frame start, frame end, line start, line end, black pixel data, image data, training pattern etc).

In order to correctly latch the data on the receiver end, bit and word alignment has to be performed on a per channel base, including the sync channel. The sensor can send out a training pattern over the different channels to achieve this.

Figure 2: Image Data on LVDS Output Channels shows how the data is sent over the LVDS channels. 1 data channel outputs 2 pixels of 1 kernel sequentially. The channels run at 310 MHz using dual data rate (= 620 Mbps). Thus 1 pixel (= 10 bit) over 1 channel takes 5 clock cycles @ 310 MHz. 1 kernel (= 8 pixels) over 4 channels takes 10 clock cycles at 310 MHz. The output order is MSB first.

If one chooses to use the subsampling mode, the data order will be different as to when subsampling is disabled. The data output order for a mono sensor is different than for a color sensor when subsampling is enabled (read 1, skip 1 versus read 2, skip 2). The differences will be described in the next sections.

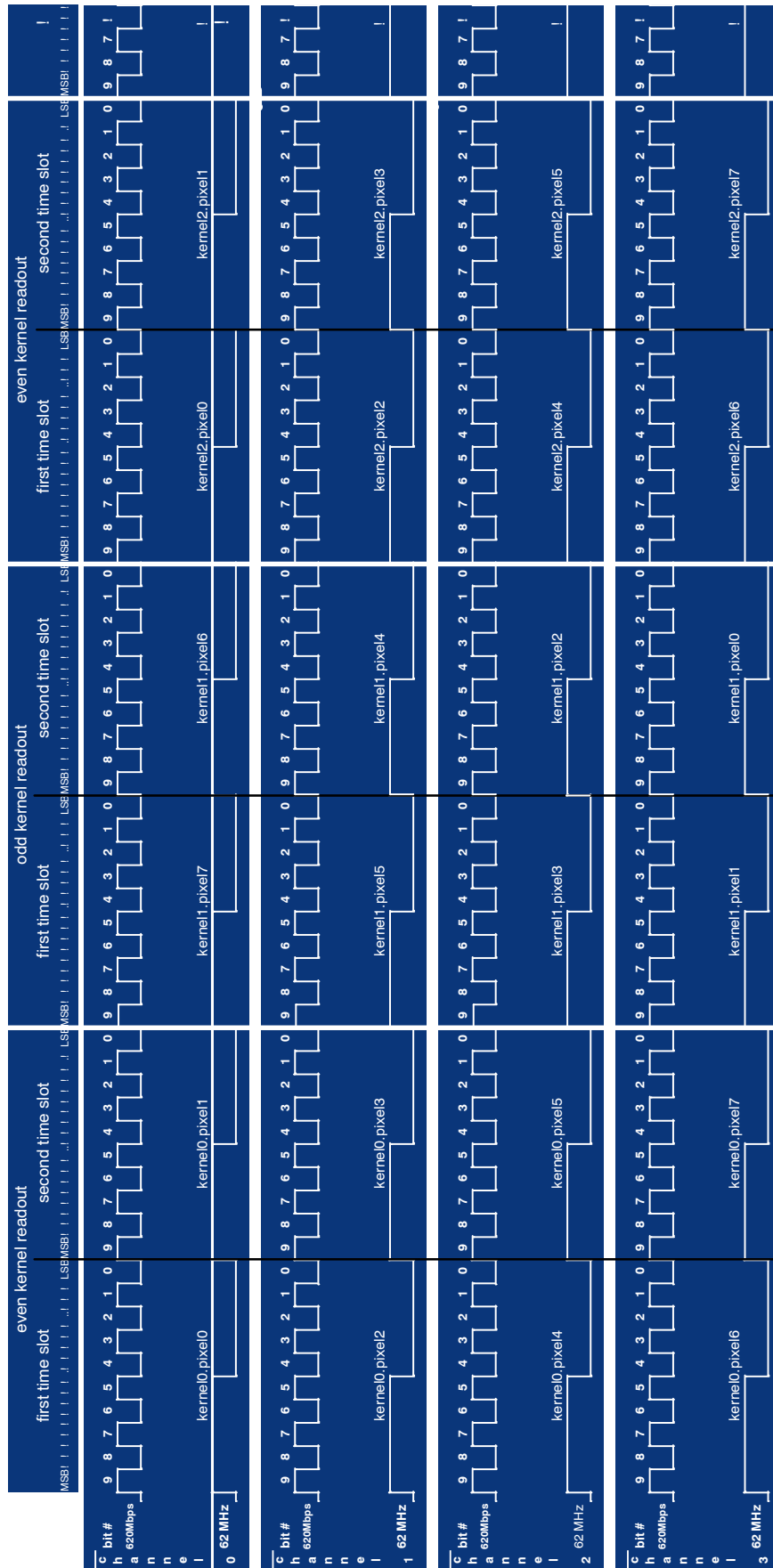


Figure 2. Image Data on LVDS Output Channels (Normal Readout, Subsampling Disabled)

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## NORMAL READOUT (SUBSAMPLING DISABLED)

**Table 1. PIXEL LOCATION ON THE LVDS CHANNELS BEFORE REMAPPING (SUBSAMPLING DISABLED)**

	LVDS channel 0	LVDS channel 1	LVDS channel 2	LVDS channel 3
Row0	K0.P0	K0.P2	K0.P4	K0.P6
	K0.P1	K0.P3	K0.P5	K0.P7
	K1.P7	K1.P5	K1.P3	K1.P1
	K1.P6	K1.P4	K1.P2	K1.P0
	K2.P0	K2.P2	K2.P4	K2.P6
	K2.P1	K2.P3	K2.P5	K2.P7
	K3.P7	K3.P5	K3.P3	K3.P1
	K3.P6	K3.P4	K3.P2	K3.P0
	...	...	...	...
	K159.P7	K159.P5	K159.P3	K159.P1
	K159.P6	K159.P4	K159.P2	K159.P0
	Row1	K0.P0	K0.P2	K0.P4
K0.P1		K0.P3	K0.P5	K0.P7
K1.P7		K1.P5	K1.P3	K1.P1
K1.P6		K1.P4	K1.P2	K1.P0
K2.P0		K2.P2	K2.P4	K2.P6
K2.P1		K2.P3	K2.P5	K2.P7
K3.P7		K3.P5	K3.P3	K3.P1
K3.P6		K3.P4	K3.P2	K3.P0
...		...	...	...
K159.P7		K159.P5	K159.P3	K159.P1
K159.P6		K159.P4	K159.P2	K159.P0
...		...	...	...
...	...	...	...	
Row1023	K0.P0	K0.P2	K0.P4	K0.P6
	K0.P1	K0.P3	K0.P5	K0.P7
	K1.P7	K1.P5	K1.P3	K1.P1
	K1.P6	K1.P4	K1.P2	K1.P0
	K2.P0	K2.P2	K2.P4	K2.P6
	K2.P1	K2.P3	K2.P5	K2.P7
	K3.P7	K3.P5	K3.P3	K3.P1
	K3.P6	K3.P4	K3.P2	K3.P0
	...	...	...	...
	K159.P7	K159.P5	K159.P3	K159.P1
	K159.P6	K159.P4	K159.P2	K159.P0

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**Table 2. PIXEL LOCATION IN THE IMAGE ARRAY AFTER REMAPPING (SUBSAMPLING DISABLED)**

Column Row	0	1	2	3	4	5	6	7	8	9	10	...	1278	1279
0	K0. P0	K0. P1	K0. P2	K0. P3	K0. P4	K0. P5	K0. P6	K0. P7	K1. P0	K1. P1	K1. P2	...	K159. P6	K159. P7
1	K0. P0	K0. P1	K0. P2	K0. P3	K0. P4	K0. P5	K0. P6	K0. P7	K1. P0	K1. P1	K1. P2	...	K159. P6	K159. P7
2	K0. P0	K0. P1	K0. P2	K0. P3	K0. P4	K0. P5	K0. P6	K0. P7	K1. P0	K1. P1	K1. P2	...	K159. P6	K159. P7
3	K0. P0	K0. P1	K0. P2	K0. P3	K0. P4	K0. P5	K0. P6	K0. P7	K1. P0	K1. P1	K1. P2	...	K159. P6	K159. P7
4	K0. P0	K0. P1	K0. P2	K0. P3	K0. P4	K0. P5	K0. P6	K0. P7	K1. P0	K1. P1	K1. P2	...	K159. P6	K159. P7
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1023	K0. P0	K0. P1	K0. P2	K0. P3	K0. P4	K0. P5	K0. P6	K0. P7	K1. P0	K1. P1	K1. P2	...	K159. P6	K159. P7

## SUBSAMPLING ON MONO SENSOR

**Table 3. PIXEL LOCATION ON THE LVDS CHANNELS BEFORE REMAPPING (MONO SUBSAMPLING)**

	LVDS channel 0	LVDS channel 1	LVDS channel 2	LVDS channel 3
Row0	K0.P0	K0.P2	K0.P4	K0.P6
	K1.P7	K1.P5	K1.P3	K1.P1
	K2.P0	K2.P2	K2.P4	K2.P6
	K3.P7	K3.P5	K3.P3	K3.P1
	...	...	...	...
	K158.P0	K158.P2	K158.P4	K158.P6
	K159.P7	K159.P5	K159.P3	K159.P1
Row1	K0.P0	K0.P2	K0.P4	K0.P6
	K1.P7	K1.P5	K1.P3	K1.P1
	K2.P0	K2.P2	K2.P4	K2.P6
	K3.P7	K3.P5	K3.P3	K3.P1
	...	...	...	...
	K158.P0	K158.P2	K158.P4	K158.P6
	K159.P7	K159.P5	K159.P3	K159.P1
...	...	...	...	
Row511	K0.P0	K0.P2	K0.P4	K0.P6
	K1.P7	K1.P5	K1.P3	K1.P1
	K2.P0	K2.P2	K2.P4	K2.P6
	K3.P7	K3.P5	K3.P3	K3.P1
	...	...	...	...
	K158.P0	K158.P2	K158.P4	K158.P6
	K159.P7	K159.P5	K159.P3	K159.P1

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**Table 4. PIXEL LOCATION IN THE IMAGE ARRAY AFTER REMAPPING (MONO SUBSAMPLING)**

Column \ Row	0	1	2	3	4	5	6	7	...	638	639
0	K0.P0	K0.P2	K0.P4	K0.P6	K1.P1	K1.P3	K1.P5	K1.P7	...	K159.P5	K159.P7
1	K0.P0	K0.P2	K0.P4	K0.P6	K1.P1	K1.P3	K1.P5	K1.P7	...	K159.P5	K159.P7
2	K0.P0	K0.P2	K0.P4	K0.P6	K1.P1	K1.P3	K1.P5	K1.P7	...	K159.P5	K159.P7
3	K0.P0	K0.P2	K0.P4	K0.P6	K1.P1	K1.P3	K1.P5	K1.P7	...	K159.P5	K159.P7
4	K0.P0	K0.P2	K0.P4	K0.P6	K1.P1	K1.P3	K1.P5	K1.P7	...	K159.P5	K159.P7
...	...	...	...	...	...	...	...	...	...	...	...
511	K0.P0	K0.P2	K0.P4	K0.P6	K1.P1	K1.P3	K1.P5	K1.P7	...	K159.P5	K159.P7

## SUBSAMPLING ON COLOR SENSOR


**Table 5. PIXEL LOCATION ON THE LVDS CHANNELS BEFORE REMAPPING (COLOR SUBSAMPLING)**

	LVDS channel 0	LVDS channel 1	LVDS channel 2	LVDS channel 3
Row0	K0.P0	K1.P5	K0.P4	K1.P1
	K0.P1	K1.P4	K0.P5	K1.P0
	K2.P0	K3.P5	K2.P4	K3.P1
	K2.P1	K3.P4	K2.P5	K3.P0
	...	...	...	...
	K158.P0	K159.P5	K158.P4	K159.P1
	K158.P1	K159.P4	K158.P5	K159.P0
Row1	K0.P0	K1.P5	K0.P4	K1.P1
	K0.P1	K1.P4	K0.P5	K1.P0
	K2.P0	K3.P5	K2.P4	K3.P1
	K2.P1	K3.P4	K2.P5	K3.P0
	...	...	...	...
	K158.P0	K159.P5	K158.P4	K159.P1
	K158.P1	K159.P4	K158.P5	K159.P0
...	...	...	...	
Row511	K0.P0	K1.P5	K0.P4	K1.P1
	K0.P1	K1.P4	K0.P5	K1.P0
	K2.P0	K3.P5	K2.P4	K3.P1
	K2.P1	K3.P4	K2.P5	K3.P0
	...	...	...	...
	K158.P0	K159.P5	K158.P4	K159.P1
	K158.P1	K159.P4	K158.P5	K159.P0

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**Table 6. PIXEL LOCATION IN THE IMAGE ARRAY AFTER REMAPPING (COLOR SUBSAMPLING)**

Column \ Row	0	1	2	3	4	5	6	7	...	638	639
0	K0.P0	K0.P1	K0.P4	K0.P5	K1.P0	K1.P1	K1.P4	K1.P5	...	K159.P4	K159.P5
1	K0.P0	K0.P1	K0.P4	K0.P5	K1.P0	K1.P1	K1.P4	K1.P5	...	K159.P4	K159.P5
2	K0.P0	K0.P1	K0.P4	K0.P5	K1.P0	K1.P1	K1.P4	K1.P5	...	K159.P4	K159.P5
3	K0.P0	K0.P1	K0.P4	K0.P5	K1.P0	K1.P1	K1.P4	K1.P5	...	K159.P4	K159.P5
4	K0.P0	K0.P1	K0.P4	K0.P5	K1.P0	K1.P1	K1.P4	K1.P5	...	K159.P4	K159.P5
...	...	...	...	...	...	...	...	...	...	...	...
511	K0.P0	K0.P1	K0.P4	K0.P5	K1.P0	K1.P1	K1.P4	K1.P5	...	K159.P4	K159.P5

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