CH7308 LVDS Upscaler Coefficient Programming Guide

1. Introduction

This application note focuses on the basic guidelines on how to program the upscaler coefficients for the CH7308 LVDS output. Many types of graphics and video displays in use today require that the graphics data be scaled from lower resolution modes supported by the graphics controller (such as VGA) to the native resolution of the supported display devices (such as SVGA, XGA, SXGA, SXGA+ and UXGA). In addition, many computer users want to display video in a window. To fit within the window, the video source may need to be scaled up or down. The CH7308 has a scaling function for the LVDS output. In addition, customers can program scaler coefficients based on their own discretion.

The guidelines discussed here are intended to enable customers to adjust the scaler coefficients for this product by themselves. Customers are urged to evaluate the performance of the scaling function and find the best suitable coefficients for the system prior to bringing the design to production. The default settings are provided, with which better text display is scaled.

2. Technical Background for Scaling

The simplest form of scaling up is accomplished by pixel duplication where (m) out of every (n) samples are duplicated both horizontally and vertically. However, pixel duplication introduces undesirable visual artifacts and is not generally recommended.

2.1 Bilinear Interpolation

An improvement in video quality of scaled images is possible using linear interpolation. When an output sample falls between two input samples (horizontally or vertically), the output sample is computed by linearly interpolating between the two samples. This is known as bilinear interpolation.

Bilinear interpolation is to calculate the distance-weighted average of the four neighboring pixels linearly:

PO = (1-dy)*[(1-dx)*P + dx*PH] + dy*[(1-dx)*PV + dx*PHV]

PO is the output pixel.

P, PH, PV, PHV are four neighboring pixels of PO.

The distances from P to PH, from P to PV, from PH to PHV, from PV to PHV are normalized to 1. dx, dy are normalized distances, shown in **Figure 1**.

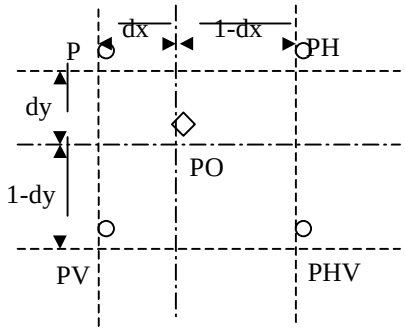

Figure 1: Linear Interpolation Diagram

However, depending on the image content, bilinear interpolation can cause undesirable visual artifacts. For example, graphics images containing text are required to have sharper edges than moving picture images. Bilinear interpolation applies equal edge enhancement to all images regardless of content.

2.2 Programmable Non-linear Interpolation (Patent pending)

The algorithm developed is an interpolation process which allows the user to choose an arbitrary non-linear interpolation function by programming coefficients. This offers the advantage of being able to select the interpolation function for different types of images and so control the degree of sharpness.

Instead of using dx, dy as the weights for P, PH, PV, PHV, two coefficients NVx, NVy are used to replace dx and dy. NVx is a function of dx: NVx = F(dx). NVy is a function of dy: NVy = F(dy). F is programmable. **Figure 2** is an example of the non-linearity. Changing the curve will change F. If NVx = dx and NVy = dy, the type of interpolation becomes bilinear.

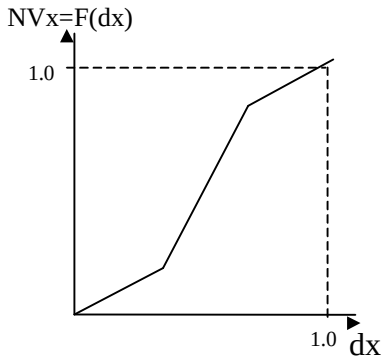

Figure 2: Non-Linear Interpolation dx-NVx Curve

3. Programmable Coefficients Selections

Customers can adjust the coefficients by using the Opcode* 36h with different arguments. There are 5 different interpolation functions available to use. Each function composes of 8 upscaler coefficients. The interpolation function is chosen by setting corresponding arguments for Opcode 36h. It is detailed in the **Table 1** below.

Table 1: Upscaler Interpolation Function Details

Argument Value for Opcode 36h (Decimal)	VAL[0:7]	Corresponding curve
0 <default>	0,0,0,1,4,7,8,8	Nonlinear 1
1	0,1,2,3,4,5,6,7	Linear
2	0,0,0,2,4,6,8,8	Nonlinear 2
3	0,0,0,0,4,8,8,8	Nonlinear 3
4	0,-1,0,2,4,6,8,9	Nonlinear 4

VAL[0:7] represents 8 different upscaler coefficients. If the argument value for Opcode 36h is set to a value greater than 4, the default scaling function (Nonlinear1) will be chosen. The Nonlinear1 (default) scaling function is the function that corresponds to setting the argument value to 0. When the argument of Opcode 36h is set to 1, the upscaling will use linear interpolation and will have a smooth scaling effect. The other 4 interpolation functions are nonlinear interpolation, which gives the edge for sharper text scaling.

Customers can set the desired argument value by using the BMP (Bios Modification Program) utility provided by Intel. Referring to **Figure 3**, the value entered in the "coefficient 0" field of the BMP tool is used to select which interpolation function is to be used. The range of this value is from 0 to 4.

* Intel Proprietary

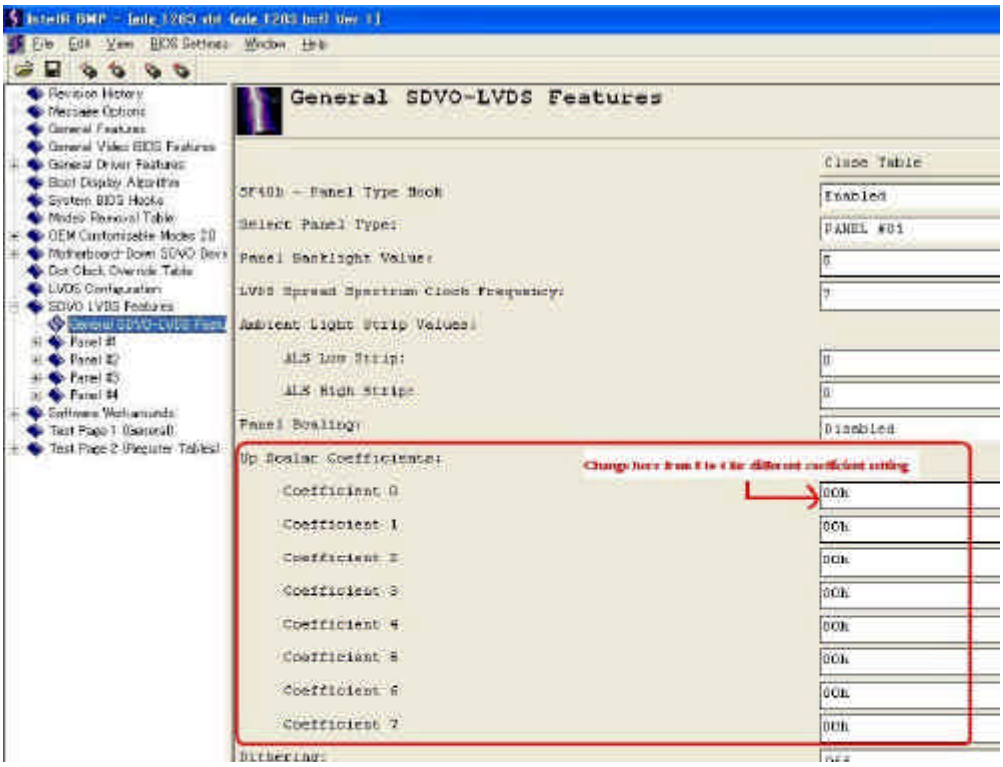

Figure 3: Setting Arguments in BMP

Figure 4 shows the corresponding curves for different interpolation functions.

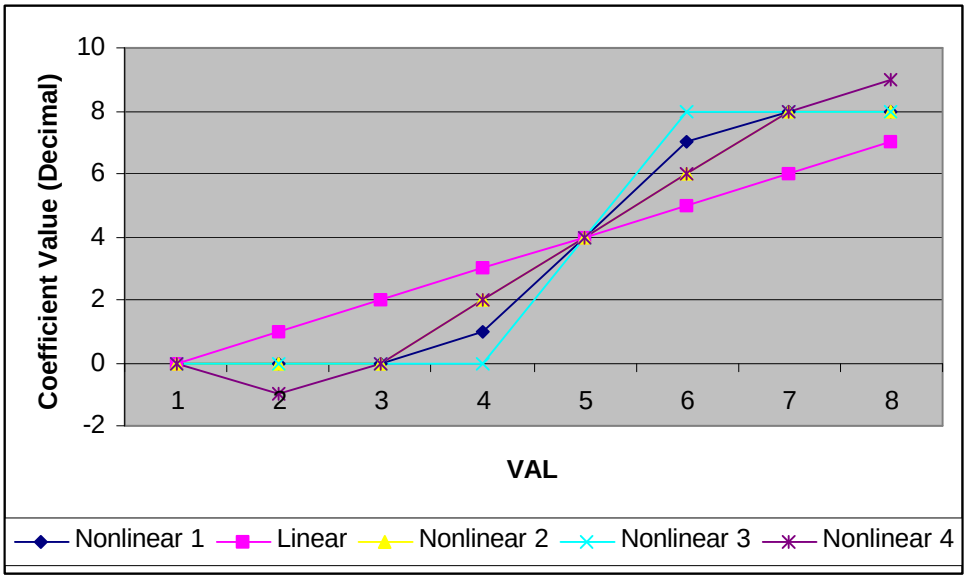

Figure 4: Curves for Different Interpolation Functions

Typically, for images containing text, nonlinear interpolation functions should be used. It is because text display usually requires a sharper display. And for motion pictures or still images, using the linear interpolation function will produce better results.

Selecting which interpolation function to use depends on the customers' preference in terms of the display considerations. The CH7308 gives customers options to select which interpolation function fits their application the closest and gives the best overall performance.

4. Revision History

Revision	Date	Section	Description
1.0	4/1/05	All	First Revision.
1.1	2/7/06	All	Generalized the document to refer to both the CH7308A and the CH7308B

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