Intel® HD Graphics OpenSource PRM

Volume 3 Part 2: Display Registers

For the all new 2010 Intel Core Processor Family Programmer's Reference Manual (PRM)

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Contents

Display Registers [DevILK]

1.1 Introduction and Register Summary

This chapter contains the register descriptions for the display portion of a family of integrated graphics devices. These registers do vary by devices within the family of devices so special attention needs to be paid to which devices use which registers and register fields.

Different devices within the family may add, modify, or delete registers or register fields relative to another device in the same family based on the supported functions of that device. Additional information on the use and programming of these registers can be found in the display chapter.

The following table contains the sections break down where the register information is contained within this chapter:

Address Range	Description
40000h-4FFFFh	Shared Functions
50000h-5FFFFh	Messages
60000h–6FFFFh	Pipe and Port Controls
70000h–7FFFFh	Plane Controls

1.1.1 Terminology

Description	Software Use	Should be implemented as
Read/Write	This bit can be read or written.	
Reserved:	Don't assume a value for these bits. Writes have no effect.	Writes are ignored. Reads return zero.
Reserved: write as zero, must be zero, or MBZ	Software must always write a zero to these bits. This allows new features to be added using these bits that will be disabled when using old software and as the default case.	Writes are ignored. Reads return zero. Maybe be connected as Read/Write in future projects.
Reserved: software must preserve contents	Software must write the original value back to this bit. This allows new features to be added using these bits.	Read only Read/Write.
Read Only	This bit is read only. The read value is determined by hardware. Writes to this bit have no effect.	According to each specific bit. The bit value is determined by hardware and not affected by register writes to the actual bit.
Read/Clear	This bit can be read. Writes to it with a one cause the bit to clear.	Hardware events cause the bit to be set and the bit will be cleared on a write operation where the corresponding bit has a one for a value.
Double Buffered	Write when desired. Read gives the unbuffered value (written value) unless specified otherwise. Written values will update to take effect after a certain point. Some have a specific arming sequence where a write to another register is required before the update can take place. This is used to ensure atomic updates of several registers.	Two stages of registers used. First stage is written into and used for readback (unless specified otherwise). First stage value is transferred into second stage at the update point. Second stage value is used to control hardware. Arm/disarm flag needed for specific arming sequences.

1.1.2 Register Protection for Panel Protection

TBD

1.1.3 Display Mode Set Sequence

Enable sequence
[ILK]: CPU PLL warmup = 20uS [ILK]: CPU FDI transmitter PLL warmup = 10us [ILK]: DMI latency = 20uS FDI training pattern 1 time = 0.5uS FDI training pattern 2 time = 1.5uS FDI idle pattern time = 31uS
Enable sequence

Enable panel power as needed to retrieve panel configuration

1. Enable PCH clock reference source and PCH SSC modulator, wait for warmup (Can be done anytime before enabling port)
2. If enabling port on PCH: (Must be done before enabling CPU pipe or FDI)
    a. Enable PCH FDI Receiver PLL, wait for warmup plus DMI latency
    b. Switch from Rawclk to PCDclk in FDI Receiver (FDI A OR FDI B)
    c. [ILK] CPU FDI PLL is always on and does not need to be enabled
3. Enable CPU panel fitter if needed for hires, required for VGA (Can be done anytime before enabling CPU pipe)
4. Configure CPU pipe timings, M/N/TU, and other pipe settings (Can be done anytime before enabling CPU pipe)
5. Enable CPU pipe
6. Configure and enable CPU planes (VGA or hires)
7. If enabling port on PCH:
    a. Train FDI
        i. Set pre-emphasis and voltage (iterate if training steps fail)
        ii. Enable CPU FDI Transmitter and PCH FDI Receiver with Training Pattern 1 enabled.
        iii. Wait for FDI training pattern 1 time
        iv. Read PCH FDI Receiver ISR
        v. Enable training pattern 2 on CPU FDI Transmitter and PCH FDI Receiver
        vi. Wait for FDI training pattern 2 time
        vii. Read PCH FDI Receiver ISR
        viii. Enable normal pixel output on CPU FDI Transmitter and PCH FDI Receiver
        ix. Wait for FDI idle pattern time for link to become active
    b. Configure and enable PCH DPLL, wait for PCH DPLL warmup (Can be done anytime before enabling PCH transcoder)
    c. Configure PCH transcoder timings, M/N/TU, and other transcoder settings (should match CPU settings).
    d. Enable PCH transcoder
8. Enable ports
9. Enable panel power through panel power sequencing
10. Wait for panel power sequencing to reach enabled steady state
11. Disable panel power override
12. Enable panel backlight

Disable sequence
1. Disable Panel backlight 2. Disable panel power through panel power sequencing 3. Disable CPU planes (VGA or hires) 4. [ILK] Disable CPU panel fitter 5. Disable CPU pipe 6. Wait for CPU pipe off status (CPU pipe config register pipe state) 7. [ILK] Disable CPU panel fitter (Can be done anytime after CPU pipe is off) 8. Else disabling port on PCH: a. Disable CPU FDI Transmitter and PCH FDI Receiver b. Disable port c. Disable PCH transcoder d. Wait for PCH transcoder off status (PCH transcoder config register transcoder state) e. Disable PCH DPLL (Can be done anytime after PCH ports and transcoder are off) f. If no other PCH transcoder is enabled i. Switch from PCDclk to Rawclk in PCH FDI Receiver ii. Disable PCH FDI Receiver PLL 9. If SSC is no longer needed, disable PCH SSC modulator 10. If clock reference no longer needed, disable PCH clock reference source

2. North Shared Functions (40000h–4FFFFh)

2.1 VGA Control Registers

2.1.1 VGACNTRL—VGA Display Plane Control Register

VGACNTRL—VGA Display Plane Control Register	
Register Type:	MMIO
Address Offset:	41000h
Project:	All
Default Value:	00002900h
Access:	R/W
Size (in bits):	32

Bit	Description
31	**VGA_Display_Disable** Project: All Default Value: 0b VGA Display Enabled This bit will disable the VGA compatible display mode. It has no effect on VGA register or A0000-BFFFF memory aperture accesses which are controlled by the PCI configuration and VGA register settings. VGA display should only be enabled if all display planes other than VGA are disabled. After enabling the VGA, most display planes need to stay disabled, only the VGA popup (cursor A) can be enabled.
30	**Reserved** Project: All Format: PBC

Value	Name	Description	Project
0b	Enable	VGA Display Enabled	All
1b	Disable	VGA Display Disabled	All

VGACNTRL—VGA Display Plane Control Register

29 **VGA_Pipe_Select**

Project: All

Default Value: 0b

For dual pipe devices, this bit determines which pipe is to receive the VGA display data. This must be changed only when the VGA display is in the disabled state via the VGA display disable bit or during the write to enable VGA display.

Value	Name	Description	Project
0b	PipeA	Selects Assigns the VGA display to Pipe A	All
1b	PipeB	Selects Assigns the VGA display to Pipe B	All

28:27 **Reserved** Project: All Format: PBC

26 **VGA_Border_Enable**

Project: All

Default Value: 0b

This bit determines if the VGA border areas are included in the active display area and do or do not appear on the port output.

The border if enabled will be scaled along with the pixel data. Setting this bit allows the popup to be positioned overlapping the border area of the image.

Value	Name	Description	Project
0b	Disable	VGA Border areas are not included in the image size calculations for active area.	All
1b	Enable	VGA Border areas are enabled and passed to the display pipe for display and used in the image size calculations.	All

25 **Reserved** Project: All Format: PBC

24 **Pipe_Color_Space_Conversion_Enable**

Project: All

Default Value: 0b

This bit enables pipe color space conversion for the VGA pixel data. CSC mode in the pipe CSC registers must be set to match the format of the VGA pixel data.

Value	Name	Description	Project
0b	Bypass	VGA pixel data bypasses the pipe color space conversion logic	All
1b	Pass	VGA pixel data passes through the pipe color space conversion logic	All

VGACNTRL—VGA Display Plane Control Register

23 **VGA_Palette_Read_Select**

Project: All

Default Value: 0b

This bit only applies to dual display pipe devices and determines which palette VGA palette read accesses will occur from.

VGA palette reads are reads from I/O address 0x3c9.

Value	Name	Description	Project
0b	Palette A	VGA palette reads will access Palette A	All
1b	Palette B	VGA palette reads will access Palette B	All

22 **VGA_Palette_A_Write_Disable**

Project: All

Default Value: 0b

This determines which palette the VGA palette writes will have as a destination. One or both palettes can be the destination. If both are disabled, writes will not affect the palette contents.

VGA palette writes are writes to I/O address 0x3C9h.

Value	Name	Description	Project
0b	Update Palette A	VGA palette writes will update Palette A	All
1b	Not Update Palette A	VGA palette writes will not update Palette A	All

21 **VGA_Palette_B_Write_Disable**

Project: All

Default Value: 0b

This determines which palette the VGA palette writes will have as a destination. One or both palettes can be the destination. If both are disabled, writes will not affect the palette contents.

VGA palette writes are writes to I/O address 0x3C9h.

Value	Name	Description	Project
0b	Update Palette B	VGA palette writes will update Palette B	All
1b	Not Update Palette B	VGA palette writes will not update Palette B	All

20 **Legacy_VGA_8-Bit_Palette_Enable**

Project: All

Default Value: 0b

This bit only affects reads and writes to the palette through VGA I/O addresses. In the 6-bit mode, the 8-bits of data are shifted up two bits on the write (upper two bits are lost) and shifted two bits down on the read. It provides backward compatibility for original VGA programs (in it's default state) as well as VESA VBE support for 8-bit palette. It does not affect palette accesses through the palette register MMIO path.

Value	Name	Description	Project
0b	6 bit DAC	6-bit DAC	All
1b	8 bit DAC	8-bit DAC	All

VGACNTRL—VGA Display Plane Control Register

19	**Reserved**
18	**Reserved**
17:16	**Reserved** Project: All Format: PBC
15:12	**Reserved**
11:8	**Reserved**
7:6	**Blink_Duty_Cycle** Project: All Default Value: 00b Controls the VGA text mode blink duty cycle relative to the VGA cursor blink duty cycle.
5:0	**VSYNC_Blink_Rate** Project: All Controls the VGA blink rate in terms of the number of VSYNCs per on/off cycle. These bits are programmed with the (VSYNCs/cycle)/2-1. The proper programming of this register is determined by the VSYNC rate that the display requires when in a VGA display mode.

Value	Name	Description	Project
00b	100%	100% Duty Cycle, Full Cursor Rate	All
01b	25%	25% Duty Cycle, ½ Cursor Rate	All
10b	50%	50% Duty Cycle, ½ Cursor Rate	All
11b	75%	75% Duty Cycle, ½ Cursor Rate	All

2.2 Sine ROM Registers

2.2.1 SINE_ROM—Sine ROM

SINE_ROM—Sine ROM

Register Type:	MMIO
Address Offset:	42200h
Project:	All
Default Value:	00000000h
Access:	R/W Special
Size (in bits):	32

This register can be used to calculate a sine (or cosine). The intent is to enable calculation of filter coefficients.

The angle is written to bits [16:6] as a 11 bit fixed point 0.11 value (example for setting different degrees below). Then the sine is read from bits [16:6] as a 11 bit fixed point, 1.10 value.

Bit	Description
31:17	**Reserved** Project: All Format:
16:6	**Sine** Project: All Default Value: 0b Write the angle, read the sine **Programming Notes** Examples of values to write: 00000000000b = 0 or 360 degrees 01000000000b = 90 degrees 10000000000b = 180 degrees 11000000000b = 270 degrees
5:0	**Reserved** Project: All Format:

2.3 Power Measurement Registers

These registers are read by the PMU to get information for use in device power estimation.

2.3.1 DE_POWER1 – Display Engine Power Register 1

DE_POWER1 – Display Engine Power Register 1

Register Type:	43208hMMIO
Project:Address Offset:	All42400h
Default Value:Project:	00000000hDevSNB
Access:Default Value:	R/W00000000h
Size (in bits):Access:	32Read Only

The contents of this register can not be changed, except bit 31, while compression is enabled

Size (in bits): 32

Bit	Description
31:8	**Reserved** Project: All Format: MBZ **Enable_Frame_Buffer_Compression** Project: All Default Value: 0b This bit is used to globally enable DPFC function at the next Vertical Blank start.
307:4	**Plane_SelectTransmit_Lanes_Enabled** Project: All Range 0..12 The total number of eDP & FDI lanes enabled. Default Value: 0b

Value	Name	Description	Project
0b	Disable	Disable frame buffer compression	All
1b	Enable	Enable frame buffer compression	All

Value	Name	Description	Project
0b	Plane A	Plane A	All
1b	Plane B	Plane B	All

DE_POWER1 – Display Engine Power Register 1

293:2

CPU_Fence_EnableEnabled_Panel_Fitters

Project: DevILKAll

Range 0..2

Each enabled panel fitter consumes an additional xx mW of power.

Default Value: 0b

Value	Name	Description	Project
0b	No CPU Disp Buf	Display Buffer is not in a CPU fence. No modifications are allowed from CPU to the Display Buffer	All
1b	CPU Disp Buf	Display Buffer exists in a CPU fence	All

291:0

Enabled_DPLLs

Project: All

Range 0..2

Each DPLL enabled consumes xx mW of power.

Reserved

28

Reserved Project: All Format: MBZ

27

CS_SYNC_FLIP_NUKE_Disable

Project: All

Default Value: 0b

Setting this bit will disable the command streamer SYNC Flips from resetting the DPFC.

Value	Name	Description	Project
0b	Enable	Enable the CS SYNC Flip Nuke	All
1b	Disable	Disable the CS SYNC Flip Nuke	All

26

MMIO_SYNC_FLIP_Nuke_Disable

Project: All

Default Value: 0b

Setting this bit will disable the MMIO Sync Flip from resetting the DPFC.

Value	Name	Description	Project
0b	Enable	Enable the MMIO Sync Flip Nuke	All
1b	Disable	Disable the MMIO Sync Flip Nuke	All

25

Persistent_Mode

Project: All

Default Value: 0b

Value	Name	Description	Project
0b	Non Persistent	Non Persistent Mode	All
1b	Persistent	Persistent Mode. Enable the invalid modify qualify from CS	All

DE_POWER1 – Display Engine Power Register 1

24:16	**Reserved**
15	**Reserved**
14:8	**Reserved** Project: All Format: MBZ
7:6	**Compression_Limit** Project: All Default Value: 0b This register sets a minimum limit on compression. It is also used to determine the size of the compressed buffer.

Compression Ratio	Pixel Format	
	16 bpp	32 bpp
1	Not Supported	Supported (CFB=FB)
½	Supported (CFB=FB)	Supported (CFB=1/2 FB)
¼	Supported (CFB=1/2FB)	Supported (CFB=1/4 FB)

FB = Frame Buffer Size

CFB = Compressed Frame Buffer Size

Value	Name	Description	Project
00b	1:1	1:1 compression, compressed buffer is the same size as the uncompressed buffer	All
01b	2:1	2:1 compression, compressed buffer is one half the size of the uncompressed buffer.	All
10b	4:1	4:1 compression, compressed buffer is one quarter the size of the uncompressed buffer.	All
11b	Reserved	Reserved	All

5:4	**Write_Back_Watermark** Project: All Default Value: 0b Compressed data write back engine waits for this amount of data (per segment) to be ready before writing the data out to memory. Compression SR mode must be a 1, or SR disabled for this to take effect.

Value	Name	Description	Project
00b	4 cache lines	4 cache lines	All
01b	8 cache lines	8 cache lines	All
1Xb	Reserved	Reserved	All

DE_POWER1 – Display Engine Power Register 1	
3:0	**CPU_Fence_Number** Project: DevILK Default Value: 0b This field specifies the CPU visible FENCE number corresponding to the placement of the uncompressed frame buffer
3:0	**Reserved**

2.3.2 DE_POWER2 – Display Engine Power Register 2

DE_POWER2 – Display Engine Power Register 2	
Register Type:	MMIO
Address Offset:	42404h
Project:	DevSNB
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32
Bit	**Description**
31:0	**DE_bandwidth_counter** Project: All This counter increments on every cache line put arriving at the DE. The bandwidth is estimated by taking the difference between two reads at a known interval. The counter is only reset at boot time.

2.4 DPFC Control Registers (43200h–433FFh)

2.4.1 DPFC_CB_BASE – DPFC Compressed Buffer Base Address

DPFC_CB_BASE – DPFC Compressed Buffer Base Address					
Register Type:	MMIO				
Address Offset:	43200h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
The contents of this register can not be changed while compression is enabled.					
Bit	**Description**				
31:28	**Reserved**	Project:	All	Format:	MBZ
27:12	**Compressed_Frame_Buffer_Offset_Address** This register specifies offset of the Compressed Frame Buffer from the base of stolen memory. The buffer must be 4K byte aligned.			Project:	All
11:0	**Reserved**	Project:	All	Format:	MBZ

2.4.2 DPFC_CONTROL— DPFC Control

DPFC_CONTROL— DPFC Control	
Register Type:	MMIO
Address Offset:	43208h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
The contents of this register can not be changed, except bit 31, while compression is enabled	

DPFC_CONTROL— DPFC Control

<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>31</td><td>
Enable_Frame_Buffer_Compression
Project: All
Default Value: 0b
This bit is used to globally enable DPFC function at the next Vertical Blank start.
[ILK, Workaround to allow CxSR after Frame Buffer Compression is disabled:

Prerequisite: Frame buffer compression and display pipe enabled
Enable primary plane on the selected pipe if it is not already enabled
Program Pipe Main Watermark for the selected pipe (WM0_PIPE_A or WM0_Pipe_B) to all 0s
Wait for vertical blank on the selected pipe
Disable frame buffer compression
Restore Pipe Main Watermark
Wait for vertical blank on the selected pipe
Restore primary plane

<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>0b</td><td>Disable</td><td>Disable frame buffer compression</td><td>All</td></tr>
<tr><td>1b</td><td>Enable</td><td>Enable frame buffer compression</td><td>All</td></tr>
</table>
</td></tr>
<tr><td>30</td><td>
Plane_Select
Project: All
Default Value: 0b
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>0b</td><td>Plane A</td><td>Plane A</td><td>All</td></tr>
<tr><td>1b</td><td>Plane B</td><td>Plane B</td><td>All</td></tr>
</table>
</td></tr>
<tr><td>29</td><td>
CPU_Fence_Enable
Project: All
Default Value: 0b
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>0b</td><td>No CPU Disp Buf</td><td>Display Buffer is not in a CPU fence. No modifications are allowed from CPU to the Display Buffer</td><td>All</td></tr>
<tr><td>1b</td><td>CPU Disp Buf</td><td>Display Buffer exists in a CPU fence</td><td>All</td></tr>
</table>
</td></tr>
<tr><td>28</td><td>Reserved Project: All Format: MBZ</td></tr>
</table>

DPFC_CONTROL— DPFC Control

27

CS_SYNC_FLIP_NUKE_Disable

Project: All

Default Value: 0b

Setting this bit will disable the command streamer SYNC Flips from resetting the DPFC.

Value	Name	Description	Project
0b	Enable	Enable the CS SYNC Flip Nuke	All
1b	Disable	Disable the CS SYNC Flip Nuke	All

26

MMIO_SYNC_FLIP_Nuke_Disable

Project: All

Default Value: 0b

Setting this bit will disable the MMIO Sync Flip from resetting the DPFC.

Value	Name	Description	Project
0b	Enable	Enable the MMIO Sync Flip Nuke	All
1b	Disable	Disable the MMIO Sync Flip Nuke	All

25

Persistent_Mode

Project: All

Default Value: 0b

Value	Name	Description	Project
0b	Non Persistent	Non Persistent Mode	All
1b	Persistent	Persistent Mode. Enable the invalid modify qualify from CS	All

DPFC_CONTROL— DPFC Control

24:16

Compression_Control(testmode)

Project: All

Security: Test

Default Value: 0b

Setting the bits in this register disables certain compression capabilities.

Value	Name	Description	Project
1XXXXXXXXb	Disable	Run length without 1 nibble ([ILK] this setting is not allowed)	All
0XXXXXXXXb	Enable	Run length with 1 nibble	All
X1XXXXXXXb	Disable	Run length without 2 nibble ILK] this setting is not allowed)	All
X0XXXXXXXb	Enable	Run length with 2 nibble	All
XX1XXXXXXb	Disable	Mono Palette Disabled	All
XX0XXXXXXb	Enable	Mono Palette Enabled	All
XXX1XXXXXb	Disable	Historical Palette Disabled	All
XXX0XXXXXb	Enable	Historical Palette Enabled	All
XXXX1XXXXb	Disable	Delta 6 Disabled	All
XXXX0XXXXb	Enable	Delta 6 Enabled	All
XXXXX1XXXb	Disable	Delta 5 Disabled	All
XXXXX0XXXb	Enable	Delta 5 Enabled	All
XXXXXX1XXb	Disable	Delta 4 Disabled	All
XXXXXX0XXb	Enable	Delta 4 Enabled	All
XXXXXXX1Xb	Disable	Delta 3 Disabled	All
XXXXXXX0Xb	Enable	Delta 3 Enabled	All
XXXXXXXX1b	Disable	Delta 2 Disabled	All
XXXXXXXX0b	Enable	Delta 2 Enabled	All

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SLB_Initialization_Flush_Disable_Control(testmode)

Project: All

Security: Test

Default Value: 0b

Setting this bit will disable the SLB flush mechanism for the first frame DPFC is on.

Value	Name	Description	Project
0b	Enable	Enable the SLB initialization flush	All
1b	Disable	Disable SLB initialization flush	All

14:8 **Reserved** Project: All Format: MBZ

DPFC_CONTROL— DPFC Control

7:6 **Compression_Limit**

Project: All

Default Value: 0b

This register sets a minimum limit on compression. It is also used to determine the size of the compressed buffer.

Compression Ratio	Pixel Format	
	16 bpp	32 bpp
1	Not Supported	Supported (CFB=FB)
½	Supported (CFB=FB)	Supported (CFB=1/2 FB)
¼	Supported (CFB=1/2FB)	Supported (CFB=1/4 FB)

FB = Frame Buffer Size

CFB = Compressed Frame Buffer Size

Value	Name	Description	Project
00b	1:1	1:1 compression, compressed buffer is the same size as the uncompressed buffer	All
01b	2:1	2:1 compression, compressed buffer is one half the size of the uncompressed buffer.	All
10b	4:1	4:1 compression, compressed buffer is one quarter the size of the uncompressed buffer.	All
11b	Reserved	Reserved	All

5:4 **Write_Back_Watermark**

Project: All

Default Value: 0b

Compressed data write back engine waits for this amount of data (per segment) to be ready before writing the data out to memory. Compression SR mode must be a 1, or SR disabled for this to take effect.

Value	Name	Description	Project
00b	4 cache lines	4 cache lines	All
01b	8 cache lines	8 cache lines	All
1Xb	Reserved	Reserved	All

3:0 **CPU_Fence_Number**

Project: All

Default Value: 0b

This field specifies the CPU visible FENCE number corresponding to the placement of the uncompressed frame buffer.[

2.4.3 DPFC_RECOMP_CTL — DPFC ReComp Control

DPFC_RECOMP_CTL — DPFC ReComp Control

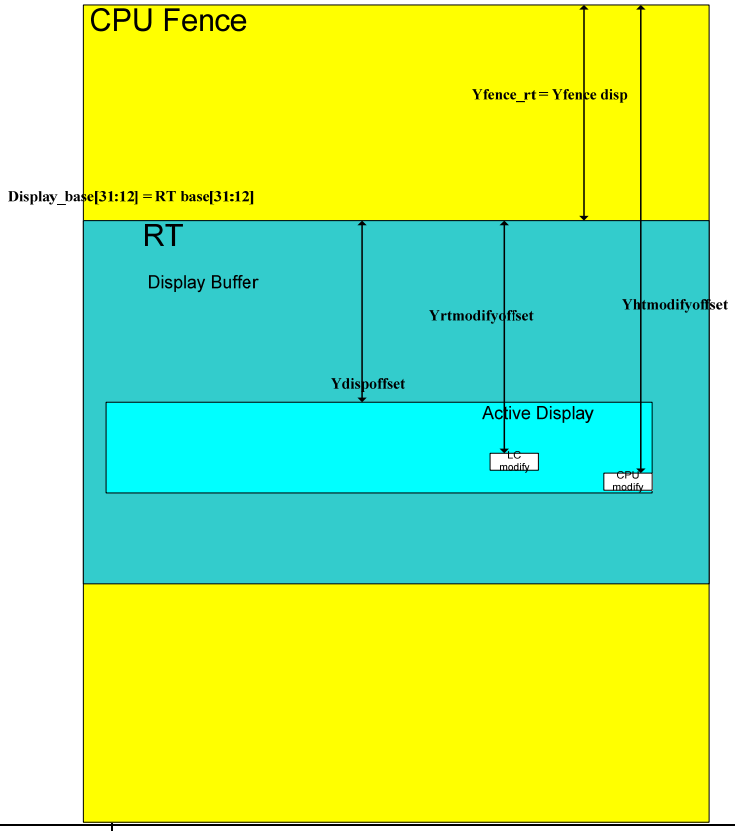
Register Type: MMIO
Address Offset: 4320Ch
Project: All
Default Value: 00000000h
Access: R/W
Size (in bits): 32

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27	**Enable_ReComp_Stall** Project: All Default Value: 0b **Value** / **Name** / **Description** / **Project** 0b / Disable / Disable / All 1b / Enable / Enable / All
26:16	**ReComp_Stall_Invalidation_Watermark** Project: All If this many or more invalidations occur in one frame, stop compression until the number falls below watermark, then start the recomp timer.
15:6	**Reserved** Project: All Format: MBZ
5:0	**ReCompression_Timer_Count** Project: All After invalidations fall below watermark, wait this many frames before restarting the compressor. A 0 means restart compression on the following frame.

2.4.4 DPFC_CPU_Fence_Offset — Y Offset CPU Fence Base to Display Buffer Base

DPFC_CPU_Fence_Offset — Y Offset CPU Fence Base to Display Buffer Base	
Register Type:	MMIO
Address Offset:	43218h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

The contents of this register can not be changed while compression is enabled.



Bit	Description
31:22	**Reserved** Project: All Format: MBZ
21:0	**Yfence_disp** Project: All Y offset from the CPU fence to the Display Buffer base. [DevSNB] The CPU fence is always programmed to match the Display Buffer base, so this offset must be programmed to 0 to match.

2.5 Interrupt Control Registers

2.5.1 Display Engine Interrupt Registers Bit Definition

Display Engine Interrupt Registers Bit Definition	
Project:	All
Size (in bits):	32
Display Engine (DE) interrupt bits come from events within the display engine, except for some which explicitly list a non-display engine source. The DEIIR and GTIIR and PMIIR are ORed together to generate the CPU interrupt. The Display Engine Interrupt Control Registers all share the same bit definitions from this table.	
Bit	**Description**
31	**Master_Interrupt_Control** Project: All Format: This bit exists only in the DEIER Display Engine Interrupt Enable Register. This is the master control for the Display to CPU interrupt. This bit must be set to 1 for any interrupts to propagate to the system.
30	**Reserved** Project: All Format:
29	**Sprite_Plane_B_flip_done** Project: All Format: This is an active high pulse when a sprite plane B flip is done.
28	**Sprite_Plane_A_flip_done** Project: All Format: This is an active high pulse when a sprite plane A flip is done.
27	**Primary_Plane_B_flip_done** Project: All Format: This is an active high pulse when a primary plane B flip is done.
26	**Primary_Plane_A_flip_done** Project: All Format: This is an active high pulse when a primary plane A flip is done.
25	**PCU_event [DevILK]:** Project: DevILK Format: This is an active high pulse when a thermal or render geyserville event has occured. Interrupt source and status should be checked in RGVINTRSTS (MCHBAR+1184h) and TIS1 (MCHBAR+101Eh). This event comes display directly on a wire.
25	**Reserved** Project: **DevSNB** Format:
24	**GTT_fault** Project: All Format: This is an active high level while either of the GTT Fault Status register bits are set.
23	**Poison** Project: All Format: This is an active high pulse on receiving the poison message.
22	**Performance_counter** Project: All Format: This is an active high pulse when the performance counter reaches the threshold value programmed in the Performance Counter Source register.

Display Engine Interrupt Registers Bit Definition	
21	**PCH_Display_interrupt_event** Project: All Format: This is an active high level while there is an interrupt being generated by the PCH Display. It will stay asserted until the interrupts in the PCH Display are all cleared. Only the rising edge of the PCH Display interrupt will cause the IIR to be set here, so all PCH Display Interrupts, including back to back interrupts, must be cleared before a new PCH Display Interrupt can cause the IIR to be set here.
20	**AUX_Channel_A** Project: All Format: This is an active high pulse on the AUX A done event.
18	**GSE** Project: DevSNB Format: This is an active high pulse on the GSE system level event.
17	**DPST_histogram_event** Project: All Format: This is an active high pulse on the DPST histogram event.
16	**DPST_phase_in_event** Project: All Format: This is an active high pulse on the DPST phase in event.
15	**Pipe_B_vblank** Project: All Format: This is an active high level for the duration of the Pipe B vertical blank.
14	**Pipe_B_even_field** Project: All Format: This is an active high level for the duration of the Pipe B interlaced even field.
13	**Pipe_B_odd_field** Project: All Format: This is an active high level for the duration of the Pipe B interlaced odd field.
12	**Pipe_B_line_compare** Project: All Format: This is an active high level for the duration of the selected Pipe B scan lines.
11	**Pipe_B_vsync** Project: All Format: This is an active high level for the duration of the Pipe B vertical sync.
10	**Pipe_B_CRC_done** Project: All Format: This is an active high pulse on the Pipe B CRC done.
9	**Pipe_B_CRC_error** Project: All Format: This is an active high pulse on the Pipe B CRC error.
8	**Pipe_B_FIFO_underrun** Project: All Format: This is an active high level for the duration of the Pipe B FIFO underrun.
7	**Pipe_A_vblank** Project: All Format: This is an active high level for the duration of the Pipe A vertical blank.
6	**Pipe_A_even_field** Project: All Format: This is an active high level for the duration of the Pipe A interlaced even field.
5	**Pipe_A_odd_field** Project: All Format: This is an active high level for the duration of the Pipe A interlaced odd field.
4	**Pipe_A_line_compare** Project: All Format: This is an active high level for the duration of the selected Pipe A scan lines.

Display Engine Interrupt Registers Bit Definition	
3	**Pipe_A_vsync** Project: All Format: This is an active high level for the duration of the Pipe A vertical sync.
2	**Pipe_A_CRC_done** Project: All Format: This is an active high pulse on the Pipe A CRC done.
1	**Pipe_A_CRC_error** Project: All Format: This is an active high pulse on the Pipe A CRC error.
0	**Pipe_A_FIFO_underrun** Project: All Format: This is an active high level for the duration of the Pipe A FIFO underrun.

2.5.2 DEISR — Display Engine Interrupt Status Register

DEISR — Display Engine Interrupt Status Register

Register Type: MMIO
Address Offset: 44000h
Project: All
Default Value: 00000000h
Access: Read Only
Size (in bits): 32

The ISR register contains the non-persistent value of all interrupt status bits. The IMR register selects which of these interrupt conditions are reported in the persistent IIR (i.e., set bits must be cleared by software). Bits in the IER are used to selectively enable IIR bits to cause CPU interrupts.

Bit	Description
31:0	**Display_Engine_Interrupt_Status_Bits** Project: All Format: Display Engine Interrupt Registers Bit Definition See Description Above This field contains the non-persistent values of all interrupt status bits.

Value	Name	Description	Project
0b	Condition Doesn't exist	Interrupt Condition currently does not exist	All
1b	Condition Exists	Interrupt Condition currently exists	All

Programming Notes
Some inputs to this register are short pulses; therefore software should not expect to use this register to sample these conditions.

2.5.3 DEIMR — Display Engine Interrupt Mask Register

DEIMR — Display Engine Interrupt Mask Register	
Register Type:	MMIO
Address Offset:	44004h
Project:	All
Default Value:	FFFFFFFFh
Access:	R/W
Size (in bits):	32

The IMR register is used by software to control which Interrupt Status Register bits are “masked” or “unmasked”. “Unmasked” bits will be reported in the IIR, possibly triggering a CPU interrupt, and will persist in the IIR until cleared by software. “Masked” bits will not be reported in the IIR and therefore cannot generate CPU interrupts.

Bit	Description
31:0	**Display_Engine_Interrupt_Mask_Bits** Project: All Format: Display Engine Interrupt Registers Bit Definition See Description Above This field contains a bit mask which selects which interrupt bits from the ISR are reported in the IIR.

Value	Name	Description	Project
0b	Not Masked	Not Masked – will be reported in the IIR	All
1b	Masked	Masked – will not be reported in the IIR	All

2.5.4 DEIIR — Display Engine Interrupt Identity Register

DEIIR — Display Engine Interrupt Identity Register	
Register Type:	MMIO
Address Offset:	44008h
Project:	All
Default Value:	00000000h
Access:	R/W Clear
Size (in bits):	32

The IIR register contains the interrupt bits that are “unmasked” by the IMR and thus can generate CPU interrupts (if enabled via the IER). When a CPU interrupt is generated, this should be the first register to be interrogated to determine the source of the interrupt. **Writing a ‘1’ into the appropriate bit position within this register clears interrupts.**

Bit	Description
31:0	**Display_Engine_Interrupt_Identity_Bits** Project: All Format: Display Engine Interrupt Registers Bit Definition See Description Above This field holds the persistent values of the interrupt bits from the ISR which are “unmasked” by the IMR. If enabled by the IER, bits set in this register will generate a CPU interrupt. Bits set in this register will remain set (persist) until the interrupt condition is “cleared” via software by writing a ‘1’ to the appropriate bit(s) For each bit, the IIR can store a second pending interrupt if two or more of the same interrupt

Value	Name	Description	Project
0b	Condition Not Detected	Interrupt Condition Not Detected	All
1b	Condition Detected	Interrupt Condition Detected (may or may not have actually generated a CPU interrupt)	All

2.5.5 DEIER — Display Engine Interrupt Enable Register

DEIER — Display Engine Interrupt Enable Register	
Register Type:	MMIO
Address Offset:	4400Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

The IER register contains an interrupt enable bit for each interrupt bit in the IIR register. A disabled interrupt will still appear in the Interrupt Identity Register to allow polling of interrupt sources.

Bit	Description
31:0	**Display_Engine_Interrupt_Enable_Bits** Project: All Format: Display Engine Interrupt Registers Bit Definition See Description Above The bits in this register enable a CPU interrupt to be generated whenever the corresponding bit in the Interrupt Identity Register becomes set. The DEIER master interrupt control bit must be set to 1 for any interrupts to propagate to the system.

Value	Name	Description	Project
0b	Disable	Disable	All
1b	Enable	Enable	All

2.5.6 GT Interrupt Registers Bit Definition

GT Interrupt Registers Bit Definition	
Project:	All
Size (in bits):	32
GT interrupt bits come to display either directly on wires [DevILK] or through interrupt message 0x50200 [DevSNB]. . The DEIIR and GTIIR and PMIIR are ORed together to generate the CPU interrupt. The GT Interrupt Control Registers all share the same bit definition from this table.	
Bit	**Description**
31:10	**Reserved** Project: DevILK Format:
9	**Bit_Stream_Pipeline_Counter_Exceeded_Notify_Interrupt** Project: DevILK The counter threshold for the execution of the Bit Stream Pipeline is exceeded. Driver needs to attempt hang recovery.
7	**Page_Fault** Project: DevILK This bit is set whenever there is a pending PPGTT (page or directory) fault.
6	**Media_Decode_Pipeline_Counter_Exceeded_Notify_Interrupt** Project: DevILK The counter threshold for the execution of the media pipeline is exceeded. Driver needs to attempt hang recovery.
5	**Video_Decode_Command_Parser_User_Interrupt** Project: DevILK This status bit is set when an MI_USER_INTERRUPT instruction is executed on the Media Decode Command Parser. Note that instruction execution is not halted and proceeds normally. A mechanism such as an MI_STORE_DATA instruction is required to associate a particular meaning to a user interrupt.
4	**PIPE_CONTROL_Notify_Interrupt** Project: DevILK The Pipe Control packet (Fences) specified in *3D pipeline* document may optionally generate an Interrupt. The Store QW associated with a fence is completed ahead of the MSI. This ordering is not guaranteed if PCI Line Intr# mechanism is used.

GT Interrupt Registers Bit Definition	
3	**Render_Command_Parser_Master_Error** Project: DevILK When this status bit is set, it indicates that the hardware has detected an error. It is set by the device upon an error condition and cleared by a CPU write of a one to the appropriate bit contained in the Error ID register followed by a write of a one to this bit in the IIR. Further information on the source of the error comes from the "Error Status Register" which along with the "Error Mask Register" determine which error conditions will cause the error status bit to be set and the interrupt to occur. **Page Table Error:** Indicates a page table error. **Instruction Parser Error**: The Renderer Instruction Parser encounters an error while parsing an instruction.
2	**Sync_Status** Project: DevILK This bit is toggled when the Instruction Parser completes a flush with the sync enable bit active in the INSTPM register. The toggle event will happen after all the graphics engines are flushed. The HW Status DWord write resulting from this toggle will cause the CPU's view of graphics memory to be coherent as well (flush and invalidate the render cache).
0	**Render_Command_Parser_User_Interrupt** Project: DevILK This status bit is set when an MI_USER_INTERRUPT instruction is executed on the Render Command Parser. Note that instruction execution is not halted and proceeds normally. A mechanism such as an MI_STORE_DATA instruction is required to associate a particular meaning to a user interrupt.
31:0	**Reserved**
31	**Reserved** Project: DevSNB Format:
29	**Blitter_page_directory_faults** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit29
28:27	**Reserved** Project: DevSNB Format:
26	**Blitter_MI_FLUSH_DW_notify** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit26
25	**Blitter_Command_Streamer_error_interrupt** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit25
24	**Billter_MMIO_sync_flush_status** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit24
23	**Reserved** Project: DevSNB Format:
22	**Blitter_Command_Streamer_MI_USER_INTERRUPT** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit22

GT Interrupt Registers Bit Definition					
21	**Reserved**	Project:	DevSNB	Format:	
19	**Video_page_directory_faults** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit19				
18	**Video_Command_Streamer_Watchdog_counter_exceeded** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit18				
17	**Reserved**	Project:	DevSNB	Format:	MBZ
16	**Video_MI_FLUSH_DW_notify** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit16				
15	**Video_Command_Streamer_error_interrupt** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit15				
14	**Video_MMIO_sync_flush_status** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit14				
13	**Reserved**	Project:	DevSNB	Format:	
12	**Video_Command_Streamer_MI_USER_INTERRUPT** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit12				
11:9	**Reserved**	Project:	DevSNB	Format:	
7	**Render_page_directory_faults** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit7				
6	**Render_Command_Streamer_Watchdog_counter_exceeded** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit6				
5	**Reserved**	Project:	DevSNB	Format:	
4	**Render_PIPE_CONTROL_notify** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit4				
3	**Render_Command_Streamer_error_interrupt** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit3.				
2	**Render_MMIO_sync_flush_status** Project: DevSNB				

GT Interrupt Registers Bit Definition	
	This is a write of logic1 via interrupt message from GT via 0x50200 bit2
0	**Render_Command_Streamer_MI_USER_INTERRUPT** Project: DevSNB This is a write of logic1 via interrupt message from GT via 0x50200 bit0

2.5.7 GTISR — GT Interrupt Status Register

GTISR — GT Interrupt Status Register	
Register Type:	MMIO
Address Offset:	44010h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

The ISR register contains the non-persistent value of all interrupt status bits. The IMR register selects which of these interrupt conditions are reported in the persistent IIR (i.e., set bits must be cleared by software). Bits in the IER are used to selectively enable IIR bits to cause CPU interrupts.

Bit	Description
31:0	**GT_Interrupt_Status_Bits** Project: All Format: GT Interrupt Registers Bit Definition See Description Above This field contains the non-persistent values of all interrupt status bits.

Value	Name	Description	Project
0b	Condition Doesn't Exist	Interrupt Condition currently does not exist	All
1b	Condition Exists	Interrupt Condition currently exists	All

Programming Notes
Some inputs to this register are short pulses; therefore software should not expect to use this register to sample these conditions.

2.5.8 GTIMR — GT Interrupt Mask Register

GTIMR — GT Interrupt Mask Register	
Register Type:	MMIO
Address Offset:	44014h
Project:	All
Default Value:	FFFFFFFFh
Access:	R/W
Size (in bits):	32

The IMR register is used by software to control which Interrupt Status Register bits are "masked" or "unmasked". "Unmasked" bits will be reported in the IIR, possibly triggering a CPU interrupt, and will persist in the IIR until cleared by software. "Masked" bits will not be reported in the IIR and therefore cannot generate CPU interrupts.
For command streamer interrupts DO NOT use this register to mask interrupt events. Instead use the individual command streamer MASK bits.

GTIMR — GT Interrupt Mask Register	
Bit	**Description**
31:0	**GT_Interrupt_Mask_Bits** Project: All Format: GT Interrupt Registers Bit Definition See Description Above This field contains a bit mask which selects which interrupt bits from the ISR are reported in the IIR.

Value	Name	Description	Project
0b	Not Masked	Not Masked – will be reported in the IIR	All
1b	Masked	Masked – will not be reported in the IIR	All

2.5.9 GTIIR — GT Interrupt Identity Register

GTIIR — GT Interrupt Identity Register	
Register Type:	MMIO
Address Offset:	44018h
Project:	All
Default Value:	00000000h
Access:	R/W Clear
Size (in bits):	32

The IIR register contains the interrupt bits that are “unmasked” by the IMR and thus can generate CPU interrupts (if enabled via the IER). When a CPU interrupt is generated, this should be the first register to be interrogated to determine the source of the interrupt. **Writing a ‘1’ into the appropriate bit position within this register clears interrupts.**

Bit	Description
31:0	**GT_Interrupt_Identity_Bits** Project: All Format: GT Interrupt Registers Bit Definition See Description Above This field holds the persistent values of the interrupt bits from the ISR which are “unmasked” by the IMR. If enabled by the IER, bits set in this register will generate a CPU interrupt. Bits set in this register will remain set (persist) until the interrupt condition is “cleared” via software by writing a ‘1’ to the appropriate bit(s).

Value	Name	Description	Project
0b	Condition Not Detected	Interrupt Condition Not Detected	All
1b	Condition Detected	Interrupt Condition Detected (may or may not have actually generated a CPU interrupt)	All

2.5.10 GTIER — GT Interrupt Enable Register

GTIER — GT Interrupt Enable Register	
Register Type:	MMIO
Address Offset:	4401Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

The IER register contains an interrupt enable bit for each interrupt bit in the IIR register. A disabled interrupt will still appear in the Interrupt Identity Register to allow polling of interrupt sources.

Bit	Description
31:0	**GT_Interrupt_Enable_Bits** Project: All Format: GT Interrupt Registers Bit Definition See Description Above The bits in this register enable a CPU interrupt to be generated whenever the corresponding bit in the Interrupt Identity Register becomes set. The DEIER master interrupt control bit must be set to 1 for any interrupts to propagate to the system.

Value	Name	Description	Project
0b	Disable	Disable	All
1b	Enable	Enable	All

2.5.11 Power Management Interrupt Registers Bit Definition [DevSNB]

Power Management Interrupt Registers Bit Definition [DevSNB]	
Project: DevSNB **Size(in bits):** 32	
Power Management interrupt bits come to display through interrupt message 0x50210. The DEIIR and GTIIR and PMIIR are ORed together to generate the CPU interrupt. The Power Management Interrupt Control Registers all share the same bit definition from this table.	
Bit	**Description**
31:26	**Reserved** Project: All Format:
25	**PCU_pcode2driver_mailbox_event** Project: All Format: This is a write of logic1 via interrupt message from PCU via 0x50210 bit25
24	**PCU_Thermal_Event** Project: All Format: This is a write of logic1 via interrupt message from PCU via 0x50210 bit24
23:7	**Reserved** Project: All Format:
6	**Render_Frequency_Downward_Timeout_During_RC6_interrupt** Project: All Format: This is a write of logic1 via interrupt message from GT via 0x50210 bit6
5	**RP_UP_threshold_interrupt** Project: All Format: This is a write of logic1 via interrupt message from GT via 0x50210 bit5
4	**RP_DOWN_threshold_interrupt** Project: All Format: This is a write of logic1 via interrupt message from GT via 0x50210 bit4
3	**Reserved** Project: All Format:
2	**Render_geyserville_UP_evaluation_interval_interrupt** Project: All Format: This is a write of logic1 via interrupt message from GT via 0x50210 bit2
1	**Render_geyserville_Down_evaluation_interval_interrupt** Project: All Format: BitFieldDesc
0	**Reserved** Project: All Format: MBZ

2.5.12 PMISR — PM Interrupt Status Register

PMISR — PM Interrupt Status Register	
Register Type:	MMIO
Address Offset:	44020h
Project:	DevSNB
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

The ISR register contains the non-persistent value of all interrupt status bits. The IMR register selects which of these interrupt conditions are reported in the persistent IIR (i.e., set bits must be cleared by software). Bits in the IER are used to selectively enable IIR bits to cause CPU interrupts.

Bit	Description
31:0	**Power_Management_Interrupt_Status_Bits** Project: All Format: Power Management Interrupt Registers Bit Definition See Description Above This field contains the non-persistent values of all interrupt status bits.

Value	Name	Description	Project
0b	Condition Does Not Exist	Interrupt Condition currently does not exist	All
1b	Condition Exists	Interrupt Condition currently exists	All

Programming Notes
Some inputs to this register are short pulses, therefore software should not expect to use this register to sample these conditions.

2.5.13 PMIMR — Power Management Interrupt Mask Register

PMIMR — Power Management Interrupt Mask Register	
Register Type:	MMIO
Address Offset:	44024h
Project:	DevSNB
Default Value:	FFFFFFFFh
Access:	R/W
Size (in bits):	32

The IMR register is used by software to control which Interrupt Status Register bits are “masked” or “unmasked”. “Unmasked” bits will be reported in the IIR, possibly triggering a CPU interrupt, and will persist in the IIR until cleared by software. “Masked” bits will not be reported in the IIR and therefore cannot generate CPU interrupts.
For power management interrupts DO NOT use this register to mask interrupt events. Instead use the individual power management MASK bits in the corresponding PMunit register space.

PMIMR — Power Management Interrupt Mask Register	
Bit	**Description**
31:0	**Power_Management_Interrupt_Mask_Bits** Project: All Format: Power Management Interrupt Registers Bit Definition See Description Above This field contains a bit mask which selects which interrupt bits from the ISR are reported in the IIR.

Value	Name	Description	Project
0b	Not Masked	Not Masked – will be reported in the IIR	All
1b	Masked	Masked – will not be reported in the IIR	All

2.5.14 PMIIR — Power Management Interrupt Identity Register

PMIIR — Power Management Interrupt Identity Register	
Register Type:	MMIO
Address Offset:	44028h
Project:	DevSNB
Default Value:	00000000h
Access:	R/W Clear
Size (in bits):	32

The IIR register contains the interrupt bits that are “unmasked” by the IMR and thus can generate CPU interrupts (if enabled via the IER). When a CPU interrupt is generated, this should be the first register to be interrogated to determine the source of the interrupt. **Writing a ‘1’ into the appropriate bit position within this register clears interrupts**.

Bit	Description
31:0	**Power_Management_Interrupt_Identity_Bits** Project: All Format: Power Management Interrupt Registers Bit Definition See Description Above This field holds the persistent values of the interrupt bits from the ISR which are “unmasked” by the IMR. If enabled by the IER, bits set in this register will generate a CPU interrupt. Bits set in this register will remain set (persist) until the interrupt condition is “cleared” via software by writing a ‘1’ to the appropriate bit(s). For each bit, the IIR can store a second pending interrupt if two or more of the same interrupt conditions occur before the first condition is cleared. Upon clearing the interrupt, the IIR bit will momentarily go low, then return high to indicate there is another interrupt pending.

Value	Name	Description	Project
0b	IC No Detect	Interrupt Condition Not Detected	All
1b	IC Detect	Interrupt Condition Detected (may or may not have actually generated a CPU interrupt)	All

2.5.15 PMIER — Power Management Interrupt Enable Register

PMIER — Power Management Interrupt Enable Register	
Register Type:	MMIO
Address Offset:	4402Ch
Project:	DevSNB
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

The IER register contains an interrupt enable bit for each interrupt bit in the IIR register. A disabled interrupt will still appear in the Interrupt Identity Register to allow polling of interrupt sources.

Bit	Description
31:0	**Power Management Interrupt Enable Bits** Project: All Format: Power Management Interrupt Registers Bit Definition See Description Above The bits in this register enable a CPU interrupt to be generated whenever the corresponding bit in the Interrupt Identity Register becomes set. The DEIER master interrupt control bit must be set to 1 for any interrupts to propagate to the system.

Value	Name	Description	Project
0b	Disable	Disable	All
1b	Enable	Enable	All

2.5.16 Port Hot Plug Control Register

Digital Port Hot Plug Control Register	
Register Type:	MMIO
Address Offset:	44030h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

Bit	Description
31:5	**Reserved** Project: All Format:

Digital Port Hot Plug Control Register

4

Digital_Port_A_Hot_Plug_Detect_Input_Enable

Project: All

Default Value: 0b

Controls the state of the HPD buffer for the digital port. The buffer state is independent of whether the port is enabled or not.

Value	Name	Description	Project
0b	Disable	Buffer disabled	All
1b	Enable	Buffer enabled. Hot plugs bit reflect the electrical state of the HPD pin	All

3:2

Digital_Port_A_Hot_Plug_Short_Pulse_Duration

Project: All

Default Value: 0b

These bits define the duration of the pulse defined as a short pulse.

Value	Name	Description	Project
00b	2ms	2 ms	All
01b	4.5ms	4.5 ms	All
10b	6ms	6 ms	All
11b	100ms	100 ms	All

1:0

Digital_Port_A_Hot_Plug_Interrupt_Detect_Status

Project: All

Access: R/W Clear

Default Value: 0b

This reflects hot plug detect status on the digital port. This bit is used for either monitor hotplug/unplug or for notification of a sink event. When either a long or short pulse is detected, one of these bits will set. These bits are ORed together to go to the main ISR hotplug register bit. These are sticky bits, cleared by writing 1s to them.

Value	Name	Description	Project
00b	Not Detected	Digital port hot plug event not detected	All
1Xb	Long Pulse	Digital port long pulse hot plug event detected	All
X1b	Short Pulse	Digital port short pulse hot plug event detected	All

2.5.17 GTT Fault Status Register

GTT Fault Status Register

Register Type: MMIO
Address Offset: 44040h
Project: All
Default Value: 00000000h
Access: R/W Clear
Size (in bits): 32

Bit	Description
31:8	**Reserved** Project: All Format:
7	**Invalid_GTT_page_table_entry** Project: All Default Value: 0b This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit. This event comes to display either directly on a wire [ILK] or through message 0x50220 bit 1 [DevSNB].
6	**Invalid_page_table_entry_data** Project: All Default Value: 0b This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit. This event comes to display either directly on a wire or through message 0x50220. This event comes to display either directly on a wire ILK] or through message 0x50220 bit 0 [DevSNB].
5	**Cursor_B_GTT_Fault_Status** Project: All Default Value: 0b This reflects GTT fault status for this plane. This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit.

Bit 7:

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

Bit 6:

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

Bit 5:

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

GTT Fault Status Register

4

Cursor_A_GTT_Fault_Status

Project: All

Default Value: 0b

This reflects GTT fault status for this plane. This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit.

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

3

Sprite_B_GTT_Fault_Status

Project: All

Default Value: 0b

This reflects GTT fault status for this plane. This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit.

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

2

Sprite_A_GTT_Fault_Status

Project: All

Default Value: 0b

This reflects GTT fault status for this plane. This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit.

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

1

Primary_B_GTT_Fault_Status

Project: All

Default Value: 0b

This reflects GTT fault status for this plane. This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit.

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

GTT Fault Status Register	
0	**Primary_A_GTT_Fault_Status** Project: All Default Value: 0b This reflects GTT fault status for this plane. This is a sticky bit, cleared by writing 1 to it. All the GTT Fault Status bits are ORed together to go to the main ISR GTT Fault bit.

Value	Name	Description	Project
0b	Not Detected	Event not detected	All
1b	Detected	Event detected	All

2.6 Display Engine Render Response

2.6.1 Display Engine Render Response Message Bit Definition

Display Engine Render Response Message Bit Definition	
Project: DevSNB **Size(in bits):** 32	
Display Engine (DE) render response message bits come from events within the display engine. The Display Engine Render Response Message Registers all share the same bit definitions from this table.	
Bit	**Description**
31:14	**Reserved** Project: All Format: MBZ
13	**Pipe_B_Start_of_Horizontal_Blank_Event** Project: All Format: This even will be reported on the start of the Pipe B Horizontal Blank.
12	**Reserved** Project: All Format: MBZ
11	**Pipe_B_Start_of_Vertical_Blank_Event** Project: All Format: This even will be reported on the start of the Pipe B Vertical Blank.
10	**Pipe_B_Sprite_Plane_Flip_Done_Event** Project: All Format: This even will be reported on the completion of a flip for the Pipe B Sprite Plane.
9	**Pipe_B_Primary_Plane_Flip_Done_Event** Project: All Format: This even will be reported on the completion of a flip for the Pipe B Primary Plane.
8	**Pipe_B_Scanline_Event** Project: All Format: This even will be reported on the start of the scan line specified in the Pipe B Display Scan Line Count Range Compare Register.
7:6	**Reserved** Project: All Format: MBZ

Display Engine Render Response Message Bit Definition	
5	**Pipe_A_Start_of_Horizontal_Blank_Event** Project: All Format: This even will be reported on the start of the Pipe A Horizontal Blank.
4	**Reserved** Project: All Format: MBZ
3	**Pipe_A_Start_of_Vertical_Blank_Event** Project: All Format: This even will be reported on the start of the Pipe A Vertical Blank.
2	**Pipe_A_Sprite_Plane_Flip_Done_Event** Project: All Format: This even will be reported on the completion of a flip for the Pipe A Sprite Plane.
1	**Pipe_A_Primary_Plane_Flip_Done_Event** Project: All Format: This even will be reported on the completion of a flip for the Pipe A Primary Plane.
0	**Pipe_A_Scanline_Event** Project: All Format: This even will be reported on the start of the scan line specified in the Pipe A Display Scan Line Count Range Compare Register.

2.6.2 DERRMR — Display Engine Render Response Mask Register

DERRMR — Display Engine Render Response Mask Register

Register Type: MMIO
Address Offset: 44050h
Project: DevSNB
Default Value: FFFFFFFFh
Access: R/W
Size (in bits): 32

This register is used by software to control which render response message bits are “masked” or “unmasked”. “Unmasked” bits will cause a render response message to be sent and will be reported in that message. “Masked” bits will not be reported and will not cause a render response message to be sent.

Bit	Description
31:0	**Display_Engine_Render_Response_Message_Mask_Bits** Project: All Format: Display Engine Render Response Message Bit Definition See Description Above This field contains a bit mask which selects which events cause and are reported in the render response message.

Value	Name	Description	Project
0b	Not Masked	Not Masked – will be cause and be reported in the message	All
1b	Masked	Masked – will not cause or be reported in the message	All

2.7 Display Arbitration Control

2.7.1 DISP_ARB_CTL—Display Arbiter Control

DISP_ARB_CTL—Display Arbiter Control	
Register Type:	MMIO
Address Offset:	45000h
Project:	All
Default Value:	C2240622h
Access:	R/W
Size (in bits):	32
Trusted Type:	1

Bit	Description
31	**FBC_Memory_Wake(testmode)** Project: All Security: Test Default Value: 1b Setting this bit allows FBC compressed write requests to wake memory from SR (default: on)
30	**KVMr_Memory_Wake(testmode)** Project: All Security: Test Default Value: 1b Setting this bit allows KVMr display write back requests to wake memory from SR. (default: on)
29	**Opportunistic_Fetch_Mode_Enable(testmode)** Project: All Security: Test Default Value: 0b Setting this bit allows opportunistic data fetches (even when above watermark) when other clients wake the system from SelfRefresh. For any opportunistic fetch to happen, display should not be in the process of waking the system.
28	**Reserved** Project: All Format:
27:26	**HP_Queue_Watermark** Project: All Default Value: 00b

DISP_ARB_CTL—Display Arbiter Control

25:24

LP_Write_Request_Limit

Project: All

Default Value: 10b 4

The value in this register indicates the maximum number of back to back LP write requests that will be accepted from a single client before re-arbitrating.

Value	Name	Description	Project
00b	1	1	All
01b	2	2	All
10b	4	4 (default)	All
11b	8	8	All

23:20

TLB_Request_Limit

Project: All

Default Value: 0010b 2

Range: 1..15

The value in this register indicates the maximum number of TLB requests that can be made in an arbitration loop. Range 1 – 15, (default 2). Zero is not a valid programming.

19:16

TLB_Request_In-Flight_Limit

Project: All

Default Value: 0100b 4

Range: 1..15

The value in this register indicates the maximum number of TLB (or VTd) requests that can be in flight at any given time. Range 1 – 15, (default 4). Zero is not a valid programming.

15

FBC_Watermark_Disable(testmode)

Project: All

Security: Test

Default Value: 0b

Setting this bit disables the FBC watermarks.

[ILK, This bit must be set to 1 for all steppings.

14:13

Address_Swizzling_for_Tiled-Surfaces

Project: All

Default Value: 00b

DRAM configuration registers show if memory address swizzling is needed.

Value	Name	Description	Project
00b	No Display	No display request address swizzling	All
01b	Enable	Enable display request address bit[6] swizzling for tiled surfaces	All
1Xb	Reserved	Reserved	All

DISP_ARB_CTL—Display Arbiter Control		
12	**Reserved** Project: All Format:	
11:8	**HP_Page_Break_Limit** Project: All Default Value: 0110b 6 Range: 1..15 The value in this register represents the maximum number of page breaks allowed in a HP request chain. Range 1 – 15, (default 6). Zero is not a valid programming.	
7	**Reserved** Project: All Format:	
6:0	**HP_Data_Request_Limit** Project: All Default Value: 01000010b 34 Range: 1..127 The value in this register represents the maximum number of cachelines allowed in a HP request chain. Range 1 – 127, (default 34). Zero is not a valid programming.	

2.7.2 DISP_ARB_CTL2—Display Arbiter Control 2 [DevSNB]

DISP_ARB_CTL2—Display Arbiter Control 2 [DevSNB]

Register Type: MMIO
Address Offset: 45004h
Project: DevSNB
Default Value: 00000000h
Access: R/W
Size (in bits): 32

Bit	Description
31:9	**Reserved** Project: All Format:
8	**Fetch_Timing** Project: All Default Value: 0b The value in this register is valid only when Opportunistic Fetches are enabled. The value in this register is used to specify when an opportunistic fetch can happen. For any opportunistic fetch to happen, display should not be in the process of waking the system.

Value	Name	Description	Project
0b	FE inSR	Fetch on falling edge of inSR	All
1b	Not inSR	Fetch when not inSR	All

DISP_ARB_CTL2—Display Arbiter Control 2 [DevSNB]

7 — **Opportunistic_Fetch_Behavior**

Project: All

Default Value: 0h

The value in this register is valid only when Opportunistic Fetches are enabled. The value in this register represents the fetch behavior when an opportunistic fetch is triggered. For any opportunistic fetch to happen, display should not be in the process of waking the system.

Value	Name	Description	Project
0h	One Burst	One Burst Only	All
1h	Fill FIFO	Fill FIFO to Top	All

6 — **Reserved** Project: All Format: MBZ

5:4 — **Inflight_HP_Read_Request_Limit**

Project: All

Default Value: 00b

The value in this register represents the maximum number of HP read request transactions that can inflight at any given time.

Value	Name	Description	Project
00b	128 HP	128 HP inflight transactions limit	All
01b	64 HP	64 HP inflight transactions limit	All
10b	32 HP	32 HP inflight transactions limit	All
11b	16 HP	16 HP inflight transactions limit	All

3:2 — **Reserved** Project: All Format:

1:0 — **RTID_FIFO_Watermark**

Project: All

Default Value: 0b

The value in this register represents the watermark value for the RTID FIFO. HP transactions will start only when the FIFO level is above or equal the watermark

Value	Name	Description	Project
00b	8 RTIDs	8 RTIDs available in FIFO	All
01b	16 RTIDs	16 RTIDs available in FIFO	All
10b	32 RTIDs	32 RTIDs available in FIFO	All
11b	RESERVED	Reserved	All

2.8 Display Watermark Registers

The watermark registers are used to control the display to memory request timing. The watermarks must be programmed according to the rules provided in the “Programming Watermarks” document. The default values of the watermarks should allow the display to operate in any mode supported by the memory configuration. However, the default watermarks are not optimized for power or memory bandwidth efficiency. Watermarks must enable from the bottom up, meaning if WM2 is disabled, WM3 must also be disabled, and if WM1 is disabled, both WM2 and WM3 must also be disabled. Watermark latency values must increase from the bottom up, meaning WM1 (if enabled) must have higher latency than WM0, and so on. [ILK] The low power 1 display watermark register latency value must be programmed to match the Memory Latency Timer Register (MLTR, MCHBAR BDF 0:0:0, Offset 0x1222) Self Refresh Latency Time microsecond value, and the low power 2 display watermark register latency value must be programmed to match the Memory Latency Timer Register MPLL Shutdown Latency Time microsecond value.

2.8.1 WM0_PIPE_A—Pipe A Main Watermarks

WM0_PIPE_A—Pipe A Main Watermarks

Register Type: MMIO
Address Offset: 45100h
Project: All
Default Value: 00783818h
Access: R/W
Size (in bits): 32

Bit	Description
31:23	**Reserved** Project: All Format:
22:16	**Pipe_A_Primary_Watermark** Project: All Number in 64Bs of data in FIFO below which the Pipe A Primary stream will generate requests to memory
15:14	**Reserved** Project: All Format:
13:8	**Pipe_A_Sprite_Watermark** Project: All Number in 64Bs of data in FIFO below which the Pipe A Sprite stream will generate requests to memory
7:5	**Reserved** Project: All Format:
4:0	**Pipe_A_Cursor_Watermark** Project: All Number in 64Bs of data in FIFO below which the Pipe A Cursor stream will generate requests to memory

2.8.2 WM0_PIPE_B—Pipe B Main Watermarks

WM0_PIPE_B—Pipe B Main Watermarks	
Register Type:	MMIO
Address Offset:	45104h
Project:	All
Default Value:	00783818h
Access:	R/W
Size (in bits):	32
Trusted Type:	1

Bit	Description
31:23	**Reserved** Project: All Format:
22:16	**Pipe_B_Primary_Watermark** Project: All Number in 64Bs of data in FIFO below which the Pipe B Primary stream will generate requests to memory
15:14	**Reserved** Project: All Format:
13:8	**Pipe_B_Sprite_Watermark** Project: All Number in 64Bs of data in FIFO below which the Pipe B Sprite stream will generate requests to memory
7:5	**Reserved** Project: All Format:
4:0	**Pipe_B_Cursor_Watermark** Project: All Number in 64Bs of data in FIFO below which the Pipe B Cursor stream will generate requests to memory

2.8.3 WM1—Low Power 1 Display Watermarks

WM1—Low Power 1 Display Watermarks			
Register Type:	MMIO		
Address Offset:	45108h		
Project:	All		
Default Value:	00000000h		
Access:	R/W		
Size (in bits):	32		
These watermark values will be used only when one pipe is enabled and no sprites are enabled (or the conditions for using the Low Power 1 Sprite Watermark are met) and the display is in LP1 state.			
Bit	**Description**		
31	**Enabled** Project: All Enables LP1 watermarks		
30:24	**Latency** Project: All The latency associated with the LP1 watermarks in half usecs.		
23:20	**FBC_LP1_Watermark** Project: All Number of equivalent lines of the primary display for this WM		
19:17	**Reserved** Project: All Format:		
16:8	**LP1_Primary_Watermark** Project: All Number in 64Bs of data in FIFO below which the Primary stream will generate requests to memory.		
7:6	**Reserved** Project: All Format:		
5:0	**LP1_Cursor_Watermark** Project: All Number in 64Bs of data in FIFO below which the Cursor stream will generate requests to memory.		

2.8.4 WM2—Low Power 2 Display Watermarks

WM2—Low Power 2 Display Watermarks	
Register Type:	MMIO
Address Offset:	4510Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
These watermark values will be used only when one pipe is enabled and no sprites are enabled and the display is in LP2 state.	

WM2—Low Power 2 Display Watermarks	
Bit	**Description**
31	**Enabled** Project: All Enables LP2 watermarks
30:24	**Latency** Project: All The latency associated with the LP2 watermarks in half usecs.
23:20	**FBC_LP2_Watermark** Project: All Number of equivalent lines of the primary display for this WM
19:17	**Reserved** Project: All Format:
16:8	**LP2_Primary_Watermark** Project: All Number in 64Bs of data in FIFO below which the Primary stream will generate requests to memory.
7:6	**Reserved** Project: All Format:
5:0	**LP2_Cursor_Watermark** Project: All Number in 64Bs of data in FIFO below which the Cursor stream will generate requests to memory.

2.8.5 WM3—Low Power 3 Display Watermarks

WM3—Low Power 3 Display Watermarks	
Register Type:	MMIO
Address Offset:	45110h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
These watermark values will be used only when one pipe is enabled and no sprites are enabled and the display is in LP3 state.	
Bit	**Description**
31	**Enabled** Project: All Enables LP3 watermarks
30:24	**Latency** Project: All The latency associated with the LP3 watermarks in half usecs.
23:20	**FBC_LP3_Watermark** Project: All Number of equivalent lines of the primary display for this WM
19:17	**Reserved** Project: All Format:
16:8	**LP3_Primary_Watermark** Project: All Number in 64Bs of data in FIFO below which the Primary stream will generate requests to memory.

WM3—Low Power 3 Display Watermarks	
5:0	**LP3_Cursor_Watermark** Project: All Number in 64Bs of data in FIFO below which the Cursor stream will generate requests to memory.

2.8.6 WM1S—Low Power 1 Sprite Watermark

WM1S—Low Power 1 Sprite Watermark	
Register Type:	MMIO
Address Offset:	45120h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
This watermark will be used only when one pipe is enabled and a sprite is enabled and sprite scaling is not enabled and the display is in LP1 state.	
Bit	**Description**
31	**Enabled** Project: All Enables LP1 Sprite watermark. This bit allows memory self refresh to be entered when sprite is enabled.
30:8	**Reserved** Project: All Format:
7:0	**LP1_Sprite_Watermark** Project: All Default Value: 0b Number in 64Bs of data in FIFO below which the Sprite stream will generate requests to memory.

2.9 Refresh Rate Hardware Control Register

2.9.1 RR_HW_CTL—Refresh Rate Hardware Control

RR_HW_CTL—Refresh Rate Hardware Control	
Register Type:	MMIO
Address Offset:	45300h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

This register has additional settings for hardware controlled switching between refresh rates. Hardware controlled refresh rate switching is enabled in the pipe configuration registers. Hardware monitors frame buffer modifications, flips, and cursor position updates, to know when to enter or exit the low power refresh rate mode. Hardware will hold a minimum number of frames in a refresh rate mode before switching to another refresh rate mode.

Bit	Description
31:16	**Reserved** Project: All Format: MBZ
15:8	**Minimum_Number_Of_High_Power_Frames** Project: All This field specifies the minimum number of frames that must be spent in the high power refresh rate mode before allowing a switch to the low power refresh rate mode. This field is programmed to the number of frames desired minus two.
7:0	**Minimum_Number_Of_Low_Power_Frames** Project: All This field specifies the minimum number of frames that must be spent in the low power refresh rate mode before allowing a switch to the high power refresh rate mode. This field is programmed to the number of frames desired minus two.

2.10 Backlight Control and Modulation Histogram Registers

2.10.1 BLC_PWM_CTL2—Backlight PWM Control Register 2

BLC_PWM_CTL2—Backlight PWM Control Register 2	
Register Type:	MMIO
Address Offset:	48250h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

Bit	Description
31	**PWM_Enable** Project: All Default Value: 0b This bit enables the PWM counter logic

Value	Name	Description	Project
0b	Disable	PWM disabled (drives 0 always)	All
1b	Enable	PWM enabled	All

Bit	Description
30	**Reserved** Project: All Format:
29	**PWM_Pipe_assignment** Project: All Default Value: 0b This bit assigns PWM to a pipe. The PWM counter will run off of this pipe's PLL. The PWM function must be disabled in order to change the value of this field.

Value	Name	Description	Project
0b	Pipe A	Pipe A	All
1b	Pipe B	Pipe B	All

Bit	Description
28:27	**Reserved** Project: All Format:
26	**Phase-In_Interrupt_Status** Project: All Access: R/W Clear Default Value: 0b This bit will be set by hardware when a Phase-In interrupt has occurred. Software will clear this bit by writing a '1', which will reset the interrupt generation.

BLC_PWM_CTL2—Backlight PWM Control Register 2	
25	**Phase_In_Enable** Project: All Setting this bit enables a PWM phase in based on the programming of the Phase In registers below. This bit clears itself when the phase in is completed.
24	**Phase_In_Interrupt_Enable** Project: All Setting this bit enables an interrupt to be generated when the PWM phase in is completed.
23:16	**Phase_In_time_base** Project: All Default Value: 0b This field determines the number of VBLANK events that pass before one increment occurs.
15:8	**Phase_In_Count** Project: All This field determines the number of increment events in this phase in. Writes to this register should only occur when hardware-phase-ins are disabled. Reads to this register can occur any time, where the value in this field indicates the number of increment events remaining to fully apply a phase-in request as hardware automatically decrements this value. A value of 0 is invalid.
7:0	**Phase_In_Increment** Project: All This field indicates the amount to adjust the PWM duty cycle register on each increment event. This is a two's complement number.

Value	Name	Description	Project
0b		Invalid	All
01h-FFh		VBlank Count	All

2.10.2 BLC_PWM_CTL—Backlight PWM Control Register

BLC_PWM_CTL—Backlight PWM Control Register	
Register Type:	MMIO
Address Offset:	48254h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

Bit	Description
31:16	**Reserved** Project: All Format:
15:0	**Backlight_Duty_Cycle** Project: All This field determines the number of time base events for the active portion of the PWM backlight control. This should never be larger than the frequency field. A value of zero will turn the backlight off. A value equal to the backlight modulation frequency field will be full on. This field gets updated when it is desired to change the intensity of the backlight, it will take affect at the end of the current PWM cycle. This value represents the active time of the PWM stream in PCH display raw clock periods multiplied by 128.

2.10.3 BLM_HIST_CTL—Image Enhancement Histogram Control Register

BLM_HIST_CTL—Image Enhancement Histogram Control Register

Register Type: MMIO
Address Offset: 48260h
Project: All
Default Value: 00000000h
Access: R/W
Size (in bits): 32

Bit	Description
31	**Image_Enhancement_Histogram_Enabled** Project: All Default Value: 0b This bit enables the Image Enhancement histogram logic to collect data.

Value	Name	Description	Project
0b	Disable	Image histogram is disabled	All
1b	Enable	The image histogram is enabled. When this bit is changed from a zero to a one, histogram calculations will begin after the next VBLANK of the assigned pipe.	All

Bit	Description
30	**Image_Enhancement_Modification_Table_Enabled** Project: All Default Value 0b This bit enables the Image Enhancement modification table.

Value	Name	Description	Project
0b	Disable	Disabled	All
1b	Enable	Enabled. When this bit is changed from a zero to a one, modifications begin after the next VBLANK of the assigned pipe.	All

BLM_HIST_CTL—Image Enhancement Histogram Control Register

29 — **Image_Enhancement_Pipe_assignment**

Project: All

Default Value: 0b

This bit assigns the IE function to a pipe. IE events will be synchronized to the VBLANK of the selected pipe. The IE function must be disabled in order to change the value of this field.

Value	Name	Description	Project
0b	Pipe A	Pipe A	All
1b	Pipe B	Pipe B	All

28:25 — **Reserved** Project: All Format:

24 — **Histogram Mode Select**

Project: All

Default Value: 0b

Value	Name	Description	Project
0b	YUV	YUV Luma Mode	All
1b	HSV	HSV Intensity Mode	All

23:16 — **Sync_to_Phase_In_Count** Project: All

This field indicates the phase in count number on which the Image Enhancement table will be loaded if the Sync to Phase in is enabled.

15 — **Reserved** Project: All Format:

14:13 — **Enhancement_mode**

Project: All

Default Value: 00b

Value	Name	Description	Project
00b	Direct	Direct look up mode	All
01b	Additive	Additive mode	All
10b	Multiplicative	Multiplicative mode	All
11b	Reserved	Reserved	All

12 — **Sync_to_Phase_In** Project: All

Setting this bit enables the double buffered registers to be loaded on the phase in count value specified instead of the next vblank.

BLM_HIST_CTL—Image Enhancement Histogram Control Register	
11	**Bin_Register_Function_Select** Project: All Default Value: 0b This field indicates what data is being written to or read from the bin data register. **Value** / **Name** / **Description** / **Project** 0b / BTC / Bin Threshold Count. A read from the bin data register returns that bin's threshold value from the most recent vblank load event (guardband threshold trip). Valid range for the Bin Index is 0 to 31. / All 1b / BIE / Bin Image Enhancement Value. Valid range for the Bin Index is 0 to 32 / All
10:7	**Reserved** Project: All Format:
6:0	**Bin_Register_Index** Project: All This field indicates the bin number whose data can be accessed through the bin data register. This value is automatically incremented by a read or a write to the bin data register if the busy bit is not set.

2.10.4 Image Enhancement Bin Data Register

Image Enhancement Bin Data Register(F0 Threshold Count Usage)	
Register Type:	MMIO
Address Offset:	48264h
Project:	All
Exists If:	BLM_HIST_CTL:Bin Register Function Select = 0
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32
Writes to this address are steered to the correct register by programming the Bin Register Function Select and the Bin Register Index. Function 0 usage (Threshold Count) this Function is Read Only	
Bit	**Description**
31	**Busy_Bit** Project: All If set , the engine is busy, the rest of the register is undefined. If clear, the register contains valid data.
30:22	**Reserved** Project: All Format:
21:0	**Bin_Count** Project: All The total number of pixels in this bin, value is updated at the start of each vblank.

Image Enhancement Bin Data Register(F1 Image Enhancement Usage)

Register Type:	MMIO
Address Offset:	48264h
Project:	All
Exists If:	BLM_HIST_CTL:Bin Register Function Select = 1
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Next vblank if in normal mode, or on phase in Sync event frame if it is enabled

Writes to this address are steered to the correct register by programming the Bin Register Function Select and the Bin Register Index.
Function 1 usage (Image Enhancement) this Function is Read/Write

Bit	Description
31:10	**Reserved** Project: All Format:
9:0	**Image_Bin_Correction_Factor** Project: All The correction value for this bin. Writes to this register are double buffered on the next vblank if in normal mode, or on the phase in Sync event frame if it is enabled. The value written here is the 10bit corrected channel value for the lowest point of the bin.

2.10.5 Histogram Threshold Guardband Register

Histogram Threshold Guardband Register	
Register Type:	MMIO
Address Offset:	48268h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank

Bit	Description
31	**Histogram_Interrupt_enable** Project: All Default Value: 0b

Value	Name	Description	Project
0b	Disable	Disabled	All
1b	Enable	This generates a histogram interrupt once a Histogram event occurs. Software must always program 1.	All

Bit	Description
30	**Histogram_Event_status** Project: All Access: R/W Clear Default Value: 0b When a Histogram event has occurred, this will get set by the hardware. For any more Histogram events to occur, the software needs to clear this bit by writing a '1'. The default state for this bit is '0'

Value	Name	Description	Project
0b	Not Occurred	Histogram event has not occurred	All
1b	Occured	Histogram event has occurred	All

Bit	Description
29:22	**Guardband_Interrupt_Delay** Project: All An interrupt is always generated after this many consecutive frames of the guardband threshold being surpassed. This value is double buffered on start of vblank. A value of 0 is invalid.
21:0	**Threshold_Guardband** Project: All This value is used to determine the guardband for the threshold interrupt generation. This single value is used for all the segments. This value is double buffered on start of vblank

2.11 Motion Blur Mitigation (MBM) Control

These registers are use to control the MBM logic. (Sometimes called LOT, panel overdrive, or LRTC).
Before enabling MBM, software should have identically programmed both pipes source size and gamma tables. Additionally, before executing a flip on the selected pipe (which generates the MBM frame) software should have loaded the address of the reference frame into the second plane(s), this can be done by MMIO or by a flip command. The second pipe does not need to have it's panel fitter, link, or link PLL enabled (or anything else down the pipe from MBM).

2.11.1 MBM_CTRL—MBM Control

MBM_CTRL—MBM Control

Register Type: MMIO
Address Offset: 48800h
Project: All
Default Value: 00000000h
Access: R/W
Size (in bits): 32

Bit	Description
31	**MBM_Enable** Project: All Default Value: 0b This bit enables MBM logic.

Value	Name	Description	Project
0b	Disable	MBM is Disabled	All
1b	Enable	MBM is Enabled	All

Bit	Description
30	**Reserved** Project: All Format:
29	**MBM Pipe Select** Project: All Default Value: 0b This bit assigns MBM modification to the selected pipe.

Value	Name	Description	Project
0b	Pipe A	PipeA (PipeA will fetch the current buffer and PipeB will fetch the previous buffer)	All
1b	Pipe B	PipeB (PipeB will fetch the current buffer and PipeA will fetch the previous buffer)	All

<table>
<tr><th colspan="2">MBM_CTRL—MBM Control</th></tr>
<tr><td>28:27</td><td>MBM_Surface_select
Project: All
Default Value: 0b
<table><tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr><tr><td>00b</td><td>None</td><td>None</td><td>All</td></tr><tr><td>01b</td><td>Sprite</td><td>Sprite Only</td><td>All</td></tr><tr><td>10b</td><td>Primary</td><td>Primary Only</td><td>All</td></tr><tr><td>11b</td><td>Both</td><td>Both sprite and primary</td><td>All</td></tr></table></td></tr>
<tr><td>26:24</td><td>Reserved Project: All Format:</td></tr>
<tr><td>23:16</td><td>MBM_Delta_Threshold
Project: All
Default Value: 00000000b
If the delta value between the current and previous component values exceed this threshold a compensated value is generated. Otherwise, the current value is passed through.</td></tr>
<tr><td>15:0</td><td>Reserved Project: All Format:</td></tr>
</table>

2.11.2 MBM_TBL—MBM Overdrive Table

MBM_TBL—MBM Overdrive Table

Register Type:	MMIO
Address Offset:	48810h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	63x32

These will be the overdrive values to be used as the lookup table entries for MBM. Correction table factors are stored x-major, groups of input values go together, ascending from row entry zero. The first row is internally hard coded to 0, so the first address actually corresponds to the second row of the table. The last row is internally hard coded to 256, so only 7 rows total are programmable.

Overdrive table address offsets:

	0	**31**	**63**	**95**	**127**	**159**	**191**	**223**	**255**
0	0	0	0	0	0	0	0	0	0
31	48810h	48814h	48818h	4881Ch	48820h	48824h	48828h	4882Ch	48830h
63	48834h	48838h	4883Ch	48840h	48844h	48848h	4884Ch	48850h	48854h
95	48858h	4885Ch	48860h	48864h	48868h	4886Ch	48870h	48874h	48878h
127	4887Ch	48880h	48884h	48888h	4888Ch	48890h	48894h	48898h	4889Ch
159	488A0h	488A4h	488A8h	488ACh	488B0h	488B4h	488B8h	488BCh	488C0h
191	488C4h	488C8h	488CCh	488D0h	488D4h	488D8h	488DCh	488E0h	488E4h
223	488E8h	488ECh	488F0h	488F4h	488F8h	488FCh	48900h	48904h	48908h
255	256	256	256	256	256	256	256	256	256

Previous Pixel Value Range
Current Pixel Value Range
Address Offset
Hard Coded Value

DWord	Bit	Description
0..62	31:24	**Reserved** Project: All Format:
	23:16	**Red_MBM_overdrive_value** Project: All
	15:8	**Green_MBM_overdrive_value** Project: All
	7:0	**Blue_MBM_overdrive_value** Project: All

2.12 Color Conversion & Control Registers

These registers contain the coefficients of the pipe color space converter. There are 12 values in 6 registers for each pipe. Or alternately a YUV frame buffer could be converted to RGB.

The high color channel is the most significant bits of the color. The low color channel is the least significant bits of the color. The medium color channel is the bits between high and low. For example: In RGB modes Red is in the High channel, Green in Medium, and Blue in Low. In YUV modes, U is in the High channel, Y in Medium, and V in Low.

The color space conversion registers are double buffered and are updated on the start of vertical blank following a write to the CSC Mode register for the respective pipe.

CSC Coefficient Description

Project: All
Default Value: 0000h
Size (in bits): 16

Coefficients for the CSC are stored in sign-exponent-mantissa format. Two CSC coefficients are stored in each dword, the table below show the data packing in each dword.

Bit	Description
15	**Sign** Project: All **Value** / **Name** / **Description** / **Project** 0b / Positive / Positive / All 1b / Negative / Negative / All
14:12	**Exponent_bits** Project: All Represented as 2^{-n} **Value** / **Name** / **Description** / **Project** 110b / 4 / 4 or mantissa is bb.bbbbbbb / All 111b / 2 / 2 or mantissa is b.bbbbbbbb / All 000b / 1 / 1 or mantissa is 0.bbbbbbbbb / All 001b / 0.5 / 0.5 or mantissa is 0.0bbbbbbbbb / All 010b / 0.25 / 0.25 or mantissa is 0.00bbbbbbbbb / All 011b / 0.125 / 0.125 or mantissa is 0.000bbbbbbbbb / All others / Reserved / Reserved / All
11:3	**Mantissa** Project: All
2:0	**Reserved** Project: All Format:

The matrix equations are as follows:

```
Y = (RY * R) + (GY * G) + (BY * B)
U = (RU * R) + (GU * G) + (BU * B)
V = (RV * R) + (GV * G) + (BV * B)
```

The standard programming for RGB to YUV is in the following table.

	Bt.601		Bt.709	
	Value	Program	Value	Program
RU	0.2990	0x1990	0.21260	0x2D98
GU	0.5870	0x0968	0.71520	0x0B70
BU	0.1140	0x3E98	0.07220	0x3940
RV	-0.1687	0xAAC8	-0.11460	0xBEA8
GV	-0.3313	0x9A98	-0.38540	0x9C58
BV	0.5000	0x0800	0.50000	0x0800
RY	0.5000	0x0800	0.50000	0x0800
GY	-0.4187	0x9D68	-0.45420	0x9E88
BY	-0.0813	0xBA68	-0.04580	0xB5E0

The standard programming for YUV to sRGB without scaling is in the following table.

The input is VYU on high, medium, and low channels respectively.

The output is RGB on high, medium, and low channels respectively.

Program the pre-CSC offsets to -128, -16, and -128 for high, medium, and low channels respectively.

The coefficients can be scaled if desired.

	Bt.601 Reverse		Bt.709 Reverse	
	Value	Program	Value	Program
GY	1.000	0x7800	1.000	0x7800
BY	0.000	0x0000	0.000	0x0000
RY	1.371	0x7AF8	1.574	0x7C98
GU	1.000	0x7800	1.000	0x7800
BU	-0.336	0x9AC0	-0.187	0xABF8
RU	-0.698	0x8B28	-0.468	0x9EF8
GV	1.000	0x7800	1.000	0x7800
BV	1.732	0x7DD8	1.855	0x7ED8
RV	0.000	0x0000	0.000	0x0000

2.12.1 Pipe A Color Control

2.12.1.1 CSC_A_Coefficients 1

CSC_A_Coefficients 1	
Register Type:	MMIO
Address Offset:	49010h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:16	**RY** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**GY** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.

2.12.1.2 CSC_A_Coefficients 2

CSC_A_Coefficients 2	
Register Type:	MMIO
Address Offset:	49014h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:16	**BY** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**Reserved** Project: All Format:

2.12.1.3 CSC_A_Coefficients 3

CSC_A_Coefficients 3	
Register Type:	MMIO
Address Offset:	49018h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:16	**RU** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**GU** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.

2.12.1.4 CSC_A_Coefficients 4

CSC_A_Coefficients 4	
Register Type:	MMIO
Address Offset:	4901Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:16	**BU** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**Reserved** Project: All Format:

2.12.1.5 CSC_A_Coefficients 5

CSC_A_Coefficients 5	
Register Type:	MMIO
Address Offset:	49020h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:16	**RV** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**GV** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.

2.12.1.6 CSC_A_Coefficients 6

CSC_A_Coefficients 6	
Register Type:	MMIO
Address Offset:	49024h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:16	**BV** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**Reserved** Project: All Format:

2.12.1.7 CSC_A_Mode

CSC_A_Mode	
Register Type:	MMIO
Address Offset:	49028h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank
Writes to this register arm CSC_A registers	

Bit	Description
31:3	**Reserved** Project: All Format:

CSC_A_Mode

2 — CSC_Black_Screen_Offset

Project: All

Default Value: 0b

Adds an offset to the data output from CSC

In sRGB ouput mode: RGB is defined as R`+ 1/16, G`+ 1/16, B`+ 1/16

In rcYUV output mode: YUV is defined as Y'+ 1/16, U and V are output in excess 2048 format

Value	Name	Description	Project
0b	No Offset	CSC output has no offset added (will be RGB or YUV, depending on bit 0)	All
1b	Offset	CSC output has offset added (will be sRGB or rcYUV depending on bit 0)	All

1 — CSC_Position

Project: All

Default Value: 0b

Selects the CSC position in the pipe.

Value	Name	Description	Project
0b	CSC After	CSC is after gamma and DPST image enhancement	All
1b	CSC Before	CSC is before gamma and DPST image enhancement	All

0 — CSC_Mode

Project: All

Default Value: 0b

Selects the CSC direction.

Value	Name	Description	Project
0b	RGB to YUV	RGB to YUV conversion	All
1b	YUV to RGB	YUV to RGB conversion	All

2.12.1.8 Pre-CSC_A High Color Channel Offset

Pre-CSC_A High Color Channel Offset	
Register Type:	MMIO
Address Offset:	49030h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:13	**Reserved** Project: All Format:
12:0	**Pre-CSC_High_Color_Channel_Offset** Project: All This 13-bit 2's complement value is used to give an offset to the color channel as it enters CSC logic.

2.12.1.9 Pre-CSC_A Medium Color Channel Offset

Pre-CSC_A Medium Color Channel Offset	
Register Type:	MMIO
Address Offset:	49034h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:13	**Reserved** Project: All Format:
12:0	**Pre-CSC_Medium_Color_Channel_Offset** Project: All This 13-bit 2's complement value is used to give an offset to the color channel as it enters CSC logic.

2.12.1.10 Pre-CSC_A Low Color Channel Offset

Pre-CSC_A Low Color Channel Offset	
Register Type:	MMIO
Address Offset:	49038h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_A_Mode

Bit	Description
31:13	**Reserved** Project: All Format:
12:0	**Pre-CSC_Low_Color_Channel_Offset** Project: All This 13-bit 2's complement value is used to give an offset to the color channel as it enters CSC logic.

2.12.2 Pipe B Color Control

2.12.2.1 CSC_B_Coefficients 1

CSC_B_Coefficients 1	
Register Type:	MMIO
Address Offset:	49110h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:16	**RY** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**GY** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.

2.12.2.2 CSC_B_Coefficients 2

CSC_B_Coefficients 2	
Register Type:	MMIO
Address Offset:	49114h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:16	**BY** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**Reserved** Project: All Format:

2.12.2.3 CSC_B_Coefficients 3

CSC_B_Coefficients 3	
Register Type:	MMIO
Address Offset:	49118h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:16	**RU** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**GU** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.

2.12.2.4 CSC_B_Coefficients 4

CSC_B_Coefficients 4	
Register Type:	MMIO
Address Offset:	4911Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:16	**BU** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**Reserved** Project: All Format:

2.12.2.5 CSC_B_Coefficients 5

CSC_B_Coefficients 5	
Register Type:	MMIO
Address Offset:	49120h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:16	**RV** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**GV** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.

2.12.2.6 CSC_B_Coefficients 6

CSC_B_Coefficients 6	
Register Type:	MMIO
Address Offset:	49124h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:16	**BV** Project: All Format: CSC COEFFICIENT DESCRIPTION CSC coefficient. See format description above.
15:0	**Reserved** Project: All Format:

2.12.2.7 CSC_B_Mode

CSC_B_Mode	
Register Type:	MMIO
Address Offset:	49128h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank
Writes to this register arm CSC_B registers	

Bit	Description
31:3	**Reserved** Project: All Format:

CSC_B_Mode

2 — CSC_Black_Screen_Offset

Project: All

Default Value: 0b

Adds an offset to the data output from CSC

In sRGB ouput mode: RGB is defined as R`+ 1/16, G`+ 1/16, B`+ 1/16

In rcYUV output mode: YUV is defined as Y'+ 1/16, U and V are output in excess 2048 format

Value	Name	Description	Project
0b	No Offset	CSC output has no offset added (will be RGB or YUV, depending on bit 0)	All
1b	Offset	CSC output has offset added (will be sRGB or rcYUV depending on bit 0)	All

1 — CSC_Position

Project: All

Default Value: 0b

Selects the CSC position in the pipe.

Value	Name	Description	Project
0b	CSC After	CSC is after gamma and DPST image enhancement	All
1b	CSC Before	CSC is before gamma and DPST image enhancement	All

0 — CSC_Mode

Project: All

Default Value: 0b

Selects the CSC direction. Input and output formats and position within the pipe

Value	Name	Description	Project
0b	RGB to YUV	RGB to YUV conversion	All
1b	YUV to RGB	YUV to RGB conversion	All

2.12.2.8 Pre-CSC_B High Color Channel Offset

Pre-CSC_B High Color Channel Offset	
Register Type:	MMIO
Address Offset:	49130h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:13	**Reserved** Project: All Format:
12:0	**Pre-CSC_B_High_Color_Channel_Offset** Project: All This 13-bit 2's complement value is used to give an offset to the color channel as it enters CSC logic.

2.12.2.9 Pre-CSC_B Medium Color Channel Offset

Pre-CSC_B Medium Color Channel Offset	
Register Type:	MMIO
Address Offset:	49134h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:13	**Reserved** Project: All Format:
12:0	**Pre-CSC_B_Medium_Color_Channel_Offset** Project: All This 13-bit 2's complement value is used to give an offset to the color channel as it enters CSC logic.

2.12.2.10 Pre-CSC_B Low Color Channel Offset

Pre-CSC_B Low Color Channel Offset	
Register Type:	MMIO
Address Offset:	49138h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to CSC_B_Mode

Bit	Description
31:13	**Reserved** Project: All Format:
12:0	**Pre-CSC_B_Low_Color_Channel_Offset** Project: All This 13-bit 2's complement value is used to give an offset to the color channel as it enters CSC logic.

2.13 Display Palette Registers (4A000h–4CFFFh)

The display palette provides a means to correct the gamma of an image stored in a frame buffer to match the gamma of the monitor or presentation device. Additionally, the display palette provide a method for converting indexed data values to color values for VGA and 8-bpp indexed display modes. The display palette is located after the plane blender. Using the individual plane gamma enables, the blended pixels can go through or bypass the palette on a pixel by pixel basis.

The display palette can be accessed through multiple methods and operate in one of three different modes.

8 bit legacy palette mode (for indexed VGA and 8 bpp formats and for legacy gamma):

256 entries of 24 bits each (8 bits per color).

For indexed formats, an 8 bit per pixel value is used to lookup a 24 bit per pixel value from the palette which then is padded to 36 bits. This permits a compact data format to choose from 256 colors out of a larger palette of colors. The legacy palette is accessible through both MMIO and VGA palette register I/O addresses. Through VGA palette register I/O addresses, the palette can look as though there are only 6 bits per color component (this mapping is handled inside the VGA engine).

For legacy gamma, the 36 bits per pixel gamma input is chopped to 24 bits and used to lookup a 24 bit pixel value from the palette which then is padded to 36 bits. This permits a color to be re-mapped to a different brightness for gamma correction. This provides the lowest quality gamma and should only be used for legacy requirements.

10 bit precision palette mode (for 10 bit gamma):
1024 entries of 30 bits each (10 bits per color).

For 10 bit gamma, the 36 bits per pixel gamma input is chopped to 30 bits and used to lookup a 30 bit pixel value from the palette which then is padded to 36 bits. This permits a color to be re-mapped to a different brightness for gamma correction. This provides the highest quality gamma for non-indexed pixel data formats of 30 bits per pixel or less.

12 bit interpolated gamma mode:
512 entries of 16 bits each (format described in 12 bit interpolated gamma programming notes).

For 12 bit interpolated gamma, the 36 bits per pixel gamma input is used to lookup reference points (16 bits per color in 12.4 format) along a gamma curve and interpolate a 36 bit pixel result. This permits a color to be re-mapped to a different brightness for gamma correction. This provides the highest quality gamma for pixel data formats greater than 30 bits per pixel.

Pixel chopping refers to removing the LSBs of each color component to reduce bits per pixel. Pixel padding refers to adding LSBs to each color component to increase bits per pixel.

Accesses to the palette entries require that the core display clock is running at the time of the update. All write accesses to the palette must be in dwords. Byte or word writes to the palettes are not allowed.

2.13.1 LGC_PALETTE_A—Pipe A Legacy Display Palette

LGC_PALETTE_A—Pipe A Legacy Display Palette		
Register Type:	MMIO	
Address Offset:	4A000h	
Project:	All	
Default Value:	UUUUUUUUh	
Access:	R/W (DWORD access only, no byte access)	
Size (in bits):	256x32	
DWord	**Bit**	**Description**
0..255	31:24	**Reserved** Project: All Format:
	23:16	**Red_Palette_Entry** Project: All Format:
	15:8	**Green_Palette_Entry** Project: All Format:
	7:0	**Blue_Palette_Entry** Project: All Format:

2.13.2 LGC_PALETTE_B—Pipe B Legacy Display Palette

LGC_PALETTE_B—Pipe B Legacy Display Palette		
Register Type:	MMIO	
Address Offset:	4A800h	
Project:	All	
Default Value:	UUUUUUUUh	
Access:	R/W (DWORD access only, no byte access)	
Size (in bits):	256x32	
DWord	**Bit**	**Description**
0..255	31:24	**Reserved** Project: All Format:
	23:16	**Red_Palette_Entry** Project: All Format:
	15:8	**Green_Palette_Entry** Project: All Format:
	7:0	**Blue_Palette_Entry** Project: All Format:

2.13.3 PREC_PALETTE_A—Pipe A Precision Display Palette

10 bit Precision Palette Mode Format	
Project:	All
Format for 10 bit precision palette mode.	
Bit	**Description**
31:30	**Reserved** Project: All Format:
29:20	**Red_Palette_Entry** Project: All
19:10	**Green_Palette_Entry** Project: All
9:0	**Blue_Palette_Entry** Project: All

12-bit Interpolated Precision Palette Mode (odd Dword) Format	
Project:	All
Format for 12 bit interpolated gamma mode, odd dwords.	
Bit	**Description**
31:30	**Reserved** Project: All Format:
29:20	**Red_ Base[11:2]** Project: All
19:10	**Green_ Base[11:2]** Project: All

12-bit Interpolated Precision Palette Mode (odd Dword) Format			
9:0	**Blue_ Base[11:2]**	Project:	All

12-bit Interpolated Precision Palette Mode (even Dword) Format					
Project:	All				
Format for 12 bit interpolated gamma mode, odd dwords..					
Bit	**Description**				
31:30	**Reserved**	Project:	All	Format:	MBZ
29:28	**Red_Base[1:0]**			Project:	All
27:24	**Red_Fraction**			Project:	All
23:20	**Reserved**	Project:	All	Format:	
19:18	**Green_Base[1:0]**			Project:	All
17:14	**Green_Fraction**			Project:	All
13:10	**Reserved**	Project:	All	Format:	
9:8	**Blue_Base[1:0]**			Project:	All
7:4	**Blue_Fraction**			Project:	All
3:0	**Reserved**	Project:	All	Format:	

PREC_PALETTE_A—Pipe A Precision Display Palette(10 bit)

Register Type: MMIO
Address Offset: 4B000h
Project: All
Exists If: PIPEACONF:Pipe_A_Palette/Gamma_Unit_mode = 01b
Default Value: UUUUUUUUh
Access: R/W (DWORD access only, no byte access)
Size (in bits): 1024x32

DWord	Bit	Description
0..1023	31:0	**10bit_mode** Project: All Format: 10 bit Precision Palette Mode Format See format description above

PREC_PALETTE_A—Pipe A Precision Display Palette(12 bit)		
Register Type:	MMIO	
Address Offset:	4B000h	
Project:	All	
Exists If:	PIPEACONF:Pipe_A_Palette/Gamma_Unit_mode = 10b	
Default Value:	UUUUUUUUh	
Access:	R/W (DWORD access only, no byte access)	
Size (in bits):	1024x32	
DWord	**Bit**	**Description**
0,2,4,..1022	31:0	**12bit_even** Project: All Format: 12-bit Interpolated Precision Palette Mode (even Dword) Format See format description above
1,3,5,..1023	31:0	**12bit_odd** Project: All Format: 12-bit Interpolated Precision Palette Mode (odd Dword) Format See format description above

2.13.4 PREC_PALETTE_B—Pipe B Precision Display Palette

PREC_PALETTE_B—Pipe B Precision Display Palette(10 bit)		
Register Type:	MMIO	
Address Offset:	4C000h	
Project:	All	
Exists If:	PIPEBCONF:Pipe_B_Palette/Gamma_Unit_mode = 01b	
Default Value:	UUUUUUUUh	
Access:	R/W (DWORD access only, no byte access)	
Size (in bits):	1024x32	
DWord	**Bit**	**Description**
0..1023	31:0	**10bit_mode** Project: All Format: 10 bit Precision Palette Mode Format See format description above

PREC_PALETTE_B—Pipe B Precision Display Palette(12 bit)		
Register Type:	MMIO	
Address Offset:	4C000h	
Project:	All	
Exists If:	PIPEBCONF:Pipe_B_Palette/Gamma_Unit_mode = 10b	
Default Value:	UUUUUUUUh	
Access:	R/W (DWORD access only, no byte access)	
Size (in bits):	1024x32	
DWord	**Bit**	**Description**
0..1023	63:32	**12bit_odd** Project: All Format: 12-bit Interpolated Precision Palette Mode (odd Dword) Format See format description above
	31:0	**12bit_even** Project: All Format: 12-bit Interpolated Precision Palette Mode (even Dword) Format See format description above

12-bit Interpolated Gamma Programming Notes:

The 12-bit gamma correction curve is represented by specifying a set of reference points spaced equally along the desired curve. Red, Green, and Blue each have 513 reference points. The first 512 reference points are stored in the precision palette RAM, and the final value is stored in the GCMAX register. The first 512 reference points are 16 bits represented in a 12.4 format with 12 integer and 4 fractional bits. The final reference points are 17 bits represented in a 13.4 format with 13 integer and 4 fractional bits.

During operation the appropriate reference point pairs (adjacent) are selected for each color, and the output is interpolated between these two reference point values.

To program the gamma correction reference points, calculate the desired gamma curve for inputs from 0 to 4096. Every 8th point on the curve (0, 8, 16 ... 4088, 4096) becomes a reference point. Convert the gamma value to the 13.4 format. The first 512 reference points are saved to the precision palette RAM, where the even DWords contain the lower 6 bits of the reference point value, and the odd DWords contain the upper 10 bits of the reference point value. The final 513th reference point is saved in the GCMAX registers in 13.4 format.

Example equation for gamma curve of 2.2:

For (X = 0..4096) { gamma = [(X / 4096) ^ 2.2] * 4096 }

The curve must be flat or increasing, never decreasing.

2.13.5 PIPEAGCMAX—Pipe A Gamma Correction Max

Pipe Max Gamma Correction Format	
Project:	All
Default Value:	00010000h

Bit	Description
31:17	**Reserved** Project: All Format:
16:0	**Max_Color_Gamma_Correction_Point** Project: All 513th reference point for the color channel of the 12-bit pipe piecewise linear gamma correction. The value should always be programmed to be less than or equal to 4096.0.

PIPEAGCMAX—Pipe A Gamma Correction Max	
Register Type:	MMIO
Address Offset:	4D000h
Project:	All
Default Value:	00010000h
Access:	R/W
Size (in bits):	3x32

DWord	Bit	Description
0	31:0	**Red** Project: All Format: Pipe Max Gamma Correction Format
1	31:0	**Green** Project: All Format: Pipe Max Gamma Correction Format
2	31:0	**Blue** Project: All Format: Pipe Max Gamma Correction Format

2.13.6 PIPEBGCMAX —Pipe B Gamma Correction Max

PIPEBGCMAX—Pipe B Gamma Correction Max						
Register Type: MMIO **Address Offset:** 4D010h **Project:** All **Default Value:** 00010000h **Access:** R/W **Size (in bits):** 3x32						
DWord	**Bit**	**Description**				
0	31:0	**Red**	Project:	All	Format:	Pipe Max Gamma Correction Format
1	31:0	**Green**	Project:	All	Format:	Pipe Max Gamma Correction Format
2	31:0	**Blue**	Project:	All	Format:	Pipe Max Gamma Correction Format

2.14 Software Flag Registers (4F000h–4F10Fh)

2.14.1 Software Flag Registers

Software Flag Registers						
Register Type: MMIO **Address Offset:** 4F000h **Project:** All **Default Value:** 00000000h **Access:** R/W **Size (in bits):** 36x32						
These registers are used as scratch pad data storage space and have no direct effect on hardware operation. The use of these registers is defined by the software architecture.						
DWord	**Bit**	**Description**				
0..35	31:0	**Reserved**	Project:	All	Format:	PBC

2.14.2 GT Scratchpad

GT Scratchpad		
Register Type:	MMIO	
Address Offset:	4F100h	
Project:	All	
Default Value:	00000000h	
Access:	R/W	
Size (in bits):	8x32	
These registers are used as scratch pad data storage space and have no direct effect on hardware operation. The use of these registers is defined by the software architecture.		
DWord	**Bit**	**Description**
0..7	31:0	**Reserved** Project: All Format: PBC

3. North Pipe and Port Controls (60000h–6FFFFh)

3.1.1 Pipe A Timing

3.1.1.1 HTOTAL_A—Pipe A Horizontal Total Register

HTOTAL_A—Pipe A Horizontal Total Register	
Register Type:	MMIO
Address Offset:	60000h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

Bit	Description
31:29	**Reserved** Project: All Format: MBZ
28:16	**Pipe_A_Horizontal_Total_Display_Clocks** Project: All This 13-bit field provides Horizontal Total up to 8192 pixels encompassing the Horizontal Active Display period, front/back border and retrace period. This field is programmed to the number of clocks desired minus one. This number of clocks needs to be a multiple of two when driving the LVDS port in two channel mode. This value should always be equal or greater to the sum of the horizontal active and the horizontal blank, and border region sizes.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Pipe_A_Horizontal_Active_Display_Pixels** Project: All This 12-bit field provides Horizontal Active Display resolutions up to 4096 pixels. Note that the first horizontal active display pixel is considered pixel number 0. The value programmed should be the (active pixels/line – 1). The number of active pixels will be limited to multiples of two pixels when driving the integrated LVDS port in two channel mode. The minimum horizontal active display size allowed will be 64 pixels.

3.1.1.2 HBLANK_A—Pipe A Horizontal Blank Register

HBLANK_A—Pipe A Horizontal Blank Register	
Register Type:	MMIO
Address Offset:	60004h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

Bit	Description
31:29	**Reserved** Project: All Format:
28:16	**Pipe_A_Horizontal_Blank_End** Project: All This 13-bit field specifies the position of Horizontal Blank End expressed in terms of the absolute pixel number relative to the horizontal active display start. The value programmed should be the HBLANK End pixel position, where the first active pixel is considered position 0; the second active pixel is considered position 1, etc. Horizontal blank ending at the same point as the horizontal total indicates that there is no left hand border area. HBLANK size has a minimum value of 32 clocks. The number of clocks within blank needs to be a multiple of two when driving the LVDS port in two channel mode. The value loaded in the register would be equal to RightBorder+Active+HBlank-1. The border must be 0, so this register must always be programmed to the same value as the Horizontal Total.
15:13	**Reserved** Project: All Format:
12:0	**Pipe_A_Horizontal_Blank_Start** Project: All This 13-bit field specifies the Horizontal Blank Start position expressed in terms of the absolute pixel number relative to the horizontal active display start. The value programmed should be the HBLANK Start pixel position, where the first active pixel is considered position 0; the second active pixel is considered position 1, etc. The number of clocks for both left and right borders need to be a multiple of two when driving the LVDS port in two channel mode. Horizontal blank should only start after the end of the horizontal active region. The value loaded in the register would be equal to RightBorder+Active-1. The border must be 0, so this register must always be programmed to the same value as the Horizontal Active.

3.1.1.3 HSYNC_A—Pipe A Horizontal Sync Register

HSYNC_A—Pipe A Horizontal Sync Register	
Register Type:	MMIO
Address Offset:	60008h
Project:	All
Default Value:	00000000h
Size (in bits):	32

Bit	Description
31:29	**Reserved** Project: All Format: MBZ
28:16	**Pipe_A_Horizontal_Sync_End** Project: All Default Value: 0b This 13-bit field specifies the horizontal Sync End position expressed in terms of the absolute pixel number relative to the horizontal active display start. The value programmed should be the HSYNC End pixel position, where the first active pixel is considered position 0; the second active pixel is considered position 1, etc. The number of clocks in the sync period needs to be a multiple of two when driving the LVDS port in two channel mode. This value should be greater than the horizontal sync start position and would be loaded with the Active+RightBorder+FrontPorch+Sync-1.
15:13	**Reserved** Project: All Format: MBZ
12:0	**Pipe_A_Horizontal_Sync_Start** Project: All Default Value: 0b This 13-bit field specifies the horizontal Sync Start position expressed in terms of the absolute pixel number relative to the horizontal active display start. The value programmed should be the HSYNC Start pixel position, where the first active pixel is considered position 0; the second active pixel is considered position 1, etc. Note that when HSYNC Start is programmed equal to HBLANK Start, both HSYNC and HBLANK will be asserted on the same pixel clock. It should never be programmed to less than HBLANK start. The number of cycles from the beginning of the line needs to be a multiple of two when driving the LVDS port in two channel mode. This register should not be less than the horizontal active end. This register should be loaded with the Active+RightBorder+FrontPorch-1.

3.1.1.4 VTOTAL_A—Pipe A Vertical Total Register

VTOTAL_A—Pipe A Vertical Total Register	
	MMIO
Address Offset:	6000Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

Bit	Description
31:29	**Reserved** Project: All Format:
28:16	**Pipe_A_Vertical_Total_Display_Lines** Project: All This 13 bit field provides Vertical Total up to 8192 lines encompassing the Vertical Active Display Lines, top/bottom border and retrace period. The value programmed should be the number of lines required minus one. Vertical total needs to be large enough to be greater than the sum of the vertical active, vertical border, and the vertical blank regions. The vertical counter is incremented on the leading edge of the horizontal sync. For interlaced display modes, this indicates the total number of lines in both fields. In interlaced modes, hardware automatically divides this number by 2 to get the number of lines in each field.
15:12	**Reserved** Project: All Format:
11:0	**Pipe_A_Vertical_Active_Display_Lines** Project: All This 12-bit field provides vertical active display resolutions up to 4096 lines. It should be programmed with the desired number of lines minus one. When using the internal panel fitting logic, the minimum vertical active area must be seven lines. For interlaced display modes, this indicates the total number of lines in both fields. In interlaced modes, hardware automatically divides this number by 2 to get the number of lines in each field.

3.1.1.5 VBLANK_A—Pipe A Vertical Blank Register

VBLANK_A—Pipe A Vertical Blank Register	
	MMIO
Address Offset:	60010h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

Bit	Description
31:29	**Reserved** Project: All Format:

VBLANK_A—Pipe A Vertical Blank Register	
28:16	**Pipe_A_Vertical_Blank_End** Project: All This 13-bit field specifies the Vertical Blank End position expressed in terms of the absolute Line number relative to the vertical active display start. The value programmed should be the VBLANK End line position, where the first active line is considered line 0, the second active line is considered line 1, etc. The end of vertical blank should be after the start of vertical blank and before or equal to the vertical total. This register should be loaded with the Vactive+BottomBorder+VBlank-1. For interlaced display modes, hardware automatically divides this number by 2 to get the vertical blank end in each field. It does not count the two half lines that get added when operating in modes with half lines. The border must be 0, so this register must always be programmed to the same value as the Vertical Total.
15:13	**Reserved** Project: All Format:
12:0	**Pipe_A_Vertical_Blank_Start** Project: All This 13-bit field specifies the Vertical Blank Start expressed in terms of the absolute line number relative to the vertical active display start. The value programmed should be the VBLANK Start line position, where the first active line is considered line 0, the second active line is considered line 1, etc. Minimum vertical blank size is required to be at least three lines. Blank should start after the end of active. This register is loaded with the Vactive+BottomBorder-1. For interlaced display modes, hardware automatically divides this number by 2 to get the vertical blank start in each field. It does not count the two half lines that get added when operating in modes with half lines. The border must be 0, so this register must always be programmed to the same value as the Vertical Active.

3.1.1.6 VSYNC_A—Pipe A Vertical Sync Register

VSYNC_A—Pipe A Vertical Sync Register	
	MMIO
Address Offset:	60014h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Bit	**Description**
31:29	**Reserved** Project: All Format:
28:16	**Pipe_A_Vertical_Sync_End** Project: All This 13-bit field specifies the Vertical Sync End position expressed in terms of the absolute Line number relative to the vertical active display start. The value programmed should be the VSYNC End line position, where the first active line is considered line 0, the second active line is considered line 1, etc. This register should be loaded with Vactive+BottomBorder+FrontPorch+Sync-1. For interlaced display modes, hardware automatically divides this number by 2 to get the vertical sync end in each field. It does not count the two half lines that get added when operating in modes with half lines.

VSYNC_A—Pipe A Vertical Sync Register		
15:13	**Reserved** Project: All Format:	
12:0	**Pipe_A_Vertical_Sync_Start** Project: All This 13-bit field specifies the Vertical Sync Start position expressed in terms of the absolute line number relative to the vertical active display start. The value programmed should be the VSYNC Start line position, where the first active line is considered line 0, the second active line is considered line 1, etc. This register would be loaded with Vactive+BottomBorder+FrontPorch-1. For interlaced display modes, hardware automatically divides this number by 2 to get the vertical sync start in each field. It does not count the two half lines that get added when operating in modes with half lines.	

3.1.1.7 PIPEASRC—Pipe A Source Image Size

PIPEASRC—Pipe A Source Image Size	
	MMIO
Address Offset:	6001Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27:16	**Pipe_A_Horizontal_Source_Image_Size** Project: All This 12-bit field specifies Horizontal source image size up to 4096. This determines the size of the image created by the display planes sent to the blender. The value programmed should be the source image size minus one. It must represent a size that is a multiple of two (even numbers) when driving the LVDS port in two channel mode. This implies that for this mode, the value programmed will always be an odd number. Except in the case of panel fitting internal or in an external device, this register field would be programmed to a value identical to the horizontal active. This is the only register of the timing registers that is allowed to be programmed while the pipe is enabled.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Pipe_A_Vertical_Source_Image_Size** Project: All This 12-bit field specifies the vertical source image size up to 4096 lines. This determines the size of the image created by the display planes sent to the blender. The value programmed should be the source image size minus one. Except in the case of panel fitting internal or in an external device, this register field would be programmed to a value identical to the vertical active. For interlaced display modes, hardware automatically divides this number by 2 to get the vertical source image size in each field.

3.1.1.8 VSYNCSHIFT_A— Vertical Sync Shift Register

VSYNCSHIFT_A— Vertical Sync Shift Register	
	MMIO
Address Offset:	60028h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Trusted Type:	1

Bit	Description
31:13	**Reserved** Project: All Format:
12:0	**Pipe_A_Second_Field_Vertical_Sync_Shift** Project: All This value specifies the vertical sync alignment for the start of the interlaced second field expressed in terms of the absolute pixel number relative to the horizontal active display start. This value will only be used if the PIPEACONF is programmed to an interlaced mode. Typically, the interlaced second field vertical sync should start one pixel after the point halfway between successive horizontal syncs, so the value of this register should be programmed to: (horizontal sync start - floor[horizontal total / 2]). (use the actual horizontal sync start and horizontal total values and not the minus one values programmed into the registers) This vertical sync shift only occurs during the interlaced second field. In all other cases the vertical sync start position is aligned with horizontal sync start.

3.1.2 Pipe A M/N Values

Calculation of TU is as follows:
For modes that divide into the link frequency evenly,
Active/TU = payload/capacity
Please note that this is the same ratio as data m/n:
Payload/capacity = dot clk * bytes per pixel / ls_clk * # of lanes

3.1.2.1 PipeADataN1— Pipe A Data N value 1

PipeADataM1— Pipe A Data M value 1					
Register Type:	MMIO				
Address Offset:	60030h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
This is the primary pipe data M value used for embedded DisplayPort and FDI. It is used in conjunction with the data N value 1. When switching between two refresh rates, both the M1/N1 data and link values and the M2/N2 link values must be programmed. Data M value 1 is used for the higher power M value setting.					
Bit	**Description**				
31	**Reserved**	Project:	All	Format:	MBZ
24	**Reserved**	Project:	All	Format:	MBZ
23:0	**Pipe_A_Data_M_value**			Project:	All
	This field is the m value for internal use of the DDA. Calculation of this value is as follows: **Data m/n = dot clock * bytes per pixel / ls_clk * # of lanes**				

3.1.2.2 PipeADataM2— Pipe A Data M value 2

PipeADataM2— Pipe A Data M value 2						
Register Type:	MMIO					
Address Offset:	60038h					
Project:	All					
Default Value:	00000000h					
Access:	R/W					
Size (in bits):	32					
This is the second pipe data M value used for embedded FDI. It is used in conjunction with the data N value 2. When switching between two refresh rates, both the M1/N1 data and link values and the M2/N2 link values must be programmed. This value updates at the beginning of vblank. Data M value 2 is used for the lower power M value setting.						
Bit	**Description**					
31	**Reserved**	Project:	All	Format:	MBZ	
24	**Reserved**	Project:	All	Format:	MBZ	
23:0	**Pipe_A_Data_M_value**				Project:	All
	This field is the m value for internal use of the DDA. Calculation of this value is as follows: **Data m/n = dot clock * bytes per pixel / ls_clk * # of lanes**					

3.1.2.3 PipeADataN2— Pipe A Data N value 2

PipeADataN2— Pipe A Data N value 2						
Register Type:	MMIO					
Address Offset:	6003Ch					
Project:	All					
Default Value:	00000000h					
Access:	R/W					
Size (in bits):	32					
This is the second pipe data N value used for FDI. It is used in conjunction with the data N value 2. When switching between two refresh rates, both the M1/N1 data and link values and the M2/N2 link values must be programmed. This value updates at the beginning of vblank. Data N value 2 is used for the lower power N value setting.						
Bit	**Description**					
31:24	**Reserved**	Project:	All		Format:	MBZ
23:0	**Pipe_A_Data_N_value**				Project:	All
	This field is the n value for internal use of the DDA. Calculation of this value is as follows: **Data m/n = dot clock * bytes per pixel / ls_clk * # of lanes**					

3.1.2.4 PipeADPLinkM1— Pipe A Link M value 1

PipeADPLinkM1— Pipe A Link M value 1						
Register Type:	MMIO					
Address Offset:	60040h					
Project:	All					
Default Value:	00000000h					
Access:	R/W					
Size (in bits):	32					
This is the primary link data M value used for embedded FDI. It is used in conjunction with the link N value 1. When switching between two refresh rates, both the M1/N1 data and link values and the M2/N2 link values must be programmed. This value updates at the beginning of vblank. Link M value 1 is used for the higher power M value setting.						
Bit	**Description**					
31:24	**Reserved**	Project:	All		Format:	MBZ

PipeADPLinkM1— Pipe A Link M value 1	
23:0	**Pipe_A_Link_M_value** Project: All This field is the m value for external transmission in the Main Stream Attributes. Calculation of this value is as follows: **Link m/n = pixel clk / ls_clk**

3.1.2.5 PipeADPLinkN1— Pipe A Link N value 1

PipeADPLinkN1— Pipe A Link N value 1	
Register Type:	MMIO
Address Offset:	60044h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
This is the primary link data N value used for embedded FDI. It is used in conjunction with the link N value 1. When switching between two refresh rates, both the M1/N1 data and link values and the M2/N2 link values must be programmed. This value updates at the beginning of vblank. Link N value 1 is used for the higher power N value setting.	
Bit	**Description**
31:24	**Reserved** Project: All Format: MBZ
23:0	**Pipe_A_Link_N_value** Project: All This field is the n value for external transmission in the Main Stream Attributes and VB-ID. Calculation of this value is as follows (to be filled in): **Link m/n = pixel clk / ls_clk**

3.1.2.6 PipeADPLinkM2— Pipe A Link M value 2

PipeADPLinkM2— Pipe A Link M value 2					
Register Type:	MMIO				
Address Offset:	60048h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
This is the secondary link data M value used for embedded FDI. It is used in conjunction with the link N value 2. When switching between two refresh rates, both the M1/N1 data and link values and the M2/N2 link values must be programmed. This value updates at the beginning of vblank. Link M value 2 is used for the lower power M value setting.					
Bit	**Description**				
31:24	**Reserved**	Project:	All	Format:	MBZ
23:0	**Pipe_A_Link_M_value**			Project:	All
	This field is the m value for external transmission in the Main Stream Attributes. Calculation of this value is as follows: **Link m/n = pixel clk / ls_clk**				

3.1.2.7 PipeADPLinkN2— Pipe A Link N value 2

PipeADPLinkN2— Pipe A Link N value 2					
Register Type:	MMIO				
Address Offset:	6004Ch				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
This is the secondary link data N value used for embedded FDI. It is used in conjunction with the link N value 1. When switching between two refresh rates, both the M1/N1 data and link values and the M2/N2 link values must be programmed. This value updates at the beginning of vblank. Link N value 2 is used for the lower power N value setting.					
Bit	**Description**				
31:24	**Reserved**	Project:	All	Format:	MBZ

PipeADPLinkN2— Pipe A Link N value 2	
23:0	**Pipe_A_Link_N_value** Project: All This field is the n value for external transmission in the Main Stream Attributes and VB-ID. Calculation of this value is as follows (to be filled in): **Link m/n = pixel clk / ls_clk**

3.1.3 Pipe B M/N Values

3.1.3.1 PipeBDataM1— Pipe B Data M value 1

PipeBDataM1— Pipe B Data M value 1			
Register Type: MMIO **Address Offset:** 61030h **Project:** All **Default Value:** 00000000h **Access:** R/W **Size (in bits):** 32			
See pipe A description			
Bit	**Description**		
31	**Reserved** Project: All	Format:	MBZ
30:25	**TU_Size** See pipe A description	Project:	All
24	**Reserved** Project: All	Format:	MBZ
23:0	**Pipe_B_Data_M_value** See pipe A description	Project:	All

3.1.3.2 PipeBDataN1— Pipe B Data N value 1

PipeBDataN1— Pipe B Data N value 1					
Register Type:	MMIO				
Address Offset:	61034h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
See pipe A description					
Bit	**Description**				
31:24	**Reserved**	Project:	All	Format:	MBZ
23:0	**Pipe_B_Data_N_value** See pipe A description			Project:	All

3.1.3.3 PipeBDataM2— Pipe B Data M value 2

PipeBDataM2— Pipe B Data M value 2					
Register Type:	MMIO				
Address Offset:	61038h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
See pipe A description					
Bit	**Description**				
31	**Reserved**	Project:	All	Format:	MBZ
30:25	**TU_Size** See pipe A description			Project:	All
24	**Reserved**	Project:	All	Format:	MBZ
23:0	**Pipe_B_Data_M_value** See pipe A description			Project:	All

3.1.3.4 PipeBDataN2— Pipe B Data N value 2

PipeBDataN2— Pipe B Data N value 2					
Register Type:	MMIO				
Address Offset:	6103Ch				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
See pipe A description					
Bit	**Description**				
31:24	**Reserved** Project: All Format: MBZ				
23:0	**Pipe_B_Data_N_value** Project: All See pipe A description				

3.1.3.5 PipeBDPLinkM1— Pipe B Link M value 1

PipeBDPLinkM1— Pipe B Link M value 1					
Register Type:	MMIO				
Address Offset:	61040h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
See pipe A description					
Bit	**Description**				
31:24	**Reserved** Project: All Format: MBZ				
23:0	**Pipe_B_Link_M_value** Project: All See pipe A description				

3.1.3.6 PipeBDPLinkN1— Pipe B Link N value 1

PipeBDPLinkN1— Pipe B Link N value 1					
Register Type:	MMIO				
Address Offset:	61044h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
See pipe A description.					
Bit	**Description**				
31:24	**Reserved**	Project:	All	Format:	MBZ
23:0	**Pipe_B_Link_N_value** See pipe A description			Project:	All

3.1.3.7 PipeBDPLinkM2— Pipe B Link M value 2

PipeBDPLinkM2— Pipe B Link M value 2					
Register Type:	MMIO				
Address Offset:	61048h				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
See pipe A description					
Bit	**Description**				
31:24	**Reserved**	Project:	All	Format:	MBZ
23:0	**Pipe_B_Link_M_value** See pipe A description			Project:	All

3.1.3.8 PipeBDPLinkN2— Pipe B Link N value 2

PipeBDPLinkN2— Pipe B Link N value 2					
Register Type:	MMIO				
Address Offset:	6104Ch				
Project:	All				
Default Value:	00000000h				
Access:	R/W				
Size (in bits):	32				
See pipe A description					
Bit	**Description**				
31:24	**Reserved**	Project:	All	Format:	MBZ
23:0	**Pipe_B_Link_N_value** See pipe A description			Project:	All

3.1.4 Panel Fitter Control Registers

3.1.4.1 PF_PWR_GATE_CTRL—Panel Fitter Power Gate Control

PFA_PWR_GATE_CTRL—Panel Fitter A Power Gate Control					
Register Type:	MMIO				
Address Offset:	68060h				
Project:	DevSNB				
Default Value:	00006453h				
Access:	R/W				
Size (in bits):	32				
Double Buffer Update Point:	Start of vertical blank after armed				
Double Buffer Armed By:	Write to PFA_WIN_SZ				
Bit	**Description**				
31:16	**Reserved**	Project:	All	Format:	MBZ

PFA_PWR_GATE_CTRL—Panel Fitter A Power Gate Control

15:13 **LATE_SIGNAL_SEQUENCE_START** Project: All

Start of the late signal to the first RAM bank in number of cdclks after the start of power gating sequence. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
000b	Start time 0	Start time 0	All
001b	Start time 256	Start time 256	All
010b	Start time 512	Start time 512	All
011b	Start time 768	Start time 768	All
100b	Start time 1024	Start time 1024	All
101b	Start time 1280	Start time 1280	All
110b	Start time 1536	Start time 1536	All
111b	Start time 1792	Start time 1792	All

12 **Reserved** Project: All Format: MBZ

11:9 **MID_SIGNAL_SEQUENCE_START** Project: All

Start of the mid signal to the first RAM bank in number of cdclks after the start of power gating sequence. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
000b	Start time 0	Start time 0	All
001b	Start time 256	Start time 256	All
010b	Start time 512	Start time 512	All
011b	Start time 768	Start time 768	All
100b	Start time 1024	Start time 1024	All
101b	Start time 1280	Start time 1280	All
110b	Start time 1536	Start time 1536	All
111b	Start time 1792	Start time 1792	All

8 **Reserved** Project: All Format: MBZ

7:6 **LATE_SIGNAL_DELAY** Project: All

Delay between late signals going into successive RAM banks in number of cdclks. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
00b	Start time 0	Start time 0	All
01b	Start time 256	Start time 256	All
10b	Start time 512	Start time 512	All
11b	Start time 768	Start time 768	All

5 **Reserved** Project: All Format: MBZ

PFA_PWR_GATE_CTRL—Panel Fitter A Power Gate Control

4:3	**MID_SIGNAL_DELAY** Project: All Delay between mid signals going into successive RAM banks in number of cdclks. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
00b	Start time 0	Start time 0	All
01b	Start time 256	Start time 256	All
10b	Start time 512	Start time 512	All
11b	Start time 768	Start time 768	All

2	**Reserved** Project: All Format: MBZ
1:0	**EARLY_SIGNAL_DELAY** Project: All Delay between early signals going into successive RAM banks in number of cdclks. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
00b	Start time 0	Start time 0	All
01b	Start time 256	Start time 256	All
10b	Start time 512	Start time 512	All
11b	Start time 768	Start time 768	All

PFB_PWR_GATE_CTRL—Panel Fitter B Power Gate Control

Register Type:	MMIO
Address Offset:	68860h
Project:	DevSNB
Default Value:	00006453h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to PFA_WIN_SZ

Bit	Description
31:16	**Reserved** Project: All Format: MBZ

PFB_PWR_GATE_CTRL—Panel Fitter B Power Gate Control

15:13 **LATE_SIGNAL_SEQUENCE_START** Project: All

Start of the late signal to the first RAM bank in number of cdclks after the start of power gating sequence. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
000b	Start time 0	Start time 0	All
001b	Start time 256	Start time 256	All
010b	Start time 512	Start time 512	All
011b	Start time 768	Start time 768	All
100b	Start time 1024	Start time 1024	All
101b	Start time 1280	Start time 1280	All
110b	Start time 1536	Start time 1536	All
111b	Start time 1792	Start time 1792	All

12 **Reserved** Project: All Format: MBZ

11:9 **MID_SIGNAL_SEQUENCE_START** Project: All

Start of the mid signal to the first RAM bank in number of cdclks after the start of power gating sequence. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
000b	Start time 0	Start time 0	All
001b	Start time 256	Start time 256	All
010b	Start time 512	Start time 512	All
011b	Start time 768	Start time 768	All
100b	Start time 1024	Start time 1024	All
101b	Start time 1280	Start time 1280	All
110b	Start time 1536	Start time 1536	All
111b	Start time 1792	Start time 1792	All

8 **Reserved** Project: All Format: MBZ

7:6 **LATE_SIGNAL_DELAY** Project: All

Delay between late signals going into successive RAM banks in number of cdclks. Applicable for both power gating on and off conditions.

Value	Name	Description	Project
00b	Start time 0	Start time 0	All
01b	Start time 256	Start time 256	All
10b	Start time 512	Start time 512	All
11b	Start time 768	Start time 768	All

5 **Reserved** Project: All Format: MBZ

PFB_PWR_GATE_CTRL—Panel Fitter B Power Gate Control	
4:3	**MID_SIGNAL_DELAY** Project: All Delay between mid signals going into successive RAM banks in number of cdclks. Applicable for both power gating on and off conditions. **Value** / **Name** / **Description** / **Project** 00b / Start time 0 / Start time 0 / All 01b / Start time 256 / Start time 256 / All 10b / Start time 512 / Start time 512 / All 11b / Start time 768 / Start time 768 / All
2	**Reserved** Project: All Format: MBZ
1:0	**EARLY_SIGNAL_DELAY** Project: All Delay between early signals going into successive RAM banks in number of cdclks. Applicable for both power gating on and off conditions. **Value** / **Name** / **Description** / **Project** 00b / Start time 0 / Start time 0 / All 01b / Start time 256 / Start time 256 / All 10b / Start time 512 / Start time 512 / All 11b / Start time 768 / Start time 768 / All

3.1.4.2 PF_WIN_POS—Panel Fitter Window Position

PFA_WIN_POS—Panel Fitter A Window Position	
Register Type:	MMIO
Address Offset:	68070h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to PFA_WIN_SZ
Bit	**Description**
31:29	**Reserved** Project: All Format:
28:16	**XPOS** Project: All The X coordinate (in pixels) of the upper left most pixel of the display window. Measured from the end of horizontal blank.
15:12	**Reserved** Project: All Format:

PFA_WIN_POS—Panel Fitter A Window Position	
11:0	**YPOS** Project: All The Y coordinate (in lines) of the upper left most pixel of the display window. Measured from the end of the start of the Non-Blanked Region (or end of the vertical interval, whatever).

PFB_WIN_POS—Panel Fitter B Window Position	
Register Type:	MMIO
Address Offset:	68870h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to PFB_WIN_SZ

Bit	Description
31:29	**Reserved** Project: All Format:
28:16	**XPOS** Project: All The X coordinate (in pixels) of the upper left most pixel of the display window. Measured from the end of horizontal blank.
15:12	**Reserved** Project: All Format:
11:0	**YPOS** Project: All The Y coordinate (in lines) of the upper left most pixel of the display window. Measured from the end of the start of the Non-Blanked Region (or end of the vertical interval, whatever).

]
]

3.1.4.3 PF_WIN_SZ—Panel Fitter Window Size

Coordinates are determined with a value of (0,0) being the upper left corner of the display device (rotation does not affect this). Writes to the window size arm PF registers for the pipe.

PFA_WIN_SZ—Panel Fitter A Window Size				
Register Type:	MMIO			
Address Offset:	68074h			
Project:	All			
Default Value:	00000000h			
Access:	R/W			
Size (in bits):	32			
Double Buffer Update Point:	Start of vertical blank			
Bit	**Description**			
31:29	**Reserved**	Project: All		Format:
28:16	**XSIZE**	Project: All		
	The horizontal size in pixels of the desired video window.			
15:12	**Reserved**	Project: All		Format:
11:0	**YSIZE**	Project: All		
	The vertical size in pixels of the desired video window. LSB must be zero for interlaced modes			

PFB_WIN_SZ—Panel Fitter B Window Size				
Register Type:	MMIO			
Address Offset:	68874h			
Project:	All			
Default Value:	00000000h			
Access:	R/W			
Size (in bits):	32			
Double Buffer Update Point:	Start of vertical blank			
Bit	**Description**			
31:29	**Reserved**	Project: All		Format:
28:16	**XSIZE**	Project: All		
	The horizontal size in pixels of the desired video window.			
15:12	**Reserved**	Project: All		Format:
11:0	**YSIZE**	Project: All		
	The vertical size in pixels of the desired video window. LSB must be zero for interlaced modes			

3.1.4.4 PF_CTRL_1—Panel Fitter Control 1

PFA_CTRL_1—Panel Fitter A Control 1

Register Type:	MMIO
Address Offset:	68080h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank after armed
Double Buffer Armed By:	Write to PFA_WIN_SZ

Bit	Description
31	**Enable_Pipe_Scaler** Project: All Default Value: 0b **Value** / **Name** / **Description** / **Project** 0b / Disable / Data bypasses the scaler / All 1b / Enable / The scaler is enabled / All
30	**Reserved**
29	**Reserved**
28	**Reserved**
27	**VADAPT** Project: All Puts the adaptive vertical filter into adaptive mode, intended for use in interlace output modes only. **Value** / **Name** / **Description** / **Project** 0b / Disable / Adaptive filtering disabled / All 1b / Enable / Adaptive filtering enabled / All
26:25	**VADAPT_MODE** Project: All Puts the adaptive vertical filter into adaptive mode, intended for use in interlace output modes only. **Value** / **Name** / **Description** / **Project** 00b / Least Adaptive / Least Adaptive (Recommended) / All 01b / Moderately Adaptive / Moderately Adaptive / All 10b / Reserved / Reserved / All 11b / Most Adaptive / Most Adaptive / All

PFA_CTRL_1—Panel Fitter A Control 1

24:23 **FILTER_SELECT** Project: All

Filter coefficient selection

Value	Name	Description	Project
00b	Programmed	Programmed Coefficients (Recommended)	All
01b	Hardcoded Med	Hardcoded Coefficients for Medium 3x3 Filtering	All
10b	Edge Enhance	Hardcoded Coefficients for Edge Enhancing 3x3 Filtering	All
11b	Edge Soften	Hardcoded Coefficients for Edge Softening 3x3 Filtering	All

22 **CHR_PREF** Project: All

Chroma Pre-filter enable. Can be used to further reduce chroma bandwidth in TV modes.

Value	Name	Description	Project
0b	Disable	Pre-filter disabled	All
1b	Enable	Pre-filter enabled	All

21 **Reserved**

20 **Reserved**

19:0 **Reserved** Project: All Format:

PFB_CTRL_1—Panel Fitter B Control 1

Register Type: MMIO
Address Offset: 68880h
Project: All
Default Value: 00000000h
Access: R/W
Size (in bits): 32
Double Buffer Update Point: Start of vertical blank after armed
Double Buffer Armed By: Write to PFB_WIN_SZ

Bit	Description
31	**Enable_Pipe_Scaler** Project: All Default Value: 0b

Value	Name	Description	Project
0b	Disable	Data bypasses the scaler	All
1b	Enable	The scaler is enabled	All

Bit	Description
30	**Reserved**
29	**Reserved**
28	**Reserved**
27	**VADAPT** Project: All Puts the adaptive vertical filter into adaptive mode, intended for use in interlace output modes only.

Value	Name	Description	Project
0b	Disable	Adaptive filtering disabled	All
1b	Enable	Adaptive filtering enabled	All

Bit	Description
26:25	**VADAPT_MODE** Project: All Puts the adaptive vertical filter into adaptive mode, intended for use in interlace output modes only.

Value	Name	Description	Project
00b	Least Adaptive	Least Adaptive (Recommended)	All
01b	Moderately Adaptive	Moderately Adaptive	All
10b	Reserved	Reserved	All
11b	Most Adaptive	Most Adaptive	All

PFB_CTRL_1—Panel Fitter B Control 1	
24:23	**FILTER_SELECT** Project: All Filter coefficient selection

Value	Name	Description	Project
00b	Programmed	Programmed Coefficients (Recommended)	All
01b	Hardcoded Med	Hardcoded Coefficients for Medium 3x3 Filtering	All
10b	Edge Enhance	Hardcoded Coefficients for Edge Enhancing 3x3 Filtering	All
11b	Edge Soften	Hardcoded Coefficients for Edge Softening 3x3 Filtering	All

22	**CHR_PREF** Project: All Chroma Pre-filter enable. Can be used to further reduce chroma bandwidth in TV modes.

Value	Name	Description	Project
0b	Disable	Pre-filter disabled	All
1b	Enable	Pre-filter enabled	All

21	**Reserved**
20	**Reserved**
19:0	**Reserved** Project: All Format:

3.1.5 Panel Fitter Coefficient Registers

Coefficients for the panel fitter filters are stored in sign-exponent-mantissa format. The number of mantissa bit varies based on the filter. There are three exponent bits but not all values are allowed, ranges are specified per filter. Two filter coefficients are stored in each dword, the tables below show the data packing in each of the words. Unused bits are considered reserved and should be written zero. The default value of all coefficient registers is 00000000h. Coefficients greater than 1.0 are only allowed in the center tap of the filter, center coeffs can not use the “100” exponent.

For RGB modes the Luma and Chroma filter coeffs are programmed with the same values.

Panel Fitter Coefficient Definition	
Project:	All
Bit	**Description**
15	**Sign_bit** Project: All

Value	Name	Description	Project
0b	Positive	Positive	All
1b	Negative	Negative	All

<table>
<tr><th colspan="2">Panel Fitter Coefficient Definition</th></tr>
<tr><td>14</td><td>Reserved Project: All Format: MBZ</td></tr>
<tr><td>13:12</td><td>Exponent_bits
Project: All
The meaning of the exponent bits varies for center tap or non-center tap coefficients.
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>00b</td><td>2 or 0.125</td><td>Center taps: 2 or mantissa is b.bbbbbb…
Non-center taps: 0.125 or mantissa is 0.000bbbbbbb</td><td>All</td></tr>
<tr><td>01b</td><td>1</td><td>1 or mantissa is 0.bbbbbbb…</td><td>All</td></tr>
<tr><td>10b</td><td>0.5</td><td>0.5 or mantissa is 0.0bbbbbbb…</td><td>All</td></tr>
<tr><td>11b</td><td>0.25</td><td>0.25 or mantissa is 0.00bbbbbbb…</td><td>All</td></tr>
<tr><td>others</td><td>Reserved</td><td>Reserved</td><td>All</td></tr>
</table></td></tr>
<tr><td>11:3</td><td>Mantissa Project: All
Size of the mantissa varies based on the filter, but the MSB of the mantissa is always bit 11.
Center tap coefficients use all 9 bits of mantissa.
Non-center tap coefficients use only the upper 7 bits of mantissa and the lower 2 bits are ignored.</td></tr>
<tr><td>2:0</td><td>Reserved Project: All Format: MBZ</td></tr>
</table>

3.1.6 Panel Fitter Horizontal Coefficients

Coefficients are packed in the horizontal coefficient registers as follows (with the letter representing the tap and the number representing the coefficient set):

Address	bits [31:16]	bits[15:0]
68x00	B0	A0
68x04	D0	C0
68x08	F0	E0
68x0C	A1	G0
68x10	C1	B1

etc….

3.1.6.1 PF_HFILTL_COEF—Panel Fitter Horizontal Luma/Red Coefficients

PFA_HFILTL_COEF—Panel Fitter A Horizontal Luma/Red Coefficients

Register Type: MMIO
Address Offset: 68100h
Project: All
Default Value: 00000000h
Access: R/W
Size (in bits): 60x32

17 phases of 7 taps require 60 dwords
Center coefficient is 1.2.9
Other coefficients are 1.2.7

DWord	Bit	Description				
0..59	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

PFB_HFILTL_COEF—Panel Fitter B Horizontal Luma/Red Coefficients						
Register Type:	MMIO					
Address Offset:	68900h					
Project:	All					
Default Value:	00000000h					
Access:	R/W					
Size (in bits):	60x32					
17 phases of 7 taps require 60 dwords Center coefficient is 1.2.9 Other coefficients are 1.2.7						
DWord	**Bit**	**Description**				
0..59	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

3.1.6.2 PF_HFILTC_COEF—Panel Fitter Horizontal Chroma/Green and Blue Coefficients

PFA_HFILTC_COEF—Panel Fitter A Horizontal Chroma/Green and Blue Coefficients						
Register Type:	MMIO					
Address Offset:	68200h					
Project:	All					
Default Value:	00000000h					
Access:	R/W					
Size (in bits):	60x32					
17 phases of 7 taps require 60 dwords Center coefficient is 1.2.9 Other coefficients are 1.2.7						
DWord	**Bit**	**Description**				
0..59	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

PFB_HFILTC_COEF—Panel Fitter B Horizontal Chroma/Green and Blue Coefficients	
Register Type:	MMIO
Address Offset:	68A00h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	60x32

17 phases of 7 taps require 60 dwords
Center coefficient is 1.2.9
Other coefficients are 1.2.7

DWord	Bit	Description				
0..59	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

3.1.7 Panel Fitter Vertical Coefficients

Coefficients are packed in the vertical coefficient registers as follows (with the letter representing the tap and the number representing the coefficient set). When the vertical filter is in 3 line mode the three taps used are A, C & E, B & C must be programmed to zero in three line mode.

Address	bits [31:16]	bits[15:0]
68x00	B0	A0
68x04	D0	C0
68x08	A1	E0
68x0C	C1	B1
68x10	E1	D1

etc….

3.1.7.1 PF_VFILTL_COEF—Panel Fitter Vertical Luma/Red Coefficients

PFA_VFILTL_COEF—Panel Fitter A Vertical Luma/Red Coefficients						
Register Type:	MMIO					
Address Offset:	68300h					
Project:	All					
Default Value:	00000000h					
Access:	R/W					
Size (in bits):	43x32					
17 phases of 5 taps require 43 dwords Center coefficient is 1.2.9 Other coefficients are 1.2.7						
DWord	**Bit**	**Description**				
0..42	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

PFB_VFILTC_COEF—Panel Fitter B Vertical Chroma/Green and Blue Coefficients						
Register Type:	MMIO					
Address Offset:	68C00h					
Project:	All					
Default Value:	00000000h					
Access:	R/W					
Size (in bits):	43x32					
17 phases of 5 taps require 43 dwords Center coefficient is 1.2.9 Other coefficients are 1.2.7						
DWord	**Bit**	**Description**				
0..42	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

3.1.7.2 PF_VFILTC_COEF—Panel Fitter Vertical Chroma/Green and Blue Coefficients

PFA_VFILTC_COEF—Panel Fitter A Vertical Chroma/Green and Blue Coefficients						
Register Type: MMIO **Address Offset:** 68400h **Project:** All **Default Value:** 00000000h **Access:** R/W **Size (in bits):** 43x32						
17 phases of 5 taps require 43 dwords Center coefficient is 1.2.9 Other coefficients are 1.2.7						
DWord	**Bit**	**Description**				
0..42	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

PFB_VFILTC_COEF—Panel Fitter B Vertical Chroma/Green and Blue Coefficients						
Register Type: MMIO **Address Offset:** 68C00h **Project:** All **Default Value:** 00000000h **Access:** R/W **Size (in bits):** 43x32						
17 phases of 5 taps require 43 dwords Center coefficient is 1.2.9 Other coefficients are 1.2.7						
DWord	**Bit**	**Description**				
0..42	31:16	**Coefficient2**	Project:	All	Format:	Panel Fitter Coefficient Definition
	15:0	**Coefficient1**	Project:	All	Format:	Panel Fitter Coefficient Definition

3.1.8 FDI AFE Control (6C000h–6DFFFh)

Documented separately

4. Plane Controls (70000h–7FFFFh)

4.1.1 Display Pipeline A

4.1.1.1 PIPEA_DSL—Pipe A Display Scan Line

PIPEA_DSL—Pipe A Display Scan Line

Register Type:	MMIO
Address Offset:	70000h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

This register enables the read back of the display pipe vertical “line counter”. The value increments at the leading edge of HSYNC and can be safely read any time. The value resets to line zero at the first active line of the display. In interlaced display timings, the scan line counter provides the current line in the field. One field will have a total number of lines that is one greater than the other field. Content locked display will adjust the total number of lines displayed.

Bit	Description
31	**Current_Field** Project: All Default Value: 0 Provides read back of the current field being displayed on display pipe A.
30:13	**Reserved** Project: All Format:
12:0	**Line_Counter_for_Display** Project: All Provides read back of the display pipe A vertical line counter. This is an indication of the current display scan line to be used by software to synchronize with the display.

Value	Name	Description	Project
0b	Odd	First field (odd field)	All
1b	Even	Second field (even field)	All

4.1.1.2 PIPEA_SLC—Pipe A Display Scan Line Count Range Compare

PIPEA_SLC—Pipe A Display Scan Line Count Range Compare	
Register Type:	MMIO
Address Offset:	70004h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32

[DevSNB] The scan line number register is compared with the display line value from the pipe timing generator. The result of this comparison is used to generate interrupts and render responses.
The value programmed should be desired value – 1, so for line 0, the value programmed is VTOTAL, and for line 1, the value programmed is 0. Content locked display will adjust the total number of lines displayed.

[ILK] The Top and Bottom Line Count Compare registers are compared with the display line values from pipe A timing generator. The Top compare register operator is a less than or equal, while the Bottom compare register operator is a greater than or equal. The results of these 2 comparisons are used to generate interrupts. For range check, the value programmed should be the (desired value – 1), so for line 0, the value programmed is VTOTAL, and for line 1, the value programmed is 0. Content locked display will adjust the total number of lines displayed.

Bit	Description
31	**Inclusive/Exclusive** Project: **ILK** Default Value: 0b **Value** / **Name** / **Description** / **Project** 0b / Exclusive / Exclusive: outside of the range / All 1b / Inclusive / Inclusive: within the range / All
30:29	**Reserved** Project: **ILK** Format: MBZ
28:16	**Start_Scan_Line_Number** Project: **ILK** Format: Range: 0..Vertical Total This field specifies the starting scan line number of the Scan Line Window. Scan line 0 is the first line of the display frame.
15:13	**Reserved** Project: **ILK** Format: MBZ
12:0	**End_Scan_Line_Number** Project: **ILK** Format: Range: 0..Vertical Total This field specifies the ending scan line number of the Scan Line Window. Scan line 0 is the first line of the display frame.
31:13	**Reserved** Project: **DevSNB** Format: MBZ

PIPEA_SLC—Pipe A Display Scan Line Count Range Compare	
12:0	**Scan_Line_Number** Project: **DevSNB** Range 0..Vertical Total This field specifies the scan line number on which to generate scan line interrupt and render response.

4.1.1.3 PIPEACONF—Pipe A Configuration Register

PIPEACONF—Pipe A Configuration Register	
Register Type:	MMIO
Address Offset:	70008h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank OR pipe disabled

Bit	Description
31	**Pipe_A_Enable** Project: All Default Value: 0b Setting this bit to the value of one, turns on pipe A. This must be done before any planes are enabled on this pipe. Changing it to a zero should only be done when all planes that are assigned to this pipe have been disabled. Turning the pipe enable bit off disables the timing generator in this pipe. Synchronization pulses to the display are not maintained if the timing generator is disabled. Pipe timing registers must contain valid values before this bit is enabled.

Value	Name	Description	Project
0b	Disable	Disable	All
1b	Enable	Enable	All

Bit	Description
30	**Pipe_State** Project: All Default Value: 0b This bit indicates the actual state of the pipe. Since there can be some delay between disabling the pipe and the pipe actually shutting off, this bit indicates the true current state of the pipe.

Value	Name	Description	Project
0b	Disable	Disable State	All
1b	Enable	Enable State	All

Bit	Description
29	**Reserved** Project: All Format:
28:27	**Reserved**
26	**Reserved**
26	**Reserved** Project: DevILK Format:

PIPEACONF—Pipe A Configuration Register

25:24 **Pipe_A_Palette/Gamma_Unit_Mode**

Project: All

Default Value: 0b

These bits select which mode the pipe gamma correction logic works in. See the Display Palette Registers for information on the different palette/gamma modes. Other gamma units such as in the sprite are unaffected by this bit.

Value	Name	Description	Project
00b	8 bit	8-bit Legacy Palette Mode	All
01b	10 bt	10-bit Precision Palette Mode	All
10b	12 bit	12-bit Interpolated Gamma Mode	All
11b	Reserved	Reserved	All

23:21 **Interlaced_Mode**

Project: All

Default Value: 0b

These bits are used for software control of interlaced behavior. They are updated immediately if the pipe is off, or in the vertical blank after programming if pipe is enabled.

Note: VGA display modes do not work while in interlaced fetch modes

Value	Name	Description	Project
000b	PF-PD	Progressive Fetch / Progressive display	All
001b	PF-ID	Progressive Fetch / Interlaced display (TV) **Requires panel fitting to be enabled**	All
010b	Reserved	Reserved	All
011b	IF-ID	Interlaced Fetch / Interlaced display (programmable sync, normal interlaced)	All
100b	IF-ID-DBL	Interlaced embedded panel with interlaced fetch (pixel doubling power savings mode, no PF enabled)	All
101b	PF-ID-DBL	Interlaced embedded panel with progressive fetch (pixel doubling power savings mode with PF enabled) **Requires panel fitting to be enabled**	All
others	Reserved	Reserved	All

PIPEACONF—Pipe A Configuration Register

20 — Display_Power_Mode_Switch

Project: All

Default Value: 0b

This bit is used for software to set the power saving progressive mode. The pipe enters or exits the power savings mode on the vblank after this bit is written. Please note that bits 17:16 of this register must be set to 00 in order for this bit to take effect.

Value	Name	Description	Project
0b	Progressive	Pipe is in progressive mode	All
1b	Power save	Pipe is in power savings progressive mode	All

19 — Reserved: Must be zero

18 — Reserved: Must be zero

17:16 — Refresh_Rate_CxSR_Mode_Association

Project: All

Default Value: 0b

These bits select how refresh rates are tied to big FIFO mode on pipe A. When they are set to anything other than 00, bits 23:21 of this register must be programmed to 000. Switching between 01 and 10 settings directly is not allowed. Software must program this field to 00 before switching. Software is responsible for enabling this mode only for integrated display panels that support corresponding mode.

Value	Name	Description	Project
00b	None	No dynamic refresh rate change enabled. Software control through bits 23:21 only	All
01b	PTP	Progressive-to-progressive refresh rate change enabled and tied to big FIFO mode. For the CPU and PCH, link and data M and N 1 values are used for high power settings. For the PCH, pixel clock FPA0 values are used for high power settings	All
10b	PTI	Progressive-to-interlaced refresh rate change enabled and tied to big FIFO mode. Pixel clock value does not change in this case. However, data and link M values in the CPU and PCH (as appropriate) are divided by 2 (shifted right by 1 bit) when in big FIFO mode. If scaling is enabled, the planes will fetch progressive data which will be interlaced by the panel fitter. If scaling is disabled, the planes will fetch interlaced data, reducing the amount of data fetched	All
11b		Reserved	All

PIPEACONF—Pipe A Configuration Register

15:14 Display_Rotation_Info

Project: All

Default Value: 0b

These are informative bits set by software to indicate this pipe is being rotated. Software should set these for both hardware and software rotation cases. Hardware rotation is **not** enabled through these bits.

Value	Name	Description	Project
00b	None	No rotation on this pipe	All
01b	90	90° rotation on this pipe	All
10b	180	180° rotation on this pipe	All
11b	270	270° rotation on this pipe	All

13 Color_Range_Select

Project: All

Default Value: 0b

This bit is used to select the color range of outputs.

Value	Name	Description	Project
0b	Full	Apply full 0-2^n - 1 color range to the output	All
1b	CE	Apply CE color range to the output	All

12:11 Pipe_output_color_space_select

Project: All

Default Value: 0b

Informs the ports of the pipe output color space. Plane data formats and CSC need to be programmed to match what is selected here.

Value	Name	Description	Project
00b	RGB	RGB	All
01b	YUV 601	YUV 601	All
10b	YUV 709	YUV 709	All
11b	Reserved	Reserved	All

10:9 Reserved

10:9 Reserved Project: DevILK Format:

8 Reserved Project: All Format: MBZ

PIPEACONF—Pipe A Configuration Register

7:5 Bits_Per_Color

Project: All

Default Value: 0b

This field selects the number of bits per color sent to a receiver device connected to this pipe. Color format takes place on the Vblank after being written. Color format change can be done independent of a pixel clock change.

Software should enable dithering in the pipe/port if selecting a pixel color depth higher or lower than the pixel color depth of the frame buffer.

Value	Name	Description	Project
000b	8 bits	8 bits per color	All
001b	10 bits	10 bits per color	All
010b	6 bits	6 bits per color	All
011b	12 bits	12 bits per color	All
1XXb	Reserved	Reserved	All

4 Dithering_enable

Project: All

Default Value: 0b

This bit enables dithering

Value	Name	Description	Project
0b	Disable	Dithering disabled	All
1b	Enable	Dithering enabled	All

3:2 Dithering_type

Project: All

Default Value: 0b

These bits select dithering type.

Value	Name	Description	Project
00b	Spatial	Spatial only	All
01b	ST1	Spatio-Temporal 1	All
10b	Reserved	Reserved	All
11b	Reserved	Reserved	All

1 Reserved

0 Reserved Project: All Format: MBZ

4.1.2 Display Pipeline A Counters and Timestamps

4.1.2.1 PIPEA_FRMCOUNT—Pipe A Frame Counter

PIPEA_FRMCOUNT—Pipe A Frame Counter	
Register Type:	MMIO
Address Offset:	70040h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Frame_Counter** Project: All Format: Provides read back of the display pipe frame counter. This counter increments on every start of vertical blank and rolls over back to 0 after 2^32 frames.

4.1.2.2 PIPEA_FLIPCOUNT—Pipe A Flip Counter

PIPEA_FLIPCOUNT—Pipe A Flip Counter	
Register Type:	MMIO
Address Offset:	70044h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Flip_Counter** Project: All Format: Provides read back of the display pipe flip counter. This counter increments on each flip of the surface of the primary plane on this pipe. This includes command streamer asynchronous and synchronous flips and any MMIO writes to the primary plane surface address. It rolls over back to 0 after 2^32 flips.

4.1.2.3 PIPEA_FRMTIMESTAMP—Pipe A Frame Time Stamp

PIPEA_FRMTIMESTAMP—Pipe A Frame Time Stamp	
Register Type:	MMIO
Address Offset:	70048h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Frame_Time_Stamp** Project: All Format: Provides read back of the display pipe frame time stamp. The time stamp value is sampled at every start of vertical blank. The TIMESTAMP register has information on the time stamp value.

4.1.2.4 PIPEA_FLIPTIMESTAMP—Pipe A Flip Time Stamp

PIPEA_FLIPTIMESTAMP—Pipe A Flip Time Stamp	
Register Type:	MMIO
Address Offset:	7004Ch
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Flip_Time_Stamp** Project: All Format: Provides read back of the display pipe flip time stamp. The time stamp value is sampled on each flip of the surface of the primary plane on this pipe. This includes command streamer asynchronous and synchronous flips and any MMIO writes to the primary plane surface address. The TIMESTAMP register has information on the time stamp value.

4.1.3 Display Timestamp

This register provides an elapsed real-time value that can be used as a timestamp for GPU events over short periods of time.

The register counts at a constant frequency by adjusting the increment amount according to the actual core display clock frequency. SW therefore does not need to know the reference clock frequency.

4.1.3.1 TIMESTAMP_HI—Time Stamp High Value

TIMESTAMP_HI—Time Stamp High Value	
Register Type:	MMIO
Address Offset:	70070h
Project:	All
Default Value:	00000000h
Access:	R/W Clear
Size (in bits):	32

Bit	Description
31:0	**TIMESTAMP_High** Project: All Format: This field increments every microsecond. The value in this field is latched in the Pipe Flip TIMESTAMP registers when flips occur, and in the Pipe Frame TIMESTAMP registers at start of vertical blank. The register value will reset if any value is written to it. The register is not reset by a graphics software reset.

4.1.4 Display Pipeline B

4.1.4.1 PIPEB_DSL—Pipe B Display Scan Line

PIPEB_DSL—Pipe B Display Scan Line

Register Type: MMIO
Address Offset: 71000h
Project: All
Default Value: 00000000h
Access: Read Only
Size (in bits): 32

See Pipe A description

Bit	Description
31	**Current_Field** Project: All Default Value: 0b Provides read back of the current field being displayed on display pipe B. **Value** / **Name** / **Description** / **Project** 0b / First / First field (odd field) / All 1b / Second / Second field (even field) / All
30:13	**Reserved** Project: All Format: MBZ
12:0	**Line_Counter_for_Display** Project: All Format: See pipe A description.

4.1.4.2 PIPEB_SLC—Pipe B Display Scan Line Count Range Compare

PIPEB_SLC—Pipe B Display Scan Line Count Range Compare

Register Type: MMIO
Address Offset: 71004h
Project: All
Default Value: 00000000h
Access: R/W
Size (in bits): 32

See Pipe A description

Bit	Description
31	**Inclusive/Exclusive** Project: All Default Value: 0b **Value** / **Name** / **Description** / **Project** 0b / Exclusive / Exclusive: outside of the range / All 1b / Inclusive / Inclusive: within the range / All
30:29	**Reserved** Project: All Format:
28:16	**Start_Scan_Line_Number** Project: All Default Value: 0b Format: U13 Scan lines, where scan line 0 is the first line of the display frame. Range 0..Display Buffer height in lines-1 See pipe A description
15:13	**Reserved** Project: All Format:
12:0	**End_Scan_Line_Number** Project: All Default Value: 0b Format: U13 Scan lines, where scan line 0 is the first line of the display frame. Range 0..Display Buffer height in lines-1 See pipe A description

4.1.4.3 PIPEBCONF—Pipe B Configuration Register

PIPEBCONF—Pipe B Configuration Register

Register Type:	MMIO
Address Offset:	71008h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank OR pipe disabled

Bit	Description
31	**Pipe_B_Enable** Project: All Default Value: 0b Setting this bit to the value of one, turns on pipe B. This must be done before any planes are enabled on this pipe. Changing it to a zero should only be done when all planes that are assigned to this pipe have been disabled. Turning the pipe enable bit off disables the timing generator in this pipe. Synchronization pulses to the display are not maintained if the timing generator is disabled. Pipe timing registers must contain valid values before this bit is enabled.

Value	Name	Description	Project
0b	Disable	Disable	All
1b	Enable	Enable	All

Bit	Description
30	**Pipe_State** Project: All Default Value: 0b This bit indicates the actual state of the pipe. Since there can be some delay between disabling the pipe and the pipe actually shutting off, this bit indicates the true current state of the pipe.

Value	Name	Description	Project
0b	Disable	Disable	All
1b	Enable	Enable	All

29	**Reserved** Project: All Format:
28:27	**Reserved**
26	**Reserved**
26	**Reserved** Project: DevILK Format:

PIPEBCONF—Pipe B Configuration Register

25:24

Pipe_B_Palette/Gamma_Unit_Mode

Project: All

Default Value: 0b

These bits select which mode the pipe gamma correction logic works in. See the Display Palette Registers for information on the different palette/gamma modes. Other gamma units such as in the sprite are unaffected by this bit.

Value	Name	Description	Project
00b	8 bit	8-bit Legacy Palette Mode	All
01b	10 bit	10-bit Precision Palette Mode	All
10b	12 bit	12-bit Interpolated Gamma Mode	All
11b	Reserved	Reserved	All

23:21

Interlaced_Mode

Project: All

Default Value: 0b

These bits are used for software control of interlaced behavior. They are updated immediately if the pipe is off, or in the vertical blank after programming if pipe is enabled.

Note: VGA display modes do not work while in interlaced fetch modes

Value	Name	Description	Project
000b	PF-PD	Progressive Fetch / Progressive display	All
001b	PF-ID	Progressive Fetch / Interlaced display (TV) **Requires panel fitting to be enabled**	All
010b	Reserved	Reserved	All
011b	IF-ID	Interlaced Fetch / Interlaced display (programmable sync, normal interlaced)	All
100b	IF-ID-DBL	Interlaced embedded panel with interlaced fetch (pixel doubling power savings mode, no PF enabled)	All
101b	PF-ID-DBL	Interlaced embedded panel with progressive fetch (pixel doubling power savings mode with PF enabled) **Requires panel fitting to be enabled in progressive mode**	All
11Xb	Reserved	Reserved	All

PIPEBCONF—Pipe B Configuration Register

20 — **Display_Power_Mode_Switch**

Project: All

Default Value: 0b

This bit is used for software to set the power saving progressive mode. The pipe enters or exits the power savings mode on the vblank after this bit is written. Please note that bits 17:16 of this register must be set to 00 in order for this bit to take effect.

Value	Name	Description	Project
0b	Progressive	Pipe is in progressive mode	All
1b	Power Save	Pipe is in power savings progressive mode	All

19 — **Reserved: Must be zero**

18 — **Reserved: Must be zero**

17:16 — **Refresh_Rate_CxSR_Mode_Association**

Project: All

Default Value: 0b

These bits select how refresh rates are tied to big FIFO mode on pipe B. When they are set to anything other than 00, bits 23:21 of this register must be programmed to 000. Switching between 01 and 10 settings directly is not allowed. Software must program this field to 00 before switching. Software is responsible for enabling this mode only for integrated display panels that support corresponding mode.

Value	Name	Description	Project
00b	None	No dynamic refresh rate change enabled. Software control through bits 23:21 only	All
01b	PTP	Progressive-to-progressive refresh rate change enabled and tied to big FIFO mode. For the CPU and PCH, link and data M and N 1 values are used for high power settings. For the PCH, pixel clock FPA0 values are used for high power settings	All
10b	PTI	Progressive-to-interlaced refresh rate change enabled and tied to big FIFO mode. Pixel clock value does not change in this case. However, data and link M values in the CPU and PCH (as appropriate) are divided by 2 (shifted right by 1 bit) when in big FIFO mode. If scaling is enabled, the planes will fetch progressive data which will be interlaced by the panel fitter. If scaling is disabled, the planes will fetch interlaced data, reducing the amount of data fetched	All
11b	Reserved	Reserved	All

PIPEBCONF—Pipe B Configuration Register

15:14 Display_Rotation_Info

Project: All

Default Value: 0b

These are informative bits set by software to indicate this pipe is being rotated. Software should set these for both hardware and software rotation cases. Hardware rotation is **not** enabled through these bits.

Value	Name	Description	Project
00b	None	No rotation on this pipe	All
01b	90	90° rotation on this pipe	All
10b	180	180° rotation on this pipe	All
11b	270	270° rotation on this pipe	All

13 Color_Range_Select

Project: All

Default Value: 0b

This bit is used to select the color range of outputs.

Value	Name	Description	Project
0b	Full	Apply full 0-2^n - 1 color range to the output	All
1b	CE	Apply CE color range to the output	All

12:11 Pipe_output_color_space_select

Project: All

Default Value: 0b

Informs the ports of the pipe output color space. Plane data formats and CSC need to be programmed to match what is selected here.

Value	Name	Description	Project
00b	RGB	RGB	All
01b	YUV 601	YUV 601	All
10b	YUV 709	YUV 709	All
11b	Reserved	Reserved	All

10:9 Reserved

10:9 Reserved Project: DevILK Format:

8 Reserved Project: All Format: MBZ

PIPEBCONF—Pipe B Configuration Register

7:5 Bits_Per_Color

Project: All

Default Value: 0b

This field selects the number of bits per color sent to a receiver device connected to this pipe. Color format takes place on the Vblank after being written. Color format change can be done independent of a pixel clock change.

Software should enable dithering in the pipe/port if selecting a pixel color depth higher or lower than the pixel color depth of the frame buffer.

Value	Name	Description	Project
000b	8 bits	8 bits per color	All
001b	10 bits	10 bits per color	All
010b	6 bits	6 bits per color	All
011b	12 bits	12 bits per color	All
1XXb	Reserved	Reserved	All

4 Dithering_enable

Project: All

Default Value: 0b

This bit enables dithering

Value	Name	Description	Project
0b	Disable	Dithering disabled	All
1b	Enable	Dithering enabled	All

3:2 Reserved

1 Reserved

0 Reserved Project: All Format: MBZ

4.1.5 Display Pipeline B Counters and Timestamps

4.1.5.1 PIPEB_FRMCOUNT—Pipe B Frame Counter

PIPEB_FRMCOUNT—Pipe B Frame Counter	
Register Type:	MMIO
Address Offset:	71040h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Frame_Counter** Project: All Format: See Pipe A description

4.1.5.2 PIPEB_FLIPCOUNT—Pipe B Flip Counter

PIPEB_FLIPCOUNT—Pipe B Flip Counter	
Register Type:	MMIO
Address Offset:	71044h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Flip_Counter** Project: All Format: See Pipe A description

4.1.5.3 PIPEB_FRMTIMESTAMP—Pipe B Frame Time Stamp

PIPEB_FRMTIMESTAMP—Pipe B Frame Time Stamp	
Register Type:	MMIO
Address Offset:	71048h
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Frame_Time_Stamp** Project: All Format: See Pipe A description

4.1.5.4 PIPEB_FLIPTIMESTAMP—Pipe B Flip Time Stamp

PIPEB_FLIPTIMESTAMP—Pipe B Flip Time Stamp	
Register Type:	MMIO
Address Offset:	7104Ch
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Pipe_Flip_Time_Stamp** Project: All Format: See Pipe A description

4.1.6 Cursor A Plane Control Registers

The CURACNTR active register will be updated on the vertical blank or when pipe is disabled, after the CURABASE or CURAPOPUPBASE trigger register is written, or when cursor A is not yet enabled – thus providing an atomic update of the cursor A control and base address registers.

4.1.6.1 CURACNTR—Cursor A Control Register

CURACNTR—Cursor A Control Register	
Register Type:	MMIO
Address Offset:	70080h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or cursor disabled, after armed
Double Buffer Armed By:	Write to CURABASE or CURAVGAPOPUPBASE

For Hi-res modes Cursor A is connected to pipe A only. For VGA popup it follows the VGA pipe select.

Bit	Description
31:28	**Reserved** Project: All Format:
27	**Popup_Cursor_Enabled** Project: All Default Value: 0b This bit should be turned on when using Cursor A as a popup cursor. When in popup mode, hardware interprets the cursor base address as a physical address instead of a graphics address.
26	**Cursor_Gamma_Enabled** Project: All Default Value: 0b This bit only has an effect when using the cursor in a non-VGA mode. In VGA pop-up operation, the cursor data will always bypass the gamma (palette) unit.
25	**Reserved** Project: All Format:

Bit 27:

Value	Name	Description	Project
0b	Hi-Res	Cursor A is hi-res	All
1b	VGA	Cursor A is popup	All

Bit 26:

Value	Name	Description	Project
0b	Bypass	Cursor pixel data bypasses gamma correction or palette	All
1b	Gamma	Cursor pixel data is gamma to be corrected in the pipe	All

CURACNTR—Cursor A Control Register

24 — **Pipe_Color_Space_Conversion_Enable**

Project: All

Default Value: 0b

This bit enables pipe color space conversion for the cursor pixel data. CSC mode in the pipe CSC registers must be set to match the format of the cursor pixel data.

Value	Name	Description	Project
0b	Bypass	Cursor pixel data bypasses the pipe color space conversion logic	All
1b	Pass	Cursor pixel data passes through the pipe color space conversion logic	All

23:16 — **Reserved** Project: All Format:

15 — **180°_Rotation**

Project: All

Default Value: 0b

This mode causes the cursor to be rotated 180°. Only 32 bits per pixel cursors can be rotated. This field must be zero when the cursor format is 2 bits per pixel.

Value	Name	Description	Project
0b	None	No rotation	All
1b	180	180° Rotation of 32 bit per pixel cursors	All

14 — **Trickle_Feed_Enable**

Project: DevSNB

Default Value: 0b

Value	Name	Description	Project
0b	Enable	Trickle Feed Enabled - Data requests are sent whenever there is space in the Display Data Buffer	All
1b	Disable	Trickle Feed Disabled - Data requests are sent in bursts	All

14 — **Reserved** Project: DevILK Format:

13:6 — **Reserved** Project: All Format:

CURACNTR—Cursor A Control Register

5 Cursor Mode Select

Bit 5	Bits 2:0	Mode
0	000	Cursor is disabled. This is the default after reset. When the cursor register value changes from enabled to disabled, the cursor will stop fetching data at the following VBLANK event. The cursor enable can be overridden by the pipe cursor disable bit. The value of these bits do not change when disabled by the pipe cursor disable bit.
0	001	Reserved
0	010	128 x 128 32bpp AND/INVERT (not available for VGA use) See description off 64 x 64 32bpp AND/INVERT format for byte usage
0	011	256 x 256 32bpp AND/INVERT (not available for VGA use) See description off 64 x 64 32bpp AND/INVERT format for byte usage
0	100	64 x 64 2bpp Indexed 3-color and transparency mode
0	101	64 x 64 2bpp Indexed AND/XOR 2-plane mode
0	110	64 x 64 2bpp Indexed 4-color mode
0	111	64 x 64 32bpp AND/INVERT (not available for VGA use) For each pixel: Least significant three bytes provides cursor RGB 888 color information Most Significant Byte: All Ones: Opaque, show the cursor color All Zeros: Transparent (color must also equal zero) Other: Invert the underlying display pixel data (ignore the color)
1	000	Reserved
1	001	Reserved
1	010	128 x 128 32bpp ARGB (8:8:8:8 MSB-A:R:G:B) (not available for VGA use)
1	011	256 x 256 32bpp ARGB (8:8:8:8 MSB-A:R:G:B) (not available for VGA use)
1	100	64 x 64 32bpp AND/XOR (not available for VGA use) For each pixel: Least significant three bytes provides cursor RGB 888 color information Most Significant Byte: All Ones: Opaque, show the cursor color All Zeros: Transparent (color must also equal zero) Other: XOR the cursor color with the underlying display pixel data
1	101	128 x 128 32bpp AND/XOR (not available for VGA use) See description off 64 x 64 32bpp AND/XOR format for byte usage
1	110	256 x 256 32bpp AND/XOR (not available for VGA use) See description off 64 x 64 32bpp AND/XOR format for byte usage
1	111	64 x 64 32bpp ARGB (8:8:8:8 MSB-A:R:G:B) (not available for VGA use)

4:3 **Reserved** Project: All Format:

2:0 **Cursor_Mode_Select[2:0]**

Project: All

Default Value: 0b

These three bits together with bit 5 select the mode for cursor as shown in the table described in bit 5.

4.1.6.2 CURABASE—Cursor A Base Address Register

CURABASE—Cursor A Base Address Register	
Register Type:	MMIO
Address Offset:	70084h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Writes to this register arm CURA registers
This register is only used when cursor A is in the hi-res mode. In VGA popup mode CURAVGAPOPUPBASE is used instead and this register must not be written. This register specifies the graphics memory address at which the cursor image data is located.

Bit	Description
31:12	**Cursor_Base_Address[31:12]** Project: All Address: GraphicsAddress[31:12] This field specifies bits 31:12 of the graphics address of the base of the cursor for hi-res mode. The physical address used for VGA popup cursor is in the CURAVGAPOPUPBASE register. The cursor surface address must be 4K byte aligned. The cursor must be in linear memory, it cannot be tiled. When performing 180° rotation, this address does not change, hardware will internally offset to start from the last pixel of the last line of the cursor.
11:0	**Reserved** Project: All Format:

4.1.6.3 CURAPOS—Cursor A Position Register

CURAPOS—Cursor A Position Register	
Register Type:	MMIO
Address Offset:	70088h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the screen position of the cursor. The origin of the cursor position is always the upper left corner of the active image for the display pipe that the cursor is assigned.

Bit	Description
31	**Cursor_Y-Position_Sign_Bit** Project: All This bit provides the sign bit of a signed 13-bit value that specifies the horizontal position of cursor. For normal high resolution display modes, the cursor must have at least a single pixel positioned over the active screen. For use as a VGA Popup, the entire cursor must be positioned over the active area of the VGA image.
30:28	**Reserved** Project: All Format: MBZ
27:16	**Cursor_Y-Position_Magnitude_Bits** Project: All This register provides the magnitude bits of a signed 12-bit value that specifies the vertical position of cursor. The sign bit of this value is provided by bit 31of this register. For use as a VGA Popup, the entire cursor must be positioned over the active area of the VGA image. Enabling the border in VGA (VGA Border Enable bit in the VGA Config register) includes the border in what is considered the “active area”. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the end of the active video area in the unrotated orientation
15	**Cursor_X-Position_Sign_Bit** Project: All This bit provides the sign bit of a signed 13-bit value that specifies the horizontal position of cursor. For normal high resolution display modes, the cursor must have at least a single pixel positioned over the active screen. For use as a VGA Popup, the entire cursor must be positioned over the active area of the VGA image. Enabling the border in VGA (VGA Border Enable bit in the VGA Config register) includes the border in what is considered the “active area”.
14:12	**Reserved** Project: All Format: MBZ
11:0	**Cursor_X-Position_Magnitude_Bits** Project: All These 12 bits provide the signed 13-bit value that specifies the horizontal position of cursor. The sign bit is provided by bit 15 of this register. When performing 180° rotation, this field specifies the horizontal position of the lower right corner relative to the end of the active video area in the unrotated orientation.

4.1.6.4 CURAVGAPOPUPBASE—Cursor A VGA Popup Base Address Register

CURAVGAPOPUPBASE—Cursor A VGA Popup Base Address Register	
Register Type:	MMIO
Address Offset:	7008Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Writes to this register arm CURA registers

This register is only used when cursor A is in the VGA popup mode. In hi-res mode CURABASE is used instead and this register must not be written. This register specifies the physical memory address at which the cursor image data is located.

Bit	Description
31:12	**Cursor_VGA_Popup_Base_Address[31:12]** Project: All Address: PhysicalAddress[31:12] This field specifies bits 31:12 of the physical address of the base of the cursor for VGA popup mode. The graphics address used for hi-res cursor is in the CURABASE register. The cursor surface address must be 4K byte aligned. The cursor must be in linear memory, it cannot be tiled.
11:7	**Reserved** Project: All Format:
6:0	**Cursor_VGA_Popup_Base_Address_MSBs[38:32]** Project: All Address: PhysicalAddress[38:32] This field specifies bits 38:32 of the physical address of the base of the cursor for VGA popup mode. See restrictions in Cursor VGA Popup Base Address field.

4.1.6.5 CURAPALET—Cursor A Palette registers

Cursor Palette Format	
Project:	All
Bit	**Description**
31:24	**Reserved** Project: All Format: MBZ
23:16	**Red_or_Y_Value** Project: All Format: These registers specify the cursor palette. RGB data is full range unsigned numbers. YUV data will be unsigned for the Y and excess 128 notation for the UV values. The data can be pre-gamma corrected and bypass the gamma correction logic or passed through the gamma corrector.
15:8	**Green_or_U_Value** Project: All Format:
7:0	**Blue_or_V_Value** Project: All Format:

CURAPALET—Cursor A Palette registers	
Register Type:	MMIO
Address Offset:	70090h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	4x32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

The cursor palette provides color information when using one of the indexed modes. The two-bit index selects one of the four colors or two of the colors when in the AND/XOR cursor mode. The cursor palette provides color information when using one of the indexed modes. The two-bit index selects one of the four colors or two of the colors when in the AND/XOR cursor mode.

The table below describes the palette usage for different cursor modes and indexes.

Index	2 color	3color	4color
00	palette 0	palette 0	palette 0
01	palette 1	palette 1	palette 1
10	transparent	transparent	palette 2
11	invert destination	palette 3 (palette 3 all 1s)	palette 3

Palette 3 must be programmed with all 1s for invert destination.

DWord	Bit	Description
0	31:0	**CURAPALET0** Project: All Format: Cursor Palette Format

CURAPALET—Cursor A Palette registers						
1	31:0	**CURAPALET1**	Project:	All	Format:	Cursor Palette Format
2	31:0	**CURAPALET2**	Project:	All	Format:	Cursor Palette Format
3	31:0	**CURAPALET3**	Project:	All	Format:	Cursor Palette Format

4.1.6.6 CURASURFLIVE—Cursor A Live Surface Base Address

CURASURFLIVE—Cursor A Live Surface Base Address	
Register Type:	MMIO
Address Offset:	700ACh
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Cursor_A_Live_Surface_Base_Address** Project: All Format: This gives the live value of the surface base address as being currently used for the plane.

4.1.7 Cursor B Plane Control Registers

The CURBCNTR active register will be updated on the vertical blank or when pipe is disabled, after the CURBBASE trigger register is written, or when cursor B is not yet enabled – thus providing an atomic update of the cursor B control and base address registers.

4.1.7.1 CURBCNTR—Cursor B Control Register

CURBCNTR—Cursor B Control Register

Register Type:	MMIO
Address Offset:	700C0h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or cursor disabled, after armed
Double Buffer Armed By:	Write to CURBBASE

Cursor B is connected to pipe B only.

Bit	Description
31:27	**Reserved** Project: All Format: MBZ
26	**Cursor_Gamma_Enable** Project: All Default Value: 0b **Value** / **Name** / **Description** / **Project** 0b / Bypass / Cursor pixel data bypasses gamma correction / All 1b / Corrected / Cursor pixel data is gamma to be corrected / All
25	**Reserved** Project: All Format:
24	**Pipe_Color_Space_Conversion_Enable** Project: All Default Value: 0b This bit enables pipe color space conversion for the cursor pixel data. CSC mode in the pipe CSC registers must be set to match the format of the cursor pixel data **Value** / **Name** / **Description** / **Project** 0b / Bypass / Cursor pixel data bypasses the pipe color space conversion logic / All 1b / pass / Cursor pixel data passes through the pipe color space conversion logic. / All
23:16	**Reserved** Project: All Format:

CURBCNTR—Cursor B Control Register

15

180°_Rotation

Project: All

Default Value: 0b

This mode causes the cursor to be rotated 180°. Only 32 bits per pixel cursors can be rotated. This field must be zero when the cursor format is 2 bits per pixel.

Value	Name	Description	Project
0b	None	No rotation	All
1b	180	180° Rotation of 32 bit per pixel cursors	All

14

Trickle_Feed_Enable

Project: DevSNB

Default Value: 0b

Value	Name	Description	Project
0b	Enable	Trickle Feed Enabled - Data requests are sent whenever there is space in the Display Data Buffer.	All
1b	Disable	Trickle Feed Disabled - Data requests are sent in bursts.	All

14 **Reserved** Project: DevILK Format:

13:6 **Reserved** Project: All Format: MBZ

5 **Cursor_Mode_Select** Project: All Format:

Cursor Mode Select

Defined in CURACNTR—Cursor A Control Register Bit 5.

4:3 **Reserved** Project: All Format:

2:0 **Cursor_Mode_Select** Project: All Format:

These three bits together with bit 5 select the mode for cursor as shown in CURACNTR—Cursor A Control Register Bit 5.

4.1.7.2 CURBBASE—Cursor B Base Address Register

CURBBASE—Cursor B Base Address Register	
Register Type:	MMIO
Address Offset:	700C4h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Writes to this register arm CURB registers
This register specifies the graphics memory address at which the cursor image data is located.

Bit	Description
31:12	**Cursor_Base_Address[31:12]** Project: All Address: GraphicsAddress[31:12] This register specifies the graphics address of the cursor. It also acts as a trigger event to force the update of active registers on the next display event. The cursor surface address must be 4K byte aligned. The cursor must be in linear memory, it cannot be tiled. When performing 180° rotation, this address does not change, hardware will internally offset to start from the last pixel of the last line of the cursor.
11:0	**Reserved** Project: All Format: MBZ

4.1.7.3 CURBPOS—Cursor B Position Register

CURBPOS—Cursor B Position Register	
Register Type:	MMIO
Address Offset:	700C8h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the screen position of the cursor. The origin of the cursor position is always the upper left corner of the active image for the display pipe that the cursor is assigned.

Bit	Description
31	**Cursor_Y-Position_Sign_Bit** Project: All This bit provides the sign bit of a signed 13-bit value that specifies the horizontal position of cursor. For normal high resolution display modes, the cursor must have at least a single pixel positioned over the active screen.
30:28	**Reserved** Project: All Format: MBZ
27:16	**Cursor_Y-Position_Magnitude_Bits** Project: All This register provides the magnitude bits of a signed 13-bit value that specifies the vertical position of cursor. The sign bit of this value is provided by bit 31of this register. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the end of the active video area in the unrotated orientation.
15	**Cursor_X-Position_Sign_Bit** Project: All This bit provides the sign bit of a signed 13-bit value that specifies the horizontal position of cursor. For normal high resolution display modes, the cursor must have at least a single pixel positioned over the active screen.
14:12	**Reserved** Project: All Format: MBZ
11:0	**Cursor_X-Position_Magnitude_Bits** Project: All These 12 bits provide the signed 13-bit value that specifies the horizontal position of cursor. The sign bit is provided by bit 15 of this register. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the end of the active video area in the unrotated orientation.

4.1.7.4 CURBPALET—Cursor B Palette registers

CURBPALET—Cursor B Palette registers	
Register Type:	MMIO
Address Offset:	700D0h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	4x32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

The cursor palette provides color information when using one of the indexed modes. The two-bit index selects one of the four colors or two of the colors when in the AND/XOR cursor mode. The cursor palette provides color information when using one of the indexed modes. The two-bit index selects one of the four colors or two of the colors when in the AND/XOR cursor mode. See Cursor A palette usage table.

DWord	Bit	Description
0	31:0	**CURBPALET0** Project: All Format: Cursor Palette Format
1	31:0	**CURBPALET1** Project: All Format: Cursor Palette Format
2	31:0	**CURBPALET2** Project: All Format: Cursor Palette Format
3	31:0	**CURBPALET3** Project: All Format: Cursor Palette Format

4.1.7.5 CURBSURFLIVE—Cursor B Live Surface Base Address Register

CURBSURFLIVE—Cursor B Live Surface Base Address Register	
Register Type:	MMIO
Address Offset:	700ECh
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Cursor_Live_Surface_Base_Address** Project: All Format: This gives the live value of the surface base address as being currently used for the plane.

4.1.8 Primary A Plane Control

The DSPACNTR and DSPASTRIDE active registers will be updated on the vertical blank or when pipe is disabled, after the DSPASURF trigger register is written, or when the primary A is not yet enabled – thus providing an atomic update of the primary A control, stride, and base address registers.

4.1.8.1 DSPACNTR—Primary A Control Register

DSPACNTR—Primary A Control Register

Register Type:	MMIO
Address Offset:	70180h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or primary disabled, after armed
Double Buffer Armed By:	Write to DSPASURF

Primary A Plane is connected to pipe A only.

Bit	Description
31	**Primary_Plane_Enable** Project: All Format: Enable When this bit is set, the primary plane will generate pixels for display. When set to zero, primary plane memory fetches cease and plane output is transparent. The display pipe must be enabled to enable the plane. There is an override for the enable of the plane in the Pipe Configuration register. When in Self Refresh Big FIFO mode, write to this register to enable the plane will be internally buffered and delayed while Big FIFO mode is exiting.
30	**Gamma_Enable** Project: All Default Value: 0b This bit should only be changed after the plane has been disabled. It controls the bypassing of the display pipe gamma unit for the plane pixel data. For 8-bit indexed display data, this bit should be set to a one.

Value	Name	Description	Project
0b	Bypass	Plane pixel data bypasses the display pipe gamma correction logic	All
1b	Correct	Plane pixel data is gamma corrected in the display pipe gamma correction logic.	All

DSPACNTR—Primary A Control Register

29:26

Source_Pixel_Format

Project: All

Default Value: 0b

These bits should only be changed after the plane has been disabled. Pixel format of 8-bit indexed uses the pipe palette. Before entering the blender, each source format is converted to 12 bits per pixel.

Value	Name	Description	Project
0010b	8bpp	8-bpp Indexed	All
0101b	16-bit BGRX (5:6:5 MSB-R:G:B)	pixel format (XGA compatible).	All
0110b	32-bit BGRX (8:8:8:8 MSB-X:R:G:B)	pixel format. Ignore alpha	All
1000b	32-bit RGBX (2:10:10:10 MSB-X:B:G:R)	pixel format. Ignore alpha	All
1010b	32-bit BGRX (2:10:10:10 MSB-X:R:G:B)	pixel format. Ignore alpha	All
1100b	64-bit RGBX Floating Point(16:16:16:16 MSB-X:B:G:R)	pixel format. Ignore alpha	All
1110b	32-bit RGBX (8:8:8:8 MSB-X:B:G:R) Use of 64bpp format will limit the maximum dot clock to 80% of cdclk	pixel format. Ignore alpha	All
others	Reserved	Reserved	All

25

Plane_Extended_Range_Source_Select

Project: DevSNB

Default Value: 0b

This bit is used to indicate when the plane source pixel format should be processed as having extended range. This is only valid with certain source pixel formats. If the pipe is extended range and plane extended range source is not selected, the plane will fit the source pixel data into the 0 to 1 region of the extended range.

Value	Name	Description	Project
0b	Normal	Normal range source selected	All
1b	Extended	Extended range source selected.	All

25

Reserved Project: DevILK Format:

DSPACNTR—Primary A Control Register

24 **Pipe_Color_Space_Conversion_Enable**

Project: All

Default Value: 0b

This bit enables pipe color space conversion for the plane pixel data. CSC mode in the pipe CSC registers must be set to match the format of the plane pixel data.

Value	Name	Description	Project
0b	Bypass	Plane pixel data bypasses the pipe color space conversion logic	All
1b	Pass	Plane pixel data passes through the pipe color space conversion logic.	All

23:16 **Reserved** Project: All Format:

15 **180°_Display_Rotation**

Project: All

Default Value: 0b

This mode causes the plane to be rotated 180°. In addition to setting this bit, software must also set the surface address offset to the lower right corner of the unrotated image.

Value	Name	Description	Project
0b	None	No rotation	All
1b	180	180° rotation	All

14 **Trickle_Feed_Enable**

Project: All

Default Value: 0b

[ILK]: This bit must always be programmed to '1'.

Value	Name	Description	Project
0b	Enable	Trickle Feed Enabled - Plane data requests are sent whenever there is space in the Display Data Buffer.	All
1b	Disable	Trickle Feed Disabled - Plane data requests are sent in bursts	All

13 **Data_Buffer_Partitioning_Control(testmode)**

Project: All

Security: Test

Default Value: 0b

Note: When in CxSR Max FIFO mode, this bit will be ignored.

Value	Name	Description	Project
0b	Use Sprite	Primary A Data Buffer will use Sprite A buffer space when Sprite A is disabled	All
1b	Not use Sprite	Primary A Data Buffer will not use Sprite A buffer space when Sprite A is disabled	All

12:11 **Reserved** Project: All Format:

DSPACNTR—Primary A Control Register

10 — **Tiled_Surface**

Project: All

Default Value: 0b

This bit indicates that the plane surface data is in tiled memory. Only X tiling is supported for display surfaces.

When this bit is set, it affects the hardware interpretation of the DSPATILEOFF, DSPALINOFF, and DSPASURF registers.

Value	Name	Description	Project
0b	Linear	Plane uses linear memory	All
1b	X-tiled	Plane uses X-tiled memory	All

9 — **Asynchronous_Surface_Address_Update_Enable**

Project: All

Default Value: 0b

This bit will enable asynchronous updates of the surface address when written by MMIO. The surface address will change with the next TLB request or when start of vertical blank is reached. Updates during vertical blank may not complete until after the first few active lines are displayed.

Restrictions:

- No command streamer initiated surface address updates to this plane are allowed when this bit is enabled.
- Wait for flip done indication in pipe status register before writing the surface address register again with this bit set.

Value	Name	Description	Project
0b	Sync	Surface Address MMIO writes will update synchronous to start of vertical blank	All
1b	Async	Surface Address MMIO writes will update asynchronously	All

8:0 — **Reserved** Project: All Format: MBZ

Primary Plane Source Pixel Format Mapping of Bits to Colors:
Note: For 64-bit Floating Point format, each of the 16 bit color components is 1:5:10 MSB-sign:exponent:fraction

PRIMARY RGB	Ignored	Red	Green	Blue
16-bit BGRX 5:6:5	N/A	15:11	10:5	4:0
32-bit BGRX 8:8:8	31:24	23:16	15:8	7:0
32-bit RGBX 10:10:10	31:30	9:0	19:10	29:20
32-bit BGRX 10:10:10	31:30	29:20	19:10	9:0
64-bit RGBX Float 16:16:16	63:48	15:0	31:16	47:32
32-bit RGBX 8:8:8	31:24	7:0	15:8	23:16

4.1.8.2 DSPALINOFF—Primary A Linear Offset Register

DSPALINOFF—Primary A Linear Offset Register	
Register Type:	MMIO
Address Offset:	70184h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Bit	Description
31:0	**Primary_Linear_Offset** Project: All Format: This register provides the linear panning byte offset into the primary plane. This value is added to the surface address to get the address of the first pixel to be displayed. This offset must be at least pixel aligned. When performing 180° rotation, the unpanned offset must be the difference between the last pixel of the last line of the display data in its unrotated orientation and the display surface address. When the surface is tiled, the contents of this register are ignored.

4.1.8.3 DSPASTRIDE—Primary A Stride Register

DSPASTRIDE—Primary A Stride Register	
Register Type:	MMIO
Address Offset:	70188h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or primary disabled, after armed
Double Buffer Armed By:	Write to DSPASURF

Bit	Description
31:16	**Reserved** Project: All Format:
15:6	**Primary_Stride** Project: All Format: This is the stride for the primary plane in bytes. When using linear memory, this must be 64 byte aligned. When using tiled memory, this must be 512 byte aligned. This value is used to determine the line to line increment for the display. This register is updated through either a command packet passed through the command stream or writes to this register. The stride is limited to a maximum of 32K bytes for both linear and tiled memory.
5:0	**Reserved** Project: All Format:

4.1.8.4 DSPASURF—Primary A Surface Base Address Register

DSPASURF—Primary A Surface Base Address Register	
Register Type:	MMIO
Address Offset:	7019Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled
Writes to this register arm DSPA registers	

DSPASURF—Primary A Surface Base Address Register	
Bit	**Description**
31:12	**Primary_Surface_Base_Address** Project: All Address: GraphicsAddress[31:12] This address specifies the surface base address. When the surface is tiled, panning is specified using (x, y) offsets in the DSPATILEOFF register. When the surface is in linear memory, panning is specified using a linear offset in the DSPALINOFF register. This address must be 4K aligned. When performing asynchronous flips and the display surface is in tiled memory, this address must be 256K aligned. This register can be written directly through software or by command packets in the command stream. It represents an offset from the graphics memory aperture base and is mapped to physical pages through the global GTT.
11:3	**Reserved** Project: All Format:
2	**Reserved** Project: ILK Format: MBZ
0	**Reserved** Project: All Format: MBZ

4.1.8.5 DSPATILEOFF—Primary A Tiled Offset Register

DSPATILEOFF—Primary A Tiled Offset Register	
Register Type:	MMIO
Address Offset:	701A4h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the panning for the display surface. The surface base address is specified in the DSPASURF register, and this register is used to describe an offset from that base address. When the surface is in linear memory, the offset is specified in the DSPALINOFF register and the contents of this register are ignored. When the surface is tiled, the start position is specified in this register as an (x, y) offset from the beginning of the surface.

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27:16	**Primary_Start_Y-Position** Project: All Format: These 12 bits specify the vertical position in lines of the beginning of the active display plane relative to the display surface. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the start of the active display plane in the unrotated orientation.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Primary_Start_X-Position** Project: All Format: These 12 bits specify the horizontal offset in pixels of the beginning of the active display plane relative to the display surface. When performing 180° rotation, this field specifies the horizontal position of the lower right corner relative to the start of the active display plane in the unrotated orientation.

4.1.8.6 DSPASURFLIVE—Primary A Live Surface Base Address

DSPASURFLIVE—Primary A Live Surface Base Address	
Register Type:	MMIO
Address Offset:	701ACh
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32
Trusted Type:	1

Bit	Description
31:0	**Primary_Live_Surface_Base_Address** Project: All Address: GraphicsAddress[31:0] This gives the live value of the surface base address as being currently used for the plane.

4.1.9 Primary B Plane Control

The DSPBCNTR and DSPBSTRIDE active registers will be updated on the vertical blank or when pipe is disabled, after the DSPBSURF trigger register is written, or when the primary B is not yet enabled – thus providing an atomic update of the primary B control, stride, and base address registers.

4.1.9.1 DSPBCNTR—Primary B Control Register

DSPBCNTR—Primary B Control Register	
Register Type:	MMIO
Address Offset:	71180h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or primary disabled, after armed
Double Buffer Armed By:	Write to DSPBSURF
Primary B Plane is connected to pipe B only	

DSPBCNTR—Primary B Control Register

<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>31</td><td>Primary_Plane_Enable Project: All Format: Enable
When this bit is set, the primary plane will generate pixels for display. When set to zero, primary plane memory fetches cease and plane output is transparent. The display pipe must be enabled to enable the plane. There is an override for the enable of the plane in the Pipe Configuration register. When in Self Refresh Big FIFO mode, write to this register to enable the plane will be internally buffered and delayed while Big FIFO mode is exiting.</td></tr>
<tr><td>30</td><td>Gamma_Enable
Project: All
Default Value: 0b
This bit should only be changed after the plane has been disabled. It controls the bypassing of the display pipe gamma unit for the plane pixel data. For 8-bit indexed display data, this bit should be set to a one.
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>0b</td><td>Bypass</td><td>Plane pixel data bypasses the display pipe gamma correction logic</td><td>All</td></tr>
<tr><td>1b</td><td>Correct</td><td>Plane pixel data is gamma corrected in the display pipe gamma correction logic.</td><td>All</td></tr>
</table></td></tr>
<tr><td>29:26</td><td>Source_Pixel_Format
Project: All
Default Value: 0b
These bits should only be changed after the plane has been disabled. Pixel format of 8-bit indexed uses the pipe palette. Before entering the blender, each source format is converted to 12 bits per pixel.
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>0010b</td><td>8bpp</td><td>8-bpp Indexed</td><td>All</td></tr>
<tr><td>0101b</td><td>16-bit BGRX (5:6:5 MSB-R:G:B)</td><td>pixel format (XGA compatible).</td><td>All</td></tr>
<tr><td>0110b</td><td>32-bit BGRX (8:8:8:8 MSB-X:R:G:B)</td><td>pixel format. Ignore alpha</td><td>All</td></tr>
<tr><td>1000b</td><td>32-bit RGBX (2:10:10:10 MSB-X:B:G:R)</td><td>pixel format. Ignore alpha</td><td>All</td></tr>
<tr><td>1010b</td><td>32-bit BGRX (2:10:10:10 MSB-X:R:G:B)</td><td>pixel format. Ignore alpha</td><td>All</td></tr>
<tr><td>1100b</td><td>64-bit RGBX Floating Point(16:16:16:16 MSB-X:B:G:R)
Use of 64bpp format will limit the maximum dot clock to 80% of cdclk.</td><td>pixel format. Ignore alpha</td><td>All</td></tr>
<tr><td>1110b</td><td>32-bit RGBX (8:8:8:8 MSB-X:B:G:R)</td><td>pixel format. Ignore alpha</td><td>All</td></tr>
<tr><td>others</td><td>Reserved</td><td>Reserved</td><td>All</td></tr>
</table></td></tr>
</table>

DSPBCNTR—Primary B Control Register

25

Plane_Extended_Range_Source_Select

Project: DevSNB

Default Value: 0b

This bit is used to indicate when the plane source pixel format should be processed as having extended range. This is only valid with certain source pixel formats. If the pipe is extended range and plane extended range source is not selected, the plane will fit the source pixel data into the 0 to 1 region of the extended range.

Value	Name	Description	Project
0b	Normal	Normal range source selected	All
1b	Extended	Extended range source selected.	All

25 **Reserved** Project: DevILK Format:

24

Pipe_Color_Space_Conversion_Enable

Project: All

Default Value: 0b

This bit enables pipe color space conversion for the plane pixel data. CSC mode in the pipe CSC registers must be set to match the format of the plane pixel data.

Value	Name	Description	Project
0b	Bypass	Plane pixel data bypasses the pipe color space conversion logic	All
1b	Pass	Plane pixel data passes through the pipe color space conversion logic.	All

23:16 **Reserved** Project: All Format:

15

180°_Display_Rotation

Project: All

Default Value: 0b

This mode causes the plane to be rotated 180°. In addition to setting this bit, software must also set the surface address offset to the lower right corner of the unrotated image.

Value	Name	Description	Project
0b	None	No rotation	All
1b	180	180° rotation	All

14

Trickle_Feed_Enable

Project: All

Default Value: 0b

[DevILK] This bit must always be programmed to '1'.

Value	Name	Description	Project
0b	Enable	Trickle Feed Enabled - Plane data requests are sent whenever there is space in the Display Data Buffer.	All
1b	Disable	Trickle Feed Disabled - Plane data requests are sent in bursts	All

DSPBCNTR—Primary B Control Register

13 — Data_Buffer_Partitioning_Control(testmode)

Project: All

Security: Test

Default Value: 0b

Note: When in CxSR Max FIFO mode, this bit will be ignored.

Value	Name	Description	Project
0b	Use Sprite	Primary B Data Buffer will use Sprite B buffer space when Sprite B is disabled.	All
1b	Not Use Sprite	Primary B Data Buffer will not use Sprite B buffer space when Sprite B is disabled	All

12:11 — Reserved Project: All Format:

10 — Tiled_Surface

Project: All

Default Value: 0b

This bit indicates that the plane surface data is in tiled memory. Only X tiling is supported for display surfaces.

When this bit is set, it affects the hardware interpretation of the DSPBTILEOFF, DSPBLINOFF, and DSPBSURF registers.

Value	Name	Description	Project
0b	Linear	Plane uses linear memory	All
1b	X-tiled	Plane uses X-tiled memory	All

9 — Asynchronous_Surface_Address_Update_Enable

Project: All

Default Value: 0b

This bit will enable asynchronous updates of the surface address when written by MMIO. The surface address will change with the next TLB request or when start of vertical blank is reached. Updates during vertical blank may not complete until after the first few active lines are displayed.

Restrictions:

- No command streamer initiated surface address updates to this plane are allowed when this bit is enabled.
- Wait for flip done indication in pipe status register before writing the surface address register again with this bit set.

Value	Name	Description	Project
0b	Sync	Surface Address MMIO writes will update synchronous to start of vertical blank	All
1b	Async	Surface Address MMIO writes will update asynchronously	All

8:0 — Reserved Project: All Format: MBZ

See DSPACNTR - Primary Plane Source Pixel Format Mapping of Bits to Colors

4.1.9.2 DSPBLINOFF—Primary B Linear Offset Register

DSPBLINOFF—Primary B Linear Offset Register	
Register Type:	MMIO
Address Offset:	71184h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Bit	Description
31:0	**Primary_Linear_Offset** Project: All This register provides the linear panning byte offset into the primary plane. This value is added to the surface address to get the address of the first pixel to be displayed. This offset must be at least pixel aligned. When performing 180° rotation, the unpanned offset must be the difference between the last pixel of the last line of the display data in its unrotated orientation and the display surface address. When the surface is tiled, the contents of this register are ignored.

4.1.9.3 DSPBSTRIDE—Primary B Stride Register

DSPBSTRIDE—Primary B Stride Register	
Register Type:	MMIO
Address Offset:	71188h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or primary disabled, after armed
Double Buffer Armed By:	Write to DSPBSURF

Bit	Description
31:16	**Reserved** Project: All Format: MBZ

DSPBSTRIDE—Primary B Stride Register						
15:6	**Primary_Stride** Project: All This is the stride for the primary plane in bytes. When using linear memory, this must be 64 byte aligned. When using tiled memory, this must be 512 byte aligned. This value is used to determine the line to line increment for the display. This register is updated through either a command packet passed through the command stream or writes to this register. The stride is limited to a maximum of 32K bytes for both linear and tiled memory.					
5:0	**Reserved**	Project:	All		Format:	MBZ

4.1.9.4 DSPBSURF—Primary B Surface Base Address Register

DSPBSURF—Primary B Surface Base Address Register	
Register Type:	MMIO
Address Offset:	7119Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Writes to this register arm DSPB registers

Bit	Description				
31:12	**Primary_Surface_Base_Address** Project: All Address: GraphicsAddress[31:12] This address specifies the surface base address. When the surface is tiled, panning is specified using (x, y) offsets in the DSPBTILEOFF register. When the surface is in linear memory, panning is specified using a linear offset in the DSPBLINOFF register. This address must be 4K aligned. When performing asynchronous flips and the display surface is in tiled memory, this address must be 256K aligned. This register can be written directly through software or by command packets in the command stream. It represents an offset from the graphics memory aperture base and is mapped to physical pages through the global GTT.				
11:3	**Reserved**	Project:	All	Format:	
2	**Reserved**	Project:	ILK	Format:	MBZ
0	**Reserved**	Project:	All	Format:	MBZ

4.1.9.5 DSPBTILEOFF—Primary B Tiled Offset Register

Address Offset:	711A4h
Default:	00000000h
Normal Access:	Read/Write
Double Buffer Update Point:	Start of vertical blank or pipe disabled
Size:	32 bits

This register specifies the panning for the display surface. The surface base address is specified in the DSPBSURF register, and this register is used to describe an offset from that base address. When the surface is in linear memory, the offset is specified in the DSPBLINOFF register and the contents of this register are ignored. When the surface is tiled, the start position is specified in this register as an (x, y) offset from the beginning of the surface.

Bit	Descriptions
31:28	**Reserved:** Write as zero
27:16	**Primary Start Y-Position:** These 12 bits specify the vertical position in lines of the beginning of the active display plane relative to the display surface. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the start of the active display plane in the unrotated orientation.
15:12	**Reserved:** Write as zero
11:0	**Primary Start X-Position:** These 12 bits specify the horizontal offset in pixels of the beginning of the active display plane relative to the display surface. When performing 180° rotation, this field specifies the horizontal position of the lower right corner relative to the start of the active display plane in the unrotated orientation.

4.1.9.6 DSPBSURFLIVE—Primary B Live Surface Base Address

DSPBSURFLIVE—Primary B Live Surface Base Address	
Register Type:	MMIO
Address Offset:	711ACh
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Primary_Live_Surface_Base_Address** Project: All Address: GraphicsAddress[31:0] This gives the live value of the surface base address as being currently used for the plane.

4.1.10 Video Sprite A Control

Two video sprites are provided for the display of video content. These sprite planes provide windowing and keying functions as well as gamma and color space conversion from YUV to RGB. Each sprite plane is attached to only one of the pipes, Video Sprite A to pipe A and Video Sprite B to pipe B. Apart from the pipe assignments, the functionality is identical.

The DVSACNTR, DVSASTRIDE, DVSAPOS, DVSASIZE, and DVSASCALE active registers will be updated on the vertical blank or when pipe is disabled, after the DVSASURF trigger register is written, or when the sprite A is not yet enabled – thus providing an atomic update of the video sprite A control, stride, position, size, scale, and base address registers.

4.1.10.1 DVSACNTR—Video Sprite A Control Register

DVSACNTR—Video Sprite A Control Register

Register Type:	MMIO
Address Offset:	72180h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSASURF

Video Sprite A Plane is connected to pipe A only.

Bit	Description
31	**Sprite_Enable** Project: All Format: Enable When this bit is set, the sprite plane will generate pixels for display. When set to zero, sprite plane memory fetches cease and plane output is transparent. The display pipe must be enabled to enable the plane. When in Self Refresh Big FIFO mode, write to this register to enable the plane will be internally buffered and delayed while Big FIFO mode is exiting.
30	**Gamma_Enable** Project: All Default Value: 0b There are two gamma adjustments possible in the video sprite data path. This bit controls the gamma correction in the display pipe not the gamma control in this plane. It affects only the pixel data from this display plane. Gamma correction logic that is contained in the video sprite is disabled by loading the default values into those registers.

Value	Name	Description	Project
0b	Disable	Plane pixel data bypasses the display pipe gamma correction logic	All
1b	Enable	Plane pixel data is gamma corrected in the pipe gamma correction logic	All

DVSACNTR—Video Sprite A Control Register

29	**Reserved** Project: All Format: MBZ
28	**YUV_Bypass_Excess-512_Format_Conversion** Project: All Default Value: 0b

Value	Name	Description	Project
0b	Disable	Disable excess-512 conversion	All
1b	Enable	Enable excess-512 conversion	All

27	**Range_Correction_Disable** Project: All Default Value: 0b Setting this bit disables the YUV range correction logic. Normally the range compressed YUV is expanded to full range RGB, setting this bit will generate range compressed RGB. This bit should also be used if full range YUV source material is used. This bit has no effect on RGB source formats.

Value	Name	Description	Project
0b	Enable	Range correction enabled	All
1b	Disable	No range correction	All

26:25	**Source_Pixel_Format** Project: DevSNB Default Value: 0b This field selects the pixel format for the sprite. Before entering the blender, each source format is converted to 12 bits per pixel.

Value	Name	Description	Project
00b	YUV 4:2:2	YUV 4:2:2 packed pixel format (byte order programmed separately)	All
01b	RGB 32-bit 2:10:10:10	RGB 32-bit 2:10:10:10 pixel format (color order programmed separately). Ignore alpha.	All
10b	RGB 32-bit 8:8:8:8	RGB 32-bit 8:8:8:8 pixel format (color order programmed separately). Ignore alpha.	All
11b	RGB 64-bit 16:16:16:16 Use of 64bpp format will limit the maximum dot clock to 80% of cdclk.	RGB 64-bit 16:16:16:16 floating point pixel format (color order programmed separately). Ignore alpha.	All

DVSACNTR—Video Sprite A Control Register

26:25 **Source_Pixel_Format**

Project: ILK

Default Value: 0b

This field selects the pixel format for the sprite. Before entering the blender, each source format is converted to 12 bits per pixel.

Value	Name	Description	Project
00b	YUV 4:2:2	YUV 4:2:2 packed pixel format (byte order programmed separately)	All
01b	Reserved	Reserved	All
10b	32-bit BGRX	32-bit BGRX (8:8:8:8 MSB-X:R:G:B) pixel format. Ignore alpha.	All
11b	Reserved	Reserved	All

24 **Pipe_Color_Space_Conversion_Enable**

Project: All

Default Value: 0b

This bit enables pipe color space conversion for the plane pixel data. This is separate from the color conversion logic within the sprite plane. CSC mode in the pipe CSC registers must be set to match the format of the plane pixel data after the color conversion logic within the sprite plane.

Value	Name	Description	Project
0b	Disable	Plane pixel data bypasses the pipe color space conversion logic	All
1b	Enable	Plane pixel data passes through the pipe color space conversion logic	All

23 **Reserved** Project: All Format: MBZ

22 **Sprite_Source_Key_Enable**

Project: All

Default Value: 0b

This bit enables source color keying. Sprite pixel values that match (within range) the key will become transparent. Source key can not be enabled if destination key is enabled.

Value	Name	Description	Project
0b	Disable	Sprite source key is disabled	All
1b	Enable	Sprite source key is enabled	All

DVSACNTR—Video Sprite A Control Register

21 **Plane_Extended_Range_Source_Select**

Project: DevSNB

Default Value: 0b

This bit is used to indicate when the plane source pixel format should be processed as having extended range. This is only valid with certain source pixel formats. If the pipe is extended range and plane extended range source is not selected, the plane will fit the source pixel data into the 0 to 1 region of the extended range.

Value	Name	Description	Project
0b	Normal	Normal range source selected	All
1b	Extended	Extended range source selected	All

21 **Reserved** Project: ILK Format:

20 **RGB_Color_Order**

Project: DevSNB

Default Value: 0b

This field is used to select the color order when using RGB data formats. For other formats, this field is ignored.

Value	Name	Description	Project
0b	BGRX	BGRX (MSB-X:R:G:B)	All
1b	RGBX	RGBX (MSB-X:B:G:R)	All

20 **Reserved** Project: ILK Format:

19 **Color_Conversion_Disabled**

Project: All

Default Value: 0b

This bit enables or disables the color conversion logic internal to the sprite. Color conversion is intended to be used with the formats that support YUV format. This bit is ignored when using RGB source formats.

Value	Name	Description	Project
0b	Enable	Pixel data is sent through the sprite color conversion logic (only applies to YUV formats)	All
1b	Disable	Pixel data is not sent through the sprite YUV->RGB color conversion logic.	All

DVSACNTR—Video Sprite A Control Register

18

YUV_Format

Project: All

Default Value: 0b

This bit specifies the source YUV format for the YUV to RGB color conversion operation. This field is ignored when source data is RGB.

Value	Name	Description	Project
0b	BT.601	ITU-R Recommendation BT.601	All
1b	BT.709	ITU-R Recommendation BT.709	All

17:16

YUV_Byte_Order

Project: All

Default Value: 0b

This field is used to select the byte order when using YUV 4:2:2 data formats. For other formats, this field is ignored.

Value	Name	Description	Project
00b	YUYV	YUYV (8:8:8:8 MSB-V:$Y_{2:}$U:Y_{1})	All
01b	UYVY	UYVY (8:8:8:8 MSB-$Y_{2:}$V:$Y_{1:}$U)	All
10b	YVYU	YVYU (8:8:8:8 MSB-U:$Y_{2:}$V:Y_{1})	All
11b	VYUY	VYUY (8:8:8:8 MSB-$Y_{2:}$U:$Y_{1:}$V)	All

15

180°_Display_Rotation

Project: All

Default Value: 0b

This mode causes the plane to be rotated 180°. In addition to setting this bit, software must also set the surface address offset to the lower right corner of the unrotated image and calculate the x, y offset as relative to the lower right corner.

Value	Name	Description	Project
0b	None	No rotation	All
1b	180	180° rotation	All

DVSACNTR—Video Sprite A Control Register

14 — Trickle-Feed_Enable

Project: DevSNB

Default Value: 0b

Value	Name	Description	Project
0b	Enable	Trickle Feed Enabled - Data requests are sent whenever there is space in the Display Data Buffer	All
1b	Disable	Trickle Feed Disabled - Data requests are sent in bursts.	All

14 — Reserved Project: ILK Format:

13:11 — Reserved Project: All Format:

10 — Tiled_Surface

Project: All

Default Value: 0b

This bit indicates that the surface data is in tiled memory. The tile pitch is specified in bytes in the DVSASTRIDE register. Only X tiling is supported for display surfaces.

When this bit is set, it affects the hardware interpretation of the DVSASTART and DVSASURFADDR registers.

Value	Name	Description	Project
0b	Linear	Linear memory	All
1b	Tiled	Tiled memory	All

9:3 — Reserved Project: All Format: MBZ

2 — Sprite_Destination_Key

Project: All

Default Value: 0b

This bit enables the destination key function. If the pixel for the primary plane on this pipe matches the key value in DVSAKEYVAL the sprite pixel is used, otherwise the primary plane pixel is passed through the blender unmodified. Destination Key can not be enabled if source key is enabled.

Value	Name	Description	Project
0b	Disable	Destination Key is disabled	All
1b	Enable	Destination Key is enabled	All

1:0 — Reserved Project: All Format: MBZ

Sprite Source Pixel Format Mapping of Bits to Colors:

Note: For RGB formats, see the primary source pixel format mapping

SPRITE YUV	Y1	U	Y2	V
YUV 4:2:2 YUYV	7:0	15:8	23:16	31:24
YUV 4:2:2 UYVY	15:8	7:0	31:24	23:16
YUV 4:2:2 YVYU	7:0	31:24	23:16	15:8
YUV 4:2:2 VYUY	15:8	23:16	31:24	7:0

4.1.10.2 DVSALINOFF—Video Sprite A Linear Offset Register

DVSALINOFF—Video Sprite A Linear Offset Register	
Register Type:	MMIO
Address Offset:	72184h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Bit	Description
31:0	**Sprite_Linear_Offset** Project: All Format: This register provides the linear panning byte offset into the sprite plane. This value is added to the surface address to get the address of the first pixel to be displayed. This offset must be at least pixel aligned for RGB formats and even pixel aligned for YUV formats. When performing 180° rotation, the unpanned offset must be the difference between the last pixel of the last line of the display data in its unrotated orientation and the display surface address. When the surface is tiled, the contents of this register are ignored.

4.1.10.3 DVSASTRIDE—Video Sprite A Stride Register

DVSASTRIDE—Video Sprite A Stride Register	
Register Type:	MMIO
Address Offset:	72188h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSASURF

Bit	Description
31:15	**Reserved** Project: All Format:
14:6	**Sprite_Stride** Project: All Format: This is the stride for the sprite in bytes. When using linear memory, this must be 64 byte aligned. When using tiled memory, this must be 512 byte aligned. This register is updated through either a command packet passed through the command stream or writes to this register. The stride is limited to a maximum of 16K bytes when sprite scaling is not enabled, 4K bytes when sprite scaling is enabled, for both linear and tiled memory.
5:0	**Reserved** Project: All Format:

4.1.10.4 DVSAPOS—Video Sprite A Position Register

DVSAPOS—Video Sprite A Position Register	
Register Type:	MMIO
Address Offset:	7218Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSASURF

This register specifies the position of the sprite. Software must take care that the sprite does not extend out of the display active area. ie. Xposition + Xsize =< Xsrcsize

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27:16	**Sprite_Y-Position** Project: All Format: These 12 bits specify the vertical position in lines of the sprite (upper left corner) relative to the beginning of the active video area. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the end of the active video area in the unrotated orientation. The defined sprite rectangle must always be completely contained within the displayable area of the screen image.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Sprite_X-Position** Project: All Format: These 12 bits specify the horizontal position in pixels of the sprite (upper left corner) relative the beginning of the active video area. When performing 180° rotation, this field specifies the horizontal position of the original lower right corner relative to the original end of the active video area in the unrotated orientation. The defined sprite rectangle must always be completely contained within the displayable area of the screen image.

4.1.10.5 DVSASIZE—Video Sprite A Size Register

DVSASIZE—Video Sprite A Size Register	
Register Type:	MMIO
Address Offset:	72190h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSASURF

This register specifies the size of the sprite. Software must take care that the sprite does not extend out of the display active area. ie. Xposition + Xsize =< Xsrcsize

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27:16	**Sprite_Height** Project: All Format: This register field is used to specify the height of the sprite in lines. The value in the register is the height minus one. The defined sprite rectangle must always be completely contained within the displayable area of the screen image.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Sprite_Width** Project: All Format: This register field is used to specify the width of the sprite in pixels. This does not have to be the same as the stride but should be less than or equal to the stride in pixels. The value in the register is the width minus one. The defined sprite rectangle must always be completely contained within the displayable area of the screen image. The sprite width (actual width, not the width minus one value) is limited to even values when YUV source pixel format is used, or Pixel Multiply is set to Line/Pixel doubling or Pixel doubling.

4.1.10.6 DVSAKEYVAL—Video Sprite A Color Key Value Register

DVSAKEYVAL—Video Sprite A Color Key Value Register	
Register Type:	MMIO
Address Offset:	72194h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the key color to be used with the mask bits to determine if the sprite source data matches the key. This register will only have an effect when the sprite color key is enabled. In source key mode this value is the minimum value for the range compare. In destination key mode this value is the compare value.

Bit	Description
31:24	**Reserved** Project: All Format: MBZ
23:16	**V_Source_Key_Min_Value/R_Source/Dest_Key_Value** Project: All Format: Specifies the color key (minimum) value for the sprite V channel source key or the Red channel source or destination key compare value.
15:8	**Y_Source_Key_Min_Value/G_Source/Dest_Key_Value** Project: All Format: Specifies the color key (minimum) value for the sprite Y channel source key or the Green channel source or destination key compare value.
7:0	**U_Source_Key_Min_Value/B_Source/Dest_Key_Value** Project: All Format: Specifies the color key (minimum) value for the sprite U channel source key or the Blue channel source or destination key compare value.

4.1.10.7 DVSAKEYMSK—Video Sprite A Color Key Mask Register

DVSAKEYMSK—Video Sprite A Color Key Mask Register	
Register Type:	MMIO
Address Offset:	72198h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

For source key this register specifies which channels to perform range checking on.

For destination key this register specifies the key mask to be used with the color value bits to determine if the display source data matches the key when enabled. A zero bit in the mask indicates that the corresponding bit match failure should be ignored when determining if the pixel matches.

Note that source key and destination key are mutually exclusive modes of operation, they can not be used simultaneously. For the function that is not enabled, the associated bits in this register should be programmed to zeroes.

Bit	Description
31:27	**Reserved** Project: All Format: MBZ
26	**V/R_Channel_Source_Key_Enable** Project: All Format: Specifies the source color key enable for the V/Red channel
25	**Y/G_Channel_Source_Key_Enable** Project: All Format: Specifies the source color key enable for the Y/Green channel
24	**U/B_Channel_Source_Key_Enable** Project: All Format: Specifies the source color key enable for the U/Blue channel
23:16	**R_mask_Dest_Key_Value** Project: All Format: Specifies the destination color key mask for the sprite R channel
15:8	**G_mask_Dest_Key_Value** Project: All Format: Specifies the destination color key mask for the sprite G channel
7:0	**B_mask_Dest_Key_Value** Project: All Format: Specifies the destination color key mask for the sprite B channel

4.1.10.8 DVSASURF—Video Sprite A Surface Address Register

DVSASURF—Video Sprite A Surface Address Register	
Register Type:	MMIO
Address Offset:	7219Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled
Writes to this register arm DVSA registers	

Bit	Description
31:12	**Sprite_Surface_Base_Address** Project: All Address: Graphicsdress[31:12] This address specifies the surface base address. When the surface is tiled, panning is specified using (x, y) offsets in the DVSATILEOFF register. When the surface is in linear memory, panning is specified using a linear offset in the DVSALINOFF register. This address must be 4K aligned. It represents an offset from the graphics memory aperture base and is mapped to physical pages through the global GTT. The value in this register is updated through the command streamer with synchronous flips.
11:0	**Reserved** Project: All Format:

4.1.10.9 DVSAKEYMAXVAL—Video Sprite A Color Key Max Value Register

DVSAKEYMAXVAL—Video Sprite A Color Key Max Value Register	
Register Type:	MMIO
Address Offset:	721A0h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the key color to be used with the mask bits to determine if the sprite source data matches the key. This register will only have an effect when the sprite source color key is enabled

Bit	Description
31:24	**Reserved** Project: All Format: MBZ
23:16	**V_Key_Max_Value** Project: All Format: Specifies the color key value for the sprite V channel
15:8	**Y_Key_Max_Value** Project: All Format: Specifies the color key value for the sprite Y channel
7:0	**U_Key_Max_Value** Project: All Format: Specifies the color key value for the sprite U channel

4.1.10.10 DVSATILEOFF—Video Sprite A Tiled Offset Register

DVSATILEOFF—Video Sprite A Tiled Offset Register	
Register Type:	MMIO
Address Offset:	721A4h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the panning for the sprite surface in tiled memory. The surface base address is specified in the DVSASURFADDR register, and this register is used to describe an offset from that base address. When the surface is in linear memory, the offset is specified in the DVSALINOFF register and the contents of this register are ignored. When the surface is tiled, the start position is specified in this register as an (x, y) offset from the beginning of the surface.

Bit	Description
31:28	**Reserved** Project: All Format: MBZ

DVSATILEOFF—Video Sprite A Tiled Offset Register	
27:16	**Sprite_Start_Y-Position** Project: All Format: These 12 bits specify the vertical position in lines of the beginning of the active display plane relative to the display surface. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the start of the active display plane in the unrotated orientation.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Sprite_Start_X-Position** Project: All Format: These 12 bits specify the horizontal offset in pixels of the beginning of the active display plane relative to the display surface. The offset must be even pixel aligned for YUV formats. When performing 180° rotation, this field specifies the horizontal position of the lower right corner relative to the start of the active display plane in the unrotated orientation.

4.1.10.11 DVSASURFLIVE—Video Sprite A Live Surface Base Address Register

DVSASURFLIVE—Video Sprite A Live Surface Base Address Register	
Register Type:	MMIO
Address Offset:	721ACh
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32
Bit	**Description**
31:0	**Sprite_Surface_Base_Address** Project: All Address: GraphicsAddress[31:0] This gives the live value of the surface base address as being currently used for the plane.

4.1.10.12 DVSASCALE—Video Sprite A Scaler Control

DVSASCALE—Video Sprite A Scaler Control	
Register Type:	MMIO
Address Offset:	72204h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSASURF

This register controls the sprite scaling. The DVSASIZE register gives the destination (output to pipe) size of the sprite. This register gives the source (input to sprite) size of the sprite. When scaling is enabled, the source size will be scaled up or down to the destination size.
Upscaling of any amount is allowed. Downscaling up to 16X (source/destination) is allowed. Downscaling greater than 2X will involve decimation. Downscaling increases memory bandwidth requirements. Scaling can not be used with the sprite 64bpp source pixel format. Source and destination sizes must be 3x3 (3x6 when interlacing) or greater when scaling is enabled.
Horizontal downscaling limits the maximum dot clock allowed as percent of cdclk. Rules to calculate the allowed dot clock:
Start with maximum dot clock 90% of cdclk. (There is a separate requirement that planes using 64bpp formats can not be enabled with dot clock >80% of cdclk when sprite is enabled on the same pipe)
Subtract 10% more per horizontal decimation step (decimation steps at 2x, 4x, 8x, and 16x downscale).
Subtract 10% more if sprite is using the RGB data format.
Subtract 10% more if sprite scaling is enabled on the other pipe.
Then divide that by horizontal downscale amount within each decimation step.
The result is the maximum allowed dot clock as percent of cdclk frequency.

Example:

Scale factor	Decimation amount	YUV single pipe dot clock %	YUV dual pipe dot clock %	RGB single pipe dot clock %	RGB dual pipe dot clock %	Comment
1	1	90	80	80	70	No scaling
1.5	1	60	53	53	46	
1.99	1	45	40	40	35	Max downscale before decimation starts
2	2	80	70	70	60	
3	2	53	46	46	40	
3.99	2	40	35	35	30	
4	4	70	60	60	50	
6	4	46	40	40	33	
7.99	4	35	30	30	25	
8	8	60	50	50	40	
12	8	40	33	33	26	
15.99	8	30	25	25	20	Worst case dot clock
16	16	50	40	40	30	Max downscaling allowed

DVSASCALE—Video Sprite A Scaler Control

<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>31</td><td>Scaling_Enable Project: All Format: Enable
Enables the scaling function. Source width can be no more than 4k bytes. For best picture quality, disable when scaling is not required.</td></tr>
<tr><td>30:29</td><td>Filter_Control
Project: All
Default Value: 0b
Filter selection
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>00b</td><td>Medium</td><td>Medium Filtering</td><td>All</td></tr>
<tr><td>01b</td><td>Enhancing</td><td>Edge Enhancing Filtering</td><td>All</td></tr>
<tr><td>10b</td><td>Softening</td><td>Edge Softening Filtering</td><td>All</td></tr>
<tr><td>11b</td><td>Reserved</td><td>Reserved</td><td>All</td></tr>
</table></td></tr>
<tr><td>28</td><td>Even/Odd_Field_Offset
Project: All
Default Value: 0b
Select the vertical offset of the filtered data. Software is responsible for updating this to match the surface data.
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>0b</td><td>0</td><td>Vertical initial phase of 0</td><td>All</td></tr>
<tr><td>1b</td><td>0.5</td><td>Vertical initial phase of 0.5</td><td>All</td></tr>
</table></td></tr>
<tr><td>27</td><td>Even/Odd_Field_Enable
Project: All
Default Value: 0b
Enable adjustment of the vertical offset of the filtered data.
<table>
<tr><th>Value</th><th>Name</th><th>Description</th><th>Project</th></tr>
<tr><td>0b</td><td>Disable</td><td>Off (Vertical initial phase is 1/2 the scale factor)</td><td>All</td></tr>
<tr><td>1b</td><td>Enable</td><td>On (Vertical initial phase is selected by the Even/Off Field Offset bit)</td><td>All</td></tr>
</table></td></tr>
<tr><td>26:16</td><td>Source_Width Project: All Format:
The horizontal size of the source image to be scaled in pixels. Max number of pixels is 2048; minimum is 3. The value programmed is one less than the number of pixels. Source width can be no more than 4k bytes, counting from a 64 byte alignment. The sprite width (actual width, not the width minus one value) is limited to even values when YUV source pixel format is used.</td></tr>
<tr><td>15:11</td><td>Reserved Project: All Format: MBZ</td></tr>
</table>

DVSASCALE—Video Sprite A Scaler Control	
10:0	**Source_Height** Project: All Format: The vertical size of the source image to be scaled in lines. If the source is a field, this is the number of lines in the field. Max number of lines is 2048; minimum is 3 (6 when interlacing). The value programmed is one less than the number of lines. The height must be even when sprite scaling is enabled and the pipe has set planes to interlaced fetch. That means the programmed value must be odd.

4.1.10.13 DVSAGAMC—Video Sprite A Gamma Correction Registers

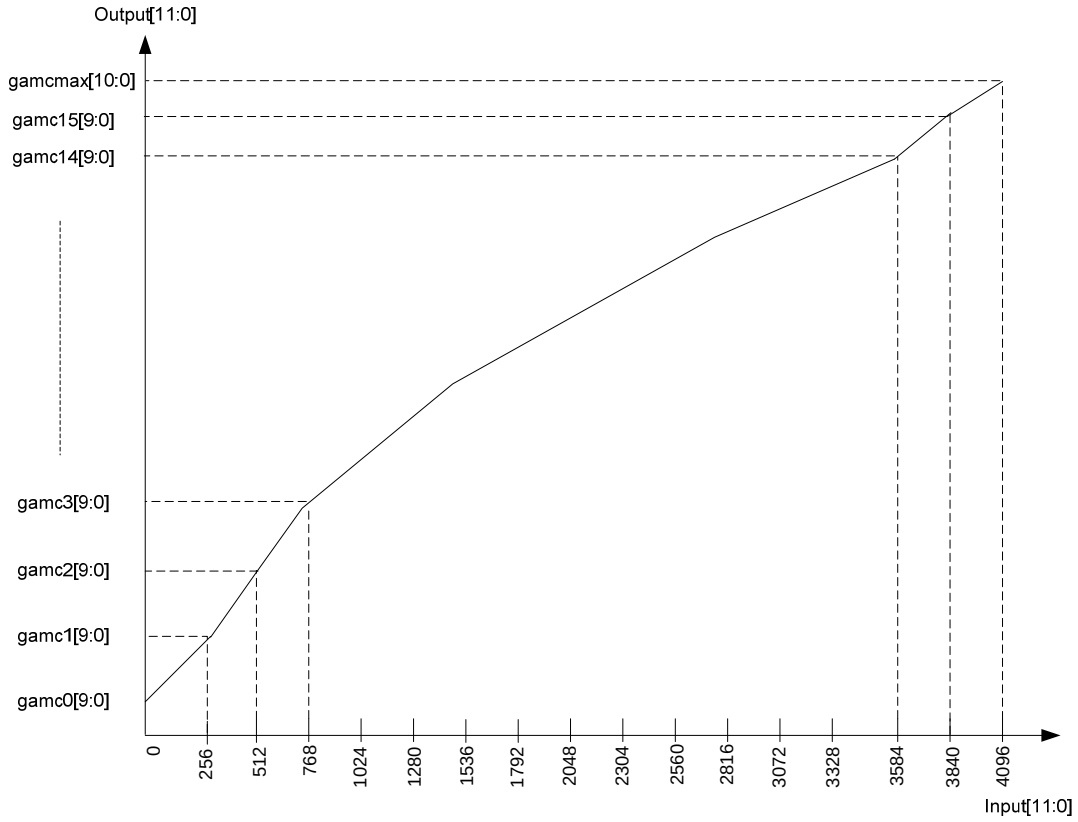
DVSGAMC Reference Point		
Project:	All	
Bit	**Description**	
31:30	**Reserved**	Project: All Format:
29:20	**Red Gamma Reference Point**	Project: All Format:
19:10	**Green Gamma Reference Point**	Project: All Format:
9:0	**Blue Gamma Reference Point**	Project: All Format:

DVSGAMC Max Reference Point		
Project:	All	
Bit	**Description**	
31:11	**Reserved** Project: All	Format:
10:0	**Final Gamma Max Reference Point**	Project: All Format:

DVSAGAMC—Video Sprite A Gamma Correction Registers	
Register Type:	MMIO
Address Offset:	72300h
Project:	All
Default Value:	00000000h; 04010040h; 08020080h; 0C0300C0h; 10040100h; 14050140h; 18060180h; 1C0701C0h; 20080200h; 24090240h; 280A0280h; 2C0B02C0h; 300C0300h; 340D0340h; 380E0380h; 3C0F03C0h; 00000400h; 00000400h; 00000400h;
Access:	R/W
Size (in bits):	19x32

These registers are used to determine the characteristics of the gamma correction for the sprite pixel data *pre-blending*. Additional gamma correction can be done in the display pipe gamma if desired.
The gamma correction curve is represented by specifying a set of reference points spaced equally along the desired curve. Red, Green, and Blue each have 17 reference points. The first 16 reference points are 10 bit values with Red, Green, and Blue sharing a single register for each point. The final max reference point is an 11 bit value with separate registers for Red, Green, and Blue. The curve must be flat or increasing, never decreasing.
During operation the appropriate reference point pairs (adjacent) are selected for each color, and the output is interpolated between these two reference point values.
The gamma correction registers are not double-buffered. They should only be updated when the sprite is off, otherwise, screen artifacts may show.
To pass sprite pixel data through gamma correction unchanged, program the gamma reference points to the default linear ramp values. When the output from sprite is set in YUV format by programming CSC bypass, or the sprite source pixel format is RGB, the sprite gamma correction will be bypassed.

Programming of the Piecewise-linear Estimation of Gamma Correction Curve



DWord	Bit	Description
0	31:0	**GAMC0** Project: All Format: DVSGAMC Reference Point
1	31:0	**GAMC1** Project: All Format: DVSGAMC Reference Point

2	31:0	**GAMC2**	Project:	All	Format:	DVSGAMC Reference Point
3	31:0	**GAMC3**	Project:	All	Format:	DVSGAMC Reference Point
4	31:0	**GAMC4**	Project:	All	Format:	DVSGAMC Reference Point
5	31:0	**GAMC5**	Project:	All	Format:	DVSGAMC Reference Point
6	31:0	**GAMC6**	Project:	All	Format:	DVSGAMC Reference Point
7	31:0	**GAMC7**	Project:	All	Format:	DVSGAMC Reference Point
8	31:0	**GAMC8**	Project:	All	Format:	DVSGAMC Reference Point
9	31:0	**GAMC9**	Project:	All	Format:	DVSGAMC Reference Point
10	31:0	**GAMC10**	Project:	All	Format:	DVSGAMC Reference Point
11	31:0	**GAMC11**	Project:	All	Format:	DVSGAMC Reference Point
12	31:0	**GAMC12**	Project:	All	Format:	DVSGAMC Reference Point
13	31:0	**GAMC13**	Project:	All	Format:	DVSGAMC Reference Point
14	31:0	**GAMC14**	Project:	All	Format:	DVSGAMC Reference Point
15	31:0	**GAMC15**	Project:	All	Format:	DVSGAMC Reference Point
16	31:0	**GAMCmaxR**	Project:	All	Format:	DVSGAMC Max Reference Point
17	31:0	**GAMCmaxG**	Project:	All	Format:	DVSGAMC Max Reference Point
18	31:0	**GAMCmaxB**	Project:	All	Format:	DVSGAMC Max Reference Point

4.1.11 Video Sprite B Control

The DVSBCNTR, DVSBSTRIDE, DVSBPOS, DVSBSIZE, and DVSBSCALE active registers will be updated on the vertical blank or when pipe is disabled, after the DVSBSURF trigger register is written, or when the sprite B is not yet enabled – thus providing an atomic update of the video sprite B control, stride, position, size, scale, and base address registers.

4.1.11.1 DVSBCNTR—Video Sprite B Control Register

DVSBCNTR—Video Sprite B Control Register	
Register Type:	MMIO
Address Offset:	73180h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSBSURF

Video Sprite B Plane is connected to pipe B only.

Bit	Description
31	**Sprite_Enable** Project: All Format: Enable When this bit is set, the sprite plane will generate pixels for display. When set to zero, sprite plane memory fetches cease and plane output is transparent. The display pipe must be enabled to enable the plane. When in Self Refresh Big FIFO mode, write to this register to enable the plane will be internally buffered and delayed while Big FIFO mode is exiting.
30	**Gamma_Enable** Project: All Default Value: 0b There are two gamma adjustments possible in the video sprite data path. This bit controls the gamma correction in the display pipe not the gamma control in this plane. It affects only the pixel data from this display plane. Gamma correction logic that is contained in the video sprite is disabled by loading the default values into those registers.
29	**Reserved** Project: All Format: MBZ
28	**YUV_Bypass_Excess-512_Format_Conversion** Project: All Default Value: 0b

Bit 30 — Gamma_Enable

Value	Name	Description	Project
0b	Disable	Plane pixel data bypasses the display pipe gamma correction logic	All
1b	Enable	Plane pixel data is gamma corrected in the pipe gamma correction logic	All

Bit 28 — YUV_Bypass_Excess-512_Format_Conversion

Value	Name	Description	Project
0b	Disable	Disable excess-512 conversion	All
1b	Enable	Enable excess-512 conversion	All

DVSBCNTR—Video Sprite B Control Register

27

Range_Correction_Disable

Project: All

Default Value: 0b

Setting this bit disables the YUV range correction logic. Normally the range compressed YUV is expanded to full range RGB, setting this bit will generate range compressed RGB. This bit should also be used if full range YUV source material is used. This bit has no effect on RGB source formats.

Value	Name	Description	Project
0b	Enable	Range correction enabled	All
1b	Disable	No range correction	All

26:25

Source_Pixel_Format

Project: DevSNB

Default Value: 0b

This field selects the pixel format for the sprite. Before entering the blender, each source format is converted to 12 bits per pixel.

Value	Name	Description	Project
00b	YUV 4:2:2	YUV 4:2:2 packed pixel format (byte order programmed separately)	All
01b	RGB 32-bit 2:10:10:10	RGB 32-bit 2:10:10:10 pixel format (color order programmed separately). Ignore alpha.	All
10b	RGB 32-bit 8:8:8:8	RGB 32-bit 8:8:8:8 pixel format (color order programmed separately). Ignore alpha.	All
11b	RGB 64-bit 16:16:16:16 Use of 64bpp format will limit the maximum dot clock to 80% of cdclk.	RGB 64-bit 16:16:16:16 floating point pixel format (color order programmed separately). Ignore alpha.	All

26:25

Source_Pixel_Format

Project: DevILK

Default Value: 0b

This field selects the pixel format for the sprite. Before entering the blender, each source format is converted to 12 bits per pixel.

Value	Name	Description	Project
00b	YUV 4:2:2	YUV 4:2:2 packed pixel format (byte order programmed separately)	All
01b	Reserved	Reserved	All
10b	32-bit BGRX	32-bit BGRX (8:8:8:8 MSB-X:R:G:B) pixel format. Ignore alpha.	All
11b	Reserved	Reserved	All

DVSBCNTR—Video Sprite B Control Register

24

Pipe_Color_Space_Conversion_Enable

Project: All

Default Value: 0b

This bit enables pipe color space conversion for the plane pixel data. This is separate from the color conversion logic within the sprite plane. CSC mode in the pipe CSC registers must be set to match the format of the plane pixel data after the color conversion logic within the sprite plane.

Value	Name	Description	Project
0b	Disable	Plane pixel data bypasses the pipe color space conversion logic	All
1b	Enable	Plane pixel data passes through the pipe color space conversion logic	All

23

Reserved Project: All Format: MBZ

22

Sprite_Source_Key_Enable

Project: All

Default Value: 0b

This bit enables source color keying. Sprite pixel values that match (within range) the key will become transparent. Source key can not be enabled if destination key is enabled.

Value	Name	Description	Project
0b	Disable	Sprite source key is disabled	All
1b	Enable	Sprite source key is enabled	All

22

Sprite_Source_Key_Enable

Project: All

Default Value: 0b

This bit enables source color keying. Sprite pixel values that match (within range) the key will become transparent. Source key can not be enabled if destination key is enabled.

Value	Name	Description	Project
0b		Sprite source key is disabled	All
1b		Sprite source key is enabled	All

DVSBCNTR—Video Sprite B Control Register

21

Plane_Extended_Range_Source_Select

Project: DevSNB

Default Value: 0b

This bit is used to indicate when the plane source pixel format should be processed as having extended range. This is only valid with certain source pixel formats. If the pipe is extended range and plane extended range source is not selected, the plane will fit the source pixel data into the 0 to 1 region of the extended range.

Value	Name	Description	Project
0b	Normal	Normal range source selected	All
1b	Extended	Extended range source selected	All

21 **Reserved** Project: DevILK Format:

20

RGB_Color_Order

Project: DevSNB

Default Value: 0b

This field is used to select the color order when using RGB data formats. For other formats, this field is ignored.

Value	Name	Description	Project
0b	BGRX	BGRX (MSB-X:R:G:B)	All
1b	RGBX	RGBX (MSB-X:B:G:R)	All

20 **Reserved** Project: DevILK Format:

19

Color_Conversion_Disabled

Project: All

Default Value: 0b

This bit enables or disables the color conversion logic internal to the sprite. Color conversion is intended to be used with the formats that support YUV format. This bit is ignored when using RGB source formats.

Value	Name	Description	Project
0b	Enable	Pixel data is sent through the sprite color conversion logic (only applies to YUV formats)	All
1b	Disable	Pixel data is not sent through the sprite YUV->RGB color conversion logic.	All

DVSBCNTR—Video Sprite B Control Register

18 — YUV_Format

Project: All

Default Value: 0b

This bit specifies the source YUV format for the YUV to RGB color conversion operation. This field is ignored when source data is RGB.

Value	Name	Description	Project
0b	BT.601	ITU-R Recommendation BT.601	All
1b	BT.709	ITU-R Recommendation BT.709	All

17:16 — YUV_Byte_Order

Project: All

Default Value: 0b

This field is used to select the byte order when using YUV 4:2:2 data formats. For other formats, this field is ignored.

Value	Name	Description	Project
00b	YUYV	YUYV (8:8:8:8 MSB-V:Y_2:U:Y_1)	All
01b	UYVY	UYVY (8:8:8:8 MSB-Y_2:V:Y_1:U)	All
10b	YVYU	YVYU (8:8:8:8 MSB-U:Y_2:V:Y_1)	All
11b	VYUY	VYUY (8:8:8:8 MSB-Y_2:U:Y_1:V)	All

15 — 180°_Display_Rotation

Project: All

Default Value: 0b

This mode causes the plane to be rotated 180°. In addition to setting this bit, software must also set the surface address offset to the lower right corner of the unrotated image and calculate the x, y offset as relative to the lower right corner.

Value	Name	Description	Project
0b	None	No rotation	All
1b	180	180° rotation	All

14 — Trickle-Feed_Enable

Project: DevSNB

Default Value: 0b

Value	Name	Description	Project
0b	Enable	Trickle Feed Enabled - Data requests are sent whenever there is space in the Display Data Buffer	All
1b	Disable	Trickle Feed Disabled - Data requests are sent in bursts.	All

14 — Reserved Project: DevILK Format:

DVSBCNTR—Video Sprite B Control Register

13:11	**Reserved** Project: All Format:
10	**Tiled_Surface** Project: All Default Value: 0b This bit indicates that the surface data is in tiled memory. The tile pitch is specified in bytes in the DVSBSTRIDE register. Only X tiling is supported for display surfaces. When this bit is set, it affects the hardware interpretation of the DVSBSTART and DVSBSURFADDR registers.
9:3	**Reserved** Project: All Format: MBZ
2	**Sprite_Destination_Key** Project: All Default Value: 0b This bit enables the destination key function. If the pixel for the primary plane on this pipe matches the key value in DVSBKEYVAL the sprite pixel is used, otherwise the primary plane pixel is passed through the blender unmodified. Destination Key can not be enabled if source key is enabled.
1:0	**Reserved** Project: All Format: MBZ

Value	Name	Description	Project
0b	Linear	Linear memory	All
1b	Tiled	Tiled memory	All

Value	Name	Description	Project
0b	Disable	Destination Key is disabled	All
1b	Enable	Destination Key is enabled	All

See DVSACNTR - Sprite Source Pixel Format Mapping of Bits to Colors

4.1.11.2 DVSBLINOFF—Video Sprite B Linear Offset Register

DVSBLINOFF—Video Sprite B Linear Offset Register	
Register Type:	MMIO
Address Offset:	73184h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

Bit	Description
31:0	**Sprite_Linear_Offset** Project: All Format: This register provides the linear panning byte offset into the sprite plane. This value is added to the surface address to get the address of the first pixel to be displayed. This offset must be at least pixel aligned for RGB formats and even pixel aligned for YUV formats. When performing 180° rotation, the unpanned offset must be the difference between the last pixel of the last line of the display data in its unrotated orientation and the display surface address. When the surface is tiled, the contents of this register are ignored.

4.1.11.3 DVSBSTRIDE—Video Sprite B Stride Register

DVSBSTRIDE—Video Sprite B Stride Register	
Register Type:	MMIO
Address Offset:	73188h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSBSURF

Bit	Description
31:15	**Reserved** Project: All Format:
14:6	**Sprite_Stride** Project: All Format: This is the stride for the sprite in bytes. When using linear memory, this must be 64 byte aligned. When using tiled memory, this must be 512 byte aligned. This register is updated through either a command packet passed through the command stream or writes to this register. The stride is limited to a maximum of 16K bytes when sprite scaling is not enabled, 4K bytes when sprite scaling is enabled, for both linear and tiled memory.
5:0	**Reserved** Project: All Format:

4.1.11.4 DVSBPOS—Video Sprite B Position Register

DVSBPOS—Video Sprite B Position Register	
Register Type:	MMIO
Address Offset:	7318Ch
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSBSURF

This register specifies the position of the sprite. Software must take care that the sprite does not extend out of the display active area. ie. Xposition + Xsize =< Xsrcsize

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27:16	**Sprite_Y-Position** Project: All Format: These 12 bits specify the vertical position in lines of the sprite (upper left corner) relative to the beginning of the active video area. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the end of the active video area in the unrotated orientation. The defined sprite rectangle must always be completely contained within the displayable area of the screen image.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Sprite_X-Position** Project: All Format: These 12 bits specify the horizontal position in pixels of the sprite (upper left corner) relative the beginning of the active video area. When performing 180° rotation, this field specifies the horizontal position of the original lower right corner relative to the original end of the active video area in the unrotated orientation. The defined sprite rectangle must always be completely contained within the displayable area of the screen image.

4.1.11.5 DVSBSIZE—Video Sprite B Size Register

DVSBSIZE—Video Sprite B Size Register	
Register Type:	MMIO
Address Offset:	73190h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSBSURF

This register specifies the size of the sprite. Software must take care that the sprite does not extend out of the display active area. ie. Xposition + Xsize =< Xsrcsize

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27:16	**Sprite_Height** Project: All Format: This register field is used to specify the height of the sprite in lines. The value in the register is the height minus one. The defined sprite rectangle must always be completely contained within the displayable area of the screen image.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Sprite_Width** Project: All Format: This register field is used to specify the width of the sprite in pixels. This does not have to be the same as the stride but should be less than or equal to the stride in pixels. The value in the register is the width minus one. The defined sprite rectangle must always be completely contained within the displayable area of the screen image. The sprite width (actual width, not the width minus one value) is limited to even values when YUV source pixel format is used, or Pixel Multiply is set to Line/Pixel doubling or Pixel doubling.

4.1.11.6 DVSBKEYVAL—Video Sprite B Color Key Value Register

DVSBKEYVAL—Video Sprite B Color Key Value Register	
Register Type:	MMIO
Address Offset:	73194h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the key color to be used with the mask bits to determine if the sprite source data matches the key. This register will only have an effect when the sprite color key is enabled. In source key mode this value is the minimum value for the range compare. In destination key mode this value is the compare value.

Bit	Description
31:24	**Reserved** Project: All Format: MBZ
23:16	**V_Source_Key_Min_Value/R_Source/Dest_Key_Value** Project: All Format: Specifies the color key (minimum) value for the sprite V channel source key or the Red channel source or destination key compare value.
15:8	**Y_Source_Key_Min_Value/G_Source/Dest_Key_Value** Project: All Format: Specifies the color key (minimum) value for the sprite Y channel source key or the Green channel source or destination key compare value.
7:0	**U_Source_Key_Min_Value/B_Source/Dest_Key_Value** Project: All Format: Specifies the color key (minimum) value for the sprite U channel source key or the Blue channel source or destination key compare value.

4.1.11.7 DVSBKEYMSK—Video Sprite B Color Key Mask Register

DVSBKEYMSK—Video Sprite B Color Key Mask Register	
Register Type:	MMIO
Address Offset:	73198h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

For source key this register specifies which channels to perform range checking on.
For destination key this register specifies the key mask to be used with the color value bits to determine if the display source data matches the key when enabled. A zero bit in the mask indicates that the corresponding bit match failure should be ignored when determining if the pixel matches.

Note that source key and destination key are mutually exclusive modes of operation, they can not be used simultaneously. For the function that is not enabled, the associated bits in this register should be programmed to zeroes.

Bit	Description
31:27	**Reserved** Project: All Format: MBZ
26	**V/R_Channel_Source_Key_Enable** Project: All Format: Specifies the source color key enable for the V/Red channel
25	**Y/G_Channel_Source_Key_Enable** Project: All Format: Specifies the source color key enable for the Y/Green channel
24	**U/B_Channel_Source_Key_Enable** Project: All Format: Specifies the source color key enable for the U/Blue channel
23:16	**R_mask_Dest_Key_Value** Project: All Format: Specifies the destination color key mask for the sprite R channel
15:8	**G_mask_Dest_Key_Value** Project: All Format: Specifies the destination color key mask for the sprite G channel
7:0	**B_mask_Dest_Key_Value** Project: All Format: Specifies the destination color key mask for the sprite B channel

4.1.11.8 DVSBSURF—Video Sprite B Surface Address Register

DVSBSURF—Video Sprite B Surface Address Register				
Register Type:	MMIO			
Address Offset:	7319Ch			
Project:	All			
Default Value:	00000000h			
Access:	R/W			
Size (in bits):	32			
Double Buffer Update Point:	Start of vertical blank or pipe disabled			
Writes to this register arm DVSB registers				
Bit	**Description**			
31:12	**Sprite_Surface_Base_Address** Project: All Address: GraphicsAddress[31:12] This address specifies the surface base address. When the surface is tiled, panning is specified using (x, y) offsets in the DVSBTILEOFF register. When the surface is in linear memory, panning is specified using a linear offset in the DVSBLINOFF register. This address must be 4K aligned. It represents an offset from the graphics memory aperture base and is mapped to physical pages through the global GTT. The value in this register is updated through the command streamer with synchronous flips.			
11:0	**Reserved**	Project:	All	Format:

4.1.11.9 DVSBKEYMAXVAL—Video Sprite B Color Key Max Value Register

DVSBKEYMAXVAL—Video Sprite B Color Key Max Value Register	
Register Type:	MMIO
Address Offset:	731A0h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the key color to be used with the mask bits to determine if the sprite source data matches the key. This register will only have an effect when the sprite source color key is enabled.

Bit	Description
31:24	**Reserved** Project: All Format: MBZ
23:16	**V_Key_Max_Value** Project: All Format: Specifies the color key value for the sprite V channel
15:8	**Y_Key_Max_Value** Project: All Format: Specifies the color key value for the sprite Y channel
7:0	**U_Key_Max_Value** Project: All Format: Specifies the color key value for the sprite U channel

4.1.11.10 DVSBTILEOFF—Video Sprite B Tiled Offset Register

DVSBTILEOFF—Video Sprite B Tiled Offset Register	
Register Type:	MMIO
Address Offset:	731A4h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Trusted Type:	1
Double Buffer Update Point:	Start of vertical blank or pipe disabled

This register specifies the panning for the sprite surface in tiled memory. The surface base address is specified in the DVSBSURFADDR register, and this register is used to describe an offset from that base address. When the surface is in linear memory, the offset is specified in the DVSBLINOFF register and the contents of this register are ignored. When the surface is tiled, the start position is specified in this register as an (x, y) offset from the beginning of the surface.

Bit	Description
31:28	**Reserved** Project: All Format: MBZ
27:16	**Sprite_Start_Y-Position** Project: All Format: These 12 bits specify the vertical position in lines of the beginning of the active display plane relative to the display surface. When performing 180° rotation, this field specifies the vertical position of the lower right corner relative to the start of the active display plane in the unrotated orientation.
15:12	**Reserved** Project: All Format: MBZ
11:0	**Sprite_Start_X-Position** Project: All Format: These 12 bits specify the horizontal offset in pixels of the beginning of the active display plane relative to the display surface. The offset must be even pixel aligned for YUV formats. When performing 180° rotation, this field specifies the horizontal position of the lower right corner relative to the start of the active display plane in the unrotated orientation.

4.1.11.11 DVSBSURFLIVE—Video Sprite B Live Surface Base Address Register

DVSBSURFLIVE—Video Sprite B Live Surface Base Address Register	
Register Type:	MMIO
Address Offset:	731ACh
Project:	All
Default Value:	00000000h
Access:	Read Only
Size (in bits):	32

Bit	Description
31:0	**Sprite_Surface_Base_Address** Project: All Address: GraphicsAddress[31:0] This gives the live value of the surface base address as being currently used for the plane.

4.1.11.12 DVSBSCALE—Video Sprite B Scaler Control

DVSBSCALE—Video Sprite B Scaler Control	
Register Type:	MMIO
Address Offset:	73204h
Project:	All
Default Value:	00000000h
Access:	R/W
Size (in bits):	32
Double Buffer Update Point:	Start of vertical blank or pipe disabled or sprite disabled, after armed
Double Buffer Armed By:	Write to DVSBSURF

This register controls the sprite scaling. The DVSBSIZE register gives the destination (output to pipe) size of the sprite. This register gives the source (input to sprite) size of the sprite. When scaling is enabled, the source size will be scaled up or down to the destination size.
Upscaling of any amount is allowed. Downscaling up to 16X (source/destination) is allowed. Downscaling greater than 2X will involve decimation. Downscaling increases memory bandwidth requirements. Scaling can not be used with the sprite 64bpp source pixel format. Source and destination sizes must be 3x3 (3x6 when interlacing) or greater when scaling is enabled.
Horizontal downscaling limits the maximum dot clock allowed as percent of cdclk. See DVSASCALE for the rules to calculate the allowed dot clock.

Bit	Description
31	**Scaling_Enable** Project: All Format: Enable Enables the scaling function. Source width can be no more than 4k bytes. For best picture quality, disable when scaling is not required. When in Self Refresh Big FIFO mode, scaling enable will be masked off while Big FIFO mode is exiting.

DVSBSCALE—Video Sprite B Scaler Control

30:29 Filter_Control

Project: All

Default Value: 0b

Filter selection

Value	Name	Description	Project
00b	Medium	Medium Filtering	All
01b	Enhancing	Edge Enhancing Filtering	All
10b	Softening	Edge Softening Filtering	All
11b	Reserved	Reserved	All

28 Even/Odd_Field_Offset

Project: All

Default Value: 0b

Select the vertical offset of the filtered data. Software is responsible for updating this to match the surface data.

Value	Name	Description	Project
0b	0	Vertical initial phase of 0	All
1b	0.5	Vertical initial phase of 0.5	All

27 Even/Odd_Field_Enable

Project: All

Default Value: 0b

Enable adjustment of the vertical offset of the filtered data.

Value	Name	Description	Project
0b	Disable	Off (Vertical initial phase is 1/2 the scale factor)	All
1b	Enable	On (Vertical initial phase is selected by the Even/Off Field Offset bit)	All

26:16 Source_Width Project: All Format:

The horizontal size of the source image to be scaled in pixels. Max number of pixels is 2048; minimum is 3. The value programmed is one less than the number of pixels. Source width can be no more than 4k bytes, counting from a 64 byte alignment. The sprite width (actual width, not the width minus one value) is limited to even values when YUV source pixel format is used.

15:11 Reserved Project: All Format: MBZ

10:0 Source_Height Project: All Format:

The vertical size of the source image to be scaled in lines. If the source is a field, this is the number of lines in the field. Max number of lines is 2048; minimum is 3 (6 when interlacing). The value programmed is one less than the number of lines.

The height must be even when sprite scaling is enabled and the pipe has set planes to interlaced fetch. That means the programmed value must be odd.

4.1.11.13 DVSBGAMC—Video Sprite B Gamma Correction Registers

DVSBGAMC—Video Sprite B Gamma Correction Registers						
Register Type:	MMIO					
Address Offset:	73300h					
Project:	All					
Default Value:	00000000h; 04010040h; 08020080h; 0C0300C0h; 10040100h; 14050140h; 18060180h; 1C0701C0h; 20080200h; 24090240h; 280A0280h; 2C0B02C0h; 300C0300h; 340D0340h; 380E0380h; 3C0F03C0h; 00000400h; 00000400h; 00000400h;					
Access:	R/W					
Size (in bits):	19x32					
See Video Sprite A description						
DWord	**Bit**	**Description**				
0	31:0	**GAMC0**	Project:	All	Format:	DVSGAMC Reference Point
1	31:0	**GAMC1**	Project:	All	Format:	DVSGAMC Reference Point
2	31:0	**GAMC2**	Project:	All	Format:	DVSGAMC Reference Point
3	31:0	**GAMC3**	Project:	All	Format:	DVSGAMC Reference Point
4	31:0	**GAMC4**	Project:	All	Format:	DVSGAMC Reference Point
5	31:0	**GAMC5**	Project:	All	Format:	DVSGAMC Reference Point
6	31:0	**GAMC6**	Project:	All	Format:	DVSGAMC Reference Point
7	31:0	**GAMC7**	Project:	All	Format:	DVSGAMC Reference Point
8	31:0	**GAMC8**	Project:	All	Format:	DVSGAMC Reference Point
9	31:0	**GAMC9**	Project:	All	Format:	DVSGAMC Reference Point
10	31:0	**GAMC10**	Project:	All	Format:	DVSGAMC Reference Point
11	31:0	**GAMC11**	Project:	All	Format:	DVSGAMC Reference Point
12	31:0	**GAMC12**	Project:	All	Format:	DVSGAMC Reference Point
13	31:0	**GAMC13**	Project:	All	Format:	DVSGAMC Reference Point
14	31:0	**GAMC14**	Project:	All	Format:	DVSGAMC Reference Point
15	31:0	**GAMC15**	Project:	All	Format:	DVSGAMC Reference Point
16	31:0	**GAMCmaxR**	Project:	All	Format:	DVSGAMC Max Reference Point
17	31:0	**GAMCmaxG**	Project:	All	Format:	DVSGAMC Max Reference Point
18	31:0	**GAMCmaxB**	Project:	All	Format:	DVSGAMC Max Reference Point