Glamo3365 3D Engine

Released

Rev. 1.0

June 22, 2005

Contents

1. Overview

Mobile Multimedia Processor (MMP) supports a powerful 2D graphics engine to enhance the performance. It only supports high color (16bpp) mode, and following functions:

1. BitBlt with ROP3
2. Color expansion
3. Transparent BitBlt with source and destination key
4. Line Drawing
5. Stretch
6. Alpha Blending, ARGB565 supports constant alpha.
   ARGB1555, ARGB4444, ARGB8888 support source bitmap for per-pixel alpha.
   ARGB8888 support source bitmap for pre-multiply alpha.
7. Anti-Aliasing Text
8. Gradient Fill

For each function, it can rotate by 90°, 180°, 270°, mirror, mirror + 90°, mirror +180° (flip) and mirror +270° the coordinate. The fill rate depends on the clock rate of 2D engine. For example, if the clock rate is 50MHz, the fill rate is 50M pixels per second.

2. Engine Register

2.1 BitBlt with ROP3

BitBlt means BIT BLock Transfer. It copies a rectangular region of one bitmap into another.

D[15:8]	D[7:0]	I/O Address
Source Base Address [15:0]		1700
Source Base Address [22:16]		1702
Source Pitch		1704
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Source Y		1708
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Destination Y		170C
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Source Base Address Register 1

Read/Write Port: 1700h

Default Value: 0000h

Field	Bits	Type	Description
SrcBaseAdr	15:0	RW	Source Base Address [15:0] The lower word of base linear address of source bitmap in byte. *Limit:* The address range of source bitmap is from 0 to 8M. *Limit:* It must align at word (16 bits) boundary, and the bit 0 is always zero for word boundary alignment.

Source Base Address Register 2

Read/Write Port: 1702h

Default Value: 0000h

Field	Bits	Type	Description
-	15:7	-	Reserved
SrcBaseAdr	6:0	RW	Source Base Address [22:16] The higher word of base linear address of source bitmap in byte.

Source Pitch Register

Read/Write Port: 1704h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
SrcPitch	10:0	RW	Source Pitch [10:0]

			The row pitch of source bitmap in byte. It is 11.0 formats. *Limit:* The row pitch of source bitmap is from 0 to 1280. *Limit:* It must align at 16 bit boundary, and the bit 0 is always zero for word boundary alignment.

Source X Register

Read/Write Port: 1706h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
SrcX	10:0	RW	Source X [10:0] Start X coordinate of source bitmap in pixel. It is in S10.0 format. *Limit:* The coordinate range of source bitmap is from -639 to 639.

Source Y Register

Read/Write Port: 1708h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
SrcY	10:0	RW	Source Y [10:0] Start Y coordinate of source bitmap in pixel. It is in S10.0 format. *Limit:* The coordinate range of source bitmap is from -639 to 639.

Destination X Register

Read/Write Port: 170Ah

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
DstX	10:0	RW	Start X coordinate of destination bitmap in pixel. It is in S10.0 format. *Limit:* The coordinate range of source bitmap is from -639 to 639.

Destination Y Register

Read/Write Port: 170Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
DstY	10:0	RW	Start Y coordinate of destination bitmap in pixel. It is in S10.0 format. *Limit:* The coordinate range of source bitmap is from -639 to 639.

Destination Base Address Register 1

Read/Write Port: 170Eh

Default Value: 0000h

Field	Bits	Type	Description
DstBaseAdr	15:0	RW	Destination Base Address [15:0] The lower word of base linear address of destination bitmap in byte. *Limit:* The address range of source bitmap is from 0 to 8M. *Limit:* It must align at word boundary, and the bit 0 is always zero for word boundary alignment.

Destination Base Address Register 2

Read/Write Port: 1710h

Default Value: 0000h

Field	Bits	Type	Description
-	15:7	-	Reserved
DstBaseAdr	6:0	RW	Destination Base Address [22:16] The higher word of base linear address of destination bitmap in byte.

Destination Pitch Register

Read/Write Port: 1712h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
DstPitch	10:0	RW	Destination Pitch [10:0] The row pitch of destination bitmap in byte. It is 11.0 formats.

			Limit: The row pitch of destination bitmap is from 0 to 1280. *Limit:* It must align at 16 bit boundary, and the bit 0 is always zero for word boundary alignment. *Notes:* If the destination bitmap is on the LCD display buffer, the destination pitch means the width of LCD size.

Destination Height Register

Read/Write Port: 1714h

Default Value: 0000h

Field	Bits	Type	Description
-	15:10	-	Reserved
DstHeight	9:0	RW	Destination Height [9:0] Device height of destination bitmap in pixel. It is 10.0 formats. *Limit:* Device height of destination bitmap is from 0 to 639. *Notes:* If the destination bitmap is on the LCD display buffer, the destination height means the height of LCD size.

Rectangular Width Register

Read/Write Port: 1716h

Default Value: 0000h

Field	Bits	Type	Description
-	15:10	-	Reserved
RectWidth	9:0	RW	Rectangular Width [9:0] Destination rectangular drawing width of destination bitmap in pixel. It is 10.0 formats. *Limit:* The size of rectangular of destination bitmap is from 0 to 640. *Notes:* It means the actual width for rectangular drawing.

Rectangular Height Register

Read/Write Port: 1718h

Default Value: 0000h

Field	Bits	Type	Description
-	15:10	-	Reserved
RectHeight	9:0	RW	Rectangular Height [9:0] Destination rectangular drawing height of destination bitmap in pixel. It is 10.0 formats.

			Limit: The size of rectangular of destination bitmap is from 0 to 640. *Notes:* It means the actual height for rectangular drawing.

Pattern Base Address Register 1

Read/Write Port: 171Ah

Default Value: 0000h

Field	Bits	Type	Description
PatBaseAdr	15:0	RW	Pattern Base Address [15:0] The lower word of base linear address of pattern bitmap in byte. *Limit:* The address range of pattern bitmap is from 0 to 8M. *Limit:* It must align at 16 bit boundary, and the bit 0 is always zero for word boundary alignment.

Pattern Base Address Register 2

Read/Write Port: 171Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:7	-	Reserved
PatBaseAdr	6:0	RW	Pattern Base Address [22:16] The higher word of base linear address of pattern bitmap in byte.

Pattern Foreground Color Register

Read/Write Port: 171Eh

Default Value: 0000h

Field	Bits	Type	Description
PatForeColor	15:0	RW	The foreground color of pattern. It is high color (16bpp) RGB565 format

Pattern Background Color Register

Read/Write Port: 1720h

Default Value: 0000h

Field	Bits	Type	Description
PatBackColor	15:0	RW	The background color of pattern. It is high color (16bpp) RGB565 format

Source Foreground Color Register

Read/Write Port: 1722h

Default Value: 0000h

Field	Bits	Type	Description
SrcForeColor	15:0	RW	The foreground color of source. It is high color (16bpp) RGB565 format

Source Background Color Register

Read/Write Port: 1724h

Default Value: 0000h

Field	Bits	Type	Description
SrcBackColor	15:0	RW	The background color of source. It is high color (16bpp) RGB565 format

Mono Mask Register 1

Read/Write Port: 1726h

Default Value: 0000h

Field	Bits	Type	Description
Mask1	15:8	RW	The monochrome mask register 1 of pattern. It is 8x8 monochrome mask patterns
Mask0	7:0	RW	The monochrome mask register 0 of pattern. It is 8x8 monochrome mask patterns

Mono Mask Register 2

Read/Write Port: 1728h

Default Value: 0000h

Field	Bits	Type	Description
Mask3	15:8	RW	The monochrome mask register 3 of pattern. It is 8x8 monochrome mask patterns
Mask2	7:0	RW	The monochrome mask register 2 of pattern. It is 8x8 monochrome mask patterns

Mono Mask Register 3

Read/Write Port: 172Ah

Default Value: 0000h

Field	Bits	Type	Description
Mask5	15:8	RW	The monochrome mask register 5 of pattern. It is 8x8

			monochrome mask patterns
Mask4	7:0	RW	The monochrome mask register 4 of pattern. It is 8x8 monochrome mask patterns

Mono Mask Register 4

Read/Write Port: 172Ch

Default Value: 0000h

Field	Bits	Type	Description
Mask7	15:8	RW	The monochrome mask register 7 of pattern. It is 8x8 monochrome mask patterns
Mask6	7:0	RW	The monochrome mask register 6 of pattern. It is 8x8 monochrome mask patterns

Rotation Reference X Register

Read/Write Port: 172Eh

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
ReferenceX	10:0	RW	Rotation reference X coordinate of destination bitmap in pixel. It is in S10.0 format. *Limit:* The coordinate range of source bitmap is from -639 to 639.

Rotation Reference Y Register

Read/Write Port: 1730h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
ReferenceY	10:0	RW	Rotation reference Y coordinate of destination bitmap in pixel. It is in S10.0 format. *Limit:* The coordinate range of source bitmap is from -639 to 639.

Left Clipping Register

Read/Write Port: 1732h

Default Value: 0000h

Field	Bits	Type	Description

-	15:11	-	Reserved
LeftClip	10:0	RW	Left bound of rectangular clipping in pixel. It is in S10.0 format. *Limit:* The clipping region is from -639 to 639.

Top Clipping Register

Read/Write Port: 1734h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
TopClip	10:0	RW	Top bound of rectangular clipping in pixel. It is in S10.0 format. *Limit:* The clipping region is from -639 to 639.

Right Clipping Register

Read/Write Port: 1736h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
RightClip	10:0	RW	Right bound of rectangular clipping in pixel. It is in S10.0 format. *Limit:* The clipping region is from -639 to 639.

Bottom Clipping Register

Read/Write Port: 1738h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
BottomClip	10:0	RW	Bottom bound of rectangular clipping in pixel. It is in S10.0 format. *Limit:* The clipping region is from -639 to 639.

Command Parameter Register 1

Read/Write Port: 173Ah

Default Value: 0000h

Field	Bits	Type	Description
-	15:6	-	Reserved
SrcRotate	5:3	RW	Source Coordinate Rotate 000 Not Rotate

			001 Rotate 90° 010 Rotate 180° 011 Rotate 270° 100 Mirror 101 Mirror + 90° 110 Mirror + 180° (Flip) 111 Mirror + 270°
DstRotate	2:0	RW	Destination Coordinate Rotate 000 Not Rotate 001 Rotate 90° 010 Rotate 180° 011 Rotate 270° 100 Mirror 101 Mirror + 90° 110 Mirror + 180° (Flip) 111 Mirror + 270°

Command Parameter Register 2

Read/Write Port: 173Ch

Default Value: 0000h

Field	Bits	Type	Description
RasterOp	15:8	RW	Raster Operations for ROP3
PatSel	7:6	RW	Pattern select 00: Pattern is from pattern foreground color register 01: Pattern is from color pattern (8x8 Color Pattern) 10: Pattern is from monochrome mask register (8x8 Mono Mask) 11: Reserved
EnTrans	5	RW	Transparent Control 0: Opaque 1: Transparent
RectClipMerge	4	RW	Rectangular Clipping Merge Control 0: Merge clipping bound with screen bound 1: Do not merge clipping bound with screen bound
RectClip	3	RW	Rectangular Clipping Control 0: Disable rectangular clipping logic 1: Enable rectangular clipping logic

Note: The definition of rectangular and merge screen boundary.

Rectangular Clipping	Merge Screen Boundary with Clipping Boundary	Clipping Boundary
No	X	Screen Boundary
Yes	Yes	Clipping with Screen Boundary
Yes	No	Rectangular Clipping Boundary

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate
Command	3:0	RW	Command 0000 BilBlt 0001 Color Expansion 0010 Transparent BitBlt 0011 Line Drawing 0100 Stretch 0101 Alpha Blending 0110 Anti-Aliasing Text 0111 Gradient Fill Others Reserved

Safe Register

Read/Write Port: 1740h

Default Value: 0000h

Field	Bits	Type	Description
ProbeSel	15:12	RW	Probe signal select
-	11	RW	Reserved
PostBufSize	10:8	RW	Set the Post Write Buffer size
-	7	RW	Reserved
BufSize	6:4	RW	Set the Source and Destination buffers size
EnDebug	3	RW	Enable probe signal debug. 0 Disable

			1 Enable
PostBufBound	2	RW	Set the Post Write Buffer Boundary. 0 Disable 1 Enable
BufBound	1	RW	Set the Src/Dst Buffer Boundary. 0 Disable 1 Enable
EnBufMerge	0	RW	Enable Source and Destination buffers Merge. 0 Enable 1 Disable

Engine Status Register

Read/Write Port: 1742h

Default Value: 0000h

Field	Bits	Type	Description
2dStatus	15:12	R	2d Status not (SRCCOORDIdle & DSTCOORDIdle & PATCOORDIdle & AD2SrcIdle)
2dStatus	11:8	R	2d Status not (AD2DstIdle & AD2PatIdle) & CommandErr & SRCBUFerr
2dStatus	7:4	R	2d Status DSTBUFerr & PATBUFerr & ATTRBUFerr & M2DInt
OverWrInt	3	R	Overwrite the Interrupt event. It indicates that the interrupt occurs more than twice before software clears the interrupt.
IntStatus	2:1	R	Status of Interrupt event 01 : The interrupt is raised on the BitBlt Service ID 1 10 : The interrupt is raised on the BitBlt Service ID 2 11 : The interrupt is raised on the BitBlt Service ID 3 Others: Reserved
2DBusy	0	R	Engine Busy

BitBlt ID Register 1

Read/Write Port: 1744h

Default Value: 0000h

Field	Bits	Type	Description
BltID1Int	15	RW	Interrupt

			0 Disable 1 Enable
BitID1Serv	14:0	RW	BitBlt Service ID 1

BitBlt ID Register 2

Read/Write Port: 1746h

Default Value: 0000h

Field	Bits	Type	Description
BltID2Int	15	RW	Interrupt 0 Disable 1 Enable
BitID2Serv	14:0	RW	BitBlt Service ID 2

BitBlt ID Register 3

Read/Write Port: 1748h

Default Value: 0000h

Field	Bits	Type	Description
BltID3Int	15	RW	Interrupt 0 Disable 1 Enable
BitID3Serv	14:0	RW	BitBlt Service ID 3

2.2 Color Expansion

Color expansion also called font expansion. It used to expand a monochrome bitmap to color bitmap.

D[15:8]	D[7:0]	I/O Address
Source Base Address [15:0]		1700
Source Base Address [22:16]		1702
Source Pitch		1704
Source X		1706
Source Y		1708
Destination X		170A
Destination Y		170C
Destination Base Address [15:0]		170E
Destination Base Address [22:16]		1710
Destination Pitch		1712
Destination Height		1714
Rectangular Width		1716
Rectangular Height		1718
Pattern Base Address [15:0]		171A
Pattern Base Address [22:16]		171C
Pattern Foreground Color		171E
Pattern Background Color		1720
Source Foreground Color		1722
Source Background Color		1724
Mask1	Mask0	1726
Mask3	Mask2	1728
Mask5	Mask4	172A
Mask7	Mask6	172C
Rotation reference X		172E
Rotation reference Y		1730
Left Clipping		1732
Top Clipping		1734
Right Clipping		1736
Bottom Clipping		1738
Command Parameter 1		173A

Command Parameter 2	173C
Command Parameter 3	173E
Safe Register	1740
Engine Status	1742
BitBlt ID 1	1744
BitBlt ID 2	1746
BitBlt ID 3	1748

All register definition is the same as BitBlt ROP3. Please reference to its register definition. Just only Source Pitch and Command Parameter Register 3 have some difference.

Source Pitch Register

Read/Write Port: 1704h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
SrcPitch	10:0	RW	Source Pitch [10:0] The row pitch of source bitmap in byte. It is 11.0 formats. *Limit:* The row pitch of source bitmap is from 0 to 1280. *Limit:* It must align at **8 bit** boundary, and the bit 0 is always zero for **byte** boundary alignment.

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate
Command	3:0	RW	Command 0000 BilBlt 0001 Color Expansion 0010 Transparent BitBlt 0011 Line Drawing 0100 Stretch 0101 Alpha Blending

			0110	Anti-Aliasing Text
			0111	Gradient Fill
			Others	Reserved

2.3 Transparent BitBlt

It copies a rectangular region of one bitmap into another, with some transparent pixels depends on the source and destination key.

D[15:8]	D[7:0]	I/O Address
Source Base Address [15:0]		1700
Source Base Address [22:16]		1702
Source Pitch		1704
Source X		1706
Source Y		1708
Destination X		170A
Destination Y		170C
Destination Base Address [15:0]		170E
Destination Base Address [22:16]		1710
Destination Pitch		1712
Destination Height		1714
Rectangular Width		1716
Rectangular Height		1718
High Value of Destination Color Key		171E
Low Value of Destination Color Key		1720
High Value of Source Color Key		1722
Low Value of Source Color Key		1724
Rotation reference X		172E
Rotation reference Y		1730
Left Clipping		1732
Top Clipping		1734
Right Clipping		1736
Bottom Clipping		1738
Command Parameter1		173A
Command Parameter2		173C
Command Parameter 3		173E
Safe Register		1740
Engine Status		1742
BitBlt ID1		1744
BitBlt ID2		1746

BitBlt ID3	1748

The absent of register number above the table means reserved register in this function

Most of the register definition are the same as BitBlt ROP3 excepting the following registers.

High Value of Destination Color Key Register

Read/Write Port: 171Eh

Default Value: 0000h

Field	Bits	Type	Description
PatForeColor	15:0	RW	The high value of destination color key. It is high color (16bpp) RGB565

Low Value of Destination Color Key Register

Read/Write Port: 1720h

Default Value: 0000h

Field	Bits	Type	Description
PatBackColor	15:0	RW	The low value of destination color key. It is high color (16bpp) RGB565

High Value of Source Color Key Register

Read/Write Port: 1722h

Default Value: 0000h

Field	Bits	Type	Description
SrcForeColor	15:0	RW	The high value of source color key. It is high color (16bpp) RGB565

Low Value of Source Color Key Register

Read/Write Port: 1724h

Default Value: 0000h

Field	Bits	Type	Description
SrcBackColor	15:0	RW	The low value of source color key. It is high color (16bpp) RGB565

Command Parameter Register 2

Read/Write Port: 173Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:12	-	Reserved

RasterOp	11:8	RW	Raster Operations for Transparent BitBlt
-	7:5	-	Reserved
RectClipMerge	4	RW	Rectangular Clipping Merge Control 0: Merge clipping bound with screen bound 1: Do not merge clipping bound with screen bound
RectClip	3	RW	Rectangular Clipping Control 0: Disable rectangular clipping logic 1: Enable rectangular clipping logic
-	2:0	-	Reserved

Table 2.3.1 The ROP for Transparent BitBlt:

ROP	Source	Destination	Read DST
0000	Never	Always	No
0001	SRC key and DST key	Otherwise	Yes
0010	not SRC key and DST key	Otherwise	Yes
0011	DST key	Otherwise	Yes
0100	SRC key and not DST key	Otherwise	Yes
0101	SRC key	Otherwise	No
0110	SRC key xor DST key	Otherwise	Yes
0111	SRC key or DST key	Otherwise	Yes
1000	not SRC key and not DST key	Otherwise	Yes
1001	SRC key xnor DST key	Otherwise	Yes
1010	not SRC key	Otherwise	No
1011	not SRC key or DST key	Otherwise	Yes
1100	not DST key	Otherwise	Yes
1101	SRC key or not DST key	Otherwise	Yes
1110	not SRC key or not DST key	Otherwise	Yes
1111	Always	Never	No

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate

Command	3:0	RW	Command	
			0000	BilBlt
			0001	Color Expansion
			0010	Transparent BitBlt
			0011	Line Drawing
			0100	Stretch
			0101	Alpha Blending
			0110	Anti-Aliasing Text
			0111	Gradient Fill
			Others	Reserved

2.4 Line Drawing

An accelerated graphics operation that draws one line on the destination bitmap.

D[15:8]	D[7:0]	I/O Address
Major Axial Pixel Count		1704
Start X		1706
Start Y		1708
Destination Base Address [15:0]		170E
Destination Base Address [22:16]		1710
Destination Pitch		1712
Destination Height		1714
Style Period		1718
Error Term[15:0]		171A
Error Term[19:16]		171C
K1 Term[15:0]		171E
K1 Term[19:16]		1720
K2 Term[15:0]		1722
K2 Term[19:16]		1724
Foreground Color		1726
Background Color		1728
Line Style 0		172A
Line Style 1		172C
Rotation reference X		172E
Rotation reference Y		1730
Left Clipping		1732
Top Clipping		1734
Right Clipping		1736
Bottom Clipping		1738
Command Parameter1		173A
Command Parameter2		173C
Command Parameter3		173E
Safe Register		1740
Engine Status		1742
BitBlt ID1		1744
BitBlt ID2		1746

BitBlt ID3	1748

The absent of register number above the table means reserved register in this function

Most of the register definition are the same as BitBlt ROP3 excepting the following registers.

Major Axial Pixel Count

Read/Write Port: 1704h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
MajorWidth	10:0	RW	Major Axial Pixel Width [10:0] The major axial pixel width. It is 11.0 formats. *Limit:* The width range of major axial is from 0 to 1278. **A value of 0 equals 1 pixel.** **i.e., the actual value is from 1 to 1279**. *Notes*: Assume draws a line from (X1,Y1) to (X2,Y2). The major axial pixel width is *max[abs(X2-X1), abs(Y2-Y1)].* The X1, Y1, X2, and Y2 are in S10.0 format.

Start X Register

Read/Write Port: 1706h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
StartX	10:0	RW	Start X [10:0] Start X coordinate of line drawing in pixel. It is in S10.0 format. *Limit:* The coordinate range of start X is from -639 to 639.

Start Y Register

Read/Write Port: 1708h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
StartY	10:0	RW	Start Y [10:0] Start Y coordinate of line drawing in pixel. It is in S10.0 format. *Limit:* The coordinate range of start Y is from -639 to 639.

Style Period Register

Read/Write Port: 1718h

Default Value: 0000h

Field	Bits	Type	Description
-	14:5	-	Reserved
StylePeriod	4:0	RW	StylePeriod [4:0] Period of the line style in pixel. It is 5.0 formats. *Notes:* A value of 0 equals 1 pixel. i.e., the actual value is from 1 to 32.

Error Term Register 1

Read/Write Port: 171Ah

Default Value: 0000h

Field	Bits	Type	Description
ErrorTerm	15:0	RW	ErrorTerm [15:0] Error Term. It is S20.0 formats. *Notes:* Assume draws a line from (X1,Y1) to (X2,Y2). The Error Term is *2*min[abs(X2-X1), abs(Y2-Y1)] – max[abs(X2-X1), abs(Y2-Y1)]*. The X1, Y1, X2, and Y2 are in S9.0 format.

Error Term Register 2

Read/Write Port: 171Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:5	-	Reserved
ErrorTerm	4:0	RW	ErrorTerm [20:16] Error Term. It is S20.0 formats. *Notes:* Assume draws a line from (X1,Y1) to (X2,Y2). The Error Term is *2*min[abs(X2-X1), abs(Y2-Y1)] – max[abs(X2-X1), abs(Y2-Y1)]*. The X1, Y1, X2, and Y2 are in S9.0 format.

K1 Term Register 1

Read/Write Port: 171Eh

Default Value: 0000h

Field	Bits	Type	Description
K1Term	15:0	RW	K1 Term [15:0]

			K1 Term. It is S20.0 formats. *Notes:* Assume draws a line from (X1,Y1) to (X2,Y2). The K1 Term is *2*min[abs(X2-X1), abs(Y2-Y1)]*. The X1, Y1, X2, and Y2 are in S10.0 format.

K1 Term Register 2

Read/Write Port: 1720h

Default Value: 0000h

Field	Bits	Type	Description
-	15:5	-	Reserved
K1Term	4:0	RW	K1 Term [20:16] K1 Term. It is S20.0 formats. *Notes:* Assume draws a line from (X1,Y1) to (X2,Y2). The K1 Term is *2*min[abs(X2-X1), abs(Y2-Y1)]*. The X1, Y1, X2, and Y2 are in S10.0 format.

K2 Term Register 1

Read/Write Port: 1722h

Default Value: 0000h

Field	Bits	Type	Description
K2Term	15:0	RW	K2 Term [15:0] K2 Term. It is S20.0 formats. *Notes:* Assume draws a line from (X1,Y1) to (X2,Y2). The K2 Term is *2*(min[abs(X2-X1), abs(Y2-Y1)] - max[abs(X2-X1), abs(Y2-Y1)])*. The X1, Y1, X2, and Y2 are in S10.0 format.

K2 Term Register 2

Read/Write Port: 1724h

Default Value: 0000h

Field	Bits	Type	Description
-	15:5	-	Reserved
K2Term	4:0	RW	K2 Term [20:16] K2 Term. It is S20.0 formats. *Notes:* Assume draws a line from (X1,Y1) to (X2,Y2). The K2 Term is *2*(min[abs(X2-X1), abs(Y2-Y1)] - max[abs(X2-X1), abs(Y2-Y1)])*. The X1, Y1, X2, and Y2 are in S10.0 format.

Foreground Color Register

Read/Write Port: 1726h

Default Value: 0000h

Field	Bits	Type	Description
ForeColor	15:0	RW	The foreground color of line. It is high color (16bpp) RGB565 format

Background Color Register

Read/Write Port: 1728h

Default Value: 0000h

Field	Bits	Type	Description
BackColor	15:0	RW	The background color of line. It is high color (16bpp) RGB565 format

Line Style 0 Register

Read/Write Port: 172Ah

Default Value: 0000h

Field	Bits	Type	Description
LineStyle0	15:0	RW	Patterns of line style 0 [15:0]

Line Style 1 Register

Read/Write Port: 172Ch

Default Value: 0000h

Field	Bits	Type	Description
LineStyle1	15:0	RW	Patterns of line style 1 [15:0]

Command Parameter Register 1

Read/Write Port: 173Ah

Default Value: 0000h

Field	Bits	Type	Description
LineStyleType	15	RW	Line style type 0 MSB first 1 LSB first
-	14:12	-	Reserved
MajorAxialSel	11	RW	Line drawing major axial selection 0 Y-axial is major 1 X-axial is major

YDirection	10	RW	Y Direction Control 0 Y counter decrease 1 Y counter increase
XDirection	9	RW	X Direction Control 0 X counter decrease 1 X counter increase
LastPixelDraw	8	RW	Line drawing last pixel draw 0 Last pixels will not be drawn 1 Last pixels will be drawn
EnLineStyle	7	RW	Enable Line style 0 Disable line style 1 Enable line style
StyleCntNotReset	6	RW	Style counter not reset 0 Style counter will be reset 1 Style counter will not be reset
-	5:3	-	Reserved
DstRotate	2:0	RW	Destination Coordinate Rotate 000 Not Rotate 001 Rotate 90° 010 Rotate 180° 011 Rotate 270° 100 Mirror 101 Mirror + 90° 110 Mirror + 180° (Flip) 111 Mirror + 270°

Command Parameter Register 2

Read/Write Port: 173Ch

Default Value: 0000h

Field	Bits	Type	Description
RasterOp	15:8	RW	Raster Operations for ROP3 *Limit*: The line drawing function just supports ROP2 operation. It's same as ROP3 Boolean truth table but without Source components. The Pattern components comes from line style, the Destination components comes from destination bitmap.
-	7:6	-	Reserved
EnTrans	5	RW	Transparent Control

			0 Opaque 1 Transparent
RectClipMerge	4	RW	Rectangular Clipping Merge Control 0: Merge clipping bound with screen bound 1: Do not merge clipping bound with screen bound
RectClip	3	RW	Rectangular Clipping Control 0: Disable rectangular clipping logic 1: Enable rectangular clipping logic
	2:0		Reserved

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate
Command	3:0	RW	Command 0000 BilBlt 0001 Color Expansion 0010 Transparent BitBlt 0011 Line Drawing 0100 Stretch 0101 Alpha Blending 0110 Anti-Aliasing Text 0111 Gradient Fill Others Reserved

Parameters Algorithm:

Assume draw a line from (X1,Y1) to (X2,Y2).

min = min(abs(X2-X1),abs(Y2-Y1));

Max = max(abs(X2-X1),abs(Y2-Y1));

K1_Term = 2*min;

K2_Term = 2*(min-Max);

Error_Term = 2*min-Max;

Major_Axial_Pixel_Count = Max;

Limitation:

The Max-min should less or equal than 639.

Software workaround

It the (Max-min) bigger than 639, adjust the end point of coordinate to the positive coordinate.

2.5 Stretch

It scales up/down a rectangular region of one bitmap into another.

D[15:8]	D[7:0]	I/O Address
Source Base Address [15:0]		1700
Source Base Address [22:16]		1702
Source Pitch		1704
Source X		1706
Source Y		1708
Destination X		170A
Destination Y		170C
Destination Base Address [15:0]		170E
Destination Base Address [22:16]		1710
Destination Pitch		1712
Destination Height		1714
Rectangular Width		1716
Rectangular Height		1718
Source Width		171E
Source Height		1720
X Error Term K1		1722
X Error Term K2		1724
Y Error Term K1		1726
Y Error Term K2		1728
X Initial Error		172A
Y Initial Error		172C
Rotation reference X		172E
Rotation reference Y		1730
Left Clipping		1732
Top Clipping		1734
Right Clipping		1736
Bottom Clipping		1738
Command Parameter1		173A
Command Parameter2		173C
Command Parameter3		173E
Safe Register		1740

Engine Status	1742
BitBlt ID1	1744
BitBlt ID2	1746
BitBlt ID3	1748

The absent of register number above the table means reserved register in this function

Most of the register definition are the same as BitBlt ROP3 excepting the following registers.

Source Width Register

Read/Write Port: 171Eh

Default Value: 0000h

Field	Bits	Type	Description
-	15:10	-	Reserved
SrcWidth	9:0	RW	The width of source bitmap in pixel. It is 10.0 formats. *Limit:* The size of rectangular of source bitmap is from 0 to 640.

Source Height Register

Read/Write Port: 1720h

Default Value: 0000h

Field	Bits	Type	Description
-	15:10	-	Reserved
SrcHeight	9:0	RW	The height of source bitmap in pixel. It is 10.0 formats. *Limit:* The size of rectangular of source bitmap is from 0 to 640.

X Error Term K1 Register

Read/Write Port: 1722h

Default Value: 0000h

Field	Bits	Type	Description
-	15:12	-	Reserved
XErrK1	11:0	RW	Stretch error term K1 in X-direction. It is S11.0 formats. *Notes:* See the 'Related Parameters Algorithm' section for more detail information.

X Error Term K2 Register

Read/Write Port: 1724h

Default Value: 0000h

Field	Bits	Type	Description
-	15:12	-	Reserved
XErrK2	11:0	RW	Stretch error term K2 in X-direction. It is S11.0 formats. *Notes:* See the 'Related Parameters Algorithm' section for more detail information.

Y Error Term K1 Register

Read/Write Port: 1726h

Default Value: 0000h

Field	Bits	Type	Description
-	15:12	-	Reserved
YErrK1	11:0	RW	Stretch error term K1 in Y-direction. It is S11.0 formats. *Notes:* See the 'Related Parameters Algorithm' section for more detail information.

Y Error Term K2 Register

Read/Write Port: 1728h

Default Value: 0000h

Field	Bits	Type	Description
-	15:12	-	Reserved
YErrK2	11:0	RW	Stretch error term K2 in Y-direction. It is S11.0 formats. *Notes:* See the 'Related Parameters Algorithm' section for more detail information.

X Initial Error Register

Read/Write Port: 172Ah

Default Value: 0000h

Field	Bits	Type	Description
-	15:12	-	Reserved
XInitErr	11:0	RW	Stretch initial error term in X-direction. It is S11.0 formats. *Notes:* See the 'Related Parameters Algorithm' section for more detail information.

Y Initial Error Register

Read/Write Port: 172Ch

Default Value: 0000h

Field	Bits	Type	Description

-	15:12	-	Reserved
YInitErr	11:0	RW	Stretch initial error term in Y-direction. It is S11.0 formats. *Notes:* See the 'Related Parameters Algorithm' section for more detail information.

Command Parameter Register 2

Read/Write Port: 173Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:5	-	Reserved
RectClipMerge	4	RW	Rectangular Clipping Merge Control 0: Merge clipping bound with screen bound 1: Do not merge clipping bound with screen bound
RectClip	3	RW	Rectangular Clipping Control 0: Disable rectangular clipping logic 1: Enable rectangular clipping logic
-	2:0	-	Reserved

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate
Command	3:0	RW	Command 0000 BilBlt 0001 Color Expansion 0010 Transparent BitBlt 0011 Line Drawing 0100 Stretch 0101 Alpha Blending 0110 Anti-Aliasing Text 0111 Gradient Fill Others Reserved

2.6 Alpha Blending

An accelerated graphics operation that copies a rectangular region of one bitmap into another, using alpha blending.

D[15:8]	D[7:0]	I/O Address
Source Base Address [15:0]		1700
Source Base Address [22:16]		1702
Source Pitch		1704
Source X		1706
Source Y		1708
Destination X		170A
Destination Y		170C
Destination Base Address [15:0]		170E
Destination Base Address [22:16]		1710
Destination Pitch		1712
Destination Height		1714
Rectangular Width		1716
Rectangular Height		1718
Constant Alpha Value		171E
Rotation reference X		172E
Rotation reference Y		1730
Left Clipping		1732
Top Clipping		1734
Right Clipping		1736
Bottom Clipping		1738
Command Parameter1		173A
Command Parameter2		173C
Command Parameter3		173E
Safe Register		1740
Engine Status		1742
BitBlt ID1		1744
BitBlt ID2		1746
BitBlt ID3		1748

Constant Alpha Value Register

Read/Write Port: 171Eh

Default Value: 0000h

Field	Bits	Type	Description
-	15:8	-	Reserved
AlphaValue	7:0	RW	Constant Alpha Value [7:0]

Command Parameter Register 1

Read/Write Port: 173Ah

Default Value: 0000h

Field	Bits	Type	Description
-	15	-	Reserved
SrcFormat	14:13	RW	The source format for alpha blending 00: ARGB8888 source bitmap 01: ARGB1555 source bitmap 10: ARGB4444 source bitmap 11: ARGB565 source bitmap (for Constant Alpha Only)
OutFormat	12	RW	Output Format 0 RGB565 format 1 RGB555 format
DisDither	11	RW	Dither function (only active on source bitmap is ARGB8888 format) 0: Enable 1: Disable
-	10:8	-	Reserved
AlphaBlendMode	7:6	RW	Alpha Blending Mode 00: Constant Alpha Dst = (Src * Ac + (255 – Ac)) * Dst. / 255. 01: Per-Pixel Alpha Dst = (Src * Src.A + (255–Src.A)) * Dst. /255 10: No Destination Constant Alpha (only for source ARGB8888) SrcNew.A = Src.A * Ac / 255 SrcNew.R = Src.R * Ac / 255 SrcNew.G = Src.G * Ac / 255 SrcNew.B = Src.B * Ac / 255 11: Premultiply Alpha (only for source ARGB8888) Dst.R = SrcNew.R + ((255–SrcNew.A) * Dst.R) /255 Dst.G = SrcNew.G + ((255–SrcNew.A) * Dst.G) /255

			Dst.B = SrcNew.B + ((255–SrcNew.A) * Dst.B) /255
SrcRotate	5:3	RW	Source Coordinate Rotate 000 Not Rotate 001 Rotate 90° 010 Rotate 180° 011 Rotate 270° 100 Mirror 101 Mirror + 90° 110 Mirror + 180° (Flip) 111 Mirror + 270°
DstRotate	2:0	RW	Destination Coordinate Rotate 000 Not Rotate 001 Rotate 90° 010 Rotate 180° 011 Rotate 270° 100 Mirror 101 Mirror + 90° 110 Mirror + 180° (Flip) 111 Mirror + 270°

Limitation:

Alpha Mode	Source Color Mode	Source Rotate	Dest. Color Mode	Dest. Rotate
Constant Alpha	ARGB8888	No	RGB565	Yes
	ARGB1555	Yes		
	ARGB4444	Yes		
Per-Pixel Alpha	ARGB8888	No	RGB565	Yes
	ARGB1555	Yes		
	ARGB4444	Yes		

Command Parameter Register 2

Read/Write Port: 173Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:5	-	Reserved
RectClipMerge	4	RW	Rectangular Clipping Merge Control 0: Merge clipping bound with screen bound 1: Do not merge clipping bound with screen bound

RectClip	3	RW	Rectangular Clipping Control 0: Disable rectangular clipping logic 1: Enable rectangular clipping logic
-	2:0	-	Reserved

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate
Command	3:0	RW	Command 0000 BilBlt 0001 Color Expansion 0010 Transparent BitBlt 0011 Line Drawing 0100 Stretch 0101 Alpha Blending 0110 Anti-Aliasing Text 0111 Gradient Fill Others Reserved

2.7 Anti-Aliasing Text

Glyphs are provide as packed 4bpp system memory surfaces, the 4bpp glyph data only needs to specify the corresponding per-pixel alpha value.

D[15:8]	D[7:0]	I/O Address
Source Base Address [15:0]		1700
Source Base Address [22:16]		1702
Source Pitch		1704
Source X		1706
Source Y		1708
Destination X		170A
Destination Y		170C
Destination Base Address [15:0]		170E
Destination Base Address [22:16]		1710
Destination Pitch		1712
Destination Height		1714
Rectangular Width		1716
Rectangular Height		1718
Foreground Color		1722
Background Color		1724
Rotation reference X		172E
Rotation reference Y		1730
Left Clipping		1732
Top Clipping		1734
Right Clipping		1736
Bottom Clipping		1738
Command Parameter1		173A
Command Parameter2		173C
Command Parameter3		173E
Safe Register		1740
Engine Status		1742
BitBlt ID1		1744
BitBlt ID2		1746
BitBlt ID3		1748

Read/Write Port: 1704h

Default Value: 0000h

Field	Bits	Type	Description
-	15:11	-	Reserved
SrcPitch	10:0	RW	Source Pitch [10:0] The row pitch of source bitmap in byte. It is 11.0 formats. *Limit:* The row pitch of source bitmap is from 0 to 1280. *Limit:* It must align at **8 bit** boundary, and the bit 0 is always zero for **byte** boundary alignment.

Command Parameter Register 1

Read/Write Port: 173Ah

Default Value: 0000h

Field	Bits	Type	Description
-	15:3	-	Reserved
DstRotate	2:0	RW	Destination Coordinate Rotate 000 Not Rotate 001 Rotate 90° 010 Rotate 180° 011 Rotate 270° 100 Mirror 101 Mirror + 90° 110 Mirror + 180° (Flip) 111 Mirror + 270°

Command Parameter Register 2

Read/Write Port: 173Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:6	-	Reserved
EnTrans	5	RW	Transparent Control 0 Opaque 1 Transparent
RectClipMerge	4	RW	Rectangular Clipping Merge Control 0: Merge clipping bound with screen bound 1: Do not merge clipping bound with screen bound
RectClip	3	RW	Rectangular Clipping Control

			0: Disable rectangular clipping logic 1: Enable rectangular clipping logic
-	2:0	-	Reserved

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate
Command	3:0	RW	Command 0000 BilBlt 0001 Color Expansion 0010 Transparent BitBlt 0011 Line Drawing 0100 Stretch 0101 Alpha Blending 0110 Anti-Aliasing Text 0111 Gradient Fill Others Reserved

2.8 Gradient Fill

To fill a rectangular area with smooth color.

D[15:8]	D[7:0]	I/O Address
Y Delta B [15:0]		1700
Y Delta B [2:0]		1702
Initial Color [15:0] (RGB)		1706
Initial Color [23:16]		1708
Destination X		170A
Destination Y		170C
Destination Base Address [15:0]		170E
Destination Base Address [22:16]		1710
Destination Pitch		1712
Destination Height		1714
Rectangular Width		1716
Rectangular Height		1718
X Delta R [15:0]		171A
X Delta R [2:0]		171C
X Delta G [15:0]		171E
X Delta G [2:0]		1720
X Delta B [15:0]		1722
X Delta B [2:0]		1724
Y Delta R [15:0]		1726
Y Delta R [2:0]		1728
Y Delta G [15:0]		172A
Y Delta G [2:0]		172C
Rotation reference X		172E
Rotation reference Y		1730
Left Clipping		1732
Top Clipping		1734
Right Clipping		1736
Bottom Clipping		1738
Command Parameter1		173A
Command Parameter2		173C
Command Parameter3		173E

Safe Register	1740
Engine Status	1742
BitBlt ID1	1744
BitBlt ID2	1746
BitBlt ID3	1748

Y Delta B Register 1

Read/Write Port: 1700h

Default Value: 0000h

Field	Bits	Type	Description
YDeltaB	15:0	RW	YDeltaB [18:0] Y Delta B Color. *Limit*: It is in the S8.10 format. *Formula* : YDeltaB= (ColorB_End - ColorB_Initial)/(Height-1)*(2^10)

Y Delta B Register 2

Read/Write Port: 1702h

Default Value: 0000h

Field	Bits	Type	Description
-	15:3	-	Reserved
YDeltaB	2:0	RW	YDeltaB [18:0] Y Delta B Color. *Limit*: It is in the S8.10 format. *Formula* : YDeltaB= (ColorB_End - ColorB_Initial)/(Height-1)*(2^10)

Initial Color Register 1

Read/Write Port: 1706h

Default Value: 0000h

Field	Bits	Type	Description
InitColor	15:0	RW	InitColor [23:0] Initial Color for RGB when RGB888 Color

Initial Color Register 2

Read/Write Port: 1708h

Default Value: 0000h

Field	Bits	Type	Description
-	15:8	-	Reserved
YDeltaB	7:0	RW	InitColor [23:0] Initial Color for RGB when RGB888 Color

X Delta R Register 1

Read/Write Port: 171Ah

Default Value: 0000h

Field	Bits	Type	Description
XDeltaR	15:0	RW	XDeltaR [18:0] X Delta R Color. *Limit*: It is in the S8.10 format. *Formula* : XDeltaR= (ColorR_End - ColorR_Initial)/(Width-1)*(2^10)

X Delta R Register 2

Read/Write Port: 171Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:3	-	Reserved
XDeltaR	2:0	RW	XDeltaR [18:0] X Delta R Color. *Limit*: It is in the S8.10 format. *Formula* : XDeltaR= (ColorR_End - ColorR_Initial)/(Width-1)*(2^10)

X Delta G Register 1

Read/Write Port: 171Eh

Default Value: 0000h

Field	Bits	Type	Description
XDeltaG	15:0	RW	XDeltaG [18:0] X Delta G Color. *Limit*: It is in the S8.10 format. *Formula* : XDeltaG= (ColorG_End - ColorG_Initial)/(Width-1)*(2^10)

X Delta G Register 2

Read/Write Port: 1720h

Default Value: 0000h

Field	Bits	Type	Description
-	15:3	-	Reserved
XDeltaG	2:0	RW	XDeltaG [18:0] X Delta G Color. *Limit*: It is in the S8.10 format. *Formula* : XDeltaG= (ColorG_End - ColorG_Initial)/(Width-1)*(2^10)

X Delta B Register 1

Read/Write Port: 1722h

Default Value: 0000h

Field	Bits	Type	Description
XDeltaB	15:0	RW	XDeltaB [18:0] X Delta B Color. *Limit*: It is in the S8.10 format. *Formula* : XDeltaB= (ColorB_End - ColorB_Initial)/(Width-1)*(2^10)

X Delta B Register 2

Read/Write Port: 1724h

Default Value: 0000h

Field	Bits	Type	Description
-	15:3	-	Reserved
XDeltaB	2:0	RW	XDeltaB [18:0] X Delta B Color. *Limit*: It is in the S8.10 format. *Formula* : XDeltaB= (ColorB_End - ColorB_Initial)/(Width-1)*(2^10)

Y Delta R Register 1

Read/Write Port: 1726h

Default Value: 0000h

Field	Bits	Type	Description
YDeltaR	15:0	RW	YDeltaR [18:0] Y Delta R Color.

			Limit: It is in the S8.10 format. *Formula* : YDeltaR= (ColorR_End - ColorR_Initial)/(Height-1)*(2^10)

Y Delta B Register 2

Read/Write Port: 1728h

Default Value: 0000h

Field	Bits	Type	Description
-	15:3	-	Reserved
YDeltaR	2:0	RW	YDeltaR [18:0] Y Delta R Color. *Limit*: It is in the S8.10 format. *Formula* : YDeltaR= (ColorR_End - ColorR_Initial)/(Height-1)*(2^10)

Y Delta G Register 1

Read/Write Port: 172Ah

Default Value: 0000h

Field	Bits	Type	Description
YDeltaG	15:0	RW	YDeltaG [18:0] Y Delta G Color. *Limit*: It is in the S8.10 format. *Formula* : YDeltaG= (ColorG_End - ColorG_Initial)/(Height-1)*(2^10)

Y Delta G Register 2

Read/Write Port: 172Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:3	-	Reserved
YDeltaG	2:0	RW	YDeltaG [18:0] Y Delta G Color. *Limit*: It is in the S8.10 format. *Formula* : YDeltaG= (ColorG_End - ColorG_Initial)/(Height-1)*(2^10)

Command Parameter Register 1

Read/Write Port: 173Ah

Default Value: 0000h

Field	Bits	Type	Description
-	15:12	-	Reserved
DisDither	11	RW	Dither function 0 Enable 1 Disable
-	10:3	-	Reserved
DstRotate	2:0	RW	Destination Coordinate Rotate 000 Not Rotate 001 Rotate 90° 010 Rotate 180° 011 Rotate 270° 100 Mirror 101 Mirror + 90° 110 Mirror + 180° (Flip) 111 Mirror + 270°

Command Parameter Register 2

Read/Write Port: 173Ch

Default Value: 0000h

Field	Bits	Type	Description
-	15:7	-	Reserved
GradientDirect	6:5	RW	Gradient Fill Direction 00: Horizontal Direction 01: Vertical Direction 10: Triangle 11: Reserved
RectClipMerge	4	RW	Rectangular Clipping Merge Control 0: Merge clipping bound with screen bound 1: Do not merge clipping bound with screen bound
RectClip	3	RW	Rectangular Clipping Control 0: Disable rectangular clipping logic 1: Enable rectangular clipping logic
-	2:0	-	Reserved

Command Parameter Register 3

Read/Write Port: 173Eh

Default Value: 000Fh

Field	Bits	Type	Description
-	15:5	-	Reserved
EnOnScreenRot	4	RW	Enable On-Screen Rotate . 0: Disable On-Screen Rotate 1: Enable On-Screen Rotate
Command	3:0	RW	Command 0000 BilBlt 0001 Color Expansion 0010 Transparent BitBlt 0011 Line Drawing 0100 Stretch 0101 Alpha Blending 0110 Anti-Aliasing Text 0111 Gradient Fill Others Reserved