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(11/2/94- 002)

SEGA SATURN

SGL Developer's Manual

Reference

SEGA SATURN

SGL Reference

Function Reference

The Sega Saturn Graphics Library (SGL) is a C language function library assembled for software development support for the Sega Saturn system. The SGL is ideal for the development of software that uses 3D graphics.

Because careful and rigorous consideration was given to the selection of the types of functions for the SGL, the total number is not that large. when used in combination, however, these functions are more than sufficient for the development of 3D games and similar software. In fact, the design concept behind the creation of the SGL was to permit fast and flexible software development through the use of combinations of simple modules.

We hope that you will find that the SGL opens up the exciting world of the Sega Saturn system.

Sega Enterprises, Ltd.

Yu Suzuki

void

slLight Light source setup

Format

```
void slLight(light)
VECTOR light;
```

Parameters

light Light source vector

Function

This function sets up the light source.
For the parameters, substitute the vector value (unit vector) that indicates the direction of the light rays.

Return Value

None

Remarks

The light source vector must be specified as a unit vector. Assuming the size of the light source vector were to exceed "1", an overflow would occur and the polygon surface color would not be displayed properly.
In addition, if the scaling operation is being performed on the current matrix, it is important to realize that the normal vector of the polygon is also affected, and thus the brightness will change accordingly.

Refer to: Chapter 3, "Light Sources

void

slperspective Perspective transformation table setup

Format

```
void slPerspective(pers)
ANGLE pers;
```

Parameters

pers Perspective angle
Range: 10 to 160 (unit: DEG

Function

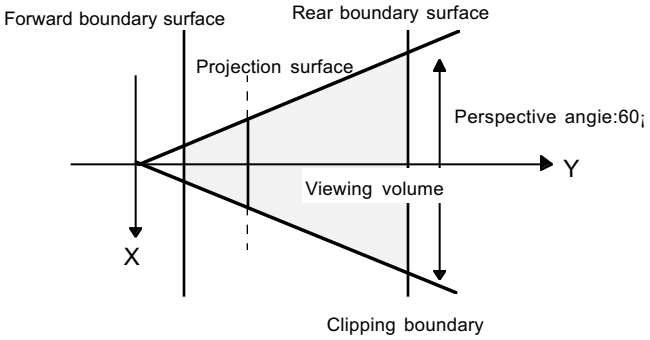
This function sets the constant for the distance to the screen, which is used in perspective transformations. The perspective angle parameter determines the angle corresponding to the width of the screen.
Because this function also sets the parameters for the rotating scroll, execute slRpasaInitSet() before calling this function when using the rotating scroll.

Return Value

None

Remarks

The functions "slWindow" and "slZdispLevel" in combination with "slPerspective" completely determine the viewing volume. The diagram below illustrates the concepts behind perspective transformation.



Refer to: Chapter 4, "Coordinate Transformation"

void

slPutPolygon Polygon model drawing

Format

```
void slPutPolygon(pat)
PDATA *pat;
```

Parameters

pat Starting address of area where polygon data is stored

Function

This function draws the polygon model specified by the parameter.
The polygon model is affected by the parallel shift component and rotation component of the current matrix, and is drawn on the screen using perspective transformations.

Return Value

None

Remarks

The polygon data is defined as a PDATA structure.
A PDATA structure includes the polygon vertex list, the number of vertices, the face list, the number of faces, and the face attribute information.
For details, refer to "Structure Reference: PDATA Structure" and Chapter 2, "Graphics," in the Programmer's Tutorial.

_œ Polygon data structure _œ

```
PDATA<Label name>={
    point_PLANE1.                                  /* vert,‡ex list */
sizeof(point_PLANE1)/SIZEOF(POINT),                /* number of vertices */
    polygon_PLANE1,                                /* face list */
    sizeof(point_PLANE1)/SIZEOF(POLYGON),          /* number of faces */
    attribute_PLANE1                               /* face attribute list */
};
```

Note: The PDATA structure is defined in "sl_def.h".Refer to: Chapter 2, "Graphics"

void

slWindow Various window settings

Format

```
void slWindow
left , top , right , bottom , Zlimit , centx , centy
Sint16 left;
Sint16 top;
Sint16 right;
Sint16 bottom;
Sint16 Zlimit;
Sint16 centx;
Sint16 centy;
```

Parameters

left	X coordinate of upper-left corner of window (screen coordinate system)
top	Y coordinate of upper-left corner of window (screen coordinate system)
right	X coordinate of lower-right corner of window (screen coordinate system)
bottom	Y coordinate of lower-right corner of window (screen coordinate system)
Zlimit	Distance to rear boundary surface of window
centx	X coordinate of vanishing point
centy	Y coordinate of vanishing point

Function

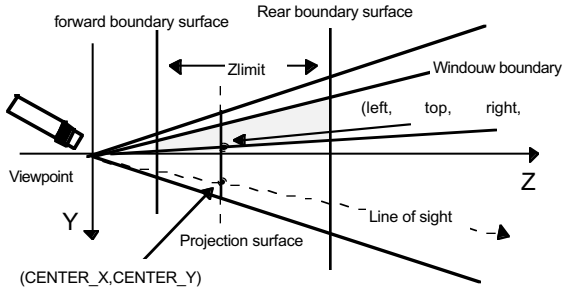
This function sets up windows that limits the display of sprites andpolygons. "Window" is the name of a rectangular area set up on the screen; two windows can be set up on the screen at one time.
Polygons and sprites can be set to be displayed or not displayed when they are inside or outside of a window.
For the parameters, substitute the X and Y screen coordinates defining the area of the window, the Z coordinate that indicates the distance to the rear boundary surface of the display, and the X and Y screen coordinates of the vanishing point.

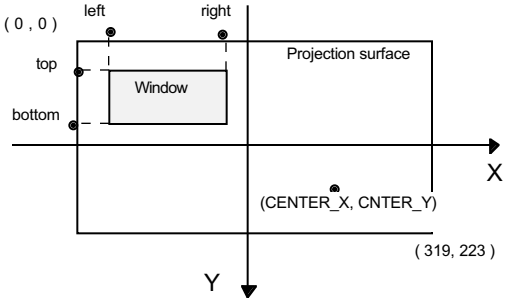
Return Value

None

Remarks

Polygons and sprites are affected by windows that are set up before the polygon or sprite is drawn.
In the SGL, a window that is the same size as the screen is set up as a default window; if the function "slWindow" is not executed, the drawing of polygons and sprites is affected by this default window.





Note: "left", "top", "right", "bottom", "CENTER_X", and "CENTER_Y" refer to the X and Y screen coordinates

Refer to: Chapter 4, "Coordinate Transformation"

void

slZdspLevel Display level specification

Format

```
void slZdspLevel(level)
Uint16 level;
```

Parameters

level Display level
1: Display from 1/2
2: Display from 1/4
3: Display from 1/8
Note: For an explanation of the display level, refer to the diagram shown below.

Function

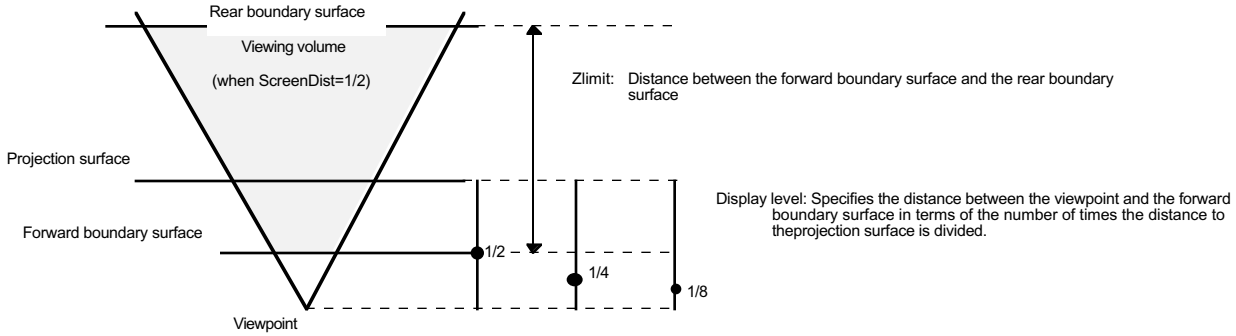
This function specifies how far in front of the projection surface to actually project (the front boundary surface).

Return Value

None

Remarks

The distance from the forward boundary surface to the rear boundary surface is the "Zlimit".
The "Zlimit" is specified by the "slWindow" function.
During system initialization, the display level is set to "1/2".



Refer to: Chapter 4, "Coordinate Transformation"

void

sllMapRA RGB map setup (using rotation parameters A)

Format

```
void sl1MapRA(a)
void *a ;
```

Parameters

a Starting address in VRAM of pattern name data table for rotation parameters A

Function

This function sets up the rotating scroll map (using rotation parameters A). For the parameter, substitute the starting address in VRAM of the pattern name data table to be registered in the map register and the map offset register. The data table uses 16 pages, starting from the specified address.

Return Value

None

Remarks

Refer to: Chapter 8, "Scrolls"

void

sllMapRB RGB map setup (using rotation parameters B)

Format

```
void sl1MapRB(b)
void *b;
```

Parameters

b Starting address of in VRAM pattern name data table for rotation parameters B

Function

This function sets up the rotating scroll map (using rotation parameters B). For the parameter, substitute the starting address in VRAM of the pattern name data table to be registered in the map register and the map offset register. The data table uses 16 pages, starting from the specified address.

Return Value

None

Remarks

Refer to: Chapter 8, "Scrolls"

sl1MapRB

void

sl16MapRA RBG0 map setting (using rotation parameters A)

Format

```
void sl16MapRA(map [16])
Uint8 map [16] ;
```

Parameters

map[16] Map number for 16 pages

Function

This function sets up a rotating scroll map consisting of 16 pages (using rotation parameters A).

Return Value

None

Remarks

This function sets the map number for 16 pages for the matrix passed as the parameter.

ABCD
EFGH
IJKL
MNOP

The matrix is set up for the pages in the 4 x 4 configuration shown above in the sequence A, B, C... N, O, P.

Refer to: Chapter 8, "Scrolls"

void

slBackColSet Background screen single-color setup

Format

```
void slBack1ColSet(colptr , rgbptr)
void *colptr ; Uint16 rgbptr ;
```

Parameters

colptr Starting address in VRAM where the background color is stored
rgbptr Color data, 5 bits for each of red, green, and blue

Function

This function sets up the background screen.
The "background screen" is the graphics screen that is displayed in the background in those areas where absolutely nothing else is displayed.

Return Value

None

Remarks

Although the background screen color specification is made with the parameter "rgbptr", refer to the RGB mode color sample "RGB_flag" in the include file "sl_def.h" for the substitution values.

¥ RGB mode color sample ¥

```
#define    CD_Black      (0<<10) : (0<<5) : RGB_Flag
#define    CD_DarkRed    (0<<10) : (0<<5) : RGB_Flag
#define    CD_DarkGreen  (0<<10) : (0<<5) : RGB_Flag

           _ç
#define    CD_Purple     (0<<10) : (0<<5) : RGB_Flag
#define    CD_Margenta   (0<<10) : (0<<5) : RGB_Flag
#define    CD_White      (0<<10) : (0<<5) : RGB_Flag
```

Note: The above values are defined in "sl_def.h",provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slBitMapNbg0,1 Bitmap mode setting

Format

void slBitMapNbg0(col_type,bmsize)
void slBitMapNbg1(col_type,bmsize)
Uint16col_type;
Uint16bmsize;

Parameters

col_type Color mode flag
bmsize VRAM Bitmap size flag

Function

This function changes the screen to bitmap mode, and sets the color mode and bitmap size.

Return Value

None

Remarks

Refer to the tables below for the flags to be substituted for the parameters. Note, however, the 16.77 million color specification can only be specified for NBG0.

	Color mode flag				
	Palette format			RGB format	
	16 colors	256 colors	2048 colors	32,768 colors	16.77 million colors
Substitution value	COL_TYPE_16	COL_TYPE_256	COL_TYPE-2048	COL_TYPE_32768	COL_TYPE_1M

Note: In color RAM mode 0 or 2, "2048 colors" becomes "1024 colors."

	Bitmap size			
	512 x 256 (H x V))	512 x 512 (H x V)	1024 x 256 (H x V))	1024 x 512 (H x V)
Substitution value	BM_512x256	BM_512x512	BM_1024x256	BM_1024x512

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: HARDWARE MANUAL vol. 2 (VDP2)

void

slBMPaletteNbg0,1 Bitmap screen palette number setting (NBG)

Format

```
void slBMPaletteNbg0(pal)
void slBMPaletteNbg1(pal)
Uint16 pal;
```

Parameters

pal Palette number (0 to 7)

Function

This function sets the palette number when displaying the bitmap screen in palette format.

Return Value

None

Remarks

Refer to: HARDWARE MANUAL vol. 2 (VDP2) slBMPaletteRbg0,1

void

slCharNbg0,1,2,3 NBG character control setup

Format

```
void slCharNbg0(col_type , chara_size)
void slCharNbg1(col_type , chara_size)
void slCharNbg2(col_type , chara_size)
void slCharNbg3(col_type , chara_size)
Uint16 col_type ,
Uint16 chara_size ;
```

Parameters

col_type	flag for the specification of the number of colors for the scroll
chara_size	flag for the character size specification

Function

This function sets the character size and the number of colors used on normal scrolls NBG0, NBG1, NBG2, and NBG3.
Refer to the table below for the substitution values for the parameters.

Return Value

None

Remarks

When the color RAM mode is 0 or 2, the 2048-color specification becomes 1024 colors. In addition, the maximum number of colors that can be specified differs according to the scroll screen type.

	Number of character colors					Character size	
	Palette format			RGB format			
	16 colors	256 colors	2048 colors	32,768 colors	16.77 million colors	1 x 1	2 x 2
Substitution value	COL_TYPE_16	COL_TYPE_256	COL_TYPE_2048	COL_TYPE_32768	COL_TYPE_1M	CHAR_SIZE_1x1	CHAR_SIZE_2x2

Note 1:In color RAM mode 0 or 2, "2048 colors" becomes "1024 colors."

Note 2:The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slCharRbg0 RBG character control setup

Format

```
void slCharRbg0(col_type , chara_size)
Uint16 col_type ,
Uint16 chara_size ;
```

Parameters

col_type	flag for the specification of the number of colors for the scroll
chara_size	flag for the character size specification

Function

This function sets the character size and the number of colors used on rotating scroll RBG0.

Refer to the table below for the substitution values for the parameters.

Return Value

None

Remarks

When the color RAM mode is 0 or 2, the 2048-color specification becomes 1024 colors.

	Number of character colors					Character size	
	Palette format			RGB format			
	16 colors	256 colors	2048 colors	32,768 colors	16.77 million colors	1 x 1	2 x 2
Substitution value	COL_TYPE_16	COL_TYPE_256	COL_TYPE_2048	COL_TYPE_32768	COL_TYPE_1M	CHAR_SIZE_1x1	CHAR_SIZE_2x2

Note 1:In color RAM mode 0 or 2, "2048 colors" becomes "1024 colors."

Note 2:The values in the above table are defined in "sl_def.h", provided with the system

Refer to: Chapter 8, "Scrolls"

void

slColOffsetOn Color offset enable setting

Format

void slColOfsetOn(flag)
Uint16 flag ;

Parameters

flag Screen specification

Function

This function sets the screen that will be affected by the color offset set by the function "slColOfsetA".

The "or" operator ("|") can be used to link together multiple parameters so that multiple screens can be set simultaneously.

Return Value

None

Remarks

For the parameter, substitute the value from the table shown below corresponding to the scroll screen to be registered.

	Scroll screen being registered						
	NBG0	NBG1	NBG2	NBG3	RBG0	BACK	SPRITE
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON	BACKON	SPRON

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slColOffsetBUse Color offset select

Format

void slColOfsetBUse(flag)
Uint16 flag;

Parameters

flag Screen

Function

This function sets the screen that will be affected by the color offset set by the function "slColOfsetB".

The "or" operator ("|") can be used to link together multiple parameters so that multiple screen can be set simultaneously.

Return Value

None

Remarks

For the parameter, substitute the value from the table shown below corresponding to the scroll screen to be registered.

	Scroll screen being registered						
	NBG0	NBG1	NBG2	NBG3	RBG0	BACK	SPRITE
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON	BACKON	SPRON

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slColOffsetA,B Color offset setting

Format

```
void slColOfsetA(r , g , b)
void slColOfsetB(r , g , b)
Sint16 r ;
Sint16 g ,
Sint16 b ;
```

Parameters

r	Red offset value (signed 9 bits)
g	Green offset value (signed 9 bits)
b	Blue offset value (signed 9 bits)

Function

These functions set the color offset values for red green and blue. The function "slColOfsetA" sets the offset values used for color offsets A, and the function "slColOfsetB" sets the offset values used for color offsets B.

Return Value

None

Remarks

To set a negative value for an offset value, substitute the complement of the absolute value of that number.

Color offset processing is executed after color operation processing.

Refer to: Chapter 8, "Scrolls"

void

slColorCalc Color calculation control setting

Format

```
void slColorCalc( flag )
Uint16 flag ;
```

Parameters

flag Color calculation control parameter

Function

This function sets parameters for color calculations, etc.

Return Value

None

Remarks

For the parameters, substitute the values in the table below according to the functions being used. Refer to "HARDWARE MANUAL vol. 2" (VDP2 User's Manual: p. 241) for details.

_œ ColorCalc substitution values _œ

Calculation method :[CC_RATE | CC_ADD] |
Image for which calculation is specified :[CC_TOP | CC_2ND] |
Extended color operations :[CC_EXT] |
Registered screen
:[NBG0ON|NBG1ON|NGB2ON|NBG3ON|RBG0ON|LNCLON|SPRON] |

Refer to: Chapter 8, "Scrolls"

void

slColorCalcOn Color calculation control enable setting

Format

```
void slColorCalcOn( flag )
Uint16  flag ;
```

Parameters

flag Specifies the screens on which color calculation is performed

Function

This function sets the screen that is affected by color calculation control.
The "or" operator ("|") can be used to link together multiple parameters so that multiple screens can be set simultaneously.

Return Value

None

Remarks

For the parameters, substitute the values in the table below according to the scroll screen being registered.

	Scroll screen being registered						
	NBG0	NBG1	NBG1	NBG2	RBG0	BACK	SPRITE
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON	BACKON	SPRON

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

sllColRAMMode Color RAM mode setting

Format

void slColRAMMode(mode)
Uint16 mode ;

Parameters

mode Uint16-type variable corresponding to the color RAM mode

Substitute the following values defined in "sl_def.h" for mode:
CRM16_1024: color RAM mode 0
CRM16_2048: color RAM mode 1
CRM32_1024: color RAM mode 2

Function

This function determines the color RAM mode.

Always be sure to set the color RAM mode before storing color data in color RAM.

For the parameter, substitute the value corresponding to the desired color RAM mode.
For details on each color RAM mode, refer to the table below.

Return Value

None

Remarks

The default color RAM mode is mode 1.

The specifics of each mode are shown in the table below. For details on color RAM mode, refer to "HARDWARE MANUAL vol. 2" (VDP2 User's Manual: p.. 43).

Color RAM mode	Color bits	Data size	Number of colors
Mode 0	5 bits for each of R, G, and B; total of 15 bits	1 word	1024 colors out of 32,768 colors
Mode 1	5 bits for each of R, G, and B; total of 15 bits	1 word	2048 colors out of 32,768 colors
Mode 2	8 bits for each of R, G, and B; total of 24 bits	2 words	1024 colors out of 16.77 million colors

Note:In color mode 0, color RAM is divided into two partitions, each storing the same color data.

Refer to: Chapter 8, "Scrolls"

void

slColRateBACK Background screen color calculation ratio setting

Format

```
void slColRateBACK(rate)
Uint16 rate ;
```

Parameters

rate Color calculation ratio (0x00 to 0x1f)

Function

This function sets the color calculation ratio used for color calculations for the background screen.

Return Value

None

Remarks

The range of calculation ratio values that can be set for the parameter is 0x00 to 0x1f. Each of these values represents a calculation ratio; for example, if "rate = 0x0f" is substituted, the calculation ratio between the top image and the 2nd image is 16:16. For details on the relationship between the substitution value and the calculation ratio, refer to the table on page 244 of the VDP2 User's Manual of the HARDWARE MANUAL vol. 2.

Refer to: Chapter 8, "Scrolls"

void

slColRateLNCL Line color screen color calculation ratio setting

Format

```
void slColRateLNCL(rate)
Uint16 rate ;
```

Parameters

rate Color calculation ratio

Function

This function sets the color calculation ratio used for color calculations for the line color screen

Return Value

None

Remarks

The range of calculation ratio values that can be set for the parameter is 0x00 to 0x1f. Each of these values represents a calculation ratio; for example, if "rate = 0x0f" is substituted, the calculation ratio between the top image and the 2nd image is 16:16. For details on the relationship between the substitution value and the calculation ratio, refer to the table on page 244 of the VDP2 User's Manual of the HARDWARE MANUAL vol. 2.

Refer to: Chapter 8, "Scrolls"

void

slColRateNbg0,1,2,3 NBG color calculation ratio setting

Format

```
void slColRateNbg0(rate)
void slColRateNbg1(rate)
void slColRateNbg2(rate)
void slColRateNbg3(rate)
Uint16 rate ;
```

Parameters

rate Color calculation ratio

Function

This function sets the color calculation ratio used for color calculations for each screen

Return Value

None

Remarks

The range of calculation ratio values that can be set for the parameter is 0x00 to 0x1f. Each of these values represents a calculation ratio; for example, if "rate = 0x0f" is substituted, the calculation ratio between the top image and the 2nd image is 16:16. For details on the relationship between the substitution value and the calculation ratio, refer to the table on page 244 of the VDP2 User's Manual of the HARDWARE MANUAL vol. 2.

Refer to: Chapter 8, "Scrolls"

void

slColRateRbg0 RBG color calculation ratio setting

Format

```
void slColRateRbg0(rate)
Uint16 rate ;
```

Parameters

rate Color calculation ratio

Function

This function sets the color calculation ratio used for color calculations for the rotating scroll screen.

Return Value

None

Remarks

The range of calculation ratio values that can be set for the parameter is 0x00 to 0x1f. Each of these values represents a calculation ratio; for example, if "rate = 0x0f" is substituted, the calculation ratio between the top image and the 2nd image is 16:16. For details on the relationship between the substitution value and the calculation ratio, refer to the table on page 244 of the VDP2 User's Manual of the HARDWARE MANUAL vol. 2.

Refer to: Chapter 8, "Scrolls"

void

slCurRpara Current rotation parameter change

Format

```
void slCurRpara(flag)
Uint16 flag ;
```

Parameters

flag Rotation parameter specification

Function

Specifies either rotation parameters A or B as the operative parameters.

Return Value

None

Remarks

For the parameter, substitute a value from the table below corresponding to the rotation parameters to be used.

	Rotation parameters A	Rotation parameters B
Substitution value	RA	RB

Note: The actual values are defined in "sLdef.h".

Refer to: Chapter 8, "Scrolls"

void

slDispCenterR RBG rotation center coordinates setting

Format

```
void slDispCenterR(x , y)
FIXED x ,
FIXED y ;
```

Parameters

x X coordinate (screen coordinate system) of center of rotation for rotating scroll

y Y coordinate (screen coordinate system) of center of rotation for rotating scroll

Function

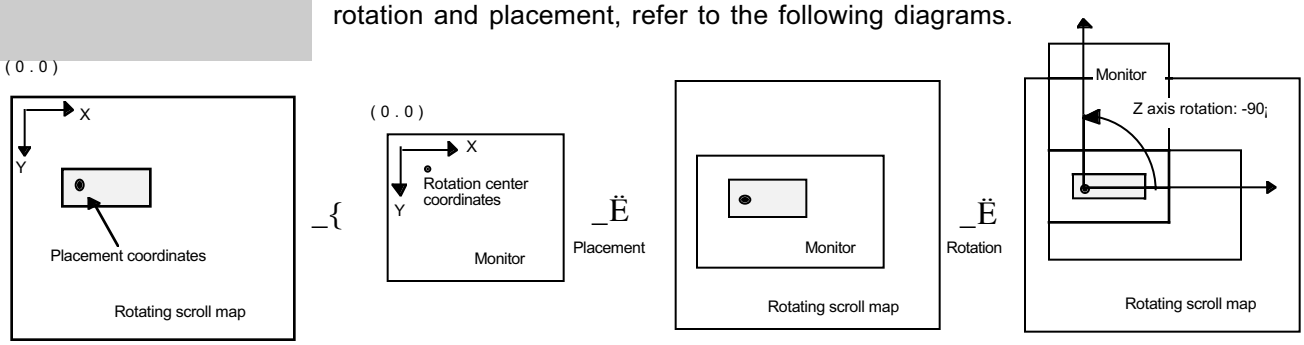
This function sets the coordinates of the center of rotation for the rotating scroll. These coordinates determine the position around which the rotating scroll rotates.

Return Value

None

Remarks

The rotating scroll display position is determined according to the placement of the monitor, using the rotation center coordinates as a reference point, in the placement coordinates on the scroll map. Use the function "slLookR" to determine the placement coordinates of the rotating scroll. For the relationship between rotation and placement, refer to the following diagrams.



Note: The positive direction on the Z axis for the scroll screen is towards the viewer.

Refer to: Chapter 8, "Scrolls"

void

slKtableRA,B Coefficient table control settings

Format

```
void slKtableRA(ktable_adr , mode)
void slKtableRB(ktable_adr , mode)
void *ktable_adr;
Uint16 mode;
```

Parameters

ktable_adr Coefficient table address in VRAM
mode Coefficient table control mode

Function

This function sets the coefficient table address in VRAM in a register and also specifies how the coefficient table is to be used and its configuration.

Return Value

None

Remarks

The following parameters can be specified:

_œ slKtableRA,B substitution values ¥_œ

Table usage	:[K_OFF	|	K_ON	] |
Coefficient data size	:[K_2WORD	|	K_1WORD	] |
Coefficient mode	:[K_MODE0	|	K_MODE1 | K_MODE2 | K_MODE3	] |
Line color	:[K_LINECOL			] |
Unit of change	:[K_DOT	|	K_LINE	] |
Fix coefficients	: [K_FIX			] |

Note: If "fix coefficients" is specified as one of the parameters, the coefficient table is assumed to beprepared beforehand and is not calculated in real time

Refer to: Chapter 8, "Scrolls

void

slLine1ColSet Line single-color setting matrix setting

Format

```
void slLine1ColSet(adr , col)
void   *adr ;
Uint16 col ;
```

Parameters

adr	Line color table address in VRAM
col	Color number

Function

This function sets the line color screen to a single color and sets that color.

Return Value

None

Remarks

For details on the line color screen, refer to Hardware Manual vol.2 (VDP2 User's Manual: p.172).

Refer to: Chapter 8, "Scrolls"

void

slLineColDisp Line color screen enable setting

Format

```
void slLineColDisp(flag)
Uint16 flag ;
```

Parameters

flag Screen specification

Function

This function sets the screen that is to be affected by the line color when it is the top image. Multiple screen specification is possible using the "or" operator.

Return Value

None

Remarks

The parameters that can be specified are shown in the table below.

	Scroll screen to be registered				
	NBG0	NBG1	NBG2	NBG3	RBG0
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slLineColTable Line color table setting

Format

```
void slLineColTable(adr)
void     *adr ,
```

Parameters

adr Line color table address in VRAM

Function

This function sets the line color table address in VRAM in the register.

Return Value

None

Remarks

For details on the line color screen, refer to Hardware Manual vol.2 (VDP2 User's Manual: p-173)

Refer to: Chapter 8, "Scrolls"

void

slLineScrollModeNbg0,1

Line scroll mode and vertical cell scroll mode setting

Format

```
void sLineScrollModeNbg0(mode)
void slLineScrollModeNbg1(mode)
Uint16 mode;
```

Parameters

mode Line scroll mode flag

Function

This function sets the line scroll mode and vertical cell scroll mode for the scroll screen

Return Value

None

Remarks

_œ Line scroll setting flags _œ

Line width	: [lineSZ1 | lineSZ2 | lineSZ4 | lineSZ8 |] |
Horizontal scaling	: [lineZoom] |
Vertical scrolling	: [lineVScroll] |
Horizontal scrolling	: [lineHScroll] |
Vertical cell scrolling	: [VCellScroll]

Note: The values in the above table are defined in "sl_def.h", provided with the system.

void

slLineScrollTable0,1 Line scroll table address setting

Format

```
void slLineScrollTable0(adr)
void slLineScrollTable1(adr)
void *adr;
```

Parameters

adr Line scroll table address in VRAM

Function

This function sets the starting address for the line scroll table in VRAM where the line scroll data was set

.

Return Value

None

Remarks

void

slLookR RBG placement coordinate setting

Format

void slLookR(x , y)
FIXED x ;
FIXED y ;

Parameters

x X coordinate (scroll coordinate system) for rotating scroll placement
y Y coordinate (scroll coordinate system) for rotating scroll placement

Function

This function sets the placement coordinates for the rotating scroll screen. The placement coordinates indicate a point on the scroll map. The rotating scroll screen display position is determined by placing the monitor so that the rotation center coordinates overlay the placement coordinates.

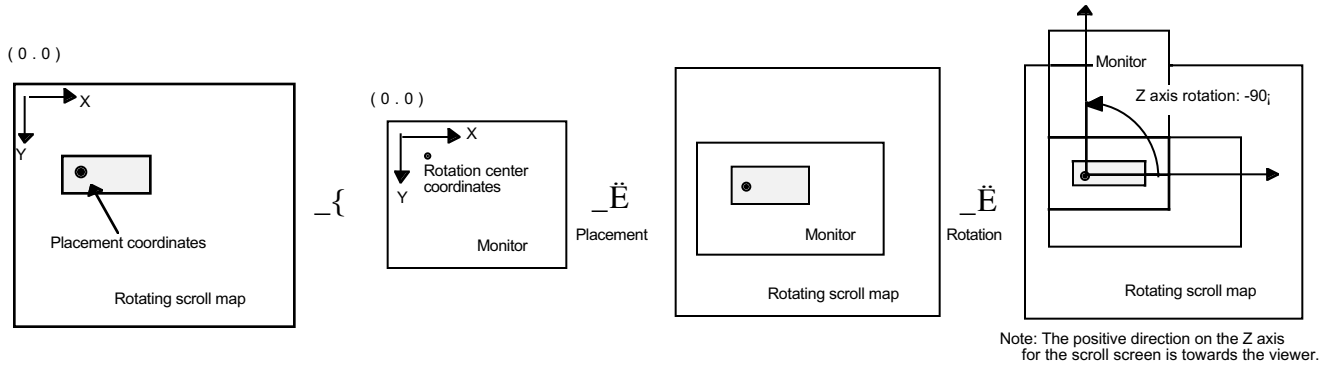
For the parameters, substitute the XY coordinate values corresponding to the scroll coordinate system.

Return Value

None

Remarks

The rotating scroll display position is determined according to the placement of the monitor, using the rotation center coordinates as a reference point, in the placement coordinates on the scroll map. Use the function "slDispCenterR" to determine the rotation center coordinates of the rotating scroll. For the relationship between rotation and placement, refer to the following diagrams.



Refer to: Chapter 8, "Scrolls"

void

slMakeKtable Coefficient table creation

Format

```
void slMakeKtable(adr)
void*adr;
```

Parameters

adr Coefficient table address in VRAM

Function

This function creates at the specified address in VRAM the coefficient table to be used for three-dimensional rotation. ("adr" must be specified within the VDP2 RAM area.)

Return Value

None

Remarks

Refer to: Chapter 8, "Scrolls"

void

slMapNbg0,1,2,3 NBG map setting

Format

```
void slMapNbg0(a , b , c , d)
void slMapNbg1(a , b , c , d)
void slMapNbg2(a , b , c , d)
void slMapNbg3(a , b , c , d)
void *a , *b , *c , *c;
```

Parameters

a	Starting address in VRAM of pattern name data table for plane a
b	Starting address in VRAM of pattern name data table for plane b
c	Starting address in VRAM of pattern name data table for plane c
d	Starting address in VRAM of pattern name data table for plane d

Function

This function sets up the normal scroll map.

For the parameters, substitute the starting addresses in VRAM of the pattern name data tables to be registered in the map register and the map offset register.

Return Value

None

Remarks

void

slOverRA RBG screen overflow processing setting (for rotation parameters A)

Format

```
void sllOverRA(mode)
Uint16 mode;
```

Parameters

mode Uint16-type value corresponding to the screen overflow processing mode specification

0: Outside of the display area, repeat image set in the display area
1: Outside of the display area, repeat the specified character pattern
2: Outside of the display area, leave entire area clear
3: Outside of the 512 (vertical) x 512 (horizontal) display area, leave everything clear

Function

This function sets the screen overflow processing mode for the rotating scroll. The screen overflow processing setting specifies how, when the rotating scroll graphics go beyond the display area, to process the portion that exceeds the display area. This setting is made for the rotating scroll plane size register.

Return Value

None

Remarks

When the rotating scroll is in bitmap format, mode 1 cannot be set.

Refer to: Chapter 8, "Scrolls"

void

slOverRB RBG screen overflow processing setting (for rotation parameters B)

Format

```
void slOverRB(mode)
Uint16 mode;
```

Parameters

mode Uint16-type value corresponding to the screen overflow processing mode specification

0: Outside of the display area, repeat image set in the display area
1: Outside of the display area, repeat the specified character pattern
2: Outside of the display area, leave entire area clear
3: Outside of the 512 (vertical) x 512 (horizontal) display area, leave everything clear

Function

This function sets the screen overflow processing mode for the rotating scroll. The screen overflow processing setting specifies how, when the rotating scroll graphics go beyond the display area, to process the portion that exceeds the display area. This setting is made for the rotating scroll plane size register.

Return Value

None

Remarks

When the rotating scroll is in bitmap format, mode 1 cannot be set.

Refer to: Chapter 8, "Scrolls"

void

slPageNbg0,1,2,3 NBG pattern name data registration

Format

```
void slPageNbg0(celadr , coladr , type)
void slPageNbg1(celadr , coladr , type)
void slPageNbg2(celadr , coladr , type)
void slPageNbg3(celadr , coladr , type)
void *celadr ;
void *coladr ;
UInt16 type ;
```

Parameters

celadr Starting address in VRAM of cell data stored in VRAM
coladr Starting address in color RAM of color data used by cells
type Flag corresponding to the pattern name data-type specification

Function

This function sets up the normal scroll NBG0, NBG1, NBG2, and NBG3 pages. For the parameters, specify, respectively, to the starting address (in VRAM) of the character pattern data used on the scroll screen, the starting address (in color RAM) for the color data used for the character patterns, and a Uint16-type value corresponding to the pattern name data-type specification.

Return Value

None

Remarks

For the parameter "type", specify a value from the following table corresponding to the pattern name data type.

Word length	Character number bits	Substitution value
1 word	Low-order 10 bits	PNB_1WORD
	Low-order 12-bits	PNB_1WORD|CN_12BIT
2 words	Low-order 16-bits	PNB_2WORD

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slPageRbg0 RBG pattern name data registration

Format

```
void slPageRbg0(celadr , coladr , type)
void *celadr ,
void *coladr ,
Uint16 type ,
```

Parameters

celadr Starting address in VRAM of cell data stored in VRAM
coladr Starting address in color RAM of color data used by cells
type Flag corresponding to the pattern name data-type specification

Function

This function sets up the rotating scroll RBG0 page. For the parameters, specify, respectively, the starting address (in VRAM) of the character pattern data used on the scroll screen, the starting address (in color RAM) for the color data used for the character patterns, and a Uint16-type value corresponding to the pattern name data-type specification.

Return Value

None

Remarks

For the parameter "type", specify a value from the following table corresponding to the pattern name data type.

Word length	Character number bits	Substitution value
1 word	Low-order 10 bits	PNB_1WORD
	Low-order 12-bits	PNB_1WORD|CN_12BIT
2 words	Low-order 16-bits	PNB_2WORD

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slPlaneNbg0,1,2,3 NBG plane size setting

Format

```
void slPlaneNbg0(type)
void slPlaneNbg1(type)
void slPlaneNbg2(type)
void slPlaneNbg3(type)
Unit16 type ;
```

Parameters

type Flag corresponding to the plane size specification

Function

This function sets the plane size for normal scrolls. Refer to the table below for the substitution values for the parameter.

Return Value

None

Remarks

When the reduction setting is set to 1/4x, do not set the plane size as 2 x 2.

This is due to the fact that the map size is different when the reduction setting is set to 1/4x. The 1 x 1 and 2 x 1 settings can be used without any problems.

	Plane size		
	1 (horizontal) x 1 (vertical)	2 (horizontal) x 1 (vertical)	2 (horizontal) x 2 (vertical)
Substitution value	PL_SIZE_1x1	PL_SIZE_2x1	PL_SIZE_2x2

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slPlaneRA RBG plane size setting (for rotation parameters A)

Format

```
void slPlaneRA(type)
Uint16 type ;
```

Parameters

type Flag corresponding to the plane size specification

Function

This function sets the plane size for rotating scrolls (using rotation parameters A). Refer to the table below for the substitution values for the parameter.

Return Value

None

Remarks

	Plane size		
	1 (horizontal) x 1 (vertical)	2 (horizontal) x 1 (vertical)	2 (horizontal) x 2 (vertical)
Substitution value	PL_SIZE_1x1	PL_SIZE_2x1	PL_SIZE_2x2

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slPlaneRB RBG plane size setting (for rotation parameters B)

Format

```
void slPlaneRB(type)
Uint16 type ;
```

Parameters

type Uint16-type value corresponding to the plane size specification

Function

This function sets the plane size for rotating scrolls (using rotation parameters B). Refer to the table below for the substitution values for the parameter.

Return Value

None

Remarks

	Plane size		
	1 (horizontal) x 1 (vertical)	2 (horizontal) x 1 (vertical)	2 (horizontal) x 2 (vertical)
Substitution value	PL_SIZE_1x1	PL_SIZE_2x1	PL_SIZE_2x2

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slPriorityRbg0 RBG priority setting

Format

```
void slPriorityRbg0(num)
Uint16 num ;
```

Parameters

num Graphics priority number (8 levels, from 0 to 7)

Function

This function assigns a priority ranking to the rotating scroll.

Higher priority numbers represent a higher display priority, so the smaller the priority number, the farther back the associated scroll screen is displayed.

If the priority number assigned is "0", the scroll is regarded to be clear and is not displayed.

Return Value

None

Remarks

If more than one scroll or polygon has been assigned the same priority number, their respective priority is ranked as shown below.

_œ Priority when priority numbers are equal _œ

SPRITE>RBG0>NBG0>NBG1>NBG2>NBG3

High (forefront of screen) ←→ Low (background of screen)

Note: Polygons are included in "sprites".

Refer to: Chapter 8, "Scrolls"

void

slPriorityNbg0,1,2,3 NBG priority setting

Format

```
void slPriorityNbg0(num)
void slPriorityNbg1(num)
void slPriorityNbg2(num)
void slPriorityNbg3(num)
Uint16 num ;
```

Parameters

num Graphics priority number (8 levels, from 0 to 7)

Function

This function assigns a priority ranking to the normal scrolls NBG0, NBG1, NBG2, and NBG3.

Higher priority numbers represent a higher display priority, so the smaller the priority number, the farther back the associated scroll screen is displayed.

If the priority number assigned is "0", the scroll is regarded to be clear and is not displayed.

Return Value

None

Remarks

If more than one scroll or polygon has been assigned the same priority number, their respective priority is ranked as shown below.

_œ Priority when priority numbers are equal

SPRITE>RBG0>NBG0>NBG1>NBG2>NBG3

High (forefront of screen) ←→ Low (background of screen)

Note: Polygons are included in "sprites".

Refer to: Chapter 8, "Scrolls"

void

slRparaInitSet Rotation parameter table storage in VRAM

Format

```
void slRparaInitSet(ptr)
ROTSCROLL *ptr ;
```

Parameters

ptr Starting address in VRAM where the rotation parameter table is stored

Function

This function stores in VRAM the rotation parameter table (size: 60H) used for the rotating scroll.

Return Value

None

Remarks

When using the rotating scroll, be sure to store the rotation parameter table in VRAM.

For details on the variable type ROTSCROLL, refer to "ROTSCROLL" in the Structure Reference.

When setting the perspective (using the function "slPerspective", execute this function first, before executing "slPerspective".

void

slRparaMode Rotation parameter mode setting

Format

```
void slRparaMode(mode)
Uint16 mode ;
```

Parameters

mode Rotation parameter mode

Function

This function specifies the rotation parameter mode. This function makes it possible to specify how rotation parameters A and B are used.

Return Value

None

Remarks

Specify one of the following values for the rotation parameter mode.

RA: Use only rotation parameters A.
RB: Use only rotation parameters B.
K_CHANGE: Change screens according to the coefficient data of rotation parameters A
W_CHANGE: Change screens according to the rotation parameter window.

	Mode 0	Mode 1	Mode 2	Mode 3
Substitution value	RA	RB	K_CHANGE	W_CHANGE

Note:The values in the above table are defined in "sl_def.h", provided with the system

Refer to: Chapter 8, "Scrolls

void

slScrAutoDisp Scroll registration (cycle pattern register setting)

Format

Uint16 slScrAutoDisp(ptr)
Uint32 ptr

Parameters

ptr Scroll flag for setting the cycle pattern

Function

This function registers in the system those scrolls for which the function settings have been completed. This function automatically sets the VRAM access specification (in the cycle pattern register) for the scroll screen specified as the parameter, and at the same time turns on the graphics setting for the registered scroll.

Refer to the table below for the scroll flags to be substituted for the parameter.

To register multiple scrolls, use the "or" operator.

Return Value

If scroll registration was successful, the function returns a "0". (OK)

If scroll registration failed, the function returns a "-1" (NG).

Remarks

If scroll registration was unsuccessful, the function returns a "-1". This indicates that the function settings and the number of screens in the scroll for which registration was attempted was outside of the range that could be registered. In this event, either decrease the number of screens to be registered, switch the reduction setting from 1/4x to 1/2x, or make whatever changes need to be made, and then attempt registration again.

Execute this function only after completing all of the scroll function settings.
This function also supports high-resoluting mode.

	Scroll screen to be registered				
	NBG0	NBG1	NBG2	NBG3	RBG0
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON

Note:The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slScrCycleSet Cycle pattern setting

Format

```
void slScrCycleSet(a , b , c , d)
Uint32 a ;
Uint32 b ;
Uint32 c ;
Uint32 d ;
```

Parameters

a	Bank A-0 cycle pattern
b	Bank A-1 cycle pattern
c	Bank B-0 cycle pattern
d	Bank B-1 cycle pattern

Function

This function sets the cycle pattern for each bank. When each bank is partitioned, cycle patterns can be set for a and b and for c and d. If the banks are not partitioned, cycle patterns can be set for a and c. For details on the settings, refer to pp. 31 and beyond in the HARDWARE MANUAL vol. 2, VDP2 User's Manual.

Return Value

None

Remarks

If the function "slScrAutoDisp" is used, "slScrCycleSet" can be used to automatically set the cycle pattern for displaying the scroll screen specified by "slScrAutoDisp".

```
slScrCycleSet (0xffffffff , 0x66554444 , 0xffffffff , 0x0012ffff);
```

A0 access setting A1 access setting B0 access setting B1 access setting

void

slScrDisp Display setting for scroll specified as parameter

Format

void slScrDisp(mode)
Uint32 mode;

Parameters

mode Display flag for scroll screen to be displayed

Function

This function makes the display setting for the scroll screen specified as the parameter.

Refer to the table below for the parameter substitution values.

To simultaneously set multiple scrolls for display, link the parameters with the "or" operator ("|").

Return Value

None

Remarks

The display setting determines which of the registered scrolls will actually undergo drawing processing. Only those scroll screens for which the display setting is "ON" will actually be drawn on the monitor by the drawing start declaration.

Scrolls that were registered by using the function "slAutoDisp" have their display setting set to "ON" at the time of registration.

	NBG0		NBG1		NBG2		NBG3		RBG0	
	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF
Substitution value	NBG0ON	NBG0OFF	NBG1ON	NBG1OFF	NBG2ON	NBG2OFF	NBG3ON	NBG3OFF	RBG0ON	RBG0OFF

Note: The values in the above table are defined in "sl_def.h", provided with the system.

ON: Draw scroll screen.

OFF: Do not draw scroll screen.

Refer to: Chapter 8, "Scrolls

void

slScrLineWindow0 Line window table0 setup

Format

```
void slScrLineWindow0(adr)
void *adr ;
```

Parameters

adr Line window data address in VRAM

Function

This function sets the address in VRAM of line window data table 0.

Return Value

None

Remarks

To enable a window, set the high-order bit to "1". To disable a window, pass the NULL value.

Ex.: address = 0x25e3f000 (when constant is specified)

Use window:
slLineWindow0((void*)(0x25e3f000@SPECIAL SYMBOL@0x80000000));

Do not use window:
slLineWindow0((void*)NULL);

address = 0x25e3f000 (when constant is specified)

Use window:
Sint16 *1ptr ;
1pts = (Sint16*) 0x25e3f000 ;
slLine Window0 ((void*)(1pts *@0x40000000)) ;

Do not use window:
slLine Window0 ((void*)NULL) ; 1pts is Sint16 (2-byte variable) pointer

void

slScrMatConv Convert current matrix to scroll format matrix

Format

void slScrMatConv(void)

Parameters

None

Function

This function converts the current matrix into a scroll-format matrix. If this function is used, the current matrix is overwritten.

Return Value

None

Remarks

To save the current matrix, execute the matrix function "slPushMatrix" before executing this function to rest the matrixs.
An example of how to save the current matrix is shown below.

_œ Saving the current matrix _œ

```
slPushMatrix();                    /* save current matrix */
{
  slRotX(DegtoAng(90));            /* change sides to bottom */
  slScrMatConv()                   /* matrix conversion */
  slScrMatSet();                   /* rotation parameter setting */
}
slpopMatrix();                     /* execute current matrix */
```

void

slScrMatSet Matrix setting

Format	
	void slScrMatSet()
Parameters	
	None
Function	
	This function uses the current matrix to set the RBG0 rotation parameters.
Return Value	
	None
Remarks	
	Also supports high-resolution mode.

Refer to: Chapter 8, "Scrolls"

void

slScrMosaicOn Mosaic processing specification screen

Format

```
void slScrMosaicOn(screen)
Uint16 screen ;
```

Parameters

screen Flag for scroll on which mosaic processing is to be performed

Function

This function sets the scroll screen on which mosaic processing is to be performed.

Multiple scroll screens can be specified simultaneously by linking multiple parameters together with the "or" operator.

Return Value

None

Remarks

For the parameter "screen", substitute the value from the table below corresponding to the scroll screen being specified.

	Scroll screen being specified				
	NBG0	NBG1	NBG2	NBG3	RBG0
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON

Note:The values in the above table are defined in "sl_def.h", provided with the system

void

slScrMosSize Horizontal and vertical specification of mosaic processing size

Format

```
void slScrMosSize(Hsize , Vsize)
Uint16 Hsize ;
Uint16 Vsize ;
```

Parameters

Hsize Horizontal size for mosaic processing
Vsize Vertical size for mosaic processing

Function

This function specifies the horizontal and vertical sizes, in dots (range: 1 to 16), for mosaic processing.
In non-interlaced mode, specify 1 to 16 dots in both the vertical and horizontal directions.
In interlaced mode, specify 2 to 32 dots in the vertical direction and 1 to 16 dots in the horizontal direction.
When mosaic processing is performed on the rotating scroll, it is only performed in the horizontal direction.

Return Value

None

Remarks

void

slScrPosNbg0,1,2,3 NBG screen display position setting

Format

```
void slScrPosNbg0(x , y)
void slScrPosNbg1(x , y)
void slScrPosNbg2(x , y)
void slScrPosNbg3(x , y)
FIXED x ;
FIXED y ;
```

Parameters

x	X coordinate (scroll coordinate system) for normal scroll placement
y	Y coordinate (scroll coordinate system) for normal scroll placement

Function

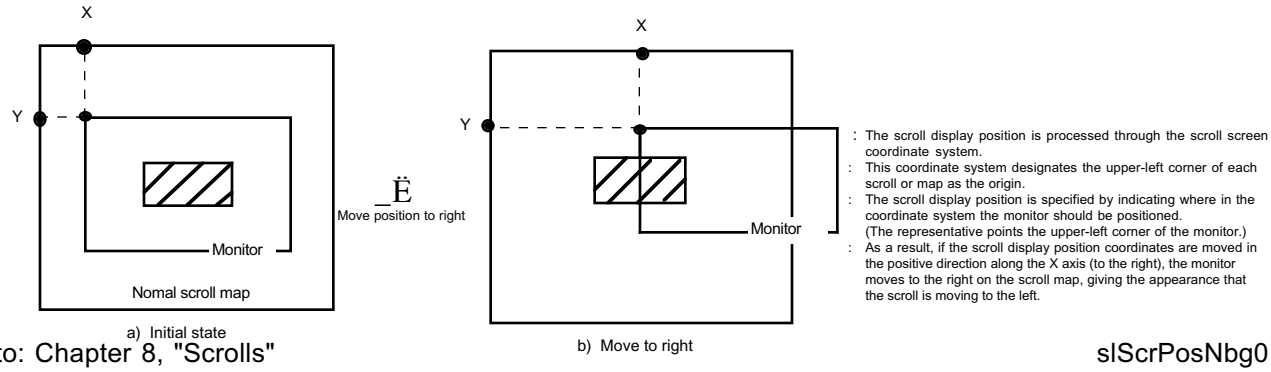
This function positions the respective normal scroll screens NBG0, NBG1, NBG2, and NBG3. For the parameters, specify the XY scroll coordinate values that indicate the display position.

Return Value

None

Remarks

The concept behind the display position specification for normal scroll screens is illustrated below. (The monitor is positioned on the scroll map.)



a) Initial state

b) Move to right

Refer to: Chapter 8, "Scrolls"

void

slScrTransparent Transparent enable display setting

Format

```
void slScrTransparent(flag)
Uint16 flag ;
```

Parameters

flag Flag specifying the transparent display setting

Function

This function specifies the handling of the transparent color for each scroll.

The specification can be made for multiple scroll screens simultaneously by linking the parameters with the "or" operator.

Return Value

None

Remarks

The parameters shown below can be specified for "flag".

For scroll screens specified by the parameter, the No. 0 character is drawn according to the data for that character; for scroll screens not specified by the parameter, the No. 0 character is drawn on the screen as a transparent character.

	Scroll screen being specified				
	NBG0	NBG1	NBG2	NBG3	RBG0
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON

Note:The values in the above table are defined in "sl_def.h", provided with the system

Refer to: Chapter 8, "Scrolls"

void

slScrWindow0 Scroll rectangular window 0setting

Format

```
void slScrWindow0(Left , Top , Right , Bottom)
Uint16 Left ;
Uint16 Top ;
Uint16 Right ;
Uint16 Bottom ;
```

Parameters

Left	X coordinate of upper left corner of window
Top	Y coordinate of upper left corner of window
Right	X coordinate of lower right corner of window
Bottom	Y coordinate of lower right corner of window

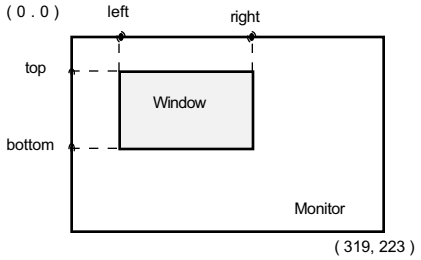
Function

This function specifies the scroll window 0 area. The rectangular window area is defined by specifying the upper left coordinates (Left, Top) and the lower right coordinates (Right, Bottom).

Return Value

None

Remarks



Note: "left", "top", "right" and "bottom" indicate the XY coordinate values for the monitor

void

slScrWindowModeNbg0,1,2,3

NBG window usage mode setting

Format

```
void slScrWindowModeNbg0(mode)
void slScrWindowModeNbg1(mode)
void slScrWindowModeNbg2(mode)
void slScrWindowModeNbg3(mode)
Uint16 mode ;
```

Parameters

mode Window usage mode flag

Function

This function sets the NBG0 to 3 window usage mode.

Return Value

None

Remarks

For the parameters, substitute the values shown in the illustration below. Multiple parameters can be specified simultaneously by linking each group of parameters with the "or" operator.

In the parameters shown below, "*_IN" displays the graphic element inside the window, and "*_OUT" displays the graphic element outside the window.

_œ slScrWindowMode substitution values _œ

Window 0	:[Use_win0] |
Window 1	:[Use_win1] |
Sprite window	:[Use_spw] |
Window condition	:[win_OR | win_AND]|
Display area setting (Win0)	:[win0_IN | win0_OUT] |
Display area setting (Win1)	:[win1_IN | win1_OUT] |
Display area setting (SpWin)	:[spw_IN | spw_OUT] |

Note: The values in the above table are defined in "sl_def.h", provided with the system.

void

slShadowOn Shadow function setting

Format

```
void slShadowOn(scrn)
Uint16 scn;
```

Parameters

scrn Flag corresponding to the scroll screen for which the shadow function is set

Function

This function sets the scroll screen on which the shadow function is used.
Multiple scroll screens can be set simultaneously by linking multiple parameters together with the "or" operator.

Return Value

None

Remarks

Refer to the table below for the scroll flags that are substituted for the parameter.

When setting multiple scroll screens, use the "or" operator.

	Scroll screen being specified					
	NBG0	NBG1	NBG2	NBG3	RBG0	BACK
Substitution value	NBG0ON	NBG1ON	NBG2ON	NBG3ON	RBG0ON	BACKON

Note: The values in the above table are defined in "sl_def.h", provided with the system.

void

slTVOff Drawing end declaration

Format	
	void slTVOff()
Parameters	
	None
Function	
	This function turns off scroll drawing processing in the monitor.
Return Value	
	None
Remarks	
	To re-initiate drawing in the monitor, execute the drawing start declaration "slTVOn".

Refer to: Chapter 8, "Scrolls'

void

slTVOn Drawing start declaration

Format	
	void slTVOn()
Parameters	
	None
Function	
	This function starts drawing in the scroll screen monitor.
Return Value	
	None
Remarks	
	To stop drawing in the monitor, execute the drawing end declaration "slTVOff".

Refer to: Chapter 8, "Scrolls"

void

slZoomModeNbg0,1 NBG expansion/reduction mode determination

Format

```
void slZoomModeNbg0(mode)
void slZoomModeNbg1(mode)
Uint16 mode ;
```

Parameters

mode Flag corresponding to the zoom mode specification

Function

This function sets the expansion/reduction mode in the reduction enable register for NBG0 and NBG1, which are the only normal scrolls that permit expansion/reduction

Return Value

None

Remarks

Depending on the reduction setting, the range for expansion/reduction changes as follows:

Reduction setting 1/1x: (1/1x to 256x)
Reduction setting 1/2x: (1/2x to 256x)
Reduction setting 1/4x: (1/4x to 256x)

	Reduction setting		
	1x	1/2x	1/4x
Substitution value	ZOOM_1	ZOOM_HALF	ZOOM_QUATER

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Refer to: Chapter 8, "Scrolls"

void

slZoomNbg0,1 NBG expansion/reduction

Format

void slZoomNbg0(x , y)
void slZoomNbg1(x , y)
FIXED x ,
FIXED y ,

Parameters

x Reciprocal of expansion/reduction ratio in direction of X axis for normal scroll
y Reciprocal of expansion/reduction ratio in direction of Y axis for normal scroll

Function

This function sets the expansion/reduction ratio for NBG0 and NBG1, the only normal scrolls that permit expansion/reduction.

For the parameters, substitute the reciprocals of the scale values in the direction of the X and Y axes, respectively. For example, to enlarge the figure by 2.0x in the direction of the X axis, substitute 1/2 for the parameter "x".

Return Value

None

Remarks

The range over which expansion/reduction is possible differs according to the reduction setting for the scroll screen being expanded/reduced.

The reduction setting is made by the function "slZoomModeNbg0,1".

For the expansion/reduction range according to the reduction setting, refer to the table below.

	Reduction setting		
	1x	1/2x	1/4x
Expansion/reduction range	1x to 256x	1/2x to 256x	1/4x to 256x

Refer to: Chapter 8, "Scrolls"

void

slZoomR RBG expansion/reduction

Format

```
void slZoomR(x , y)
FIXED x ,
FIXED y ,
```

Parameters

x Reciprocal of expansion/reduction ratio in direction of X axis for normal scroll

y Reciprocal of expansion/reduction ratio in direction of Y axis for normal scroll

Function

This function sets the expansion/reduction ratio for the rotating scroll, and saves the setting in the current rotation parameters.

For the parameters, substitute the reciprocals of the scale values in the direction of the X and Y axes, respectively. For example, to enlarge the figure by 2.0x in the direction of the X axis, substitute 1/2 for the parameter "x".

Return Value

None

Remarks

Unlike with normal scrolls, the enlargement/reduction ratio can be set to any desired ratio for the rotating scroll.

Refer to: Chapter 8, "Scrolls"

void

slZrotR RBG Z axis rotation

Format

```
void slZrotR(angz)
ANGLE angz ;
```

Parameters

angz Rotation angle of rotating scroll versus Z axis

Function

This function rotates the rotating scroll versus the Z axis.

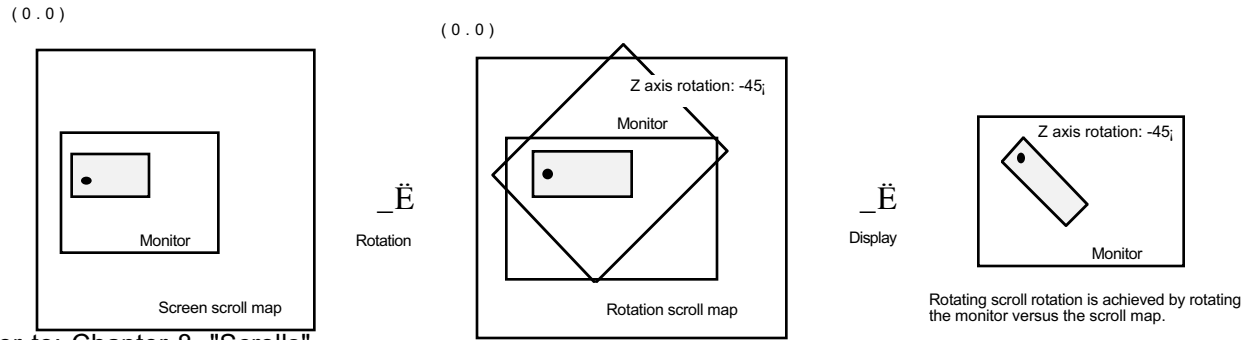
The Z axis (the positive direction is towards the viewer) is used as the rotation axis, and rotation on the positive direction is towards the right (clockwise).

Return Value

None

Remarks

The coordinates specified by the function "slDispCenterR" are the center of rotation for the rotating scroll. (The monitor rotates versus the scroll map.)



Refer to: Chapter 8, "Scrolls"

slZrotR

void

slDispSprit Sprite display with specification of position, scale, and rotation angle

Format

```
void slDispSprite(pos , atrb , Zrot)
FIXED *pos ;
SPR_ATTR *atrb ;
ANGLE Zrot;
```

Parameters

pos[XYZ] XYZ coordinate values for sprite placement, and scale value
atrb Starting address of area where sprite characteristics are stored
Zrot Z axis rotation angle

Function

This function displays a sprite, specifying the position, scale, and rotation angle. Just as in the function "slPutPolygon", sorting is performed according to the Z value. The display of a sprite set by this function is completely unaffected by the current matrix.

Return Value

None

Remarks

If a negative value is input for the scale, calculate the scale according to the Z position, multiply it by the complement of the scale, and use the result as the display scale.

For example, if -2.0 is specified for the scale, and the sprite is in a position (Z position) where it should be displayed at 0.5x, the sprite is displayed at 1.0x.

The display of the sprite is not affected by the current matrix.

Refer to: Chapter 9, "Controller Input"

void

slPutSprite

Sprite display with perspective transformation effects

Format

```
void slPutSprite(pos , atrb , Zrot)
FIXED *pos ;
SPR_ATTR *atrb ;
ANGLE Zrot ;
```

Parameters

pos[XYZ] XYZ coordinate values for sprite placement, and scale value
atrb Starting address of area where sprite characteristics are stored
Zrot Z axis rotation angle

Function

This function calculates the position using the current matrix and displays the sprite after applying scaling effects in accordance with perspective transformation.

As with the function "slDispSprite", scaling is performed according to the specified scale value. If a negative value is specified, the absolute value is used.

Return Value

None

Remarks

Refer to: Chapter 9, "Controller Input"

void

slSetSprite Sprite data setting

Format

```
void slSetSprite(parms , Zpos)
SPRITE *parms ;
FIXED Zpos ;
```

Parameters

parms Starting address of area where sprite data is stored
Zpos Z coordinate position

Function

This function sets the spritecontrol command data to be transferred to the hardware in the transfer list.

This function is used to set altered sprites that cannot be created with the library functions or to set up a window that affects specific sprites only.

Return Value

None

Remarks

For details on the effects of execution of the function "slSetSprite", refer to p. 118 and beyond in HARDWARE MANUAL vol. 2, VDP1 User's Manual.

Refer to: Chapter 9, "Controller Input"

void

slSpriteType Sprite data type specification

Format

```
void slSpriteType(type)
Uint16 type ;
```

Parameters

type Sprite type (0 to 15)

Function

This function specifies the sprite data type.

Return Value

None

Remarks

Types 0 to 7 are for low resolution (320 or 352) and types 8 to 15 are for high resolution (640 or 704); the data widths are 16 bits and 8 bits, respectively.

void

slDispHex Hexadecimal screen display

Format

```
void slDispHex(val , dspadd)
Uint32 val ,
void *dspadd ,
```

Parameters

val Value to be displayed
dspadd Text display address ("slLocate" return value)

Function

This function displays the specified variable in eight hexadecimal digits. The function "slDispHex" displays zeroes in the high-order digits. (Ex.: 00001234) If you do not wish to display zeroes in the high-order digits, use the function "slPrintHex" (which will replace the zeroes with spaces; ex.: 1234).

Return Value

None

Remarks

The text and numeric value display function group set and register the normal scroll NBG0 and the ASCII cells during system initialization and use these ASCII cells to display numeric values If, for some reason, this default data is overwritten, text and numeric values will not be displayed properly.

Refer to: Chapter 8, "Scrolls"

void

slLocate Display position calculation (parameters: cell specification)

Format

```
void *slLocate(xpos , ypos)
Uint16 xpos ,
Uint16 ypos ,
```

Parameters

xpos X coordinate of text display position (range: 0 to 63 cells)
ypos Y coordinate of text display position (range: 0 to 63 cells)

Function

This function returns the address value for text display.

The parameters indicate the XY coordinate position (in cell units) of the display on the screen. One cell consists of 8 x 8 dots, and a normal scroll screen consists of 64 x 64 cells.

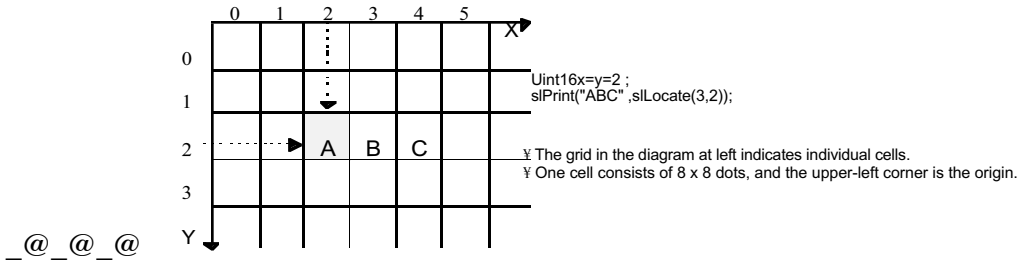
Return Value

Text display address value

Remarks

Example of how to use the function "slLocate"

```
Uint16x=y=2;
slPrint("ABC",slLocate (x,y));
```



_@_@_@

Refer to: Chapter 8, "Scrolls"

void

slPrint Character string screen display

Format

```
void slPrint(string , dspadd)
char *string ,
void *dspadd ,
```

Parameters

string Text string to be displayed
dspadd Text display address ("slLocate" return value)

Function

This function displays the character string specified as a parameter on the screen.

Return Value

None

Remarks

Refer to: Chapter 8, "Scrolls"

void

slPrintFX Fixed-point decimal screen display

Format

```
void slPrintFX(val , dspadd)
FIXED val ,
void *dspadd ,
```

Parameters

val FIXED-type numeric value to be displayed
dspadd Text display address ("slLocate" return value

Function

This function displays the FIXED-type value specified as a parameter on the screen. Zeroes in the high-order digits in the integer portion of the value and zeroes in the low-order digits in the decimal portion of the value are displayed as spaces. The integer portion and the decimal portion are both displayed as five-digit decimal numbers. If the value is negative, a "-" is displayed.

Return Value

None

Remarks

Ex.:

val = 0x00108000 _¨ 16.5
val = 0xffedc000 _¨ -19.25

Refer to: Chapter 8, "Scrolls"

void

slPrintHex

Hexadecimal screen display (zeroes in high-order digits are not displayed)

Format

```
void slPrintHex(val , dspadd)
Uint32 val ,
void *dspadd ,
```

Parameters

val Value to be displayed
dspadd Text display address ("slLocate" return value)

Function

This function displays the specified variable as an eight-digit hexadecimal number on the screen. The function "slPrintHex" does not display zeroes in the high-order digits. Zeroes in high-order digits are replaced with spaces. (Ex.: 1234) To display zeroes in the high-order digits, use the function "slDispHex". (Ex.: 00001234)

Return Value

None

Remarks

Refer to: Chapter 8, "Scrolls"

void

slPrintMatrix Matrix screen display

Format

```
void slPrintMatrix(mtrx , dspadd)
MATRIX mtrx ,
void *dspadd ,
```

Parameters

mtrx MATRIX-type variable to be displayed
dspadd Text display address ("slLocate" return value)

Function

This function displays the specified matrix as a 4-row x 3-column matrix on the screen.

Return Value

None

Remarks

Refer to: Chapter 8, "Scrolls"

void

slGetMatrix Hexadecimal screen display

Format

```
void slGetMatrix(mtpr)
MATRIXmtpr ;
```

Parameters

mtptr Starting address of MATRIX-type variable to be copied (input)

Function

This function copies the current matrix to the specified matrix.

Return Value

None

Remarks

Example of usage:

```
MATRIXmat ;
slGetMatrix(mat) ;
slPrintMatrix(mat, slLocate(3,4)) ;
```

void

slInitMatrix Matrix variable and buffer initialization

Format	
	void *slInitMatrix()
Parameters	
	None
Function	
	This function initializes the variables and buffers used in matrix operations, and prepares the environment matrix (unit matrix) for the current matrix.
Return Value	
	None
Remarks	

void

slInversMatrix

Current matrix inversion transformation

Format

void slInversMatrix()

Parameters

None

Function

This function inverts the current matrix

Return Value

None

Remarks

Refer to: slInversMatrix

void

slLoadMatrix Copy specified matrix to current matrix

Format

```
void slloadMatrix(mtptr)
MATRIX mtptr:
```

Parameters

mtptr Starting address of the MATRIX-type variable to be copied (output)

Function

This function copies the specified matrix to the current matrix.

Return Value

None

Remarks

void

slLookAt Multiply line of sight matrix by current matrix

Format

```
void slLookAt(camera, target, angz)
FIXED *camera;
FIXED *target;
ANGLE angz;
```

Parameters

camera[XYZ] XYZ coordinates indicating camera position
target[XYZ] XYZ coordinates indicating target position
angz Camera angle

Function

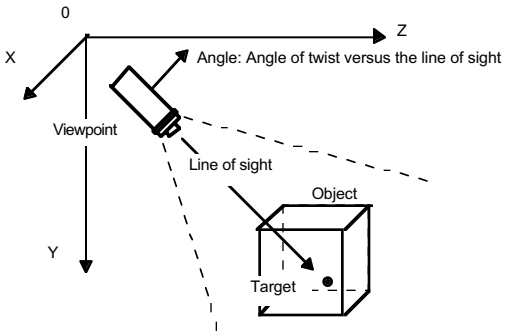
This function multiplies current matrix and the matrix (line of sight matrix) for viewing the target from the specified camera position at the specified angle.

Return Value

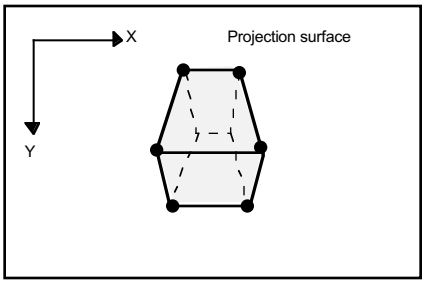
None

Remarks

When a line of sight parallel with the Y axis is selected, vectors on the XZ plane become small (the rotation around the Y axis cannot be determined) and graphics may not be drawn properly; therefore, adjust the values so that the line of sight is not parallel with the Y axis when using this function. The diagrams below illustrate the line of sight concept.



a) Conceptual model of camera



b) Image seen by camera

Refer to: Chapter 6, "The Camera"

void

slMultiMatrix Multiply specified matrix by current matrix

Format

void slMultiMatrix(mtptr)
MATRIX mtptr :

Parameters

mtptr Starting address of MATRIX-type variable being multiplied (output)

Function

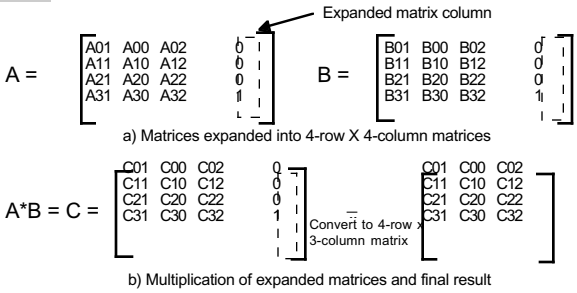
This function multiplies the specified matrix by the current matrix and makes the result the new current matrix.

Return Value

None

Remarks

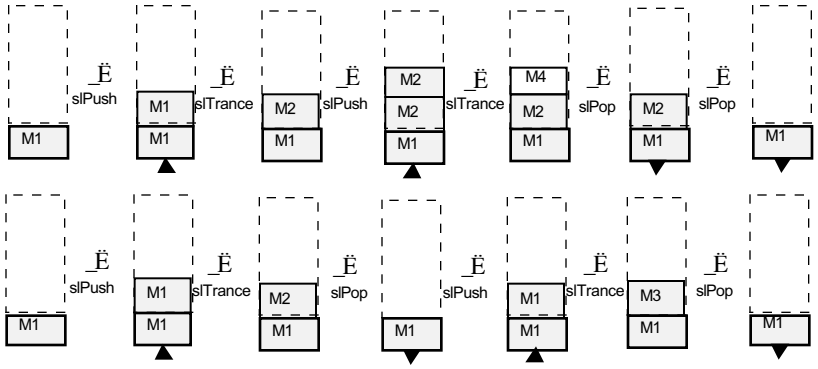
In the SGL, matrices are stored in memory as 4-row x 3-column matrices. However, when performing mathematical operations on matrices such as with this function, due to the fundamental concepts of matrix operations, the matrices are expanded internally into 4-row x 4-column matrices (as shown below) when the operations are executed.



Bool

slPopMatrix Calling a temporarily stored matrix

Format	
Parameters	Bool slPopMatrix()
Function	None
Return Value	This function sends the matrix buffer pointer back one step.
Remarks	If no matrices are nested, the function returns the FALSE value.
	The following diagram illustrates the stack model.

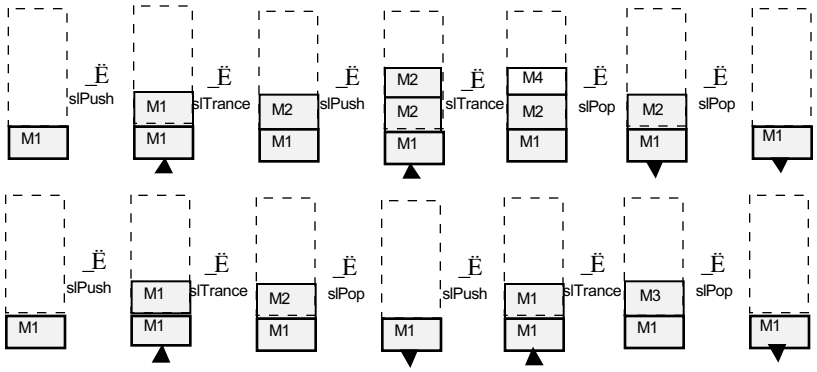


Refer to: Chapter 5, "Matrices"

Bool

slPushMatrix Temporary storage of matrix (up to 20 matrices can be nested

Format	
	Bool slPopMatrix()
Parameters	
	None
Function	
	This function advances the matrix buffer pointer, copies the previous current matrix to the stack, and makes that the new current matrix.
Return Value	
	If pointer allocation failed, the function returns the FALSE value.
Remarks	
	Up to 20 matrices can be nested in the buffer. If an attempt is made to nest more than 20 matrices in the matrix buffer, the function returns the FALSE value. The following diagram illustrates the stack model.



Bool

slPushUnitMatrix Advance pointer and copy unit matrix to current matrix

Format

Bool slPushUnitMatrix()

Parameters

None

Function

This function advances the matrix buffer pointer and then sets a unit matrix in the current matrix.

Return Value

If pointer allocation failed, the function returns the FALSE value.

Remarks

Up to 20 matrices can be nested in the buffer.

If an attempt is made to nest more than 20 matrices in the matrix buffer, the function returns the FALSE value.

Refer to: Chapter 5, "Matrices"

void

slRotAX

Rotation around any axis that passes through origin alling a temporarily stored matrix

Format

```
void slRoaAX(vctx , vcty , vctz , anga)
FIXED vctx ;
FIXED vcty ;
FIXED vctz ;
ANGLE anga ;
```

Parameters

vctx X component of rotation axis vector
vcty Y component of rotation axis vector
vctz Z component of rotation axis vector
anga Rotation angle

Function

This function adds rotation around any axis that passes through the origin. The rotation axis vector that determines the axis of rotation must be specified by a unit vector. The rotation matrix is expressed as shown below.

Return Value

None

Remarks

The rotation matrix used for adding rotation around any vector is shown below.

$$
\text{Rax} = \begin{bmatrix} NxNx(1-C)+,b & NxNy(1-C)+NzS & NxNz(1-C)-NyS \\ NyNx(1-C)-NzS & NyNy(1-C & NyNz(1-C)+NxS \\ NzNx(1-C)+NyS & NzNy(1-C+NxS & NzNz(1-C)+C \\ 0.0 & 0.0 & 0.0 \end{bmatrix}
$$

Note: Nx, Ny, and Nz are the X, Y, and Z components of the rotation axis vector.
S and C are the sine and cosine ofthe angle "anga".

Refer to: Chapter 4, "Coordinate Transformation

void

slRotX Adding rotation around X axis to current matrix

Format

```
void slRotX(angx)
ANGLEangx;
```

Parameters

angx Angle of rotation around X axis

Function

This function multiplies an X axis rotation matrix with the current matrix. The rotation matrix is expressed below.

Return Value

None

Remarks

$$Rx = \begin{bmatrix} 1.0 & 0.0 & 0.0 \\ 0.0 & \cos fÆ & \sin fÆ \\ 0.0 & -\sin fÆ & \cos fÆ \\ 0.0 & 0.0 & 0.0 \end{bmatrix}$$

a) Rotation matrix for adding rotation around the X axis

Refer to: Chapter 4, "Coordinate Transformation

void

slRotXSC Adding X axis rotation with sine and cosine specified

Format

```
void slRotXSC(sn , cs)
FIXED sn ;
FIXED cs ;
```

Parameters

sn Angle of rotation versus X axis after sine transformation
cs Angle of rotation versus X axis after cosine transformation

Function

This function specifies the sine and cosine and multiplies the values with the X-axis rotation matrix. The rotation matrix is expressed as shown below.

Return Value

None

Remarks

$$Rxsc = \begin{bmatrix} 1.0 & 0.0 & 0.0 \\ 0.0 & cs & sn \\ 0.0 & -sn & cs \\ 0.0 & 0.0 & 0.0 \end{bmatrix}$$

Note: "cs" and "sn" are the parameter substitution values

void

slRotY Adding rotation around Y axis to current matrix

Format

```
void slRotY(angy)
ANGLEangy ;
```

Parameters

angy Angle of rotation around Y axis

Function

This function multiplies a Y axis rotation matrix with the current matrix. The rotation matrix is expressed below.

Return Value

None

Remarks

$$Ry = \begin{bmatrix} \cos fÆ & .0.0 & -\sin fÆ \\ 0.0 & 1.0 & 0.0 \\ \sin fÆ & 0.0 & \cos fÆ \\ 0.0 & 0.0 & 0.0 \end{bmatrix}$$

a) Rotation matrix for adding rotation around the Y axis

Refer to: Chapter 4, "Coordinate Transformation"

void

slRotYSC

Adding Y axis rotation with sine and cosine specified

Format

```
void slRotYSC(sn , cs)
FIXED sn ;
FIXED cs ;
```

Parameters

sn Angle of rotation versus Y axis after sine transformation
cs Angle of rotation versus Y axis after cosine transformation

Function

This function specifies the sine and cosine and multiplies the values with the Y-axis rotation matrix. The rotation matrix is expressed as shown below.

Return Value

None

Remarks

$$Rysc = \begin{bmatrix} cs & 0.0 & -sn \\ 0.0 & 1.0 & 0.0 \\ sn & 0.0 & cs \\ 0.0 & 0.0 & 0.0 \end{bmatrix}$$

Note: "cs" and "sn" are the parameter substitution values

Refer to: Chapter 4, "Coordinate Transformation"

void

slRotZ Adding rotation around Z axis to current matrix

Format

```
void slRotZ(angz)
ANGLEangz ;
```

Parameters

angz Angle of rotation around Z axis

Function

This function multiplies a Z axis rotation matrix with the current matrix. The rotation matrix is expressed below.

Return Value

None

Remarks

$$Rz = \begin{bmatrix} \cos f Æ & \sin f Æ & 0.0 \\ -\sin f Æ & \cos f Æ & 0.0 \\ 0.0 & 0.0 & 1.0 \\ 0.0 & 0.0 & 0.0 \end{bmatrix}$$

a)Rotation matrix for adding rotation around the Z axis

Refer to: Chapter 4, "Coordinate Transformation"

void

slRotZSC

Adding Z axis rotation with sine and cosine specified

Format

```
void slRotZSC(sn , cs)
FIXED sn ;
FIXED cs ;
```

Parameters

sn Angle of rotation versus Z axis after sine transformation
cs Angle of rotation versus Z axis after cosine transformation

Function

This function specifies the sine and cosine and multiplies the values with the Z-axis rotation matrix. The rotation matrix is expressed as shown below.

Return Value

None

Remarks

$$Rzsc = \begin{bmatrix} cs & sn & 0.0 \\ -sn & cs & 0.0 \\ 0.0 & 0.0 & 1.0 \\ 0.0 & 0.0 & 0.0 \end{bmatrix}$$

Note: "cs" and "sn" are the parameter substitution values

Refer to: Chapter 4, "Coordinate Transformation slRotZSC "

void

slScale Current matrix scaling

Format

```
void slScale(sx , sy , sz)
FIXED sx ;
FIXED sy ;
FIXED sz ;
```

Parameters

sx Enlargement/reduction ratio in the direction of the X axis
sy Enlargement/reduction ratio in the direction of the Y axis
sz Enlargement/reduction ratio in the direction of the Z axis

Function

This function multiplies the enlargement/reduction ratio matrix by the current matrix. The enlargement/reduction matrix is expressed below.

Return Value

None

Remarks

$$Rxyz = \begin{bmatrix} sx & 0.0 & 0.0 \\ 0.0 & sy & 0.0 \\ 0.0 & 0.0 & sz \\ 0.0 & 0.0 & 0.0 \end{bmatrix}$$

Note: "sx","sy", and "sz" are parameter substitution values

Refer to: Chapter 4, "Coordinate Transformation"

void

slTranslate Current matrix movement

Format

```
void slTranslate(tx , ty , tz)
FIXED tx ;
FIXED ty ;
FIXED tz ;
```

Parameters

tx Movement in the direction of the X axis
ty Movement in the direction of the Y axis
tz Movement in the direction of the Z axis

Function

This function multiplies the parallel movement matrix with the current matrix. The parallel movement matrix is expressed as shown below.

Return Value

None

Remarks

$$Txyz = \begin{bmatrix} 1.0 & 0.0 & 0.0 \\ 0.0 & 1.0 & 0.0 \\ 0.0 & 0.0 & 1.0 \\ tx & ty & tz \end{bmatrix}$$

Note: "tx", "ty" and "tz" are the parameter substitution values.

Refer to: Chapter 4, "Coordinate Transformation"

void

slTransposeMatrix Current matrix transposition

Format	
	vioid slTransposeMatrix()
Parameters	
	None
Function	
	This function replaces the current matrix with a transposed matrix (Zero movement in parallel direction)
Return Value	
	None
Remarks	
	A transposed matrix is expressed as shown below.

$$\begin{bmatrix} M00 , M01 , M02 \\ M10 , M11 , M12 \\ M20 , M21 , M22 \\ 0.0 , 0.0 , 0.0 \end{bmatrix} \xrightarrow[\text{Conversion to transposed matrix}]{} \begin{bmatrix} M00 , M10 , M20 \\ M01 , M11 , M21 \\ M02 , M12 , M22 \\ 0.0 , 0.0 , 0.0 \end{bmatrix}$$

a)Original matrix b)Transposed matrix

Refer to: slTransposeMatrix

void

slUnitMatrix Make specified matrix a unit matrix

Format

```
void ulUjnitMatrix(mtptr)
MATRIXmtptr ;
```

Parameters

mtptr Starting address of MATRIX-type variable to be converted to a unit matrix (input)

Function

This function converts the specified matrix into a unit matrix. If CURRENT is specified for the parameter, this function changes the current matrix into a unit matrix.

Return Value

None

Remarks

Refer to: Chapter 5, "Matrices"

Uint16

slAng2Dec Convert ANGLE-type angle value into BCD-type value

Format

```
Uint16 slAng2Dec(ang)
ANGLE ang;
```

Parameters

ang ANGLE-type angle value

Function

This function converts an ANGLE-type angle value into a BCD-type value.

Return Value

Angle data converted into a BCD-TYPE VALUE

Remarks

LISTING

```
402=400 _¨ 0x0090
ang=0x1000 _¨ 0x0022
```

void

slAng2FX Convert ANGLE-type angle value into FIXED-type value

Format

```
FIXED slang2FX(ang)
angle amg;
```

Parameters

ang ANGLE-type angle value

Function

This function converts an ANGLE-type angle value into a FIXED-type value.

Return values:

Return Value

Angle data converted into a FIXED-type value

Remarks

Ex.:
ang = 0X4000 _¨ 0x005A0000 (90.0)
ang = 0X1000 _¨ 0x0016800 (22.5)

Uint16

slAng2Hex Convert ANGLE-type angle value into hexadecimal value

Format

```
Uint16 slAng2Hex(ang)
ANGLE ang ;
```

Parameters

ang ANGLE-type angle value

Function

This function converts an ANGLE-type angle value into a hexadecimal value.

Return Value

Angle data converted into a hexadecimal value

Remarks

Ex.:
ang = 0X4000 _¨ 0x005A
ang = 0X1000 _¨0X0016

ANGLE

slAtan Return angle of specified direction

Format

```
ANGLE slAtan(tx, ty)
FIXED tx;
fixed TY;
```

Parameters

tx	X component of vector in specified direction
ty	Y component of vector in specified direction

Function

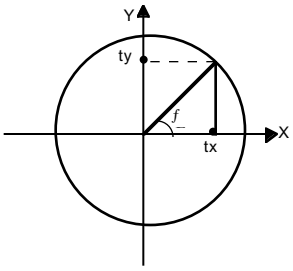
This function returns the angle of the specified direction..

Return Value

Returns the angle of the specified direction.

Remarks

The diagram below illustrates the principles behind the angle calculation in the function "slAtan".



tanƒÆ = ty/tx ;
ƒÆ= $\tan^{-1}$ty/tx = slAtan(tx , ty) ;

void

slCalcPoint

Multiply current matrix with specified point and substitute

Format

```
void slCalcPoint(x,y,z,ans)
FIXED *x,y,z;;
FIXED *ans ;
```

Parameters

x X component of transformation coordinate specification
y Y component of transformation coordinate specification
z Z component of transformation coordinate specification
ans[XYZ] XYZ component substitution variable after matrix transformation

Function

This function multiplies the XYZ coordinate values specified as parameters with the current matrix and substitutes the result into the parameter "ans[XYZ]".

Return Value

None

Remarks

FIXED

slCos Returns cosine value of specified angle

Format

```
FIXED slCos(angc)
ANGLE ANGC;
```

Parameters

angc Specified angle

Function

This function gets the cosine value for the specified angle from a Cos table.

Return Value

The function returns the cosine value for the specified angle.

Remarks

Cosine values are represented in the range 0x0000 to 0xffff. However, because 0x0008 is added to the angle data and the four low-order bits are discarded (rounding 7 down and 8 up), with the result that the range 0x0000 to 0xfff0 is used for the angle data, the precision of the operation results suffers slightly.

This treatment applies to all functions that use angle data.

Refer to: Chapter 11, "Mathematical Operation Functions"

Uint32

slDec2Hex Convert BCD code to hexadecimal code

Format

```
Uint32 slDec2Hex(val)
Uint32 val ;
```

Parameters

val BCD code to be converted

Function

This function converts a BCD code to a hexadecimal code.

Return Value

This function returns the converted hexadecimal code.

Remarks

BCD code: notation for representing the values 0 to 9 using 4 bits.

(Ex.: The decimal value "128" is represented in BCD notation as "0x128")

	Decimal	BCD	Hexadecimal
Notation	92	0x92	0x5c

Note: Example of representations of a value using each form of notation.

FIXED

slDivFX Division operation (B/A)

Format

```
FIXED slDivFX(a , b)
FIXED s ;
FIXED b ;
```

Parameters

a	A in "B/A": divisor
b	B in "B/A": dividend

Function

This function divides one fixed-point decimal by another (B/A).

Return Value

This function returns the result of "B/A".

Remarks

This function does not perform an overflow check.

Uint32

slHex2Dec Convert hexadecimal code to BCD code

Format

```
Uint32 slHex2Dec(val))
Uint32 val ;
```

Parameters

val Hexadecimal code to be converted

Function

This function converts a hexadecimal code to a BCD code.

Return Value

This function returns the converted BCD code.

Remarks

BCD code: notation for representing the values 0 to 9 using 4 bits.

(Ex.: The decimal value "128" is represented in BCD notation as "0x128")

	Decimal	BCD	Hexadecimal
Notation	92	0x92	0x5c

Note: Example of representations of a value using each form of notation

FIXED

slInnerProduct Inner product of vectors

Format	
	FIXED slInnerProduct(vctl , vct2) VECTOR vct 1 ; VECTOR vct2 ;
Parameters	
	vct1 VECTOR-type variable for which the inner product is to be taken vct2 VECTOR-type variable for which the inner product is to be taken
Function	
	This function finds the inner product of the specified vectors and returns the result
Return Value	
	This function returns the result of the inner product operation.
Remarks	
	The return value is calculated as shown below.

_œ Inner product of vectors _œ

A(X1,Y1,Z1)*B(X2,Y2,Z2) = X1*X2+Y1*Y2+Z1*Z2
= Return Value

Refer to: Chapter 11, "Mathematical Operation Functions"

FIXED

slMulFX Multiplication operation (A * B)

Format

```
FIXED slMulFX(a , b)
FIXED a :
FIXED b ;
```

Parameters

a	A in "A * B": multiplier
b	B in "A * B": multiplicand

Function

This function multiplies two fixed-point decimals together

Return Value

This function returns the product of A and B.

Remarks

FIXED

slRandom Random number generator

Format	
	FIXED slRandom()
Parameters	
	None
Function	
	This function generates a random FIXED-type value in a range from 0 to 1.
Return Value	
	A FIXED-type value ranging from 0.0 to 1.0
Remarks	

Refer to: slRandom

FIXED

slSin Returns sine value of specified angle

Format

```
FIXED slSin(angs)
ANGLE angs ;
```

Parameters

angs Specified angle

Function

This function gets the sine value for the specified angle from a Sin table.

Return Value

The function returns the sine value for the specified angle.

Remarks

Sine values are represented in the range 0x0000 to 0xffff. However, because 0x0008 is added to the angle data and the four low-order bits are discarded (rounding 7 down and 8 up), with the result that the range 0x0000 to 0xfff0 is used for the angle data, the precision of the operation results suffers slightly.

This treatment applies to all functions that use angle data.

Uint32

slSquart Calculate square root of unsigned integer value

Format

```
Uint32 slSqart(sqrt))
Uint32 sqrt ;
```

Parameters

sqrt Unsigned integer value

Function

This function calculates the square root of an unsigned integer value.

Return Value

This function returns the square root of an unsigned integer value.

Remarks

BCD code: notation for representing the values 0 to 9 using 4 bits.

FIXED

slSquartFX Calculate square root of unsigned fixed-point decimal

Format

```
FIXED slSquartFX(sqrtx)
FIXED sqrtfx ;
```

Parameters

sqrtfx Unsigned fixed-point decimal

Function

This function calculates the square root of an unsigned fixed-point decimal.

Return Value

This function returns the square root of an unsigned fixed-point decimal.

Remarks

Because the calculation is performed as for integers, the precision of the result is 8 bits for the integer portion and 8 bits for the decimal portion.

FIXED

slTan Returns tangent value of specified angle

Format

```
FIXED slTan(angt)
ANGLE ngt ;
```

Parameters

angt Specified angle

Function

This function gets the tangent value for the specified angle from a table.

Return Value

The function returns the tangent value for the specified angle

Remarks

Tangent values are represented in the range 0x0000 to 0xffff. However, because 0x0008 is added to the angle data and the four low-order bits are discarded (rounding 7 down and 8 up), with the result that the range 0x0000 to 0xfff0 is used for the angle data, the precision of the operation results suffers slightly.

This treatment applies to all functions that use angle data.

Void

slCloseEvent Event decision

Format

```
void siCloseEvent(evptr)
EVENT *evptr :
```

Parameters

evptr Starting address of area where event to be deleted is stored

Function

This function removes an event registered in the execution list from the list and releases its area. If a work area was also allocated, that area is also released.

Return Value

None

Remarks

If an event that is not registered in the event list is specified, list modification processing will be executed on the wrong event due to the incorrect list information, with information being written to unpredictable addresses and, in the worst case, the CPU may stop operating.

Refer to: Chapter 10, "Event Control"

void

slExecuteEvent Event schedule management

Format	
	void slExecuteEvent()
Parameters	
	None
Function	
	This function executes the events registered in the execution list in sequence, starting from the top of the list. : .
Return Value	
	None
Remarks	
	The function "slExecuteEvent" should be called once per frame

Refer to: Chapter 10, "Event Control"

EVENT

slGetEvent Get area equal in size to event

Format

EVENT*slGetEvent()

Parameters

None

Function

This function gets an area that is the same size as an event (128 bytes) in the part of RAM that has been allocated for events and returns the pointer to that area.

Because this function only gets an area equal in size to an event from the event area; this function does not register that area as an event.

Return Value

Pointer to the RAM area that was gotten. NULL is returned if no area was available. (There is a maximum limit of 64 events.)

Remarks

The RAM area gotten by "slGetEvent" must be released (using the function "slReturnEvent") when the event using the area is closed.

If the area is not released, the area will continue to exist, unused, in the event area.

Refer to: Chapter 10, "Event Control"

WORK

slGetWork Get new work

Format	
	WORK*slGetWork()
Parameters	
	None
Function	
	This function gets a RAM area allocated for use as a work area and returns the pointer for that area.
Return Value	
	This function returns the starting address for the new work area. The NULL value is returned if the area could not be gotten (due to maximum of 256 work areas).
Remarks	
	Refer to: Chapter 10, "Event Control"

void

slInitEvent Event processing initialization

Format

void slInitEvent()

Parameters

None

Function

This function initializes the event and work management buffers. After initialization, 64 event areas and 256 work areas are allocated within memory.

Return Value

None

Remarks

The event and work RAM itself is not initialized. Initialize the RAM in the user program after getting these areas.

Refer to: Chapter 10, "Event Control"

void

slReturnEvent Release area allocated by "slGetEvent"

Format

```
void slReturnEvent(evptr)
EVENT*evptr ;
```

Parameters

evptr Starting address of area to be released

Function

This function releases an area allocated by the "slGetEvent" function and returns it to the system.

Return Value

None

Remarks

When an area registered as an event is released by using the "slReturnEvent" function, the area is returned to the system, but because the event list is not altered (and the function does not check to see if the area was an event area), problems may arise with functions executed subsequently, such as "slGetEvent", "slSetEvent", and "slSetEventNext".
Always call the function "slCloseEvent" and release the event registration.

Refer to: Chapter 10, "Event Control"

void

slReturnWork Return work area to system

Format

```
void slReturnWork(wkptr)
WORK*wkptr ;
```

Parameters

wkptr Starting address of work area to be returned to system

Function

This function returns a RAM area used as a work area to the system.

Return Value

This function returns the converted hexadecimal code.

Remarks

Although the pointer returned to the system is registered again in the system buffer, the system does not check to see if the pointer that was returned is already registered or not. As a result, it is essential to be aware that if the same pointer is returned several times, problems can arise when "slGetWork" is executed later, such as multiple events using the same work area.

Refer to: Chapter 10, "Event Control"

EVENT

slSetEvent Event registration

Format

```
EVENT*slSetEvent(func)
void(*func)() ;
```

Parameters

func Pointer for function being registered as an event

Function

This function gets an event area and appends the event to the end of the event list. The "func" specified as the function to be executed by this event is registered.

Return Value

When the event area is gotten successfully, this function returns the starting address of the registered event area. If there are no available event areas, this function returns the NULL code.

Remarks

Although the event area is allocated as 128 bytes, the first 16 bytes are used by the system.

Refer to: Chapter 10, "Event Control"

EVENT

slSetEventNext Add new event after specified event

Format

```
EVENT*slSetEventNext(evptr , func)
EVENT*evptr ;
void(*func)()
```

Parameters

evptr Starting address of the event area immediately preceding the position where the new event is to be inserted
func Pointer for function to be registered as an event

Function

This function gets an event area and inserts/adds it to the event list. The new event is registered in the event list so that it is executed next after the event specified as a parameter.

Return Value

This function returns the starting address of the registered event area. If there are no more event areas remaining, the event is not registered and this function returns the NULL code.

Remarks

Although the event area is allocated as 128 bytes, the first 16 bytes are used by the system.

Refer to: Chapter 10, "Event Control"

Uint8

slCheckReset Get SMPC reset button status

Format

Uint8 slCheckReset()

Parameters

None

Function

This function gets the reset button status when system reset by the reset button is disabled.

Return Value

SMPC reset button status

Remarks

The following values are returned for the return value:

SMPC_RES_OFF Reset button off (initial value)
SMPC_RES_ON Reset button on

Once the status goes to on, it does not change until "slClearReset" is called.

Uint8

slGetLanguage Get SMPC memory language number

Format

Uint8 slGetLanguage ()

Parameters

None

Function

This function gets the language number from the SMPC memory information.

Return Value

Language number

Remarks

The SMPC memory information can also be referenced from the global variable "Smpc_Status".

To get the newest SMPC status for the SMPC memory information, use "slGetStatus". The following values are returned for the return value:

SMPC_ENGLISH	English
SMPC_DEUTSCH	German
SMPC_FRANCAIS	French
SMPC_ESPANOL	Spanish
SMPC_ITALIANO	Italian
SMPC_JAPAN	Japanese

Bool

slGetPeripheral Interrupt back (get peripheral data only)

Format

Bool slGetPeripheral ()

Parameters

None

Function

This function automatically gets the peripheral data and puts it into the global variable "Smpc_Peripheral".

This function also automatically gets the number of connected peripherals and puts the data into the global variables "Per_Connect1" and "Per_Connect2".

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process). Because this function is called by "slInitSystem" when the library is started up, there is no particular need to call this function unless you are changing the settings.

The settings are reflected in the data starting from the second frame after the settings are made.

Execution of this function fails when the peripheral port input/output setting is incorrect.

Uint8

slGetSoundOutput Get SMPC memory sound output mode

Format

Uint8 slGetSoundOutput()

Parameters

None

Function

This function gets the sound output mode from the SMPC memory information.

Return Value

Sound output mode

Remarks

The SMPC memory information can also be referenced from the global variable "Smpc_Status".

To get the newest SMPC status for the SMPC memory information, use "slGetStatus". The following values are returned for the return value:

SMPC_SOUND_STEREO Stereo
SMPC_SOUND_MONO Monaural

Bool

slGetStatus

Interrupt back (get SMPC status and peripheral data

Format

Bool slGetStatus ()

Parameters

None

Function

This function automatically gets the latest SMPC status and puts it into the global variable "Smpc_Status".

This function also automatically gets the peripheral data and puts it into the global variable "Smpc_Peripheral".

This function also automatically gets the number of connected peripherals and puts the data into the global variables "Per_Connect1" and "Per_Connect2".

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process). This function is called once by "slInitSystem" when the library is started up to get the SMPC status at startup.

Afterwards, the mode is set so that "slGetPeripheral" is called so that only the peripheral data is gotten.

The settings are reflected in the data starting from the second frame after the settings are made.

Execution of this function fails when the peripheral port input/output setting is incorrect.

Void

slInitPeripheral System management and peripheral control initialization

Format

void slInitPeripheral()

Parameters

None

Function

This function initializes the system management and peripheral control library.

Return Value

None

Remarks

Because this function is called by "slInitSystem" during library startup, there is no particular need to call this function.

Bool

slIntBackCancel Clear flags sets for interrupt back

Format

Bool slIntBackCancel ()

Parameters

None

Function

This function clears the settings that were made by calling "slGetPeripheral" and "slGetStatus" indicating that the SMPC status and peripheral data are to be gotten automatically.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

Bool

slResetDisable Reset disable (no wait mode)

Format

Bool slResetDisable ()

Parameters

None

Function

This function disables system reset by pressing the reset button.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

This function does not wait for the termination of SMPC command execution.

If an interrupt back has been issued, this function is queued in the command cache.

Execution of this function fails if a command cache overflow occurs.

Bool

slResetDisableWait Reset disable (wait mode)

Format

Bool slResetDisableWait ()

Parameters

None

Function

This function disables system reset by pressing the reset button.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process). This function waits for the termination of SMPC command execution.

If an interrupt back has been issued, execution of this function fails.

Bool

slResetEnable Reset enable (no wait mode)

Format

Bool slResetEnable ()

Parameters

None

Function

This function enables system reset by pressing the reset button.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process). This function does not wait for the termination of SMPC command execution.

If an interrupt back has been issued, this function is queued in the command cache.

Execution of this function fails if a command cache overflow occurs.

Bool

slResetEnableWait Reset enable (wait mode)

Format

Bool slResetEnableWait ()

Parameters

None

Function

This function enables system reset by pressing the reset button.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process). This function waits for the termination of SMPC command execution.

If an interrupt back has been issued, execution of this function fails.

Void

slSetLanguage Set SMPC memory language number

Format

```
void slSetLanguage(lang)
Uint8 lang ;
```

Parameters

Language number

Function

This function sets the language number in the SMPC memory information.

Return Value

None

Remarks

The SMPC memory information can also be referenced from the global variable "Smpc_Status".

To store the SMPC memory information in the SMPC memory, use "slSetSmpcMemory".

The following values can be used for the parameters:

SMPC_ENGLISH	English
SMPC_DEUTSCH	German
SMPC_FRANCAIS	French
SMPC_ESPANOL	Spanish
SMPC_ITALIANO	Italian
SMPC_JAPAN	Japanese

Bool

slSetSmpcMemory SMPC memory setting (no wait mode)

Format

Bool slSetSmpcMemory()

Parameters

None

Function

This function sets the SMPC memory.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

This function does not wait for the termination of SMPC command execution.

If an interrupt back has been issued, this function is queued in the command cache.

Execution of this function fails if a command cache overflow occurs.

This function sets the contents of the global variable "Smpc_Status" in the SMPC memory.

Bool

slSetSmpcMemoryWait SMPC memory setting (wait mode)

Format	
	Bool slSetSmpcMemoryWait()
Parameters	
	None
Function	
	This function sets the SMPC memory.
Return Value	
	Execution results OK: Successful NG: Failed
Remarks	
	Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process). This function waits for the termination of SMPC command execution. If an interrupt back has been issued, execution of this function fails. This function sets the contents of the global variable "Smpc_Status" in the SMPC memory.

Refer to: HARDWARE MANUAL vol. 1 (SMPC)

slSetSmpcMemoryWait

Void

slSetSoundOutput Set SMPC memory sound output mode

Format

```
void slSetSoundOutput(mode)
Uint8 mode ;
```

Parameters

mode Sound output mode

Function

This function sets the sound output mode in the SMPC memory information.

Return Value

None

Remarks

The SMPC memory information can also be referenced from the global variable "Smpc_Status".

To store the SMPC memory information in the SMPC memory, use "slSetSmpcMemory".

The following values can be used for the parameters:

SMPC_SOUND_STEREO Stereo
SMPC_SOUND_MONO Monaural

Bool

slSlaveOff Slave SH2 off (no wait mode)

Format

Bool slSlaveoff ()

Parameters

None

Function

This function turns the slave SH2 off.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

This function does not wait for the termination of SMPC command execution.

If an interrupt back has been issued, this function is queued in the command cache.

Execution of this function fails if a command cache overflow occurs.

Refer to: HARDWARE MANUAL vol. 1 (SMPC) slSlaveOff

Bool

slSlaveOffWait Slave SH2 off (wait mode)

Format

Bool slSlaveoffWait ()

Parameters

None

Function

This function turns the slave SH2 off.

Return Value

Execution results
OK: Successful
NG: Failed

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

This function waits for the termination of SMPC command execution.

If an interrupt back has been issued, execution of this function fails.

Refer to: HARDWARE MANUAL vol. 1 (SMPC) slSlaveOffWait

Bool

slSlaveOn Slave SH2 on (no wait mode)

Format	
	Bool slSlaveon ()
Parameters	
	None
Function	
	This function turns the slave SH2 on.
Return Value	
	Execution results OK: Successful NG: Failed
Remarks	
	Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process). This function does not wait for the termination of SMPC command execution. If an interrupt back has been issued, this function is queued in the command cache. Execution of this function fails if a command cache overflow occurs.

Refer to: HARDWARE MANUAL vol. 1 (SMPC) slSlaveOn

Bool

slSlaveOnWait Slave SH2 on (wait mode)

Format	
Parameters	Bool slSlaveonWait ()
Function	None
Return Value	This function turns the slave SH2 on.
Remarks	Execution results OK: Successful NG: Failed

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

This function waits for the termination of SMPC command execution.

If an interrupt back has been issued, execution of this function fails.

Uint8

slGetOptimize Get peripheral acquisition time optimization mode

Format

Uint8 slGetOptimize ()

Parameters

None

Function

This function gets the peripheral acquisition time optimization mode.

Return Value

Peripheral acquisition time optimization mode

Remarks

The following values are returned for the return value.

SMPC_OPT_ENA	Acquisition time optimization enable (initial value)
SMPC_OPT_DIS	Acquisition time optimization disable

Uint8

slGetPortMode1,2 Get port mode for peripheral port 1, 2

Format

```
Uint8 slGetPortMode1 ()
Uint8 slGetPortMode2 ()
```

Parameters

None

Function

These functions get the port mode of peripheral ports 1 and 2.

Return Value

Port mode of the peripheral port

Remarks

The following values are returned for the return value.

SMPC_PORT_15	15-byte mode (initial value)
SMPC_PORT_255	255-byte mode
SMPC_PORT_ZERO	0-byte mode

Bool

slSetOptimize Set peripheral acquisition time optimization mode

Format

```
Bool slSetOptimize(mode)
Uint8 mode ;
```

Parameters

mode Peripheral acquisition time optimization mode

Function

This function sets the peripheral acquisition time optimization mode.

Return Value

Execution results

OK: Success
NG: Failure

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

The following values can be used for the parameter.

SMPC_OPT_ENA	Acquisition time optimization enable (initial value)
SMPC_OPT_DIS	Acquisition time optimization disable

Bool

slSetPortMode1,2 Set port mode for peripheral port 1, 2

Format

```
Bool slSetPortMode1(mode)
Bool slSetPortMode2(mode)
Uint8 mode ;
```

Parameters

mode Port mode of peripheral port

Function

These functions set the port mode of peripheral ports 1 and 2.

Return Value

Execution results

OK: Success
NG: Failure

Remarks

Execution of this function fails when the semaphore cannot be gotten (because it is locked by another process).

The following values can be used for the parameter.

SMPC_PORT_15	15-byte mode (initial value)
SMPC_PORT_255	255-byte mode
SMPC_PORT_ZERO	0-byte mode

Bool

slBGMCont Restart temporarily paused BGM playback

Format

Bool slBGMCont ()

Parameters

None

Function

This function restarts playback of temporarily paused BGM.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Bool

slBGMFade Change BGM playback volume

Format

```
Bool slBGMFade(Volume,Rate)
Uint8 Volume ;
Uint8 Rate ;
```

Parameters

Volume Volume value
Rate Rate value

Function

This function gradually changes the BGM playback volume.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value from 0 to 127 for the parameter "Volume" and a value from 0 to 255 for the parameter "Rate".

"Rate" specifies the interval for changing from the present volume to the specified volume.

When "Rate" is specified as "0", the volume changes immediately to the value specified by "Volume".

Refer to: Chapter 14, "Sound Library"

Bool

slBGMOff Stop BGM playback

Format

Bool slBGMOff ()

Parameters

None

Function

This function stops BGM playback.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Bool

slBGMOn Start BGM playback

Format

```
Bool slBGMOn(Song, Prio, Volume, Rate)
Uint 16 Song ;
Uint 8 Prio ;
Uint 8 Volume ;
Uint 8 Rate
```

Parameters

Song	Sound control number
Prio	Priority value
Volume	Volume value
Rate	Rate value

Function

This function starts BGM playback.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

BGM always uses sound control number 0.

Specify the parameter "Prio" with a value from 0 to 31. The larger the value, the higher the priority.

Specify a value from 0 to 127 for the parameter "Volume" and a value from 0 to 255 for the parameter "Rate".

"Rate" specifies the interval for changing from volume value 0 to the specified volume.

When "Rate" is specified as "0", the volume changes immediately to the value specified by "Volume".

Refer to: Chapter 14, "Sound Library"

Bool

slBGMPause Pause BGM playback

Format

Bool slBGMPause()

Parameters

None

Function

This function pauses BGM playback.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Bool

slBGMStat BGM playback check

Format	
	Bool slBGMStat()
Parameters	
	None
Function	
	This function checks to determine whether or not BGM is being played back.
Return Value	
	This function returns "1" when playback is in progress (even if paused) and "0" if playback is stopped.
Remarks	

Bool

slBGMTempo Change BGM playback speed

Format

```
Bool slBGMTempo(Tempo)
Sint16 Tempo ;
```

Parameters

Tempo Tempo value

Function

This function changes the BGM playback speed.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from -32768 to 32767 for the parameter "Tempo". "Tempo" is the tempo value relative to the standard tempo 0; at 4096 (1000h) the tempo is doubled, and at -4096 the tempo is halved.

Bool

slCDDAOff Stop CD-D/A output

Format

Bool slCDDAOff ()

Parameters

None

Function

This function stops CD-D/A output.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Refer to: slCDDAOff

Bool

slCDDAOn Start CD-D/A output

Format

```
Bool slCDDAOn(LLevel, RLevel, LPan, RPan)
Uint8 LLevel ;
Uint8 RLevel ;
Sint8 LPan ;
Sint8 RPan ;
```

Parameters

LLevel Volume value (left)
RLevel Volume value (right)
LPan Pan value (left)
RPan Pan value (right)

Function

This function starts CD-D/A output.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value in the range from 0 to 127 for the parameters "LLevel" and "RLevel". (The four low-order bits are ignored, however.)

Specify a value in the range from -127 to 127 for the parameters "LPan" and "RPan". (-127 (left) <-> 0 (center) <-> 127 (right))

Note that the SCSP pans in 32 steps, so the three low-order "Pan" bits are ignored.

Refer to: slCDDAOn

Bool

slDSPOff Stop DSP playback

Format

Bool slDSPOff()

Parameters

None

Function

This function stops DSP playback.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

void

slInitSound

Set sound driver and initialize sound control CPU

Format

```
void slInitSound(Dry, Drvsz, Map, Mapsz)
Uint8 *Dry ;
Uint32 Drvsz ;
Uint8 *Map ;
Uint32 Mapsz ;
```

Parameters

Drv	Driver file address
Drvsz	Driver file size
Map	Map file address
Mapsz	Map file size

Function

This function sets the sound driver and initializes the sound control CPU (MC68000).

Return Value

None

Remarks

Refer to: Chapter 14, "Sound Library"

Bool

slPCMOff Stop playback from PCM sound source

Format

```
Bool slPCMOff (Pdat)
PCM "Pdat ;
```

Parameters

Pdat PCM-type structure data

Function

This function stops PCM playback on the specified channel.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

For details on PCM-type structures, refer to the "Structure Reference.

Sint8

slPCMOn Start playback from PCM sound source

Format

```
Sint8 slPCMOn (Pdat, Data, Size)
PCM "Pdat ;
void *Data ;
Uint32 Size ;
```

Parameters

Pdat	PCM-type structure data
Data	PCM data table address
Size	PCM data table size

Function

This function plays back music (sound effects) from a PCM source.

Return Value

This function returns a value ranging from 0 to 7 after normal termination, "-1" if the command buffer lacks sufficient space, "-2" if there is no PCM channel available, and "-3" if the PCM buffer lacks sufficient space.

Remarks

For details on PCM-type structures, refer to the "Structure Reference." PCM playback initiated by this function terminates when the data ends.

Bool

slPCMParmChange Change PCM playback parameters

Format

```
Bool slPCMParmChange(Pdat)
PCM *Pdat ;
```

Parameters

Pdat PCM-type structure data

Function

This function changes the value of each parameter for PCM playback.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

For details on PCM-type structures, refer to the "Structure Reference."

Bool

slPCMStat Check playback on specified PCM channel

Format

```
Bool slPCMStat(Pdat)
PCM *Pdat ;
```

Parameters

Pdat PCM-type structure data

Function

This function checks to determine whether or not PCM playback is in progress on the specified channel.

Return Value

This function returns "1" if playback is in progress, and "0" if it is not.

Remarks

Bool

slSequenceCont Restart generation of paused sound effect

Format

```
Bool slSequenceCont(Seqnm)
Uint8 Seqnm ;
```

Parameters

Seqnm Sequence control number

Function

This function resumes generation of a paused sound effect.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 1 to 7 for the parameter "Seqnm".

Bool

slSequenceFade Change volume of specified sound effect

Format

```
Bool slSequenceFade(Seqnm, Volume, Rate)
Uint8 Seqnm ;
Uint8 Volum
Uint8 Rate
```

Parameters

Seqnm Sequence control number
Volum Volume value
Rate Rate value

Function

This function gradually changes the volume of the specified sound effect.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 1 to 7 for the parameter "Seqnm".

Specify a value from 0 to 127 for the parameter "Volume" and a value from 0 to 255 for the parameter "Rate".

"Rate" specifies the interval for changing from the present volume to the specified volume.

When "Rate" is specified as "0", the volume changes immediately to the value specified by "Volume".

Refer to: Chapter 14, "Sound Library"

Bool

slSequenceOff Stop generation of specified sound effect

Format

```
Bool slSequenceOff(Seqnm)
Uint8 Seqnm ;
```

Parameters

Seqnm Sequence control number

Function

This function stops generation of the specified sound effect.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 1 to 7 for the parameter "Seqnm".

Refer to: Chapter 14, "Sound Library"

Uint8

slSequenceOn Start generation of specified sound effect

Format

```
Uint8 SequenceOn(Song, Prio, Volume, Pan)
Uint16 Song ;
Uint8 Prio ;
Uint8 Volume ;
Sint8 Pan ;
```

Parameters

Song	Sound control number
Prio	Priority value
Volume	Volume value
Pan	Pan value

Function

This function starts generation of the specified sound effect.

Return Value

When this function terminates normally, it returns the sequence control number.

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value from 0 to 31 for the parameter "Prio". The larger the value, the higher the priority.

Specify a value from 0 to 127 for the parameter "Volume".

Specify a value in the range from -127 to 127 for the parameter "Pan". (-127 (left) <-> 0 (center) <-> 127 (right))

Note that the SCSP pans in 32 steps, so the three low-order "Pan" bits are ignored.

Uint8

slSequencePan Change direction of generation of specified sound effect

Format

```
Uint8 SequencePan(SEqnm, Pan)
Uint8 Seqnm ;
Sint8 Pan ;
```

Parameters

Seqnm Sequence control number
Pan Pan value

Function

This function changes the direction of generation of the specified sound effect.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 1 to 7 for the parameter "Seqnm".

Specify a value in the range from -127 to 127 for the parameter "Pan". (-127 (left) <-> 0 (center) <-> 127 (right))

Note that the SCSP pans in 32 steps, so the three low-order "Pan" bits are ignored.

Bool

slSequenceReset Initialize parameters for specified sound effect

Format

```
Bool slSequenceReset(Seqnm)
Uint8 Seqnm ;
```

Parameters

Seqnm Sequence control number

Function

This function initializes the volume, tempo, and pan settings for the specified sound effect.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 1 to 7 for the parameter "Seqnm".

Bool

slSequenceStat Check playback of specified sound effect

Format

```
Bool slSequenceStat(Seqnm)
Uint8 Seqnm ;
```

Parameters

Seqnm Sequence control number

Function

This function checks to determine whether or not the specified sound effect is being played back.

Return Value

This function returns "1" if the sound effect is being played back (even if paused), and "0" if the sound effect is stopped.

Remarks

Bool

slSequenceTempo Change speed of specified sound effect

Format

```
Bool slSequenceTempo(Seqnm, Tempo)
Uint8 Seqnm ;
Sint16 Tempo ;
```

Parameters

Seqnm Sequence control number
Tempo Tempo value

Function

This function changes the speed of the specified sound effect.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 1 to 7 for the parameter "Seqnm".

Specify a value ranging from -32768 to 32767 for the parameter "Tempo". "Tempo" is the tempo value relative to the standard tempo 0; at 4096 (1000h) the tempo is doubled, and at -4096 the tempo is halved.

Bool

slSndEffect Switch sound effect by DSP

Format

```
Bool slSndEffect(Effect)
Uint8 Effect ;
```

Parameters

Effect Effect bank number

Function

This function switches the sound effect generated by the DSP.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 1 to 15 for the parameter "Effect".

Refer to: slSndEffect

Bool

slSndMapChange Change current sound map

Format

```
void *slSndMapChange(Map)
Uint8 Map :
```

Parameters

Map Map number

Function

This function changes the current sound map.

Return Value

When this function terminates normally, it returns the address of the command buffer where the parameters were set.
If there was no space available in the command buffer, the function returns "FALSE".

Remarks

After sending the sound data, set the "work area transfer completed" bit.

Refer to: slSndMapChange

Bool

slSndMixChange Switch mixer corresponding to tone bank

Format

```
Bool slSndMixChange(Tbank, Mixno)
Uint8 Tbank ;
Uint8 Mixno ;
```

Parameters

Tbank Tone bank number
Mixno Mixer number

Function

This function switches the mixer corresponding to the tone bank

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 0 to 15 for the parameter "Tbank".

Specify a value ranging from 0 to 127 for the parameter "Mixno".

Refer to: slSndMixChange

Bool

slSndMixParmChange Change mixer parameters

Format

```
Bool slSndMixParmChange(Effect, Level, Pan)
Uint8 Effect ;
Uint8 Level ;
Sint8 Pan
```

Parameters

Effect	DSP effect output channel
Level	Effect return level
Pan	Effect pan

Function

This function changes the mixer parameters.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 0 to 7 for the parameter "Effect".

Specify a value ranging from 0 to 127 for the parameter "Level". (Ignore the four low-order bits.)

Specify a value ranging from -127 to 127 for the parameter "Pan". (Ignore the three low-order bits.)

Sint8

slSndPCMNum Return available PCM channel number

Format

Sint8 slSndPCMnUM(Mode)

Parameters

PCM playback mode

Function

This function returns the number of an available PCM channel.

Return Value

If this function terminates normally, it returns a value from 0 to 7. If there are no available PCM channels, the function returns the value "-1".

Remarks

Specify the logical sum of "_Stereo" or "_Mono" and "_16Bit" or "_8Bit" for the parameter "Mode".

Although PCM permits playback of up to eight "voices," stereo playback requires two voices, so that even if only four are being played, in actuality eight voices may be in use.

Refer to slSndPCMNum

Uint8

slSndSeqNum Return available sequence control number

Format

Uint8 slSndSeqNum()

Parameters

None

Function

This function returns an available sequence control number.

Return Value

If this function terminates normally, it returns a value from 1 to 7. If there are no available sequence control numbers, the function returns the value "0".

Remarks

Refer to slSndSeqNum

Bool

slSndVolume Set the main volume

Format

Bool slSndVolume(Volume)
Uint8 Volume

Parameters

Volume Volume value

Function

This function sets the main volume.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Specify a value ranging from 0 to 127 for the parameter "Volume". (The three low-order bits are ignored, however.)

Bool

slSoundAllOff Stop playback of all sound sequences

Format

Bool slSoundAllOff()

Parameters

None

Function

This function stops playback of all sound sequences.

Return Value

If the command buffer is full, this function returns the "FALSE" value.

Remarks

Sint8

slSoundRequest Set data to be passed directly to sound driver

Format

```
Sint8 slSoundRequest(form, ...)
const char *form ;
```

Parameters

"form" indicates the size of the data that follows, in the form of character string data. However, the initial data is regarded as the function code, and is not included in the data string.

Function

This function sets the data to be passed directly to the sound driver.

Return Value

This function returns a "-2" if there was an invalid character in the form character string, and a "-1" if an attempt was made to set word data starting from an odd address.

If the function terminates normally, it returns a "0".

Remarks

Example of usage:

```
slSoundRequest ("bbwwwbb", SND_PCM_START, _Stereo@SYMBOL@PCM16Bit, Level7<<5,StreamBuf>>4,StreamSize,Pitch,0,0);
```

In this case, SND_PCM_START is the function code, and is not included in the character string.

_Stereo@SYMBOL@PCM16Bit and Level7<<5 are each passed to the sound driver as byte data, while StreamBuf>>4, StreamSize, and Pitch are each passed as word data.

Supplement: Refer to the "'slSoundRequest' Instruction List" on the following page.

Function Reference Supplement

Table 1. "slSoundRequest" Instruction List

Command Name	Command Data	Parameter Data			
Reserved	00 (hex)	Nothing			
Sequence Start (S--)	01	P1 P2 P3 P4	0-7: 0-15: 0-127: 0-31:	Sequence control number Sequence bank number Sequence song number Priority level	
Sequence Stop (S--)	02	P1	0-7:	Sequence control number	
Sequence Pause (S--)	03	P1	0-7:	Sequence control number	
Sequence Continue (S--)	04	P1	0-7:	Sequence control number	
Sequence Volume (S--)	05	P1 P2 P3	0-7: 0-127: 0-255:	Sequence control number Sequence Volume Fade Rate	For details, refer to the supplement on the fade-in and fade-out methods.
Tempo Change (S--)	07	P1 P2 P3-P4	0-7: * :	Sequence control number dummy +32767 -> -32768: Relative tempo value compared to reference tempo (0000h); 1000h (4296) is double speed, and -4296 is half speed.	
Map Change (SP-)	08	P1	0-255:	Area number of sound area map being switched	
MIDI direct control (S--)	09	P1 P2 P3 P4	00h-FFh: 00h-FFh: 00h-7Fh: 00H-7Fh:	MIDI command word MIDI channel word MIDI data 1 MIDI data 2	For details, refer to the supplement on the MIDI direct control bit image.
Volume analize start (--C)	OA	Nothing (start volume analysis)			
Volume analize stop (--C)	OB	Nothing (stop volume analysis)			
DSP stop (S P C)	OC	Nothing (stop DSP)			
Sound all Off (S P C)	OD	Nothing (stop all sequence slots)			
Sequence Pan (S--)	OE	P1 P2	0-7: bit7 BIT6-0 00h:Left<--->4Oh:Center<-->7Fh:Right	Sequence control number 0:Control OFF 1 : Control ON MIDI PAN data(00h-7Fh) (MIDI PAN consists of 128 steps, but because the SCSP PAN consists of 32 steps, the two low-order bits of MIDI PAN data are ignored.)	
CD-DA Level (--C)	80	P1 P2	00h-EOh:CD-DA level Left 8 steps: 00h (off), 20h, 40h,, 60h, 80h, A0h, C0h, and E0h (max.) 00H-EOh:CD-DA level Right 8 steps: 00h (off), 20h, 40h,, 60h, 80h, A0h, C0h, and E0h (max.)		

Continued on next page

Continued from previous page

Command Name	Command Data	Parameter Data			
CD-DA Pan (--C)	81	P1 P2	0-31: 0-31:	CD-DA pan left, 32 steps CD-DA pan right, 32 steps	
Total Volume (S P C)	82	P1	0-15:	16 steps, 0 is off	
Effect Change (S P C)	83	P1	0-15:	Effect bank number	
PCM start (-P-)	85	P1	bit7	mono 1: stereo	
			bit6-5	not use	
			bit4	0:	16bitPCM 1:8bitPCM
			bit3-0	0-7:	PCM stream playback number
		P2	bit7-5	0-7:	Direct sound Level, 8 steps
			bit4-0	0-31:	Direct sound Pan, 32 steps (ignored for Stereo)
		P3-P4	0000h-FFFFh:		PCM stream buffer start address (16 high-order bits of 20-bit data)
		P5-P6	0000h-FFFFh;		PCM stream buffer size (number of samples for one channel)
		P7-P8	0000h-FFFFh;		Pitch word (SCSP pitch register data: Oct and FNS)
		P9	bit7-3	0-15:	Effect in select (P9=Rch or MONO)
			bit2-0	0-7:	Effect send Level, 8 steps
		P10	bit7-3	0-15;	Effect in select (P10=Lch)
			bit2-0	0-7:	Effect send Level, 8 steps
PCM stop (-P-)	86	P1	0-7:	PCM stream playback number for which playback is stopped	
Mixer change (SPC)	87	P1 P2	0-15: 0-127:	Tone bank number Mixer number	
Mixer parameter change (SPC)	88	P1	0-17	Effect out select	
		P2	bit7-5	0-7:	Effect return Level, 8 steps
			bit4-0	0-31:	Effect Pan, 32 steps
Hard check (---)	89	P1	0-5:Check item		0 - DRAM 4Mbit read/write 1 - DRAM 8Mbit read/write 2 - SCSP MIDI 3 - sound source output (L/R) 4 - sound source output (L) 5 - sound source output (R)
PCM parameter change (-P-)	8A	P1		0-7:	PCM stream playback number
		P2	bit7-5	0-7:	Direct sound Level, 8 steps
			bit4-0	0-31:	Direct sound Pan, 32 steps
		P3-04		0000h-FFFFh:	pitch word
		P5	bit7-3	0-15:	Effect in select (P5=Rch or MONO)
			bit2-0	0-7:	Effect send Level, 8 steps
		P6	bit7-3	0-15:	Effect in select (P6=Lch)
			bit2-0	0-7:	Effect send Level, 8 steps
Reserved	8B-FF	Nothing			

(SPC)

S: Command that acts on Sequence playback, or that concerns Sequence playback
P: Command that acts on PCM stream playback, or that concerns PCM stream playback
C: Command that acts on CD-DA playback, or that concerns CD-DA playback

MIDI direct control bit image

	7	6	5	4	3	2	1	0
0	Priority level					CMD		
1	KNo			MIDI Ch				
2	MIDI Data #1							
3	MIDI Data #2							

Priority level	: 0 - 31	Sound priority ranking at sequence start
CMD	: 0 - 7	MIDI command 8 - F (8 - F -> 0 - 7)
KNo	: 0 - 7	Sound control number
MIDI Ch	: 0 - 31	MIDI channel
MIDI Data #1	: 0 - 127	MIDI data byte #1
MIDI Data #2	: 0 - 127	MIDI data byte #2

Fa

Issue the sequence volume command before issuing the start command. The sound fades in from Volume = 0 to the specified sequence volume at the specified fade rate. The fade-in curve can be controlled as desired by using the sequence volume command twice or more.

Fade out method

Issue the sequence volume command with Volume = 0. The sound fades out from the current sequence volume to Volume = 0 at the specified fade rate. The fade-out curve can be controlled as desired by using the sequence volume command twice or more.

Note 1:

Because commands such as "MIDI direct control" are closely affected by the relationship between the MIDI channel and tone and the usage of the DSP program and mixer, work in close cooperation with the sound developer.

Note 2:

Because a specialized DSP program is required in order to analyze each frequency band with the Volume Analyze function, use the Effect Change command to download the DSP program before issuing the Volume Analyze command. The DSP program is not needed in the case of the main volume. In addition, because the data is updated at 16msec intervals when executing Volume Analyze, the volume data should be read at 16msec intervals or more.

Note 3:

When "stereo" is specified at PCM start, the first half of the data in the area specified by P3-P4 is processed as the right channel data, and the second half is processed as the left channel data. The PCM stream buffer must be set so that it starts from an even address and is an even number of bytes in size. The PCM stream buffer start address is specified by the high-order 16 bits of 20-bit data, so the four low-order bits are always "0". The P7-P8 pitch word specifies the SCSP pitch register word octave + F number as is. For details on pitch, refer to the SCSP manual.

Note 4:

Because the sound CPU does not operate while the PCM stream playback data is being transferred (from the host to sound memory), operation is not guaranteed if music or sound effects are played simultaneously while data is transferred continuously for an extended period of time. Either use DMA burst writes, or conduct the DMA transfer in intervals.

Note 5:

Because the PCM stream playback rate can place a high demand on data transfer capabilities, in some cases not all eight "voices" will be played back. guidelines are indicated for your reference in the item entitled "Demands of data transfer."

void

slWaitSound Wait for function execution by sound driver

Format

```
void slWaitSound(Addr)
void *Addr
```

Parameters

Addr Byte-type address

Function

This function waits until the data in the specified address is "0". This function indicates that the sound driver executed a function.

Return Value

None

Remarks

Example of usage:

```
slWaitSound(slSndMapChange(0)); /* Wait for current map to be switched */
```

FIXED

slCheckOnScreen

Determine whether specified coordinates are within viewing area

Format

```
FIXED slCheckOnScreen(pos , size)
FIXED *pos ;
FIXED size ;
```

Parameters

pos[XYZ] XYZ coordinate values of object position
size Object size

Function

This function converts the specified object position through the current matrix, tests whether or not an object of the specified size at that position would be displayed on the screen or not, and returns the result.

Return Value

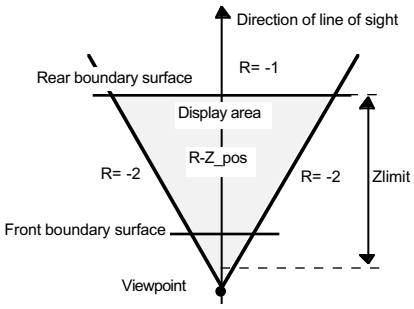
When extending beyond the display area in the Z direction: -1 (FFFFFFFF)

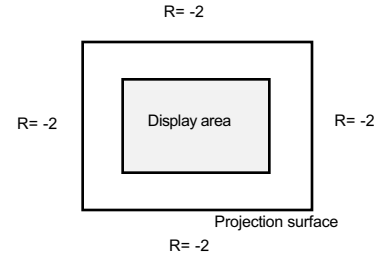
When extending beyond the display area to the left, right, top, or bottom: -2 (FFFFFFFE)

When contained within the screen: Z_position

Remarks

The following diagrams illustrate the relationship between the display area and the return value.





Note: "R="indicates the return value generated by the function "slCheckOnScreen".

Refer to: slCheckOnScreen

void

slDMACopy Block transfer using CPU DMA

Format

```
void slDMACopy(src , dst , cnt)
void*src ;
void*dst ;
Uint32 cnt ;
```

Parameters

src	Starting address of source memory area
dst	Starting address of destination memory area
cnt	Block transfer amount (bytes)

Function

This function performs a block transfer using the CPU's DMA function. For the "cnt" parameter, specify how many bytes are to be transferred.
When a transfer is made to a cache area, this function initializes the cache.

Return Value

None

Remarks

The function "slDMACopy" terminates soon after DMA is initiated. To wait until the transfer is completed, use the function "slDMAWait". If another DMA transfer has already been initiated, the function "slDMACopy" waits until the other transfer terminates before initiating a new DMA transfer.

Refer to: Chapter 9, "Controller Input"

void

slDMAWait Wait until termination of DMA transfer

Format	
Parameters	void slDMAWait(void)
Function	None
Return Value	This function waits until a DMA transfer initiated by the function "slDMACopy" terminates.
Remarks	None
	The function "slDMACopy" always uses the same channel, and if a transfer is in progress, the function waits until the first transfer terminates before initiating the new one. As a result, the user can execute consecutive DMA transfers without needing to be conscious of the completion of the transfers. An example is shown below.

_œ Consecutive execution of DMA transfers _œ

```
siDMACopy(src0 , dst0 , cnt0);     /* first transfer request */
siDMACopy(src1 , dst1 , cnt1);     /* second transfer request (execute after termination of first transfer
*/
siDMACopy(src2 , dst2 , cnt2);     /* third transfer request (execute after termination of second transfer
*/
siDMAwait(void) ;                  /* wait for termination of third transfer */
```

Refer to: Chapter 9, "Controller Input"

void

slInitSynch

Wait for V-BLANK and synchronize event processing with screen

Format

void slInitSynch()

Parameters

None

Function

This function waits for V-BLANK and synchronizes event processing with the screen.

Return Value

None

Remarks

Also refer to the function "slSynch".

void

slInitSystem SGL system initialization

Format

```
void slInitSystem(tv_mode , texadr , cnt)
Uint16tv_mode ;
TEXTURE*texadr ;
Uint16 cnt ;
```

Parameters

tv_mode Screen mode specification
texadr Starting address of memory area where texture data is stored
cnt Graphics processing unit specification

Function

This function initializes the SGL system.

For the parameters, respectively, substitute the #define value indicating the screen mode, the starting address of the memory area where the texture information table was stored, and the number of V-blanks indicating the graphics processing unit.

1 V-BLANK is 1/60 of a second if non-interlaced and 1/30 of a second if double-interlaced; the graphics processing unit is a multiple of this value.

For the screen mode specification, substitute the values shown below.

Return Value

None

Remarks

Initialization includes slave CPU initialization, matrix buffer initialization, scroll data initialization, etc.

For details on the values initialized by the function "slInitSystem", refer to the list of default values set by "slInitSystem" at the end of the function reference.

Resolution	320(H)	352(H)	640(H)	704(H)
224(V)	TV_320x224	TV_352x224	TV_640x224	TV_704x224
240(V)	TV_320x240	TV_352x240	TV_640x240	TV_704x240
448(V)	TV_320x448	TV_352x448	TV_640x448	TV_704x448
480(V)	TV_320x480	TV_352x480	TV_640x480	TV_704x480

Note: The values in the above table are defined in "sl_def.h", provided with the system

¥As shown in the examples in the table at left, the screen mode specification is defined as a macro in the form TV_horizontal x vertical (pixels), according to the resolution of the screen mode.

Refer to: Chapter 8, "Scrolls""

void

slIntFunction Register function to be executed during blanking

Format

```
void slIntFunction(func)
void(*func)() ;
```

Parameters

func Starting address of function to be registered

Function

This function registers a function to be executed during blanking.

Return Value

None

Remarks

The only functions that can be registered are void-type with no parameters.

void<function name>(void);

Refer to: slIntFunction

void

slSynch Synchronization with event processing unit time

Format

void slSynch()

Parameters

None

Function

This function waits until the event processing unit time is reached.

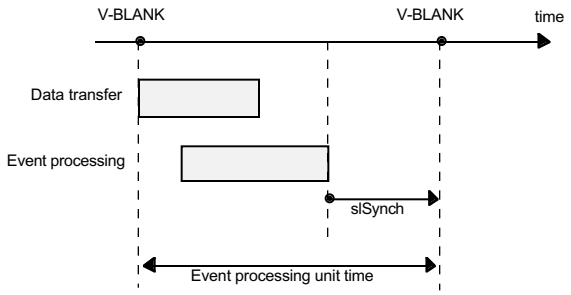
Return Value

None

Remarks

Screen switching (display), etc., is performed in the graphics processing units specified by the function "slInitSystem".

The graphics processing unit is displayed in terms of the number of V-blanks. 1 blank is 1/60 of a second if non-interlaced and 1/30 of a second if double-interlaced. Refer to the function "slInitSystem" for further details.



Refer to: Chapter 8, "Scrolls"

Bool

slTransferEntry Data transfer request during blanking

Format

```
void slTranferEntry(str , dst , size)
void*str ;
void*dst ;
Uint16 size ;
```

Parameters

str	Starting address of transfer source
dst	Starting address of transfer destination
size	Data transfer amount (bytes)

Function

This function transfers data during V_BLANK. For the parameter "size", specify how many bytes of data are to be transferred.

Return Value

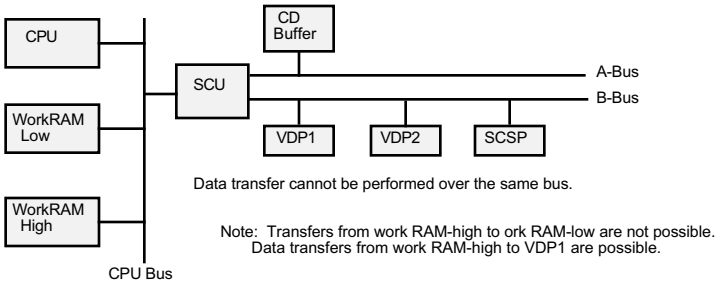
None

Remarks

In order to do a data transfer using the indirect mode of the DMA in the SCU, the data transfer cannot be made over the same bus.

For details, refer to the chapter on the SCU in the HARDWARE MANUAL vol. 1.

The diagram below is a conceptual model of the bus.



Refer to: slTransferEntry

void

slSetTrayCheck CD tray open check

Format

```
void slSetTrayCheck(flag)
Uint8 flag
```

Parameters

flag ON or OFF

Function

This function specifies whether or not to perform a check in order to shift to the multiplayer screen when the CD tray is open.

Specify the flag as either ON or OFF.

When this function is called, the status is cleared; therefore, if the tray is already open when the flag is set to ON, the check will not be made until the next time the tray is opened.

Return Value

None

Remarks

Refer to: slSetTrayCheck

void

slChashePurge Cache purge

Format

void shChashePurge()

Parameters

None

Function

This function initializes the cache data in the CPU. This function is used when the cache area is changed by a DMA transfer, etc.

Return Value

None

Remarks

Refer to: slChashePurge

Bool

slDMAStatus DMA transfer check

Format

void slDMAStatus()

Parameters

None

Function

This function checks whether or not a DMA transfer initiated by the "slDMACopy()" function or the "slDMAXCopy()" function is in progress or not, and returns a flag.

If the transfer is in progress, this function returns "ON"; if not, this function returns "OFF".

Return Value

None

Remarks

Refer to: slDMAStatus

SEGA SATURN

SGL Reference

Structure Reference

This section introduces structures, variable types and macros that are unique to the SGL. These are essential to programming with the SGL, and the defined contents of each are also important.

Study this reference in addition to the Function Reference.

ATTR Face attribute list

Structure:

```
typedef  struct {
            Uint8 flag ;
            Uint8 sort ;
            Uint16 texno ;
            Uint16 atrb ;
            Uint16 colno ;
            Uint16 gstb
            Uint16 dir ;
       } ATTR ;
```

Members:

flag	Front/back setting
sort	Sort setting
texno	Texture number
atrb	Attribute data
colno	Color number
gstb	Gouraud setting
dir	Texture reversal setting and type

Description:

This structure defines the polygon face attribute list.

Remarks:

for details on the face attributes and how to use them, refer to chapter 7, "Polygon Face Attributes," in the Programmer's Tutorials.

EVENT Event management

Structure:

```
typedef struct evnt {
        WORK *work ;
        struct event *next ;
        struct event *before ;
        void (*exad)() ;
        Uint8 user[EVENT_SIZE-(sizeof(WORK*)
                +sizeof(struct evnt*)*2+sizeof(void (*)()))]
  }EVENT;
```

Members:

work	Work area pointer
next	Starting address of next event
before	Starting address of previous event
(exad)()	Function execution address
user[]	Work area

Description:

This structure defines the event management table. Set the address received from the library function "slGetWork" in the member "work".

The default value is NULL.

Remarks

"EVENT_SIZE" in the member "user[]" is 128 bytes. As a result, the user area is 112 bytes.

Refer to: Chapter 10, "Event Control"

PDATA Polygon model data

Structure

```
typedef struct {
        POINT *pntb1 ;
        Uint32 nbPoint ;
        POLYGON *pltb1 ;
        Uint32 nbPolygon ;
        ATTR *attb1 ;
    } PDATA ;
```

Members

pntb1 Vertex list pointer
nbPoint Number of vertices
pltb1 Face list pointer
nbPolygon Number of faces
attb1 Attribute list pointer

Description:

This structure defines the polygon model data.

Remarks

PICTURE Texture registration table

Stracture

```
typedef struct  {
            Unit16 texno ;
            Unit16 cmode ;
            void *pcsrc ;
      } PICTURE ;
```

Members

texno	Texture number
cmode	Color mode
pcsrc	Starting address of texture data to be registered

Description

This structure is the information table for transferring and registering texture data within VRAM.

Remarks

Refer to the textures in the "Polygon Face Attributes.

Refer to: Chapter 7, "Polygon Face Attributes"

POLYGON Polygon face list

STRUCTURE

```
typedef struct  {
            VECTOR norm ;
            Uint16 Vertices[4] ;
      } POLYGON ;
```

Members

norm Normal vector
Vertices[4] Vertex number list

Description

This structure defines the polygon face list

Remarks

ROTSCROLL Rotation parameters

STRUCTURE

```
typdef struct {
        FIXED XST ;
        FIXED YST ;
        FIXED ZST ;
        FIXED DXST :
        FIXED DYST ;
        FIXED DX ;
        FIXED DY ;
        FIXED MATA ;
        FIXED MATB ;
        FIXED MATC ;
        FIXED MATD ;
        FIXED MATE ;
        FIXED MATF ;
        Sint16 PX ;
        Sint16 PY ;
        Sint16 pZ ;
        Sint16 dummy0 ;
        Sint16 CX ;
        Sint16 CY ;
        Sint16 CZ ;
        Sint 16 dummy1 ;
        FIXED MX ;
        FIXED MY ;
        FIXED KX ;
        FIXED KY ;
        Uint32 KAST ;
        Sint32 DKA ;
    }ROTSCRLL ;
```

Members

XST	Scroll screen start coordinate Xst
YST	Scroll screen start coordinate Yst
ZST	Scroll screen start coordinate Zst
DXST	Scroll screen vertical direction coordinate increment amount dXst
DYST	Scroll screen vertical direction coordinate increment amount dYst
DX	Scroll screen horizontal direction coordinate increment amount dX
DY	Scroll screen horizontal direction coordinate increment amount dY
MATA	Rotating matrix parameter A
MATB	Rotating matrix parameter B
MATC	Rotating matrix parameter C
MATD	Rotating matrix parameter D
MATE	Rotating matrix parameter E
MATF	Rotating matrix parameter F
PX	Viewpoint coordinate Px
PY	Viewpoint coordinate Py
PZ	Viewpoint coordinate Pz
dummy0	Dummy area
CX	Center coordinate Px
CY	Center coordinate Py

CZ Center coordinate Pz
dummy1 Dummy area
MX Parallel movement amount Mx
MY Parallel movement amount My
KX Enlargement/reduction coefficient kx
KY Enlargement/reduction coefficient ky
KAST Coefficient table start address KAst
DKAST Coefficient table vertical direction address increment DKAst
DKA Coefficient table vertical direction address increment DKA

Description

This structure defines the rotation parameter table.

The rotation parameter table is read for each line of the rotating scroll screen, and the screen is displayed according to those values.

Remarks

Used together with the NORMAL macro, this macro is used to make the POLYGON face list.

Refer to: ROTSCROLL

SPR_ATTR Sprite attributes table

STRUCTURE

```
typedef struct spratr {
        Uint16 texno ;
        Uint16 atrb ;
        Uint16 colno ;
        Uint16 gstb ;
        Uint16 dir ;
} SPR_ATTR ;
```

Members

texno	Texture number
atrb	Attribute data (display mode)
colno	Color number
gstb	Gouraud shading table
dir	Texture reversal

Description

This structure is the parameter table for sprite display. Basically, these parameters conform with the texture parameters.

Remarks

Refer to the group of functions concerning sprite display.

Refer to: SPR_ATTR

SPRITE Sprite data

STRUCTURE

```
typedef struct {
        Uint16 CTRL ;
        Uint16 LINK ;
        Uint16 PMOD ;
        Uint16 COLR ;
        Uint16 SRCA ;
        Uint16 SIZE ;
        Uint16 XA ;
        Uint16 YA ;
        Uint16 XB ;
        Uint16 YB ;
        Uint16 XC ;
        Uint16 YC ;
        Uint16 XD ;
        Uint16 YD ;
        Uint16 GRDA ;
        Uint16 DMMY ;
    } SPRITE ;
```

Members

CTRL	Control function
LINK	Link address
PMOD	Put mode
COLR	Color data
SRCA	CG address
SIZE	Character size
XA	X coordinate of display position A
YA	Y coordinate of display position A
XB	X coordinate of display position B
YB	Y coordinate of display position B
XC	X coordinate of display position C
YC	Y coordinate of display position C
XD	X coordinate of display position D
YD	Y coordinate of display position D
GRDA	Gouraud shading table
DMMY	Dummy data used to match up with size

Description

This data type is used to directly pass data to the VDP1, and is the data table used to display sprites.
Sprite picture data must be stored and registered in VRAM beforehand. (The same is true for texture data and scroll data.) For details, refer to the textures in "Polygon
Face Attributes".

Remarks

Textures and sprites used in the Sega Saturn system have very similar data structures, but their display methods differ as follows:
Textures are applied to polygon faces and displayed.
Sprites are displayed independently.

Refer to: Chapter 7, "Polygon Face Attributes"

TEXTURE Texture data

STRUCTURE

```
typedef  struct  {
            Uint16 Hsize ;
            Uint16 Vsize ;
            Uint16 CGadr ;
            Uint16 HVsize ;
        } TEXTURE ;
```

Members

Hsize	Horizontal size of texture
Vsize	Vertical size of texture
CGadr	CG address of texture/8
HVsize	Horizontal size/8, vertical size (for hardware) ((HSIZE/8)<<8)|(V SIZE)

Description

This structure is the texture management table that is needed in order to use textures in the SGL.

Remarks

For details, refer to chapter 7, "Polygon Face Attributes",in the Programmer's Tutorial.

WORK Work area management

STRUCTURE

```
typedef struct work {
        struct work *next ;
        Uint8 user[WORK_SIZE-sizeof(struct work *)] ;
    } WORK ;
```

Members

next	Pointer to next work area
user[]	Free area within the work area that the user can use

Description

This structure indicates a work area that can be used within an event. The member "user" consists of the work size (WORK_SIZE = 64 bytes) less the size of the member "next" (4 bytes), for a total of 60 bytes.

For details, refer to the Chapter 10, "Event Control" in the Programmer's Tutorial.

Remarks

SmpcDateTime RTC time

STRUCTURE

```
typedef    struct   {
           Uint16   year :
           Uint8    month ;
           Uint8    date :
           Uint8    hour ;
           Uint8    minute ;
           Uint8    second ;
} SmpcDateTime ;
```

Members

year	Year
month	Day of the week and month
date	Date
hour	Hours
minute	Minutes
second	Seconds

Description

This structure is used to reference the RTC time.

Remarks

Use this structure when referencing the "rtc" member of the system variable "Smpc_Status".

SmpcStatus SMPC status

STRUCTURE

```
typedef    struct {
           Uint8          cond ;
           SmpcDateTime   month ;
           Uint8          ctg :
           Uint8          area ;
           Uint16         system ;
           Uint32         smem ;
} SmpcStatus ;
```

Members

cond	Status
rtc	RTC time
ctg	Cartridge code
area	Area code
system	System status
smem	SMPC memory data

Description

This structure is used to reference the SMPC system status.

Remarks

Use this structure when referencing the system variable "Smpc_Status".

The member "rtc" can be referenced as the structure "SmpcDateTime".

Special get and set functions are provided for the member "smem".

PerDigital Digital device

STRUCTURE

```
typedef    struct {
           Uint8      id ;
           Uint8      ext :
           Uint16     data ;
           Uint16     push ;
           Uint16     pull ;
} PerDigital ;
```

Members

id	Peripheral ID
ext	Extended data size
data	Current button data
push	Depressed button data
pull	Unpressed button data

Description

This structure is used to reference digital devices.

Remarks

Use this structure when referencing the system variable "Smpc_Peripheral". All devices can be handled as digital devices.

PerAnalog Analog device

STRUCTURE

```
typedef    struct {
           Uint8      id ;
           Uint8      ext :
           Uint16     data ;
           Uint16     push ;
           Uint16     pull ;
           Uint8      x ;
           Uint8      y ;
           Uint8      z ;
} PerAnalog ;
```

Members

id	Peripheral ID
ext	Extended data size
data	Current button data
push	Depressed button data
pull	Unpressed button data
x	Absolute value of X axis data
y	Absolute value of Y axis data
z	Absolute value of Z axis data

Description

This structure is used to reference analog devices.

Remarks

Type-cast the system variable "Smpc_Peripheral" and use this structure to reference a peripheral as an analog device.

PerPoint Pointing device

STRUCTURE

```
typedef    struct {
           Uint8      id ;
           Uint8      ext :
           Uint16     data ;
           Uint16     push ;
           Uint16     pull ;
           Uint16     x ;
           Uint16     y :
} PerPoint ;
```

Members

id	Peripheral ID
ext	Extended data size
data	Current button data
push	Depressed button data
pull	Unpressed button data
x	X coordinate
y	Y coordinate

Description

This structure is used to reference a pointing device.

Remarks

Type-cast the system variable "Smpc_Peripheral" and use this structure to reference a peripheral as a pointing device.

PerKeyBoard Keyboard device

STRUCTURE

```
typedef    struct {
           Uint8      id ;
           Uint8      ext :
           Uint16     data ;
           Uint16     push ;
           Uint16     pull ;
           Uint8      cond ;
           Uint8      code ;
} PerKeyBoard ;
```

Members

id	Peripheral ID
ext	Extended data size
data	Current button data
push	Depressed button data
pull	Unpressed button data
cond	Status data
code	Key code

Description

This structure is used to reference the keyboard device.

Remarks

Type-cast the system variable "Smpc_Peripheral" and use this structure to reference a peripheral as a keyboard device.

ANGLE Angle data variable type

Structure

```
typedef Sint16 ANGLE ;
```

Members

Description

Angle data notation variable type.
The range from 0¡ to 359¡ is expressed by 0x0000 to 0xffff.

Remarks

FIXED Fixed-point decimal variable type

Structure

```
typedef Sint32 FIXED ;
```

Members

Description

This variable type indicates fixed-point decimal data. FIXED-type values are represented in the following manner.
High-order 16 bits: Integer portion
Low-order 16 bits: Decimal portion
Ex,: 16.5 -> 0x00108000

Remarks

MATRIX Matrix variable type

Structure

typedef FIXED MATRIX[4][3] ;

Members

Description

Matrix notation variable type

Remarks

FIXED matrix [4][3];
MATRIX matrix;
The two definitions shown above have the same meaning.

Refer to: Chapter 5, "Matrices"

POINT Vertex data type

Structure

typedef FIXED POINT[xyz] ;

Members

Description

This variable type defines the vertex data used in polygons.

Remarks

FIXED point [xyz];
FIXED point [3];
POINT point;
All three of the above definitions have the same meaning.

Refer to: Chapter 2, "Graphics"

TEXDAT Texture data variable type

Structure

```
typedef UINT16 TEXDAT ;
```

Members

Description

This variable type is used to define the actual texture itself.

Remarks

VECTOR Vector variable type

Structure

TYPED FIXED VECTOR[XYZ}

Members

Description

Vector data variable type

Remarks

FIXED vector[XYZ];
FIXED vector[3];
VECTOR vector
The above three definitions all have the same meaning.

Refer to: VECTOR

ATTRIBUTE Polygon attribute specification

Structure

```
#define  ATTRIBUTE(plane,sort,texture,color,gourand,mode,dir,option)
            _@_@_@_@     {
                        plane,(sort)|(((dir)>>16)&0x01c)|(option),__
                        texture,(mode)|(((dir)>>24)&0xc0,color__
                       gourud,(dir)&0x03f
                      }
      Uint8 plane ;
      Uint8 sort ;
      Uint16 texture ;
      Uint16 color ;
      Uint16 gouraud ;
      Uint 16 mode ;
      Uint 32 dir ;
      Uint16 option :
```

Members

plane Front/back attribute
sort Z sort specification
texture Texture number, or No_Texture
color C_RGB macro-specified color, color palette number, or No_Palet
gouraud Gouraud table, or No_Gouraud
mode Various mode specifications for the polygon
dir Specification of texture display direction, etc.
option Other settings for the polygon

Description

This macro sets the face attributes (particularly the polygon front face) concerning polygon drawing. For details on the meaning of and substitution values for each parameter, refer to chapter 7, "Polygon Face Attributes," in the Programmer's Tutorial. Also refer to the list of ATTRIBUTE macro substitution values at the end of the Structure Reference.

Remarks

When using texture, the member color is sometimes used to specify the color bank number.

C_RGB RGB value specification

Structure

```
#define C_RGB(r,g,b) (((b)&0x1f)<<10|(g)&0x1f)<<5|((r)&0x1f) |0x8000)
    Uint8r ;
    Uint8 g ;
    Uint8 b ;
```

Members

r	Red
g	Green
b	Blue

Description

This macro specifies the RGB values used to represent color gradations. The color gradation values can range from 0 to 1f for each of red, green, and blue.

Remarks

This macro cannot be used to specify the transparent color.

Refer to: Chapter 7, "Polygon Face Attributes"

DEGtoANG Angle conversion macro

Structure

```
#define DEGtoANG(d) (ANGLE)((d)*65536.0/360.0))
        float d ;
```

Members

d Angle to be converted (DEG notation)

Description

This macro converts a floating-point angle value expressed in DEG notation to an ANGLE-type value.

Remarks

NORMAL Coordinate value conversion macro

Structure

```
#define NORMAL(x,y,z) {POStoFIXED(x,y,z)
```

Members

x	X coordinate to be converted
y	Y coordinate to be converted
z	Z coordinate to be converted

Description

This macro converts a normal vector XYZ coordinates expressed by floating-point decimals into FIXED-type variables.

Remarks

Used together with the VERTICES macro, this macro is used to make the POLYGON face list.

Refer to: NORMAL

PICDEF Texture management table

Structure

```
#define   PICDEF(texno,cmode,pcsrc) {(Uint16)(texno),(Uint16)(cmde),
                                     (void*)(pcsrc)}
        Uint16 texno ;
        Uint16 cmode ;
        void*pcsrc ;
```

Members

texno Texture number
cmode Color mode (COL_16, 64, 128, 256, or 32K)
pcsrc Pointer for texture data defined by "TEXDAT"

Description

This macro creates the table of information used to set a texture in VRAM so that the texture can be handled within a program.

Remarks

Refer to: Chapter 7, "Polygon Face Attributes"

POStoFIXED Coordinate value conversion macro

Structure

```
#define POStoFIXED(x,y,z) {toFIXED(x),(toFIXED(y),toFIXED(z)}
```

Members

x	X coordinate to be converted
y	Y coordinate to be converted
z	Z coordinate to be converted

Description

This macro converts the XYZ coordinate values to FIXED-type variables.

Remarks

TEXDEF Texture registration table

Structure

```
#define  TEXDEF(h, v,presize) (h,v,(((cgaddress+(presize))*4)>>pal)/8,
                                   (((h)&0x1f8)<<5|(v))}
        Uint16h ;
        Uint16v ;
        Uint32 presize ;
```

Members

h	Horizontal size of texture
v	Vertical size of texture
presize	Previously registered texture size (vertical x horizontal)

Description

This macro creates a table for getting texture information.

Remarks

Reference macros
#define cgaddress 0x10000
#define pal COL_32K

Refer to: Chapter 7, "Polygon Face Attributes"

toFIXED Value conversion macro

Structure

```
#define toFIXED(a) ((FIXED)((a)*65536.0)
```

Members

a Value to be converted

Description

This macro converts the value supplied as the parameter into a FIXED-type value.

Remarks

VERTICES Polygon vertex variable string

Structure

```
#define  VERTICES(v0, v1, v2, v3) (v0, v1, v2, v3}}
        Uint16 v0 ;
        Uint16 v1 ;
        Uint16 v2 ;
        Uint16 v3 ;
```

Members

v0	Vertex v0
v1	Vertex v1
v2	Vertex v2
v3	Vertex v3

Description

This macro specifies the polygon vertex numbers expressed as integers.

Remarks

Used together with the NORMAL macro, this macro is used to make the polygon face list.

Refer to: Chapter 2, "Graphics"

SEGA SATURN

SGL Reference

Appendix

This appendix contains supplementary tables for the Function Reference and for the Structure Reference.

1. Default settings when the function "slInitSystem" is executed

In the SGL, when the function "slInitSystem" is executed, in addition to initializing various types of memory and system variables, the following default settings are made.

When the system is initialized, the default window is set up.

Table 1-1. Default Window Specs

Setting	Parameter	Setting	Function used to reset
Window coordinates	Left	0	slWindow
	Top	0	
	Right	ScreenXSize - 1	
	Bottom	ScreenYSize - 1	
Rear boundary surface specification	Zlimit	0x7fff	
Vanishing point	CenterX	ScreenXSize / 2	
	CenterY	ScreenYSize / 2	
Perspective angle	PersAngle	90°	slPerspective
Display level	ZdspLevel	1	slZdspLevel

ScreenXSize = Resolution (in pixels) in horizontal direction for screen mode
ScreenYSize = Resolution (in pixels) in vertical direction for screen mode

2) Scroll settings

When the system is initialized, the scrolls are set up as follows.

Table. Scroll Default Settings

Setting	Contents of setting
Scroll screens displayed	NBG0, NBG1, RBG0
Priority	NBG0 > SPR0 > SPR1 > RBG0 > NBG1 > NBG2 > NBG3 7 6 5 4 3 2 1
Number of scroll colors	256 colors on each screen
Color RAM mode	1 (2048 colors out of 32,768 colors)
VRAM partitions	Both banks A and B partitioned
Character data	NBG0, NBG1: 25E60000 -
	RBG0 : 25E00000 -
Character size	8 x 8 dots on each screen
Pattern name data	NBG0 : 25E76000 and up
	NBG1 : 25E78000 and up
	RBG0: 25E40000 and up (rotation parameters A)
	RBG0: 25E50000 and up (rotation parameters B)
Pattern name size	NBG0: 1 word, 10 bits with reversal function for each cell
	NBG1, RBG0: 1 words, 12 bits with no reversal function
Plane size	64 x 64 cells on each screen
Background screen color	Black at 25E3FFFE (R = 0, G = 0, B = 0)
Rotation parameters	25E3FF00 and up
Sprite data	Mixture of palette and RGB format
Special effects functions	Mosaic, color offset, etc., not used

2. List of substitution values for the ATTRIBUTE macro

The ATTRIBUTE macro structure and a list of the macro substitution values that can be used in the SGL for each member in the ATTRIBUTE macro structure are shown below. For details on the polygon face attribute settings made by the ATTRIBUTE macro and examples of actual usage, refer to chapter 7, "Polygon Face Attributes," in the Programmer's Tutorial.

Fig. 2-1 ATTRIBUTE Macro Structure

```
_œ ATTRIBUTE macro structure _œ
ATTRIBUTE(plane , sort , texture , color , gouraud , mode , dir , option)
```

Note: The ATTRIBUTE macro is defined in "sl_def.h".

The ATTRIBUTE macro includes the following members.

For the macro substitution values for each member, refer to the list.

plane: Specifies the front/back attribute.

sort: Determines the Z sort representative point.

texture: Substitute either a texture number or "No_Texture".

color: Substitute either a polygon face color specified by the C_RGB macro or "No_Palet".

gouraud: Specifies the starting address of the area where the gouraud table is stored. If gouraud processing is not to be used, substitute "No_Gouraud".

mode: Specifies various modes for the polygon. Multiple specification is possible by using the "or" operator, "|" to link the substitution values for each group.

dir: Sets the texture reversal function, etc.

option: Sets other polygon options; multiple specification is possible by using the "or" operator, "|". If no options are to be used, substitute "No_Option".

Table 2-1. List of ATTRIBUTE Macro Substitution Values (1/3)

Member	Macro	Contents
plane	Singl_Plane	Treats polygon as a single-sided polygon.
	Dual_Plane	Treats polygon as a double-sided polygon.
sort	SORT_MIN	Makes the point closest to the camera on the polygon the reference point.
	SORT_CEN	Makes the center point of the polygon the reference point.
	SORT_MAX	Makes the point farthest from the camera on the polygon the reference point.
	SORT_BFR	Displays the polygon that was registered last in front.
texutre	Uint16 texno	Texture number of the texture to be used
	No_Texture	No texture used
color	C_RGB(r, g, b)	Color specification using the C_RGB macro
	Uint16 color	Color palette number or color bank number
	No_Palet	Do not use color palette (when texture is in RGB mode)
gouraud	Uint16 GRaddr	Offset value for area where gouraud table is stored (8H)
	No_Gouraud	Gouraud processing not used

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Table 2-1. List of ATTRIBUTE Macro Substitution Values (2/3)

Member	Group	Macro	Contents
mode	[1]	No_Window	No restrictions concerning window (default)
		Window_In	Display inside window
		Window_Out	Display outside window
	[2]	MESHoff	Normal display (default)
		MESHon	Mesh display
	[3]	ECdis	Disable EndCode
		ECenb	Enable EndCode (default)
	[4]	SPdis	Display transparent pixels (default)
		SPenb	Do not display transparent pixels
	[5]	CL16Bnk	16-color color bank mode (default)
		CL16Look	16-color look-up mode
		CL64Bnk	64-color color bank mode
		CL128Bnk	128-color color bank mode
		CL256Bnk	256-color color bank mode
		CL32KRGB	32,768 RGB mode
	[6]	CL_Replace	Overwrite mode (default)
		Cl_Shadow	Shadow mode
		CL_Half	Semi-bright mode
		CL_Trans	Semi-transparent mode
		CL_Gouraud	Gouraud shading mode

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Table 2-1. List of ATTRIBUTE Macro Substitution Values (3/3)

Member	Macro	Contents
dir	sprNoflip	Display texture normally
	sprHflip	Flip texture horizontally
	sprVflip	Flip texture vertically
	sprHVflip	Flip texture horizontally and vertically
	sprPolygon	Display polygon
	sprPolyLine	Display polyline
option	UseLight	Make light source calculations
	UseClip	Do not display vertices outside of viewing area
	UsePalette	Specify with “UseLight” when performing light source calcutations for a palette mode polygon. In this case, 8 colors are selected from the specified palette number according to brightness (+0 is low brightness).
	No_Option	No options used

Note: The values in the above table are defined in "sl_def.h", provided with the system.

Note: Restriction on texture specifications:

If a texture is not used on an object, do not specify "sprHflip" or "sprVflip".

SEGA SATURN

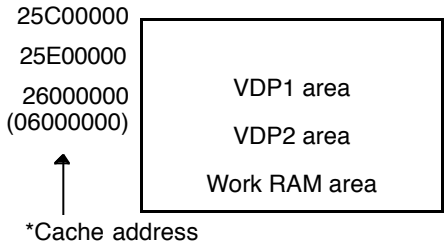
SGL Reference

Memory Map

In the Sega Graphics Library, a portion of memory is used by the system.

In general terms, memory is used as shown in the illustration below. This chapter provides more detailed information on how memory is used.

Fig. Map of Entire Memory Area



1. General

The SGL system uses 0x40000 bytes in the WORK RAM-H area for sprite and scroll control. In addition, 264 bytes in VDP1 VRAM is used for gouraud shading when showing light source effects on textures. A breakdown of this area and the default settings are shown below.

VRAM breakdown	Default value
MAX_POLYGON (number of polygons that can be used)	: 1800
MAX_VERTICES (number of vertices that can be used)	: 2500
MAX_TRANSFER (number of transfer requests during blanking)	: 20
MAX_NEST (number of nested matrices)	: 20

Fig. 1-1 Breakdown of VDP1 VRAM and the Default Values

When a model is specified by "slPutPolygon", that model is not processed if the total number of polygons or vertices (including that model) will exceed the respective maximum.

In addition, each time "slPutSprite()", "slDispSprite", and "slSetSprite()" are executed, the number of polygons increases by one; if the maximum limit is exceeded, processing of that data is halted. (However, if the specified Z position is outside of the display area, that sprite is not counted.)

2. WORK RAM-H

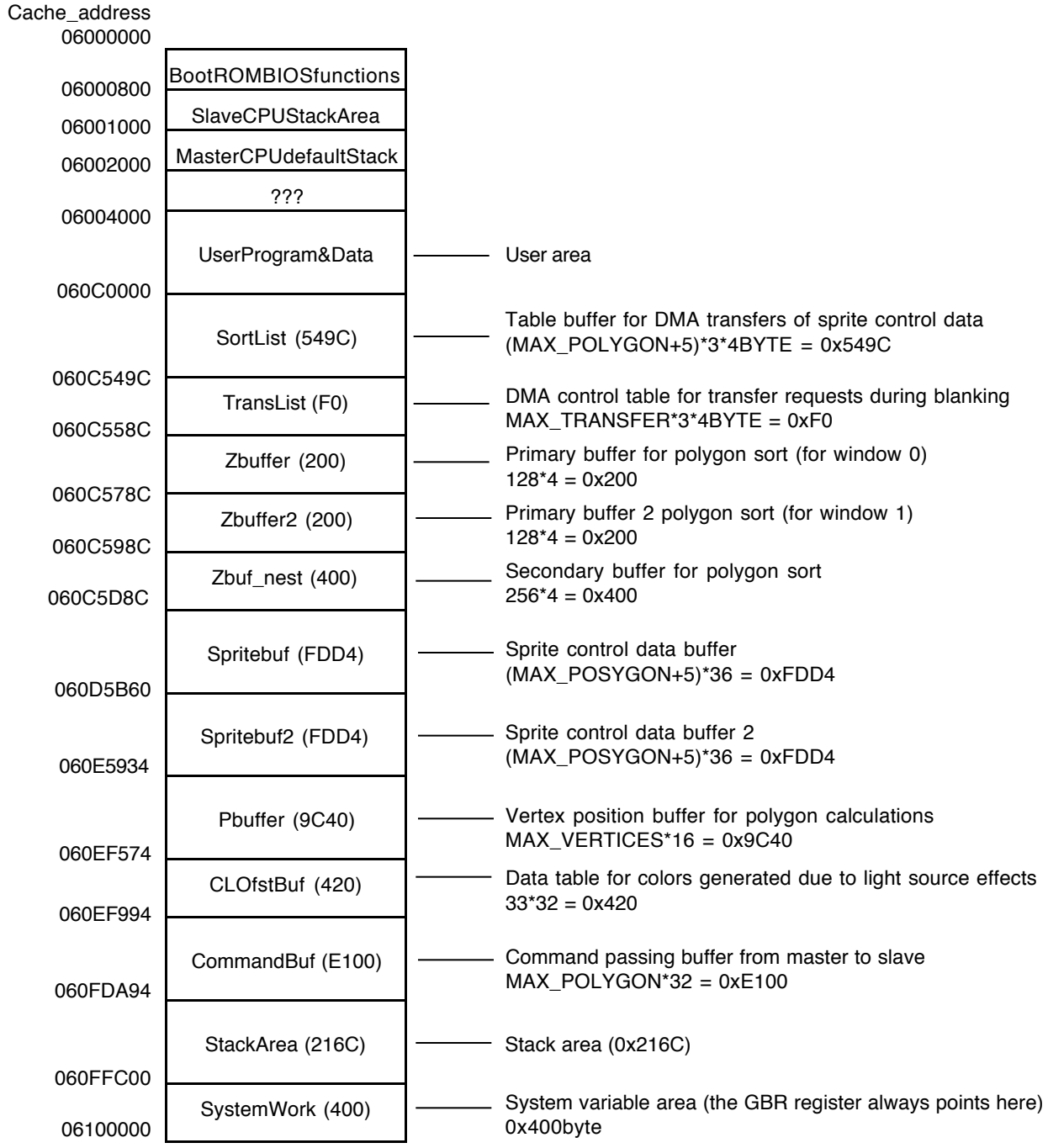


Fig.2-1 Work RAM-H Memory Map

System variables

The system variables are shown below; these variables can also be called from a C program.

000	(EventTop)	(EVENT*)	First registered event
004	(EventLast)	(EVENT*)	Last registered event
008	(EventNow)	(EVENT*)	Event being executed
00C	(EventCount)	(Uint16)	Number of events remaining
00E	(WorkCount)	(Uint16)	Number of work areas remaining
010	(MainMode)	(Uint8)	Main sequence mode
011	(SubMode)	(Uint8)	Sub sequence mode
012	(SynchConst)	(Sint8)	Video sync count
013	(SynchCount)	(Sint8)	Video sync count
014	(UserFunction)	(void (*)())	User function to be executed during blanking
018	(TransCount)	(Uint16)	Number of transfer entries during blanking
01A	(TransRequest)	(Uint8)	Transfer request during blanking
01C	(mtptr)	(MATRIX *)	Current matrix pointer
020	(MatrixCount)	(Uint16)	Matrix nest count
022	(IntCount)	(Uint16)	Interrupt count
024	(MsPbufPtr)	(Uint32 *)	Vertex coordinate calculation buffer pointer (master)
028	(SlPbufPtr)	(Uint32 *)	Vertex coordinate calculation buffer pointer (slave)
02C	(SpritePtr)	(Uint16 *)	Sprite data transfer pointer
030	(MsSdataPtr)	(Uint16 *)	Sprite data set pointer (Master)
034	(SlSdataPtr)	(Uint16 *)	Sprite data set pointer (Master)
038	(ZbufPtr)	(void **)	Z buffer pointer
03C	(FormTbl)	(TEXTURE *)	Texture data table
040	(SprbufBias)	(Uint32)	Sprite data buffer switching
044	(ComRdPtr)	(Uint32 *)	Command read pointer
048	(ComWrPtr)	(Uint32 *)	Command set pointer
04C	(MsLight)	(VECTOR)	Light source vector (master)
058	(SlLight)	(VECTOR)	Light source vector (master)
064	(ColorOffset)	(Uint8 *)	Color offset table pointer
068	(MsScreenDist)	(FIXED)	Screen position (master)
06C	(SlScreenDist)	(FIXED)	Screen position (slave)
070	(MsZlimit)	(Sint16)	Display limit Z position (master)
072	(WindowNumber)	(Uint8)	Number of windows used
073	(WinUseFlag)	(Uint8)	Window use flag
074	(TotalPolygons)	(Uint16)	Total number of polygons
076	(TotalVertices)	(Uint16)	Total number of vertices
078	(MsScreenLeft)	(Sint16)	Screen left position (master)
07A	(MsScreenTop)	(Sint16)	Screen top position (master)
07C	(MsScreenRight)	(Sint16)	Screen right position (master)
07E	(MsScreenBottom)	(Sint16)	Screen bottom position (master)

080	(MsScreenSizeX)	(Uint16)	Horizontal screen size (master)
082	(MsScreenSizeY)	(Uint16)	Vertical screen size (master)
084	(MsScreenHalfX)	(Uint16)	Horizontal screen size/2 (master)
086	(MsScreenHalfY)	(Uint16)	Vertical screen size/2 (master)
088	(SlScreenLeft)	(Sint16)	Screen left position (slave)
08A	(SlScreenTop)	(Sint16)	Screen top position (slave)
08C	(SlScreenRight)	(Sint16)	Screen right position (slave)
08E	(SlScreenBottom)	(Sint16)	Screen bottom position (slave)
090	(SlScreenSizeX)	(Sint16)	Horizontal screen size (slave)
092	(SlScreenSizeY)	(Uint16)	Vertical screen size (slave)
094	(SlScreenHalfX)	(Uint16)	Horizontal screen size/2 (slave)
096	(SlScreenHalfY)	(Uint16)	Vertical screen size/2 (slave)
098	(MsClipXAdder)	(Sint16)	Clipping calculation data (horizontal) (master)
09A	(MsClipYAdder)	(Sint16)	Clipping calculation data (vertical) (master)
09C	(SlClipXAdder)	(Sint16)	Clipping calculation data (horizontal) (slave)
09E	(SlClipYAdder)	(Sint16)	Clipping calculation data (vertical) (slave)
0A0	(SlZlimit)	(Sint16)	Display limit Z position (slave)
0A2	(WinPtr)	(Uint16)	Window data set offset
0A4	(DispPolygons)	(Uint16)	Number of display polygons
0A6	(DMAEndFlag)	(Uint8)	DMA transfer end flag (not used)
0A8	(DMASetFlag)	(Uint8)	DMA table set flag
0AA	(PutCount)	(Uint16)	Number of slPutPolygon(), sl...Sprite() calls
0AC	(MsZdpsftcnt)	(Uint8)	Screen display limit shift count (master)
0AD	(SlZdpsftcnt)	(Uint8)	Screen display limit shift count (Slave)
0B0	(Randwork)	(Uint32)	Random number generator work area
0C0	(VDP2_TVMD)	(Uint16)	TV screen mode
0C2	(VDP2_EXTEN)	(Uint16)	External signal enable
0C4	(VDP2_TVSTAT)	(Uint16)	Screen status
0C6	(VDP2_VRSIZE)	(Uint16)	VRAM size
0C8	(VDP2_HCNT)	(Uint16)	H counter
0CA	(VDP2_VCNT)	(Uint16)	V counter
0CE	(VDP2_RAMCTL)	(Uint16)	RAM control

0D0	(VDP2_CYCA0L)	(Uint16)	VRAM cycle pattern (bank A0, T0 to 3)
0D2	(VDP2_CYCA0U)	(Uint16)	VRAM cycle pattern (bank A0, T4 to 7)
0D4	(VDP2_CYCA1L)	(Uint16)	VRAM cycle pattern (bank A1, T0 to 3)
0D6	(VDP2_CYCA1U)	(Uint16)	VRAM cycle pattern (bank A1, T4 to 7)
0D8	(VDP2_CYCB0L)	(Uint16)	VRAM cycle pattern (bank B0, T0 to 3)
0DA	(VDP2_CYCB0U)	(Uint16)	VRAM cycle pattern (bank B0, T4 to 7)
0DC	(VDP2_CYCB1L)	(Uint16)	VRAM cycle pattern (bank B1, T0 to 3)
0DE	(VDP2_CYCB1U)	(Uint16)	VRAM cycle pattern (bank B1, T4 to 7)
0E0	(VDP2_BGON)	(Uint16)	Screen display enable
0E2	(VDP2_MZCTL)	(Uint16)	Mosaic control
0E4	(VDP2_SFSEL)	(Uint16)	Special function code select
0E6	(VDP2_SFCODE)	(Uint16)	Special function code
0E8	(VDP2_CHCTLA)	(Uint16)	Character control (NBG0, NBG1)
0EA	(VDP2_CHCTLB)	(Uint16)	Character control (NBG2, NBG3, RBG0)
0EC	(VDP2_BMPNA)	(Uint16)	Bit map palette number (NBG0, 1)
0EE	(VDP2_BMPNB)	(Uint16)	Bit map palette number (RBG0)
0F0	(VDP2_PNCN0)	(Uint16)	Pattern name control (NBG0)
0F2	(VDP2_PNCN1)	(Uint16)	Pattern name control (NBG1)
0F4	(VDP2_PNCN2)	(Uint16)	Pattern name control (NBG2)
0F6	(VDP2_PNCN3)	(Uint16)	Pattern name control (NBG3)
0F8	(VDP2_PNCR)	(Uint16)	Pattern name control (RBG0)
0FA	(VDP2_PLSZ)	(Uint16)	Plane size
0FC	(VDP2_MPOFN)	(Uint16)	Map offset (NBG0 to 3)
0FE	(VDP2_MPOFR)	(Uint16)	Map offset (rotation parameters A, B)
100	(VDP2_MPABN0)	(Uint16)	Map (NBG0 plane A, B)
102	(VDP2_MPCDN0)	(Uint16)	Map (NBG0 plane C, D)
104	(VDP2_MPABN1)	(Uint16)	Map (NBG1 plane A, B)
106	(VDP2_MPCDN1)	(Uint16)	Map (NBG1 plane C, D)
108	(VDP2_MPABN2)	(Uint16)	Map (NBG2 plane A, B)
10A	(VDP2_MPCDN2)	(Uint16)	Map (NBG2 plane C, D)
10C	(VDP2_MPABN3)	(Uint16)	Map (NBG3 plane A, B)
10E	(VDP2_MPCDN3)	(Uint16)	Map (NBG3 plane C, D)
110	(VDP2_MPABRA)	(Uint16)	Map (Rotation parameters A plane A, B)
112	(VDP2_MPCDRA)	(Uint16)	Map (Rotation parameters A plane C, D)
114	(VDP2_MPEFRA)	(Uint16)	Map (Rotation parameters A plane E, F)
116	(VDP2_MPGHRA)	(Uint16)	Map (Rotation parameters A plane G, H)
118	(VDP2_MPIJRA)	(Uint16)	Map (Rotation parameters A plane I, J)
11A	(VDP2_MPKLRA)	(Uint16)	Map (Rotation parameters A plane K, L)
11C	(VDP2_MPMNRA)	(Uint16)	Map (Rotation parameters A plane M, N)
11E	(VDP2_MPOPRA)	(Uint16)	Map (Rotation parameters A plane O, P)

120	(VDP2_MPABRB)	(Uint16)	Map (Rotation parameters B plane A, B)
122	(VDP2_MPCDRB)	(Uint16)	Map (Rotation parameters B plane C, D)
124	(VDP2_MPEFRB)	(Uint16)	Map (Rotation parameters B plane E, F)
126	(VDP2_MPGHRB)	(Uint16)	Map (Rotation parameters B plane G, H)
128	(VDP2_MPIJRB)	(Uint16)	Map (Rotation parameters B plane I, J)
12A	(VDP2_MPKLRB)	(Uint16)	Map (Rotation parameters B plane K, L)
12C	(VDP2_MPMNRB)	(Uint16)	Map (Rotation parameters B plane M, N)
12E	(VDP2_MPOPRB)	(Uint16)	Map (Rotation parameters B plane O, P)
130	(VDP2_SCXN0)	(FIXED)	Screen scroll value (NBG0, horizontal direction, fixed-point)
130	(VDP2_SCXIN0)	(Sint16)	Screen scroll value (NBG0, horizontal direction, integer portion)
132	(VDP2_SCXDN0)	(Uint16)	Screen scroll value (NBG0, horizontal direction, decimal portion)
134	(VDP2_SCYN0)	(FIXED)	Screen scroll value (NBG0, vertical direction, fixed-point)
134	(VDP2_SCYIN0)	(Uint16)	Screen scroll value (NBG0, vertical direction, integer portion)
136	(VDP2_SCDN0)	(Uint16)	Screen scroll value (NBG0, vertical direction, decimal portion)
138	(VDP2_ZMXN0)	(FIXED)	Coordinate increment step (NBG0, horizontal direction, fixed-point)
138	(VDP2_ZMXIN0)	(Uint16)	Coordinate increment step (NBG0, horizontal direction, integer portion)
13A	(VDP2_ZMXDN0)	(Uint16)	Coordinate increment step (NBG0, horizontal direction, decimal portion)
13C	(VDP2_ZMYN0)	(FIXED)	Coordinate increment step (NBG0, vertical direction, fixed-point)
13C	(VDP2_ZMXIN0)	(Uint16)	Coordinate increment step (NBG0, vertical direction, integer portion)
13E	(VDP2_ZMYDN0)	(Uint16)	Coordinate increment step (NBG0, vertical direction, decimal portion)
140	(VDP2_SCXN1)	(FIXED)	Screen scroll value (NBG1, horizontal direction, fixed-point)
140	(VDP2_SCXIN1)	(Uint16)	Screen scroll value (NBG1, horizontal direction, integer portion)
142	(VDP2_SCXDN1)	(Uint16)	Screen scroll value (NBG1, horizontal direction, decimal portion)
144	(VDP2_SCYN1)	(FIXED)	Screen scroll value (NBG1, vertical direction, fixed-point)
144	(VDP2_SCYIN1)	(Uint16)	Screen scroll value (NBG1, vertical direction, integer portion)
146	(VDP2_SCYDN1)	(Uint16)	Screen scroll value (NBG1, vertical direction, decimal portion)
148	(VDP2_ZMXN1)	(FIXED)	Coordinate increment step (NBG1, horizontal direction, fixed-point)
148	(VDP2_ZMXIN1)	(Uint16)	Coordinate increment step (NBG1, horizontal direction, integer portion)
14A	(VDP2_ZMXDN1)	(Uint16)	Coordinate increment step (NBG1, horizontal direction, decimal portion)
14C	(VDP2_ZMYN1)	(FIXED)	Coordinate increment step (NBG1, vertical direction, fixed-point)
14C	(VDP2_ZMYIN1)	(Uint16)	Coordinate increment step (NBG1, vertical direction, integer portion)
14E	(VDP2_ZMXDN1)	(Uint16)	Coordinate increment step (NBG1, vertical direction, decimal portion)
150	(VDP2_SCXN2)	(Uint16)	Screen scroll value (NBG2, horizontal direction)
152	(VDP2_SCYN2)	(Uint16)	Screen scroll value (NBG2, vertical direction)
154	(VDP2_SCXN3)	(Uint16)	Screen scroll value (NBG3, horizontal direction)
156	(VDP2_SCYN3)	(Uint16)	Screen scroll value (NBG3, vertical direction)
158	(VDP2_ZMCTL)	(Uint16)	Reduction enable
15A	(VDP2_SCRCTL)	(Uint16)	Line and vertical cell scroll control
15C	(VDP2_VCSTA)	(Uint16*)	Vertical cell scroll table address
160	(VDP2_LSTA0)	(Sint16*)	Line scroll table address for NBG0
164	(VDP2_LSTA1)	(Sint16*)	Line scroll table address for NBG1
168	(VDP2_LCTA)	(Uint16*)	Line color screen table address
16C	(VDP2_BKTA)	(Uint16*)	Background screen table address

170	(VDP2_RPMD)	(Uint16)	Rotation parameter mode
172	(VDP2_RPRCTL)	(Uint16)	Rotation parameter read control
174	(VDP2_KTCTL)	(Uint16)	Coefficient table control
176	(VDP2_KTAOF)	(Uint16)	Coefficient table address offset
178	(VDP2_OVPNRA)	(Uint16)	Screen overflow pattern name
17A	(VDP2_OVPNRB)	(Uint16)	Screen overflow pattern name
17C	(VDP2_RPTA)	(Sint32*)	Rotation parameter table address
180	(VDP2_WPSX0)	(Uint16)	Window position (Hstart)
182	(VDP2_WPSY0)	(Uint16)	Window position (Vstart)
184	(VDP2_WPEX0)	(Uint16)	Window position (Hstop)
186	(VDP2_WPEY0)	(Uint16)	Window position (Vstop)
188	(VDP2_WPSX1)	(Uint16)	Window position (Hstart)
18A	(VDP2_WPSY1)	(Uint16)	Window position (Vstart)
18C	(VDP2_WPEX1)	(Uint16)	Window position (Hstop)
18E	(VDP2_WPEY1)	(Uint16)	Window position (Vstop)
190	(VDP2_WCTLA)	(Uint16)	Window control
192	(VDP2_WCTLB)	(Uint16)	Window control
194	(VDP2_WCTLC)	(Uint16)	Window control
196	(VDP2_WCTLD)	(Uint16)	Window control
198	(VDP2_LWTA0)	(Uint16*)	Line window table address
19C	(VDP2_LWTA1)	(Uint16)	Sprite control
1A0	(VDP2_SPCTL)	(Uint16)	Shadow control
1A2	(VDP2_SDCTL)	(Uint16)	Color RAM address offset (NBG0 to 3)
1A4	(VDP2_CRAOFA)	(Uint16)	Color RAM address offset (RBG0, sprite)
1A6	(VDP2_CRAOFB)	(Uint16)	Line color screen enable
1A8	(VDP2_LNCLEN)	(Uint16)	Special priority mode
1AA	(VDP2_SFPRMD)	(Uint16)	Color calculation control
1AC	(VDP2_CCCTL)	(Uint16)	Special color calculation mode
1AE	(VDP2_SFCCMD)	(Uint16)	Priority number
1B0	(VDP2_PRISA)	(Uint16)	Priority number
1B2	(VDP2_PRISB)	(Uint16)	Priority number
1B4	(VDP2_PRISC)	(Uint16)	Priority number
1B6	(VDP2_PRISD)	(Uint16)	Priority number
1B8	(VDP2_PRINA)	(Uint16)	Priority number
1BA	(VDP2_PRINB)	(Uint16)	Priority number
1BC	(VDP2_PRIR)	(Uint16)	Color calculation ratio (sprite 0, 1)
1C0	(VDP2_CCRSA)	(Uint16)	Color calculation ratio (sprite 2, 3)
1C2	(VDP2_CCRSB)	(Uint16)	Color calculation ratio (sprite 4, 5)
1C4	(CCRSB_CCRSC)	(Uint16)	Color calculation ratio (sprite 6, 7)
1C6	(VDP2_CCRSD)	(Uint16)	Color calculation ratio (NBG0, 1)
1C8	(VDP2_CCRNA)	(Uint16)	Color calculation ratio (NBG2, 3)
1CA	(VDP2_CCRNB)	(Uint16)	Color calculation ratio (RBG0)
1CC	(VDP2_CCRR)	(Uint16)	Color calculation ratio (line color screen, background screen)

1CE	(VDP2_CCRLB)	(Uint16)	Color offset enable
1D0	(VDP2_CLOFEN)	(Uint16)	Color offset select
1D2	(VDP2_CLOFSL)	(Uint16)	Color offset A (red)
1D4	(VDP2_COAR)	(Uint16)	Color offset A (green)
1D6	(VDP2_COAG)	(Uint16)	** PAGE 9
1D8	(VDP2_COAB)	(Uint16)	Color offset A (blue)
1DA	(VDP2_COBR)	(Uint16)	Color offset B (red)
1DC	(VDP2_COBG)	(Uint16)	Color offset B (green)
1DE	(VDP2_COBB)	(Uint16)	Color offset B (blue)

1E0	(ScrRotPtr)	(ROTSCROLL*)	Address of rotation parameters being used
1E4	(nbg0_char_adr)	(void*)	CG address for NBG0
1E8	(nbg1_char_adr)	(void*)	CG address for NBG1
1EC	(nbg2_char_adr)	(void*)	CG address for NBG2
1F0	(nbg3_char_adr)	(void*)	CG address for NBG3
1F4	(ra_char_adr)	(void*)	Pattern name address for rotating scroll (parameters A)
1F8	(rb_char_adr)	(void*)	Pattern name address for rotating scroll (parameters B)
1FC	(nbg0_page_adr)	(void*)	Pattern name address for NBG0
200	(nbg1_page_adr)	(void*)	Pattern name address for NBG1
204	(nbg2_page_adr)	(void*)	Pattern name address for NBG2
208	(nbg3_page_adr)	(void*)	Pattern name address for NBG3
20C	(ra_page_adr)	(void*)	Pattern name address for rotating scroll (parameters A)
210	(rb_page_adr)	(void*)	Pattern name address for rotating scroll (parameters B)
214	(rpara_vram_adr)	(void*)	Rotation parameter set address
218	(k_table_adr)	(FIXED*)	Coefficient table set address
21C	(scr_work)	(Uint8[60])	Work area for slAutoDisp
278	(RotScrParA)	(ROTSCROLL*)	Rotation parameters A
2E0	(RotScrParB)	(ROTSCROLL)	Rotation parameters B
348	(Window_data)	(Uint16[18])	Window control data buffer (for two)
36C	(Center_data)	(Uint16[10])	Window center control data buffer (for two)

3. VDP1 VRAM Memory Map

Because the first and last parts of the VDP1 VRAM that begins at 0x25C00000 is used by the system, those areas cannot be used by the user.

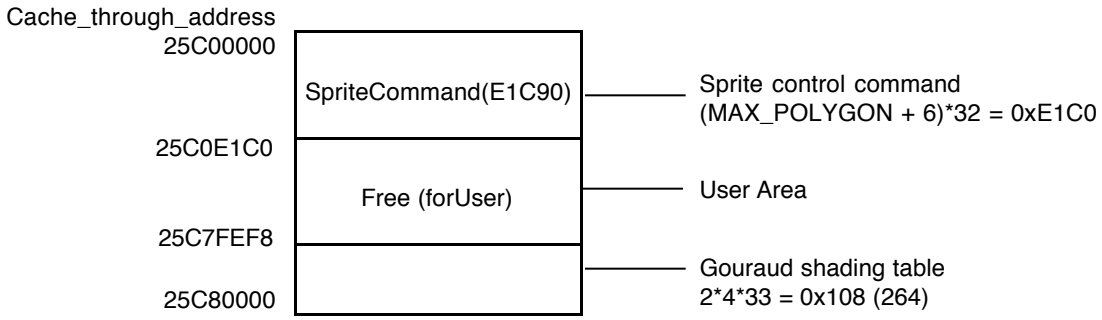


Fig. 3-1 VDP1 VRAM Memory Map

4. VDP2 VRAM Memory Map

The VDP2 VRAM that begins at 0x25E00000 is divided as follows upon system initialization.

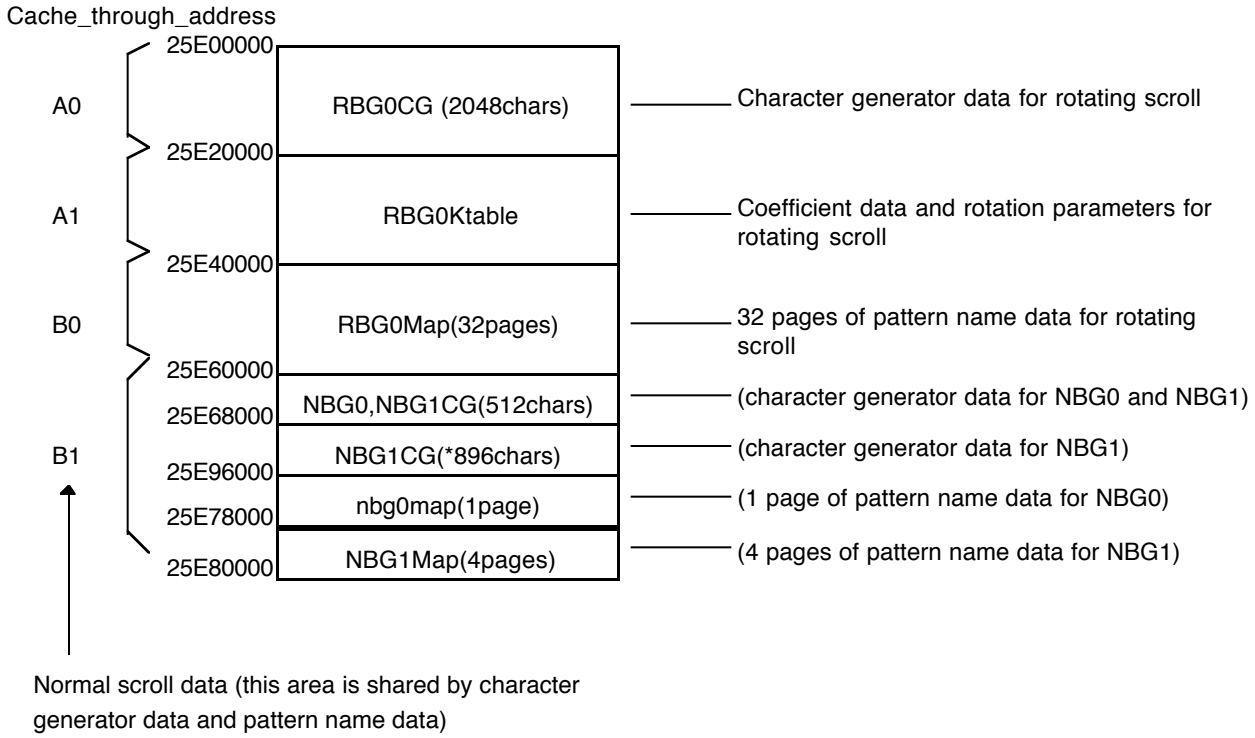


Fig. 4-1 VDP2 VRAM Memory Map

Settings at system initialization

The character generator is in 256-color mode regardless of the scroll, and the pattern name is always [1 word/1 cell].

NBG0 is in 10-bit mode with a reverse flag for each cell, while the other screens are in 12-bit mode in which reverse is specified or not for the entire screen.

The color RAM is in 16-bit, 2048-color mode, and no offset is used.

The background screen is in single-color mode, with the color data (0000) in 25E3FFFE.