

Sensoray Model 614 Caption/Overlay Programming Guide

I. Caption/Overlay Feature Summary

- Up to 8 windows or fields
- Up to 64 characters or bitmap blocks per window (field)
- 8 x 16 pixels per bitmap block or character font
- Scale:
x1 (1:1), x2 (2:1), x2v (2:1, vertically), and x4 (4:1) per window/field
- Color:
White, Black, Red, Blue, Green, Yellow, Magmata, and Cyan
on character or bitmap-block base
- Caption/Overlay mode:
Transparent or Non-transparent, on character or bitmap-block base

II. Registers for Caption/Overlay in FPGA

The 614 FPGA internal register set consists of various 16-bit wide registers that are accessed by the means of I2C bus. Some registers are accessed directly, while others are accessed indirectly via index register.

Following registers are designated for Caption/Overlay control and/or programming purpose:

Direct Access Registers

DATA

Reg INDEX: 00 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

DATA[15:0]: Data for Indirect-access Registers, selected by INDEX

INDEX

Reg INDEX: 02 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	INDEX15	INDEX14	INDEX13	INDEX12	INDEX11	INDEX10	INDEX9	INDEX8	INDEX7	INDEX6	INDEX5	INDEX4	INDEX3	INDEX2	INDEX1	INDEX0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

INDEX[15:0]: Register Index

RAM_DATA

Reg INDEX: 08 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	DATA15	DATA14	DATA13	DATA12	DATA11	DATA10	DATA9	DATA8	DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

DATA[15:0]: Data for Overlay RAM (indirectly-accessible), selected by RAM_INDEX

RAM_INDEX

Reg INDEX: 0A h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	INDEX15	INDEX14	INDEX13	INDEX12	INDEX11	INDEX10	INDEX9	INDEX8	INDEX7	INDEX6	INDEX5	INDEX4	INDEX3	INDEX2	INDEX1	INDEX0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

INDEX[15:0]: Overlay RAM Access Index

Overlay/Caption Window-1 X Position: X1START

Reg INDEX: 10 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X1START9	X1START8	X1START7	X1START6	X1START5	X1START4	X1START3	X1START2	X1START1	X1START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X1START[9:0] is the horizontal start position of the 1st window, in pixels

Overlay/Caption Window-2 X Position: X2START

Reg INDEX: 11 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X2START9	X2START8	X2START7	X2START6	X2START5	X2START4	X2START3	X2START2	X2START1	X2START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X2START[9:0] is the horizontal start position of the 2nd window, in pixels

Overlay/Caption Window-3 X Position: X3START

Reg INDEX: 12 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X3START9	X3START8	X3START7	X3START6	X3START5	X3START4	X3START3	X3START2	X3START1	X3START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X3START[9:0] is the horizontal start position of the 3rd window, in pixels

Overlay/Caption Window-4 X Position: X4START

Reg INDEX: 13 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X4START9	X4START8	X4START7	X4START6	X4START5	X4START4	X4START3	X4START2	X4START1	X4START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X4START[9:0] is the horizontal start position of the 4th window, in pixels

Overlay/Caption Window-5 X Position: X5START

Reg INDEX: 14 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X5START9	X5START8	X5START7	X5START6	X5START5	X5START4	X5START3	X5START2	X5START1	X5START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X5START[9:0] is the horizontal start position of the 5th window, in pixels

Overlay/Caption Window-6 X Position: X6START

Reg INDEX: 15 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X6START9	X6START8	X6START7	X6START6	X6START5	X6START4	X6START3	X6START2	X6START1	X6START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X6START[9:0] is the horizontal start position of the 6th window, in pixels

Overlay/Caption Window-7 X Position: X7START

Reg INDEX: 16 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X7START9	X7START8	X7START7	X7START6	X7START5	X7START4	X7START3	X7START2	X7START1	X7START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X7START[9:0] is the horizontal start position of the 7th window, in pixels

Overlay/Caption Window-8 X Position: X8START

Reg INDEX: 17 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X8START9	X8START8	X8START7	X8START6	X8START5	X8START4	X8START3	X8START2	X8START1	X8START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X8START[9:0] is the horizontal start position of the 8th window, in pixels

Overlay/Caption Window-1 X Position: X1STOP

Reg INDEX: 18 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X1STOP9	X1STOP8	X1STOP7	X1STOP6	X1STOP5	X1STOP4	X1STOP3	X1STOP2	X1STOP1	X1STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X1STOP[9:0] is the horizontal stop position of the 1st window, in pixels

Overlay/Caption Window-2 X Position: X2STOP

Reg INDEX: 19 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X2STOP9	X2STOP8	X2STOP7	X2STOP6	X2STOP5	X2STOP4	X2STOP3	X2STOP2	X2STOP1	X2STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X2STOP[9:0] is the horizontal stop position of the 2nd window, in pixels

Overlay/Caption Window-3 X Position: X3STOP

Reg INDEX: 1A h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X3STOP9	X3STOP8	X3STOP7	X3STOP6	X3STOP5	X3STOP4	X3STOP3	X3STOP2	X3STOP1	X3STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X3STOP[9:0] is the horizontal stop position of the 3rd window, in pixels

Overlay/Caption Window-4 X Position: X4STOP

Reg INDEX: 1B h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X4STOP9	X4STOP8	X4STOP7	X4STOP6	X4STOP5	X4STOP4	X4STOP3	X4STOP2	X4STOP1	X4STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X4STOP[9:0] is the horizontal stop position of the 4th window, in pixels

Overlay/Caption Window-5 X Position: X5STOP

Reg INDEX: 1C h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X5STOP9	X5STOP8	X5STOP7	X5STOP6	X5STOP5	X5STOP4	X5STOP3	X5STOP2	X5STOP1	X5STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X5STOP[9:0] is the horizontal stop position of the 5th window, in pixels

Overlay/Caption Window-6 X Position: X6STOP

Reg INDEX: 1D h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X6STOP9	X6STOP8	X6STOP7	X6STOP6	X6STOP5	X6STOP4	X6STOP3	X6STOP2	X6STOP1	X6STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X6STOP[9:0] is the horizontal stop position of the 6th window, in pixels

Overlay/Caption Window-7 X Position: X7STOP

Reg INDEX: 1E h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X7STOP9	X7STOP8	X7STOP7	X7STOP6	X7STOP5	X7STOP4	X7STOP3	X7STOP2	X7STOP1	X7STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X7STOP[9:0] is the horizontal stop position of the 7th window, in pixels

Overlay/Caption Window-8 X Position: X8STOP

Reg INDEX: 1F h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	X8STOP9	X8STOP8	X8STOP7	X8STOP6	X8STOP5	X8STOP4	X8STOP3	X8STOP2	X8STOP1	X8STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X8STOP[9:0] is the horizontal stop position of the 8th window, in pixels

Overlay/Caption Window-1 Y Position: Y1START

Reg INDEX: 20 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y1START9	Y1START8	Y1START7	Y1START6	Y1START5	Y1START4	Y1START3	Y1START2	Y1START1	Y1START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y1START[9:0] is the vertical start position of the 1st window, in pixels/lines

Overlay/Caption Window-2 Y Position: Y2START

Reg INDEX: 21 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y2START9	Y2START8	Y2START7	Y2START6	Y2START5	Y2START4	Y2START3	Y2START2	Y2START1	Y2START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y2START[9:0] is the vertical start position of the 2nd window, in pixels/lines

Overlay/Caption Window-3 Y Position: Y3START

Reg INDEX: 22 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y3START9	Y3START8	Y3START7	Y3START6	Y3START5	Y3START4	Y3START3	Y3START2	Y3START1	Y3START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y3START[9:0] is the vertical start position of the 3rd window, in pixels/lines

Overlay/Caption Window-4 Y Position: Y4START

Reg INDEX: 23 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y4START9	Y4START8	Y4START7	Y4START6	Y4START5	Y4START4	Y4START3	Y4START2	Y4START1	Y4START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y4START[9:0] is the vertical start position of the 4th window, in pixels/lines

Overlay/Caption Window-5 Y Position: Y5START

Reg INDEX: 24 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y5START9	Y5START8	Y5START7	Y5START6	Y5START5	Y5START4	Y5START3	Y5START2	Y5START1	Y5START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y5START[9:0] is the vertical start position of the 5th window, in pixels/lines

Overlay/Caption Window-6 Y Position: Y6START

Reg INDEX: 25 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y6START9	Y6START8	Y6START7	Y6START6	Y6START5	Y6START4	Y6START3	Y6START2	Y6START1	Y6START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y6START[9:0] is the vertical start position of the 6th window, in pixels/lines

Overlay/Caption Window-7 Y Position: Y7START

Reg INDEX: 26 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y7START9	Y7START8	Y7START7	Y7START6	Y7START5	Y7START4	Y7START3	Y7START2	Y7START1	Y7START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y7START[9:0] is the vertical start position of the 7th window, in pixels/lines

Overlay/Caption Window-8 Y Position: Y8START

Reg INDEX: 27 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y8START9	Y8START8	Y8START7	Y8START6	Y8START5	Y8START4	Y8START3	Y8START2	Y8START1	Y8START0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y8START[9:0] is the vertical start position of the 8th window, in pixels/lines

Overlay/Caption Window-1 Y Position: Y1STOP

Reg INDEX: 28 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y1STOP9	Y1STOP8	Y1STOP7	Y1STOP6	Y1STOP5	Y1STOP4	Y1STOP3	Y1STOP2	Y1STOP1	Y1STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y1STOP[9:0] is the vertical stop position of the 1st window, in pixels/lines

Overlay/Caption Window-2 Y Position: Y2STOP

Reg INDEX: 29 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y2STOP9	Y2STOP8	Y2STOP7	Y2STOP6	Y2STOP5	Y2STOP4	Y2STOP3	Y2STOP2	Y2STOP1	Y2STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y2STOP[9:0] is the vertical stop position of the 2nd window, in pixels/lines

Overlay/Caption Window-3 Y Position: Y3STOP

Reg INDEX: 2A h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y3STOP9	Y3STOP8	Y3STOP7	Y3STOP6	Y3STOP5	Y3STOP4	Y3STOP3	Y3STOP2	Y3STOP1	Y3STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y3STOP[9:0] is the vertical stop position of the 3rd window, in pixels/lines

Overlay/Caption Window-4 Y Position: Y4STOP

Reg INDEX: 2B h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y4STOP9	Y4STOP8	Y4STOP7	Y4STOP6	Y4STOP5	Y4STOP4	Y4STOP3	Y4STOP2	Y4STOP1	Y4STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y4STOP[9:0] is the vertical stop position of the 4th window, in pixels/lines

Overlay/Caption Window-5 Y Position: Y5STOP

Reg INDEX: 2C h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y5STOP9	Y5STOP8	Y5STOP7	Y5STOP6	Y5STOP5	Y5STOP4	Y5STOP3	Y5STOP2	Y5STOP1	Y5STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y5STOP[9:0] is the vertical stop position of the 5th window, in pixels/lines

Overlay/Caption Window-6 Y Position: Y6STOP

Reg INDEX: 2D h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y6STOP9	Y6STOP8	Y6STOP7	Y6STOP6	Y6STOP5	Y6STOP4	Y6STOP3	Y6STOP2	Y6STOP1	Y6STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y6STOP[9:0] is the vertical stop position of the 6th window, in pixels/lines

Overlay/Caption Window-7 Y Position: Y7STOP

Reg INDEX: 2E h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y7STOP9	Y7STOP8	Y7STOP7	Y7STOP6	Y7STOP5	Y7STOP4	Y7STOP3	Y7STOP2	Y7STOP1	Y7STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y7STOP[9:0] is the vertical stop position of the 7th window, in pixels/lines

Overlay/Caption Window-8 Y Position: Y8STOP

Reg INDEX: 2F h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	Y8STOP9	Y8STOP8	Y8STOP7	Y8STOP6	Y8STOP5	Y8STOP4	Y8STOP3	Y8STOP2	Y8STOP1	Y8STOP0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Y8STOP[9:0] is the vertical stop position of the 8th window, in pixels/lines

Overlay/Caption Scale Control: SCALE

Reg INDEX: 30 h

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	W8S1	W8S0	W7S1	W7S0	W6S1	W6S0	W5S1	W5S0	W4S1	W4S0	W3S1	W3S0	W2S1	W2S0	W1S1	W1S0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SCALE[1:0] is for Window-1: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

SCALE[3:2] is for Window-2: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

SCALE[5:4] is for Window-3: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

SCALE[7:6] is for Window-4: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

SCALE[9:8] is for Window-5: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

SCALE[11:10] is for Window-6: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

SCALE[13:12] is for Window-7: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

SCALE[15:14] is for Window-8: 00 -- x1; 01 -- x2; 10 -- x2 (vertically); 11 -- x4

Indirect Access FPGA RAM Blocks

(Used for storing Caption Overlay Bitmap Data and Attributes)

For Window-1 and Window-2:

Each Bitmap-Block is composed of 16-bit/word x 8 words, which holds 8 pixels x 16 lines of one bitmap-block data or one character font (8 pixels x 16 lines, if in text mode).

RAM Bitmap-Block #0~7, Data: 000 h – 03f h

RAM Bitmap-Block #8~15, Data: 040 h – 07f h

RAM Bitmap-Block #16~23, Data: 080 h – 0bf h
RAM Bitmap-Block #24~31, Data: 0c0 h – 0ff h
RAM Bitmap-Block #32~39, Data: 100 h – 13f h
RAM Bitmap-Block #40~47, Data: 140 h – 17f h
RAM Bitmap-Block #48~55, Data: 180 h – 1bf h
RAM Bitmap-Block #56~63, Data: 1c0 h – 1ff h

Then, two windows of caption/overlay attributes will be followed, to determine which bitmap block(s) or character font(s), with what color and transparent attribute, will be chosen to fill the caption/overlay windows (fields).

RAM Window-1, Attributes: 200 h – 23f h
RAM Window-2, Attributes: 240 h – 27f h

Attribute Formation:

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	Transp	Y2	Y1	Y0	U2	U1	U0	V2	V1	V0	BbCh5	BbCh4	BbCh3	BbCh2	BbCh1	BbCh0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Transp is for indicating if the caption/overlay is transparent: 0 – transparent, 1 – non transparent, with black background

Y[2:0] is the color index for the Y component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

U[2:0] is the color index for the U component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

V[2:0] is the color index for the V component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

BbCh[5:0] is for choosing which bitmap-block or character font stored in the bitmap-block RAM: i.e.

BbCh[5:0] = 0: choose Bitmap-block or Char #0, stored/started at 000 h

BbCh[5:0] = 1: choose Bitmap-block or Char #1, stored/started at 008 h

⋮

BbCh[5:0] = 62: choose Bitmap-block or Char #62, stored/started at 1f0 h

BbCh[5:0] = 63: choose Bitmap-block or Char #63, stored/started at 1f8 h

For Window-3 and Window-4:

Each Bitmap-Block is composed of 16-bit/word x 8 words, which holds 8 pixels x 16 lines of one bitmap-block data or one character font (8 pixels x 16 lines, if in text mode).

RAM Bitmap-Block #0~7, Data: 400 h – 43f h
 RAM Bitmap-Block #8~15, Data: 440 h – 47f h
 RAM Bitmap-Block #16~23, Data: 480 h – 4bf h
 RAM Bitmap-Block #24~31, Data: 4c0 h – 4ff h
 RAM Bitmap-Block #32~39, Data: 500 h – 53f h
 RAM Bitmap-Block #40~47, Data: 540 h – 57f h
 RAM Bitmap-Block #48~55, Data: 580 h – 5bf h
 RAM Bitmap-Block #56~63, Data: 5c0 h – 5ff h

Then, two windows of caption/overlay attributes will be followed, to determine which bitmap block(s) or character font(s), with what color and transparent attribute, will be chosen to fill the caption/overlay windows (fields).

RAM Window-3, Attributes: 600 h – 63f h
 RAM Window-4, Attributes: 640 h – 67f h

Attribute Formation:

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	Transp	Y2	Y1	Y0	U2	U1	U0	V2	V1	V0	BbCh5	BbCh4	BbCh3	BbCh2	BbCh1	BbCh0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Transp is for indicating if the caption/overlay is transparent: 0 – transparent, 1 – non transparent, with black background

Y[2:0] is the color index for the Y component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

U[2:0] is the color index for the U component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

V[2:0] is the color index for the V component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

RAM Window-#1, Attributes: e00 h – e3f h
RAM Window-#2, Attributes: e40 h – e7f h

Attribute Formation:

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	Transp	Y2	Y1	Y0	U2	U1	U0	V2	V1	V0	BbCh5	BbCh4	BbCh3	BbCh2	BbCh1	BbCh0
DEFAULT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Transp is for indicating if the caption/overlay is transparent: 0 – transparent, 1 – non transparent, with black background

Y[2:0] is the color index for the Y component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

U[2:0] is the color index for the U component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

V[2:0] is the color index for the V component of the caption/overlay bitmap-block or character font's color:

0 – black, 1 – white, 2 – red, 3 – blue, 4 – green, 5 – yellow, 6 – Magenta, 7 – Cyan

BbCh[5:0] is for choosing which bitmap-block or character font stored in the bitmap-block RAM: i.e.

BbCh[5:0] = 0: choose Bitmap-block or Char #0, stored/started at c00 h

BbCh[5:0] = 1: choose Bitmap-block or Char #1, stored/started at c08 h

:

:

BbCh[5:0] = 62: choose Bitmap-block or Char #62, stored/started at df0 h

BbCh[5:0] = 63: choose Bitmap-block or Char #63, stored/started at df8 h

III. Caption/Overlay Programming

As described in last section, the 614 FPGA internal registers including Caption/Overlay control and programming registers, all are accessed by the means of I2C bus.

Therefore, in Sensoray SDK-x14-win, an API function, SN_WriteI2C (I2C_Slave_Address, Bytes, Board) is provided for the caption/overlay programming purpose. In which:

I2C_Slave_Address = 0x60 (fixed I2C slave address for 614 FPGA), always;
Bytes is consisted of Register_Index+DataWord_HighByte+DataWord_LowByte;
Board is board instance.

At application level, a function,

USHORT fpga_reg_write(BOARD *b, UCHAR addr, USHORT data) is provided for caption/overlay control parameter load and/or caption character font or overlay bitmap block data load.

Window/Field Position Control

Window/Field position control includes X-Start, X-Stop, Y-Start, and Y-Stop parameter settings. With calling fpga_reg_write (board, address, data), to perform the setting load operation. In the function, the arguments:

board is board instance;

address is the register index of one of the following caption/overlay position

registers:

```
#define G_CAPWIN_X1START 0x10 // Caption window #1 X start.
#define G_CAPWIN_X2START 0x11 // Caption window #2 X start.
#define G_CAPWIN_X3START 0x12 // Caption window #3 X start.
#define G_CAPWIN_X4START 0x13 // Caption window #4 X start.
#define G_CAPWIN_X5START 0x14 // Caption window #5 X start.
#define G_CAPWIN_X6START 0x15 // Caption window #6 X start.
#define G_CAPWIN_X7START 0x16 // Caption window #7 X start.
#define G_CAPWIN_X8START 0x17 // Caption window #8 X start.
#define G_CAPWIN_X1STOP 0x18 // Caption window #1 X stop.
#define G_CAPWIN_X2STOP 0x19 // Caption window #2 X stop.
#define G_CAPWIN_X3STOP 0x1A // Caption window #3 X stop.
#define G_CAPWIN_X4STOP 0x1B // Caption window #4 X stop.
#define G_CAPWIN_X5STOP 0x1C // Caption window #5 X stop.
#define G_CAPWIN_X6STOP 0x1D // Caption window #6 X stop.
#define G_CAPWIN_X7STOP 0x1E // Caption window #7 X stop.
#define G_CAPWIN_X8STOP 0x1F // Caption window #8 X stop.
#define G_CAPWIN_Y1START 0x20 // Caption window #1 Y start.
#define G_CAPWIN_Y2START 0x21 // Caption window #2 Y start.
#define G_CAPWIN_Y3START 0x22 // Caption window #3 Y start.
#define G_CAPWIN_Y4START 0x23 // Caption window #4 Y start.
#define G_CAPWIN_Y5START 0x24 // Caption window #5 Y start.
#define G_CAPWIN_Y6START 0x25 // Caption window #6 Y start.
#define G_CAPWIN_Y7START 0x26 // Caption window #7 Y start.
#define G_CAPWIN_Y8START 0x27 // Caption window #8 Y start.
#define G_CAPWIN_Y1STOP 0x28 // Caption window #1 Y stop.
#define G_CAPWIN_Y2STOP 0x29 // Caption window #2 Y stop.
#define G_CAPWIN_Y3STOP 0x2A // Caption window #3 Y stop.
#define G_CAPWIN_Y4STOP 0x2B // Caption window #4 Y stop.
#define G_CAPWIN_Y5STOP 0x2C // Caption window #5 Y stop.
```

```

#define G_CAPWIN_Y6STOP 0x2D // Caption window #6 Y stop.
#define G_CAPWIN_Y7STOP 0x2E // Caption window #7 Y stop.
#define G_CAPWIN_Y8STOP 0x2F // Caption window #8 Y stop.

```

data is the position setting, which could be:

```

pos_x_start 2 ~ 718
pos_x_stop 2 ~ 720
pos_y_start 0 ~ 476(NTSC)/572(PAL)
pos_y_stop 0 ~ 480(NTSC)/576(PAL)

```

Caption/Overlay Scale Control

Caption/Overlay for each window/field are scalable. The following four scales are available to be selected for each window/field:

```

00 — x1 (horizontally and vertically)
01 — x2 (horizontally and vertically)
10 — x2 (vertically only)
11 — x4 (horizontally and vertically)

```

The 614 uses one Scale Control register to control the scales for all 8 windows/fields. The register bit layout is shown in Section II above, with Reg_Index=03h. By calling `fpga_reg_write (board, address, data)`, to load all scale settings. In the function, the arguments:

board is board instance;

address is the register index of the Scale Control register. It's:

```

#define G_CAPWIN_SCALE 0x30 // Caption/Overlay Scale Control Reg.

```

data is the formed scale data, consist of:

```

|w8S1|w8S0|w7S1|w7S0|w6S1|w6S0|w5S1|w5S0|w4S1|w4S0|w3S1|w3S0|w2S1|w2S0|w1S1|w1S0|

```

Caption Character Font or Overlay Bitmap Data Loading

In the 614 FPGA, there are four RAM blocks used for holding the caption character fonts and/or overlay bitmap blocks. For the program to access them and load the data, they are mapped to:

```

#define G_CAPRAMCHAR_1 0x0000 // Caption character or overlay bitmap RAM
base address for char/bmblk 0-31 of the window-1&2.
#define G_CAPRAMCHAR_2 0x0100 // Caption character or overlay bitmap RAM
base address for char/bmblk 32-63 of the window-1&2.
#define G_CAPRAMCHAR_3 0x0400 // Caption character or overlay bitmap RAM
base address for char/bmblk 0-31 of the window-3&4.
#define G_CAPRAMCHAR_4 0x0500 // Caption character or overlay bitmap RAM
base address for char/bmblk 32-63 of the window-3&4.
#define G_CAPRAMCHAR_5 0x0800 // Caption character or overlay bitmap RAM
base address for char/bmblk 0-31 of the window-5&6.
#define G_CAPRAMCHAR_6 0x0900 // Caption character or overlay bitmap RAM
base address for char/bmblk 32-63 of the window-5&6.
#define G_CAPRAMCHAR_7 0x0C00 // Caption character or overlay bitmap RAM
base address for char/bmblk 0-31 of the window-7&8.
#define G_CAPRAMCHAR_8 0x0D00 // Caption character or overlay bitmap RAM
base address for char/bmblk 32-63 of the window-7&8.

```

Within the #define's, G_CAPRAMCHAR_1 and G_CAPRAMCHAR_2 are in one RAM block (contiguously); G_CAPRAMCHAR_3 and G_CAPRAMCHAR_4 are in one RAM block (contiguously); G_CAPRAMCHAR_5 and G_CAPRAMCHAR_6 are in one RAM block (contiguously); and G_CAPRAMCHAR_7 and G_CAPRAMCHAR_8 are in another RAM block (contiguously);

With an indirect access method as shown below, to load the caption character fonts or overlay bitmap-blocks:

```
#define G_CAPRAMDATA      0x08          // Caption RAM data[15:0]
#define G_CAPRAMINDEX    0x0A          // Caption RAM index[15:0]
fpga_reg_write ( b, G_CAPRAMINDEX, capovlRamStart );
for ( i = 0; i <8; i++ )
{
    fpga_reg_write ( b, G_CAPRAMDATA, capovlData[i] );
}
```

In the example above, it's an one-char/blk-by-one-char/blk base loading sample. Consider a caption character font (8x16 pixels/char) or an overlay bitmap block (8x16 pixels/blk), consisted of

Char-byte[0]		bitmap-byte[0]
Char-byte[1]		bitmap-byte[1]
Char-byte[2]		bitmap-byte[2]
Char-byte[3]		bitmap-byte[3]
Char-byte[4]		bitmap-byte[4]
Char-byte[5]		bitmap-byte[5]
Char-byte[6]		bitmap-byte[6]
Char-byte[7]	or	bitmap-byte[7]
Char-byte[8]		bitmap-byte[8]
Char-byte[9]		bitmap-byte[9]
Char-byte[10]		bitmap-byte[10]
Char-byte[11]		bitmap-byte[11]
Char-byte[12]		bitmap-byte[12]
Char-byte[13]		bitmap-byte[13]
Char-byte[14]		bitmap-byte[14]
Char-byte[15]		bitmap-byte[15]

the capovlData [8] should be formed like:

```
capovlData[0] = Char-byte[1]; // or bitmap-byte[1]
capovlData[0] = capovlData[0]<<8 + Char-bits[0] // or bitmap-byte[0]
capovlData[1] = Char-byte[3]; // or bitmap-byte[3]
capovlData[1] = capovlData[1]<<8 + Char-bits[2] // or bitmap-byte[2]
capovlData[2] = Char-byte[5]; // or bitmap-byte[5]
capovlData[2] = capovlData[2]<<8 + Char-bits[4] // or bitmap-byte[4]
capovlData[3] = Char-byte[7]; // or bitmap-byte[7]
capovlData[3] = capovlData[3]<<8 + Char-bits[6] // or bitmap-byte[6]
capovlData[4] = Char-byte[9]; // or bitmap-byte[9]
capovlData[4] = capovlData[4]<<8 + Char-bits[8] // or bitmap-byte[8]
capovlData[5] = Char-byte[11]; // or bitmap-byte[11]
capovlData[5] = capovlData[5]<<8 + Char-bits[10] // or bitmap-byte[10]
capovlData[6] = Char-byte[13]; // or bitmap-byte[13]
capovlData[6] = capovlData[6]<<8 + Char-bits[12] // or bitmap-byte[12]
capovlData[7] = Char-byte[15]; // or bitmap-byte[15]
capovlData[7] = capovlData[7]<<8 + Char-bits[14] // or bitmap-byte[14]
```

In the char-byte[] or bitmap-byte[], when bit=1, the pixel will be overlaid; while when bit=0, the pixel will not be overlaid, but could be transparent or with a background.

Caption/Overlay Window Formation and Data Loading

Each window (field) of Caption/Overlay is formed with a series of selected caption character or overlay bitmap-block selection # + their attributes (including transparent mode and color selection). It's aligned like following for each window/field:

1st Selected Char/bmBlk Attribute (Transp+Y[2:0]+U[2:0]+V[2:0]) + Char/bmBlk#[5:0]
2nd Selected Char/bmBlk Attribute (Transp+Y[2:0]+U[2:0]+V[2:0]) + Char/bmBlk#[5:0]
3rd Selected Char/bmBlk Attribute (Transp+Y[2:0]+U[2:0]+V[2:0]) + Char/bmBlk#[5:0]
:
Last Selected Char/bmBlk Attribute (Transp+Y[2:0]+U[2:0]+V[2:0]) + Char/bmBlk#[5:0]

Refer to the Section-II, for the details of attribute formation and char/bmBlk selection.

For holding the window formation data, there are eight RAM blocks (in the 614 FPGA) designed for all eight windows/fields individually. Their base address mapping is designed as following:

```
#define G_CAPRAMATTR_1      0x0200 // Caption window #1 attr RAM base.
#define G_CAPRAMATTR_2      0x0240 // Caption window #2 attr RAM base.
#define G_CAPRAMATTR_3      0x0600 // Caption window #3 attr RAM base.
#define G_CAPRAMATTR_4      0x0640 // Caption window #4 attr RAM base.
#define G_CAPRAMATTR_5      0x0A00 // Caption window #5 attr RAM base.
#define G_CAPRAMATTR_6      0x0A40 // Caption window #6 attr RAM base.
#define G_CAPRAMATTR_7      0x0E00 // Caption window #7 attr RAM base.
#define G_CAPRAMATTR_8      0x0E40 // Caption window #8 attr RAM base.
```

To load the attribute+selection data into the FPGA RAM blocks, use the following method for the window/field data loading:

```
charbmpRAMbase = G_CAPRAMCHAR_#;
fpga_reg_write ( b, G_CAPRAMINDEX, charbmpRAMbase); // set RAM start
for ( i=0; i<N; i++ ) {
    fpga_reg_write ( b, G_CAPRAMDATA, char_bmp_blk_#[i] );
}
```

Where, # could be 1, 2, 3, 4, 5, 6, 7, or 8 (window/field number); N is the total number of the char or bitmap blocks in one window/field.