

# AZ DISPLAYS, INC.

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*COMPLETE LCD SOLUTIONS*

## SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

PART NUMBER:

AGM3224J Series

REVISED:

September 25, 2006

## General Specifications

| Item                         | <input checked="" type="checkbox"/> Standard Value                                                                                                                                                                                                                                                                                                                                                                                                                                  | Unit |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Display Pattern              | <input checked="" type="checkbox"/> Graphic <input type="checkbox"/> Character <input type="checkbox"/> Segment<br><input type="checkbox"/> _____ <input type="checkbox"/> with ICON                                                                                                                                                                                                                                                                                                |      |
| Color                        | <input checked="" type="checkbox"/> Mono. <input type="checkbox"/> Grayscale <input type="checkbox"/> _____                                                                                                                                                                                                                                                                                                                                                                         |      |
| Module Dimension (W x H x T) | 166.0(W) X 109(H) X 8.0(T)                                                                                                                                                                                                                                                                                                                                                                                                                                                          | mm   |
| Viewing Area (W x H)         | 121.0(W) X 91.6(H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | mm   |
| Active Area (W x H)          | 115.17(W) x 86.37(H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                | mm   |
| Character Size (W x H)       | \                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | mm   |
| Character Pitch (W x H)      | \                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | mm   |
| DOT Size (W x H)             | 0.33(W) x 0.33(H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | mm   |
| DOT Pitch (W x H)            | 0.36(W) x 0.36(H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | mm   |
| LCD Type                     | <input type="checkbox"/> TN, Positive <input type="checkbox"/> TN, Negative<br><input type="checkbox"/> HTN, Positive <input type="checkbox"/> HTN, Negative<br><input type="checkbox"/> STN, Yellow-Green <input type="checkbox"/> STN, Gray <input type="checkbox"/> STN, Blue<br><input checked="" type="checkbox"/> FSTN, Positive <input type="checkbox"/> FSTN, Negative<br><input type="checkbox"/> _____ <input type="checkbox"/> FM LCD <input type="checkbox"/> Color STN |      |
| Polarizer Type               | <input type="checkbox"/> Transflective <input checked="" type="checkbox"/> Transmissive <input type="checkbox"/> Reflective<br><input type="checkbox"/> Anti-Glare                                                                                                                                                                                                                                                                                                                  |      |
| View Direction               | <input checked="" type="checkbox"/> 6H <input type="checkbox"/> 12H <input type="checkbox"/> _____                                                                                                                                                                                                                                                                                                                                                                                  |      |
| LCD Controller               | <b>S1D13700</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |
| LCD Driver                   | <b>NT7701(Segment)+NT7702(Common)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |
| LCD Driving Method           | <b>1/240 duty, 1/15 bias</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |
| Interface Type               | Serial <input type="checkbox"/> I <sup>2</sup> C <input type="checkbox"/> 4-line SPI <input type="checkbox"/> 3-line SPI <input type="checkbox"/> _____<br>Parallel <input type="checkbox"/> 6800 <input checked="" type="checkbox"/> 8080 <input type="checkbox"/> 4-bit <input type="checkbox"/> _____                                                                                                                                                                            |      |
| Backlight Type               | <input type="checkbox"/> LED <input type="checkbox"/> Bottom <input type="checkbox"/> Single Side <input type="checkbox"/> Dual Side<br><input type="checkbox"/> _____ <input type="checkbox"/> EL <input checked="" type="checkbox"/> CCFL                                                                                                                                                                                                                                         |      |
| Backlight Color              | <input type="checkbox"/> Yellow-Green <input checked="" type="checkbox"/> White <input type="checkbox"/> Amber<br><input type="checkbox"/> Blue <input type="checkbox"/> Red <input type="checkbox"/> _____                                                                                                                                                                                                                                                                         |      |
| EL/CCFL Driver type          | <input type="checkbox"/> Build-in <input checked="" type="checkbox"/> External                                                                                                                                                                                                                                                                                                                                                                                                      |      |
| DC-DC Converter              | <input type="checkbox"/> Build-in <input checked="" type="checkbox"/> External                                                                                                                                                                                                                                                                                                                                                                                                      |      |
| Operation Temperature        | T <sub>OPL</sub> = 0<br>T <sub>OPH</sub> = 45                                                                                                                                                                                                                                                                                                                                                                                                                                       | °C   |
| Storage Temperature          | T <sub>STL</sub> = -25<br>T <sub>STH</sub> = 60                                                                                                                                                                                                                                                                                                                                                                                                                                     | °C   |

# Electro-optical Specifications

## Absolute Maximum Ratings

| No | Item                          | Symbol          | Min.         | Max.         | Unit |
|----|-------------------------------|-----------------|--------------|--------------|------|
| 1  | Supply Voltage For Logic      | $V_{DD}-V_{SS}$ | -0.3         | 7.0          | V    |
| 2  | Supply Voltage For LCD Driver | $V_{LCD}$       | -0.3         | 30.0         | V    |
| 3  | Input Voltage                 | $V_I$           | $V_{SS}-0.3$ | $V_{DD}+0.3$ | V    |

Note: Operating Temperature and Storage Temperature can be found in 1.General Specifications.

## Optical Characteristics<sup>(1)</sup>

| No | Item           |     | Symbol           | Condition                                           | Min. | Typ. | Max. | Unit |
|----|----------------|-----|------------------|-----------------------------------------------------|------|------|------|------|
| 1  | Contrast Ratio |     | Cr               | Ta=23±3°C<br>V <sub>LCD</sub> = Typ. <sup>(2)</sup> | -    | 3.0  | 3.5  | -    |
| 2  | Response time  |     | T <sub>ON</sub>  | Ta=23±3°C                                           | -    | 230  | 250  | ms   |
| 3  | Response time  |     | T <sub>OFF</sub> | Ta=23±3 °C                                          | -    | 320  | 350  | ms   |
| 4  | Viewing Angle  | 6H  | Θ1               | Cr = 2<br>Ta=23±3°C                                 | -    | 48   | -    | Deg. |
| 5  |                | 12H | Θ2               |                                                     | -    | 23   | -    | Deg. |
| 6  |                | 3H  | Θ3               |                                                     | -    | 48   | -    | Deg. |
| 7  |                | 9H  | Θ4               |                                                     | -    | 46   | -    | Deg. |

Note:

(1) See Appendix Definition of Optical Characteristics for detail.

(2)  $V_{LCD}$  can be found in 4.2 Electrical Characteristics *Supply Voltage for LCD Driver*

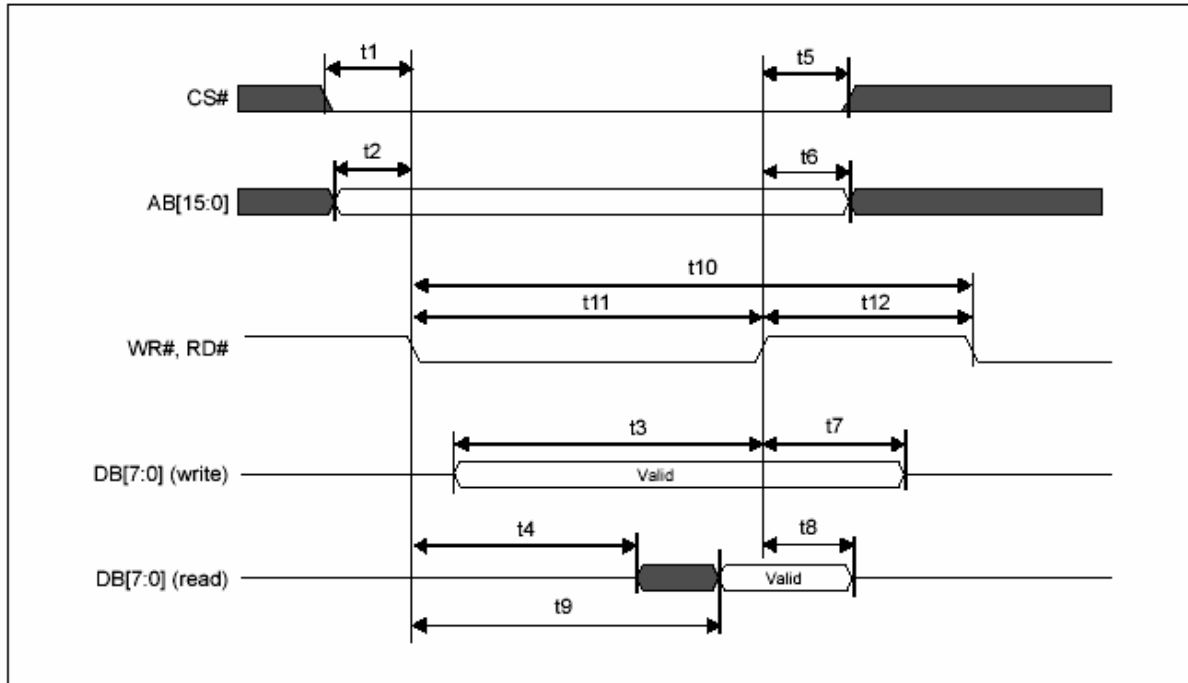
## Electrical Characteristics

| No | Item                          | Symbol          | Condition                    | Min. | Typ. | Max. | Unit |
|----|-------------------------------|-----------------|------------------------------|------|------|------|------|
| 1  | Supply Voltage for Logic      | $V_{DD}-V_{SS}$ | -                            | 3.2  | 3.3  | 3.4  | V    |
| 2  | Supply Voltage for LCD Driver | $V_{LCD}$       | $T_a=23\pm3^{\circ}\text{C}$ | 21.8 | 22.0 | 22.2 | V    |
| 3  | Supply Current for Logic      | $I_{DD}$        | -....                        | -    | -    | 3.0  | mA   |
| 4  | Frame Frequency               | $f_M$           | $T_a=23\pm3^{\circ}\text{C}$ | 70   | 75   | 80   | Hz   |

|   |                     |          |   |              |   |              |   |
|---|---------------------|----------|---|--------------|---|--------------|---|
| 5 | Input High Voltage  | $V_{IH}$ | - | $0.8 V_{DD}$ | - | $V_{DD}$     | V |
| 6 | Input Low Voltage   | $V_{IL}$ | - | $V_{SS}$     | - | $0.2 V_{DD}$ | V |
| 7 | Output High Voltage | $V_{OH}$ | - | $0.8 V_{DD}$ | - | $V_{DD}$     | V |
| 8 | Output Low Voltage  | $V_{OL}$ | - | $V_{SS}$     | - | $0.2 V_{DD}$ | V |

|    |                                   |            |                                                         |   |     |     |    |
|----|-----------------------------------|------------|---------------------------------------------------------|---|-----|-----|----|
| 9  | Supply Current for CCFL Backlight | $I_{CCFL}$ | $V_{LED} = \text{Typ.}$<br>$T_a=23\pm3^{\circ}\text{C}$ | - | 5.0 | 6.0 | mA |
| 10 | Supply Voltage for CCFL Backlight | $V_{CCFL}$ | $I_{LED} = \text{Typ.}$<br>$T_a=23\pm3^{\circ}\text{C}$ | - | 500 | -   | V  |

## Timing Characteristics



| Symbol | Parameter                                            | 3.3 Volt |        | 5.0 Volt |        | Units |
|--------|------------------------------------------------------|----------|--------|----------|--------|-------|
|        |                                                      | Min      | Max    | Min      | Max    |       |
| t1     | CS# setup time                                       | 5        | —      | 5        | —      | ns    |
| t2     | AB[15:0] setup time                                  | 5        | —      | 5        | —      | ns    |
| t3     | DB[7:0] setup time to WR# rising edge (write cycle)  | Note 2   | —      | Note 2   | —      | ns    |
| t4     | RD# falling edge to DB[7:0] driven (read cycle)      | 3        | —      | 3        | —      | ns    |
| t5     | CS# hold time                                        | 7        | —      | 7        | —      | ns    |
| t6     | AB[15:0] hold time                                   | 7        | —      | 7        | —      | ns    |
| t7     | DB[7:0] hold time from WR# rising edge (write cycle) | 5        | —      | 5        | —      | ns    |
| t8     | DB[7:0] hold time from RD# rising edge (read cycle)  | 3        | 14     | 3        | 14     | ns    |
| t9     | RD# falling edge to valid Data (read cycle)          | —        | Note 3 | —        | Note 3 | ns    |
| t10    | RD#, WR# cycle time                                  | Note 4   | —      | Note 4   | —      | ns    |
| t11    | RD#, WR# pulse active time                           | 5        | —      | 5        | —      | Ts    |
| t12    | RD#, WR# pulse inactive time                         | Note 5   | —      | Note 5   | —      | ns    |

1. Ts = System clock period
2. t3min = 2Ts + 5
3. t9max = 4Ts + 18 (for 3.3V)  
= 4Ts + 20 (for 5.0V)
4. t10min = 6Ts (for a read cycle followed by a read or write cycle)  
= 7Ts + 2 (for a write cycle followed by a write cycle)  
= 10Ts + 2 (for a write cycle followed by a read cycle)
5. t12min = 1Ts (for a read cycle followed by a read or write cycle)  
= 2Ts + 2 (for a write cycle followed by a write cycle)  
= 5Ts + 2 (for a write cycle followed by a read cycle)

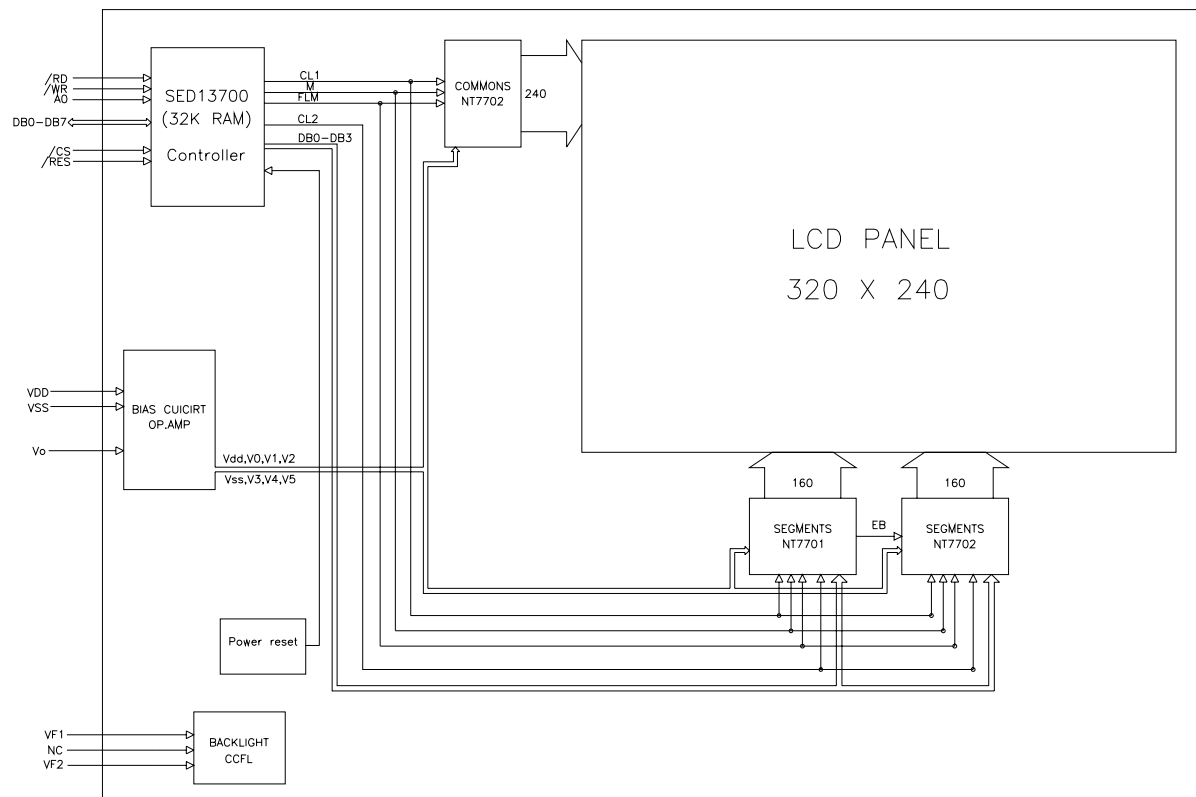
**Note:** See Data sheet of S1D13700 for detail.

# I/O Terminal

## Pin Description

| Pin NO. | Symbol | Function Description                                                                                                                                    |
|---------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | V0     | Power Supply for LCD Driver. (22V)                                                                                                                      |
| 2       | VDD    | Power Supply for Logic Cuicuit                                                                                                                          |
| 3       | VSS    | Ground                                                                                                                                                  |
| 4       | /CS    | Chip select input. Data input is enable when CS is LOW.                                                                                                 |
| 5       | /RES   | When RES is caused to go LOW, initialization is executed.                                                                                               |
| 6       | A0     | It identifies the data from MPU as display data or command.<br>HIGH: identified as display data or a command parameter.<br>LOW: identified as a command |
| 7       | /RD    | P/S=LOW : High impedance<br>P/S=HIGH : Parallel interface read signa                                                                                    |
| 8       | /WR    | P/S=LOW : High impedance<br>P/S=HIGH : Parallel interface write signal                                                                                  |
| 9-16    | D0-D7  | 8-bit bi-directional data bus.                                                                                                                          |

## Block Diagram



\*IC SED13700 has 32K bit RAM inside

# Programming

## Instruction Table<sup>(1)</sup>

| Class           | Register Address | Command     | Register Description                            | Control Byte Value | No. of Bytes |
|-----------------|------------------|-------------|-------------------------------------------------|--------------------|--------------|
| System Control  | 8000h - 8007h    | SYSTEM SET  | Initializes device and display                  | 40h                | 8            |
|                 | 8008h            | POWER SAVE  | Enters standby mode                             | 53h                | 0            |
| Display Control | 8009h - 800A     | DISP ON/OFF | Enables/disables display and display attributes | 58h<br>59h         | 1            |
|                 | 800Bh - 8014h    | SCROLL      | Sets screen block start addresses and sizes     | 44h                | 10           |
|                 | 8015h - 8016h    | CSRFORM     | Sets cursor type                                | 5Dh                | 2            |
|                 | 8017h            | CSRDIR      | Sets direction of cursor movement               | 4Ch - 4Fh          | 0            |
|                 | 8018h            | OVLAY       | Sets display overlay format                     | 5Bh                | 1            |
|                 | 8019h - 801Ah    | CGRAM ADR   | Sets start address of character generator RAM   | 5Ch                | 2            |
|                 | 801Bh            | HDOT SCR    | Sets horizontal scroll position                 | 5A                 | 1            |
| Drawing Control | 801Ch - 801Dh    | CSRW        | Sets cursor address                             | 46h                | 2            |
|                 | 801Eh - 801Fh    | CSRR        | Reads cursor address                            | 47h                | 2            |
|                 | 8020h            | GRAYSCALE   | Sets the Grayscale depth (bpp)                  | 60h                | 1            |
| Memory Control  |                  | MEMWRITE    | Writes to memory                                | 42h                | n/a          |
|                 |                  | MEMREAD     | Reads from memory                               | 43h                |              |

(1) Note: See Data sheet of S1D13700 for detail.

## Display Data RAM

### *Relationship between Display Memory and Screens*

The display memory of the S1D13700 may be used as a virtual screen of greater width than the physical size of the LCD panel address range (C/R). One layer of the S1D13700 may be considered a window through which to look at the part of display memory that comprises a virtual screen. This window can be divided into two blocks that may correspond to independent areas on the virtual screen. Therefore, it is possible to use one block as a dynamically scrollable data area and the other as a stationary message area. (See Figures 4-7 and 4-8.)

Screen

Screen

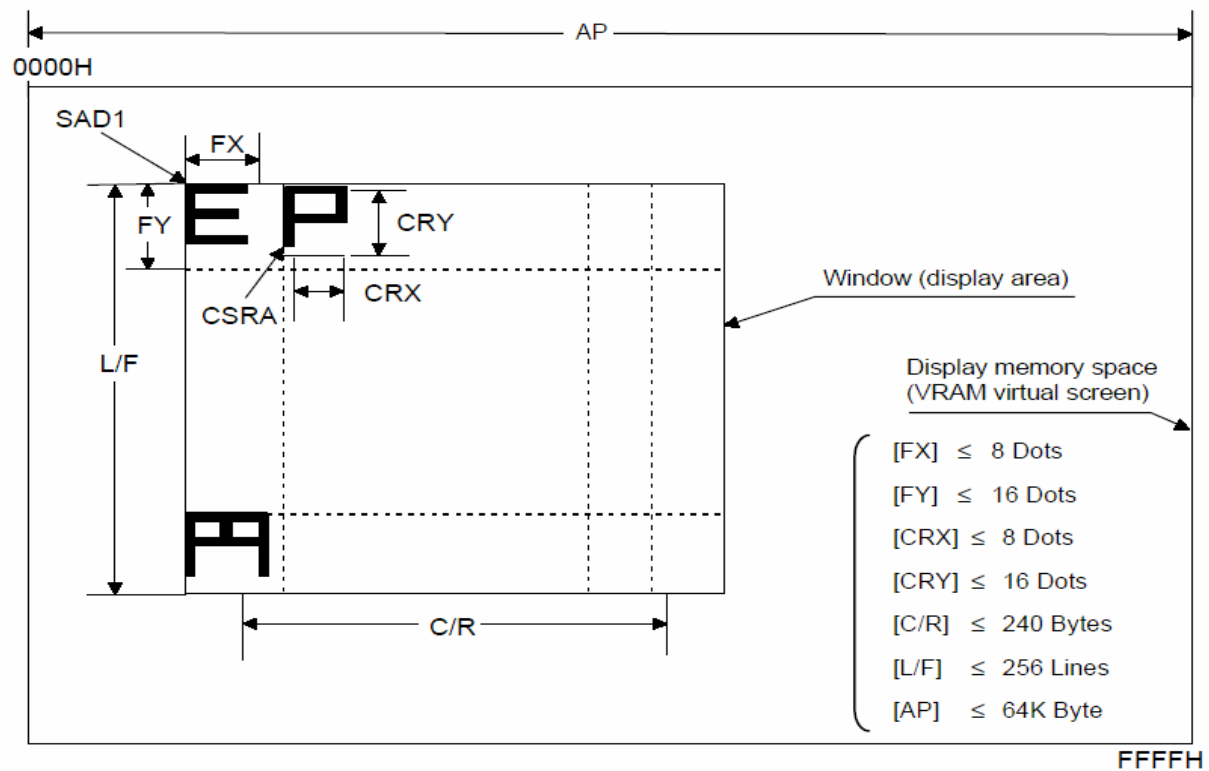
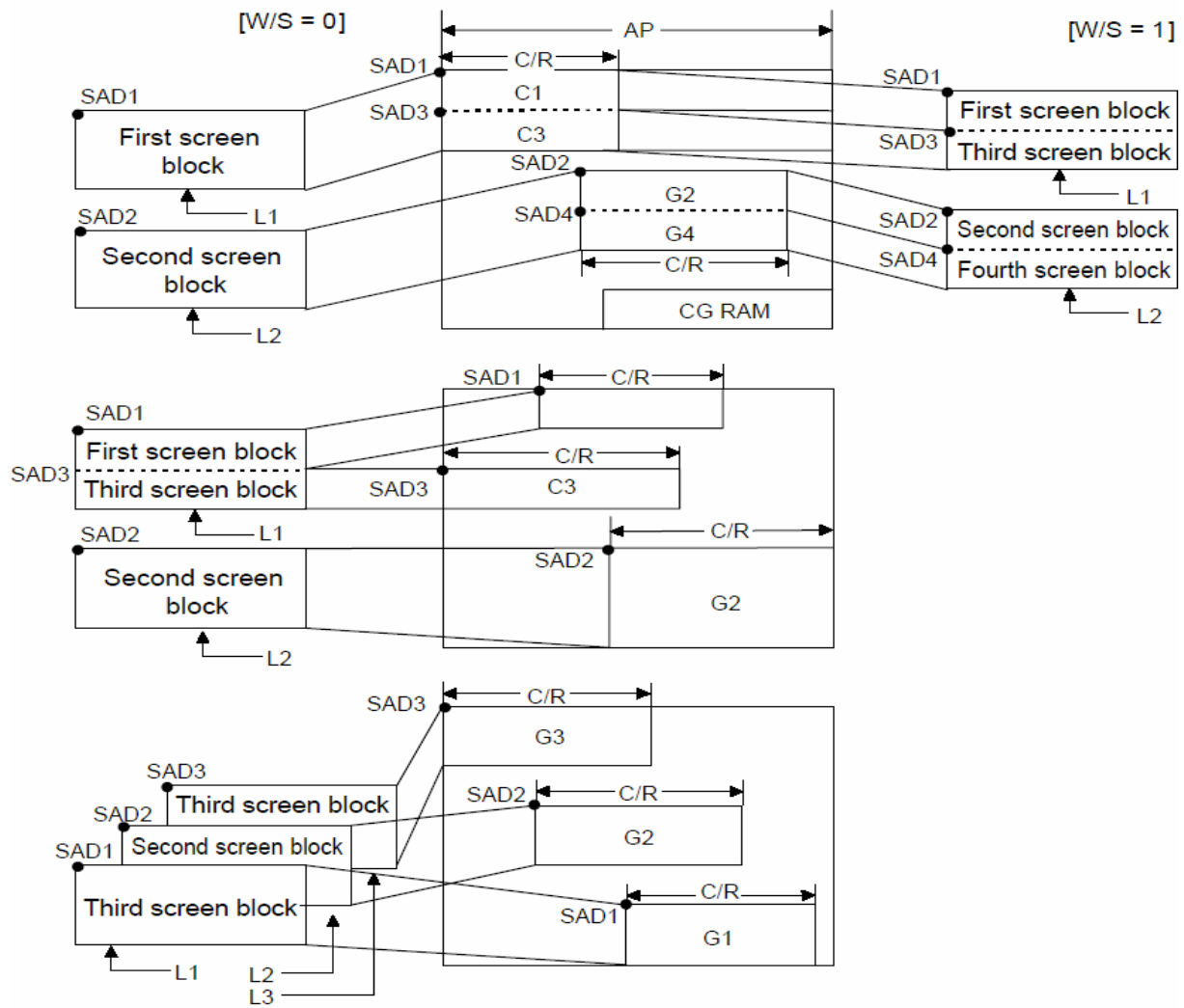


Figure 4-8 Window and display memory settings

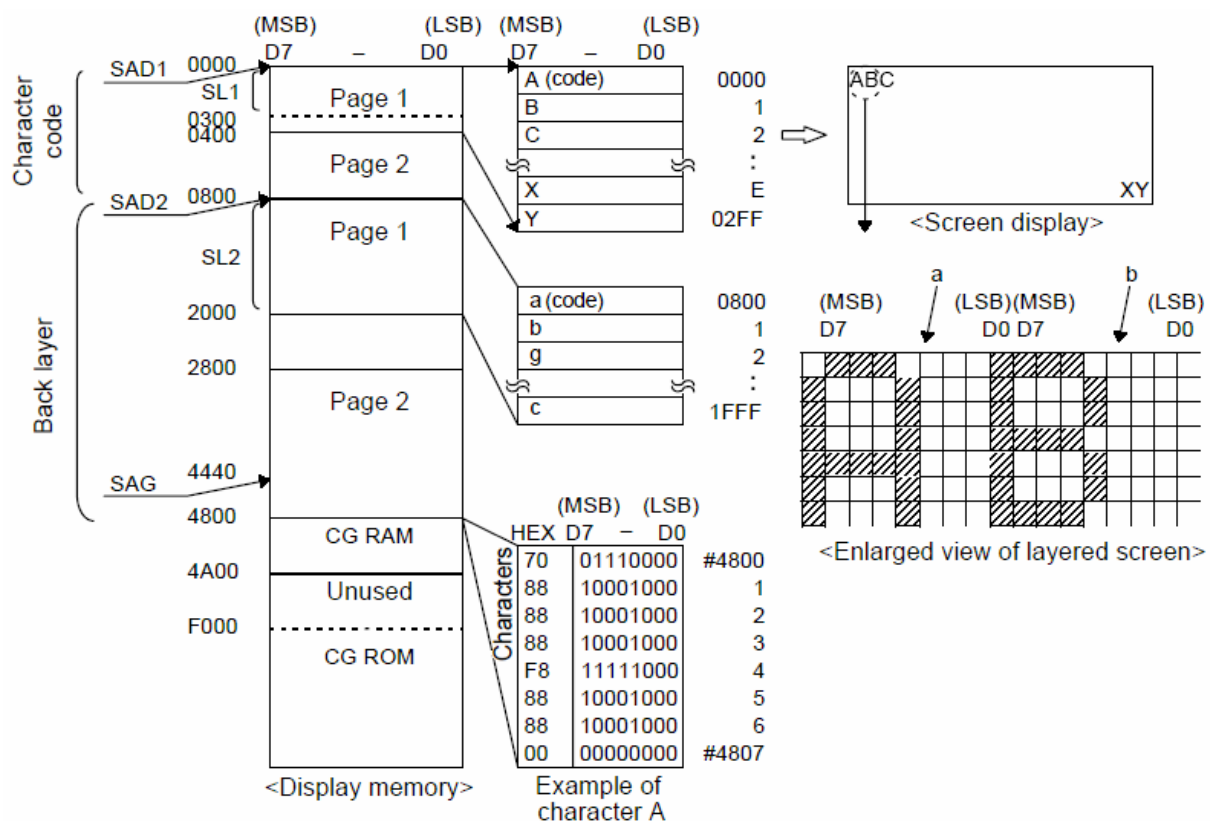
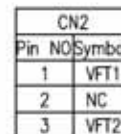


Figure 4-9 Example of display memory mapping

(1) Note: See Relationship between Display Memory and Screens of S1D13700 for detail.



SHEET 1 OF 1

