

SPECIFICATION



YMSP-G320240BDBCWSD

April 24, 2008

Version 1.0



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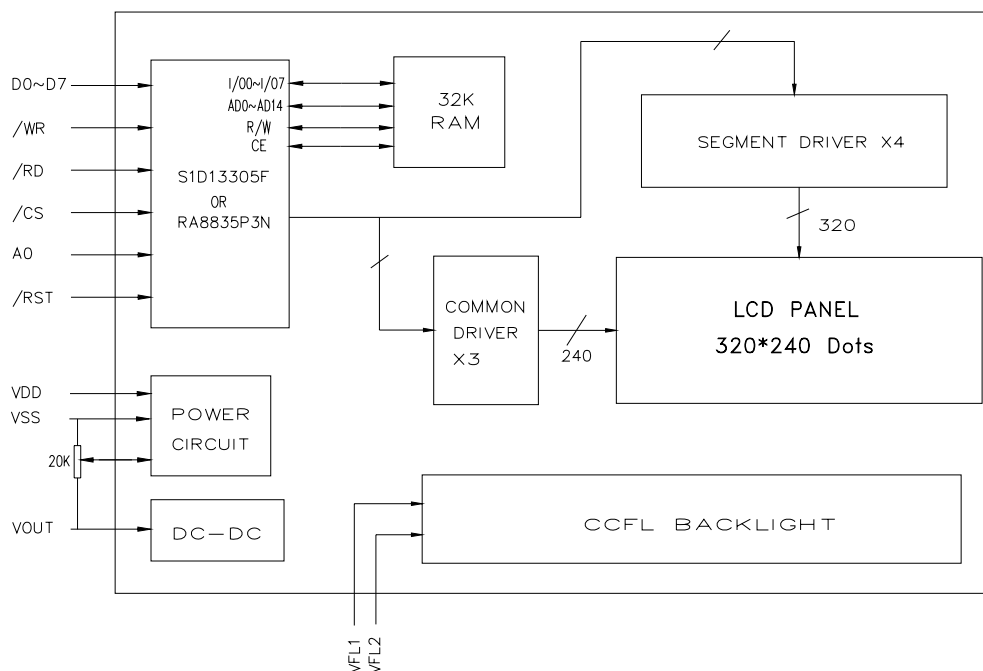
1. FEATURE

ITEM	STANDARD VALUE	UNIT
Display Type	320 *240 dots	-
LCD Type	<input checked="" type="checkbox"/> STN, BLUE, Transflective, Negative, Narrow TEMP <input type="checkbox"/> STN, YELLOW-GREEN, Transflective, Position, Extend TEMP <input type="checkbox"/> FSTN, Transflective, Position, Extend TEMP	-
LCD Duty	1/240	-
LCD Bias	1/17	-
Viewing Direction	6:00	-
Backlight Type	<input checked="" type="checkbox"/> CCFL(White) <input type="checkbox"/> LED(White)	-
Interface	6800 Series or 8080 series	-
Driver IC	SED1335F0A/RA8835P3N	-

2. MACHANICAL SPECIFICATIONS

ITEM	STANDARD VALUE	UNIT
MODULE DIMENSION	139.0(W) X120.0(H) X 12.0(T)	mm
EFFECTTVE DISPLAY AREA	103.0(W) X79.0(H)	mm
DOT SIZE	0.27(W) X 0.27(H)	mm
DOT PITCH	0.30(W) X 0.30(H)	mm

3. BLOCK DIAGRAM



4. ABSOLUTE MAXIMUM RATINGS(Ta=25°C)

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	VDD	-0.3	7.0	V
Supply voltage for LCD	VDD-V0	-0.3	30	V
Input voltage	VI	-0.5	VDD+0.5	V
Operating temperature	TOP	-20	70	°C
Storage temperature	TST	-30	80	°C

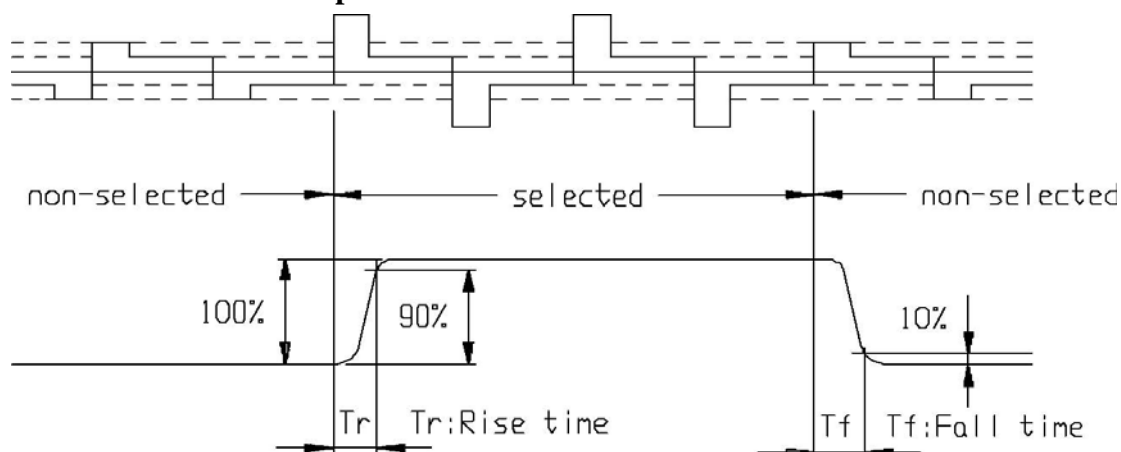
5. ELECTRICAL CHARACTERISTICS(VDD=+5.0±10%,VSS=0V,Ta=25°C)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for logic	VDD	---	4.5	5.0	5.5	V
Supply current for logic	IDD	---	---	11.9	20	mA
Operating voltage for LCD	VDD-V0	25°C	23.7	24.9	26.1	V
Supply voltage for backlight	V-BL	CCFL	---	550	---	V
		LED	---	4.2	4.6	V
Supply current for backlight	I-BL	V-BL=550V	---	530	---	mA
		V-BL=4.2V	---	260	440	mA
Input voltage "H" level	VIH	---	2.0	---	VDD	V
Input voltage "L" level	VIL	---	0	---	0.8	V

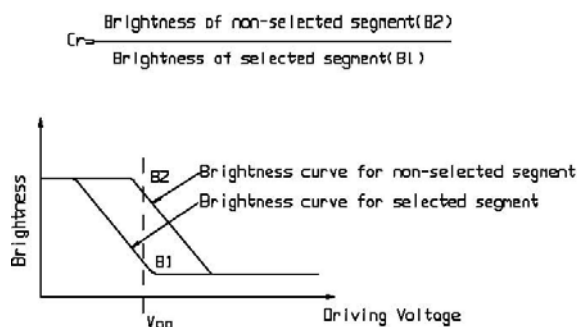
6. OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Response Time	Tr	-	-	140	-	ms	-	1
	Tf	-	-	133	-	ms	-	1
Contrast Ratio	Cr	-	-	5.1	-	-	-	2
Viewing Angle Range	θ	Cr ≥ 2	41	-	-	deg	∅ = 90	3
			38	-	-	deg	∅ = 270	3
			32	-	-	deg	∅ = 0	3
			19	-	-	deg	∅ = 180	3

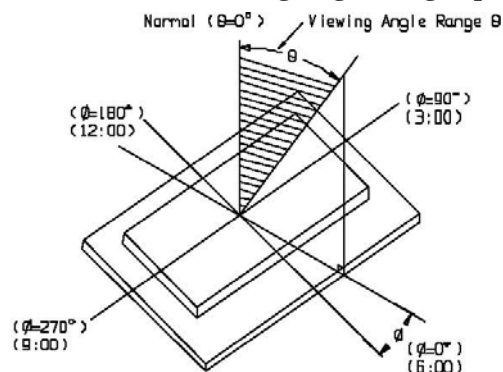
Note 1. Definition of response time



Note 2. Definition of Contrast Ratio ‘Cr’

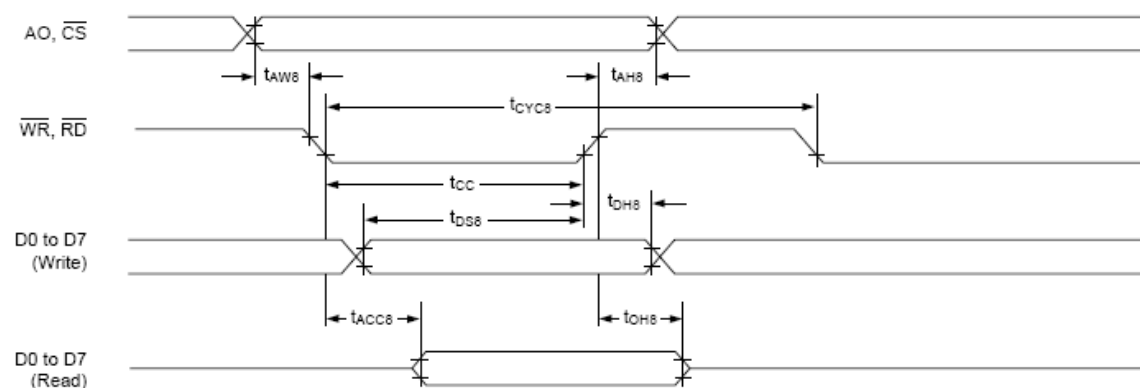


Note 3. Definition of Viewing Angle Range ‘q’



7. TIMING CHARACTERISTICS

8080 Series Timing



$T_a = -20$ to 75°C

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
A0, \overline{CS}	t_{AH8}	Address hold time	10	—	10	—	ns	CL = 100pF
	t_{AW8}	Address setup time	0	—	0	—	ns	
$\overline{WR}, \overline{RD}$	t_{CYC8}	System cycle time	See note.	—	See note.	—	ns	
	t_{CC}	Strobe pulsewidth	120	—	150	—	ns	
D0 to D7	t_{DS8}	Data setup time	120	—	120	—	ns	
	t_{DH8}	Data hold time	5	—	5	—	ns	
	t_{ACC8}	\overline{RD} access time	—	50	—	80	ns	
	t_{OH8}	Output disable time	10	50	10	55	ns	

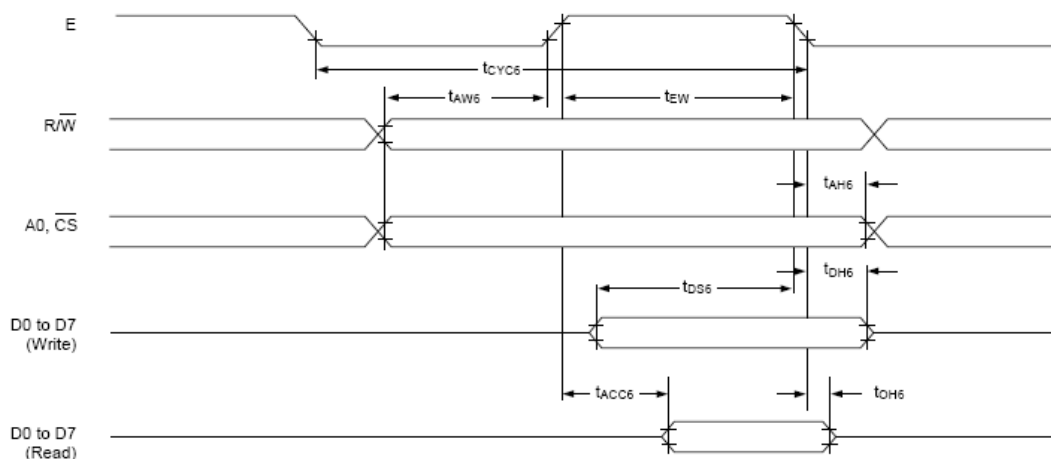
Note: For memory control and system control commands:

$t_{CYC8} = 2t_c + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$

For all other commands:

$t_{CYC8} = 4t_c + t_{CC} + 30$

6800 Series Timing



Note: t_{CYC6} indicates the interval during which CS is LOW and E is HIGH.

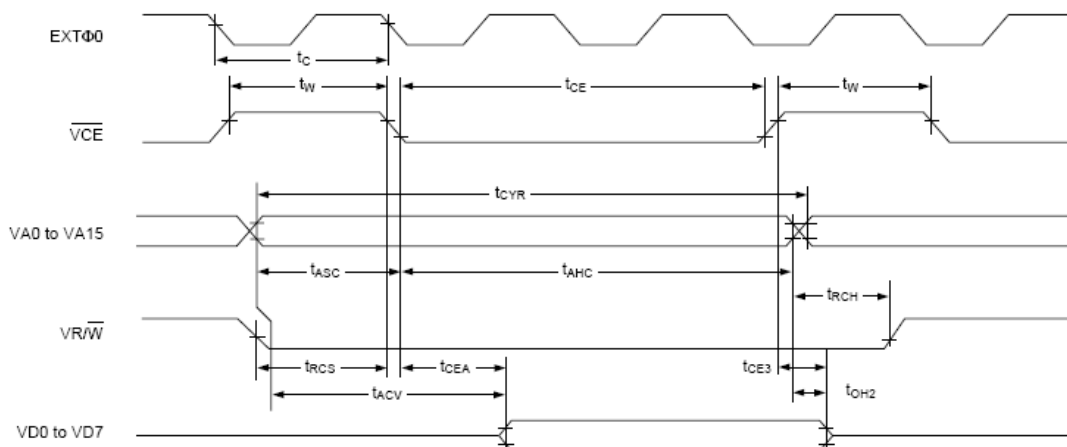
$T_a = -20$ to 70°C

Signal	Symbol	Parameter	Rating		Unit	Condition
			min	max		
A0, \overline{CS} R/W	t_{AH6}	Address hold time	10	---	ns	CL = 100+1TTL pF
	t_{AW6}	Address setup time	30	---	ns	
	t_{CYC6}	System cycle time	(1)	---	ns	
	t_{CC}	Strobe pulsewidth	220	---	ns	
D0 to D7	t_{DS6}	Data setup time	120	---	ns	
	t_{DH6}	Data hold time	10	---	ns	
	t_{ACC6}	RD access time	---	120	ns	
	t_{OH6}	Output disable time	10	50	ns	
E	t_{EW}	Enable pulse width	220	---	ns	

Note: (1) $t_{CYC6} = 2t_c + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$:
 memory control/movement control commands:
 $= 4t_c + t_{EW} + 30$:
 all other commands:

1. t_{CYC6} means a cycle of (CS.E) not E alone.

Display memory read timing

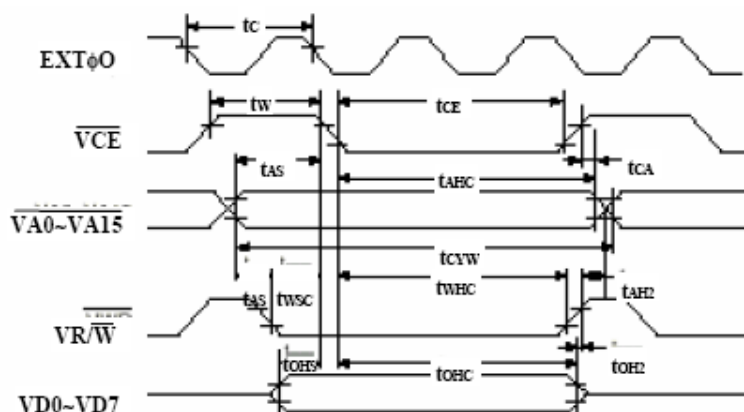


Ta=-20 to 70°C

Signal	Symbol	Parameter	Rating		Unit	Condition
			min	max		
EXT ϕ 0	tC	Clock cycle	100	---	ns	CL = 100pF +1TTL
VCE	tW	VCE high level pulse width	tc-40	---	ns	
	tCE	VCE low level pulse width	2tc-40	---	ns	
VA0 to VA15	tCYR	Read cycle time	(1)	---	ns	
	tASC	VCE address setup time (fall)	tc-45	---	ns	
	tAHC	VCE address hold time (fall)	2tc-40	---	ns	
VR/W	tRCS	VCE read cycle setup time (fall)	tc-45	---	ns	
	tRCH	VCE read cycle hold time (fall)	tc/2-35			
VD0 to VD7	tACV	Address access time	---	(2)	ns	
	tCEA	VCE access time	---	(3)	ns	
	tOH2	Output data hold time	0	---	ns	
	tCE2	VCE data off time	0			

- Note:**
1. tCYR = 3tC
 2. tACV = 3tC - 120
 3. tCEA = 2tC - 120

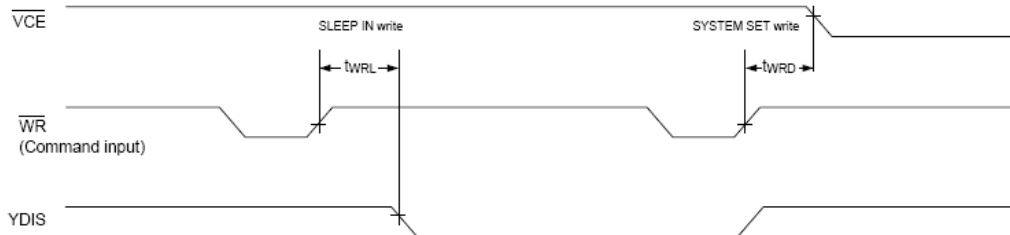
Display memory write timing



Signal	Symbol	Parameter	Rating		Unit	Condition
			min	max		
EXT ϕ 0	tC	Clock cycle	100	---	ns	CL = 100pF +1TTL
VCE	tW	VCE high level pulse width	tc-40	---	ns	
	tCE	VCE low level pulse width	2tc-40	---	ns	
VA0 to VA15	tCYR	Read cycle time	3tc	---	ns	
	tAHC	VCE address hold time (fall)	2tc-40	---	ns	
	tASC	VCE address setup time (fall)	tc-55	---	ns	
	tCA	VCE address hold time (rise)	5	---	ns	
	tAS	VR/W address setup time (fall)	0	---	ns	
	tAH2	VR/W address hold time (rise)	15	---	ns	
VR/W	tWSC	VCE write setup time (fall)	tc-55	---	ns	
	tWHC	VCE write hold time (fall)	tc/2-40	---	ns	
VD0 to VD7	tDSC	VCE data input setup time (fall)	twsc-10	---	ns	
	tDHC	VCE data input hold time (fall)	2tc-30	---	ns	
	tDH2	VR/W data hold time (rise)	10*	50	ns	

* Lines VD0 to VD7 are latched.

Sleep in command timing



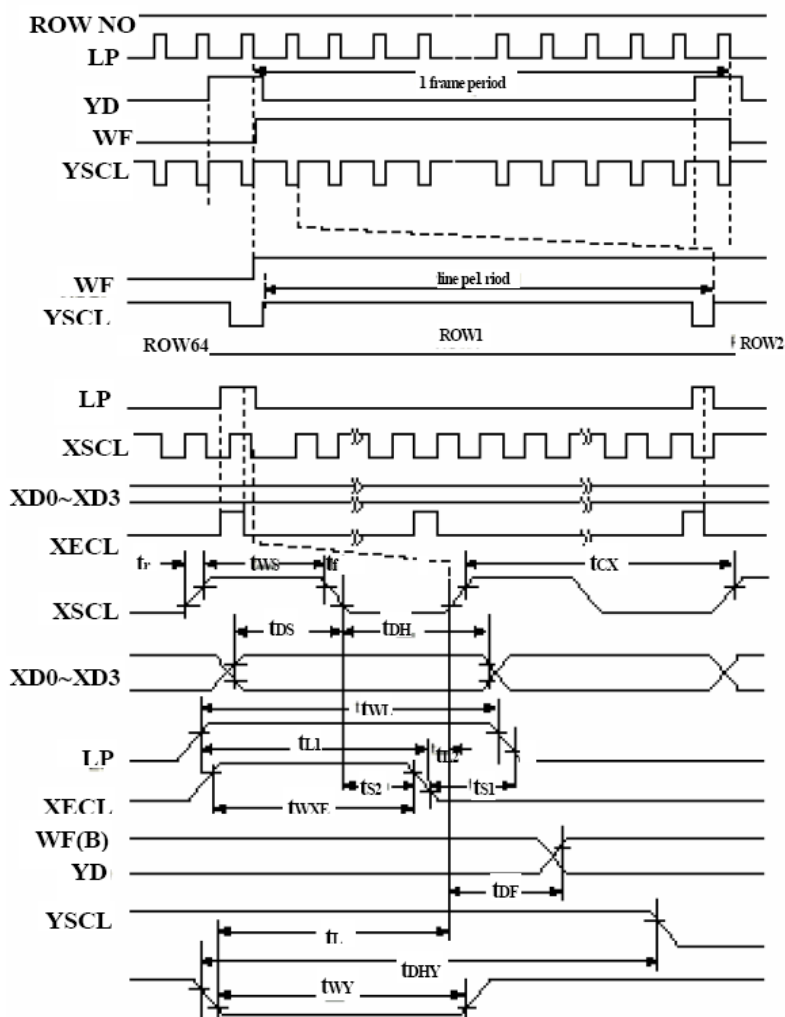
Ta = -20 to 75°C

Signal	Symbol	Parameter	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		Unit	Condition
			min	max	min	max		
WR	tWRD	VCE falling-edge delay time	See note 1.	—	See note 1.	—	ns	CL = 100 pF
	tWRL	YDIS falling-edge delay time	—	See note 2.	—	See note 2.	ns	

Notes:

1. $t_{WRD} = 18t_c + t_{OSS} + 40$ (t_{OSS} is the time delay from the sleep state until stable operation)
2. $t_{WRL} = 36t_c \times [TC/R] \times [L/F] + 70$

LCD Control timing





Signal	Symbol	Parameter	Rating		Unit	Condition
			min	max		
EXT \emptyset 0	tC	Clock cycle	100	---	ns	VDD=5.0V ±10% CL=150F
	tr	VCE high level pulse width	---	35	ns	
	tf	VCE low level pulse width	---	35	ns	
XSCL	tCX	Shift clock cycle time	4tc	---	ns	
	tWX	XSCL clock pulse width	tcx2-80	---	ns	
XD0 to XD3	tDH	X-data hold time	tcx2-100	---	ns	
	tDS	X-data setup time	tcx2-100	---	ns	
LP	tLS	Latch data setup time	tcx2-100	---	ns	
	tWL	LP signal pulse width	tcx4-80	---	ns	
XSCL	tL1	XECL setup time	tc-30	---	ns	
	tL2	XECL data hold time	tc-30	---	ns	
	tS1	Enable setup time	tc-30	---	ns	
	tS1	Enable delay time	tc-30	---	ns	
	tWXE	XECL clock pulse width	tcx3-80	---	ns	
WF	tDF	Time allowance of WF delay	---	100	ns	
YSCL	tLD	LP delay time against YSCL	tcx4-100	---	ns	
	tWY	YSCL clock pulse width	tcx4-80	---	ns	
YD	tDHY	Y-data hold time	tcx6-100	---	ns	

8. INSTRUCTION SET

8.1 The Command Set

Table 1. Command set

Class	Command	Code												Hex	Command Description	Command Read Parameters	
		RD	WR	A0	D7	D6	D5	D4	D3	D2	D1	D0	No. of Bytes			Section	
System control	SYSTEM SET	1	0	1	0	1	0	0	0	0	0	0	0	40	Initialize device and display	8	8.2.1
	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode	0	8.2.2	
Display control	DISP ON/OFF	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing	1	8.3.1	
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions	10	8.3.2	
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type	2	8.3.3	
	CGRAM ADR	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2	8.3.6	
	CSRDIR	1	0	1	0	1	0	0	1	1	CD	CD	4C to 4F	Set direction of cursor movement	0	8.3.4	
	HDOT SCR	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position	1	8.3.7	
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format	1	8.3.5	
Drawing control	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address	2	8.4.1	
	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address	2	8.4.2	
Memory control	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory	—	8.5.1	
	MREAD	1	0	1	0	1	0	0	0	0	1	1	43	Read from display memory	—	8.5.2	

Notes:

- In general, the internal registers of the SED1335 series are modified as each command parameter is input. However, the microprocessor does not have to set all the parameters of a command and may send a new command before all parameters have been input. The internal registers for the parameters that have been input will have been changed but the remaining parameter registers are unchanged.
 - 2-byte parameters (where two bytes are treated as 1 data item) are handled as follows:
 - CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.
 - SYSTEM SET, SCROLL, CGRAM ADR: Both parameter bytes are processed together. If the command is changed after half of the parameter has been input, the single byte is ignored.
- APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.

8.2 System Control Command

8.2.1. SYSTEM SET

Initializes the device, sets the window sizes, and selects the LCD interface format. Since this command sets the basic operating parameters of the SED1335 series, an

incorrect SYSTEM SET command may cause other commands to operate incorrectly.

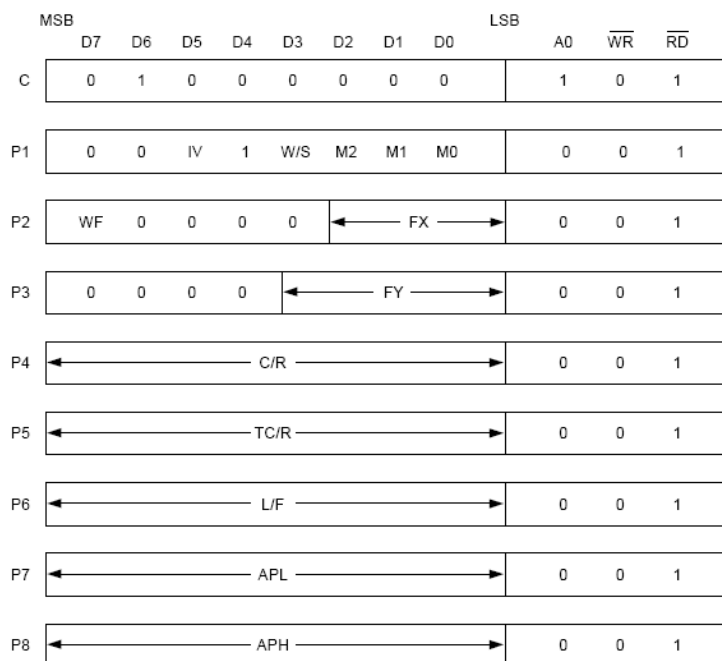


Figure 1. SYSTEM SET instruction

8.2.1.1. C

This control byte performs the following:

1. Resets the internal timing generator
2. Disables the display
3. Cancels sleep mode

Parameters following P1 are not needed if only canceling sleep mode.

8.2.1.2. M0

Selects the internal or external character generator ROM. The internal character generator ROM contains 160, 5 × 7 pixel characters, as shown in figure 70. These characters are fixed at fabrication by the metallization mask. The external character generator ROM, on the other hand, can contain up to 256 user-defined characters.

M0 = 0: Internal CG ROM
M0 = 1: External CG ROM

8.2.1.4. M2

Selects the height of the character bitmaps. Characters more than 16 pixels high can be displayed by creating a bitmap for each portion of each character and using the SED1335 series graphics mode to reposition them.

M2 = 0: 8-pixel character height (2716 or equivalent ROM)

M2 = 1: 16-pixel character height (2732 or equivalent ROM)

Note that if the CG ROM address space overlaps the display memory address space, that portion of the display memory cannot be written to.

8.2.1.3. M1

Selects the memory configuration for user-definable characters. The CG RAM codes select one of the 64 codes shown in figure 46.

M1 = 0: No D6 correction.

The CG RAM1 and CG RAM2 address spaces are not contiguous, the CG RAM1 address space is treated as character generator RAM, and the CG RAM2 address space is treated as character generator ROM.

M1 = 1: D6 correction.

The CG RAM1 and CG RAM2 address spaces are contiguous and are both treated as character generator RAM.

8.2.1.5. W/S

Selects the LCD drive method.

W/S = 0: Single-panel drive

W/S = 1: Dual-panel drive

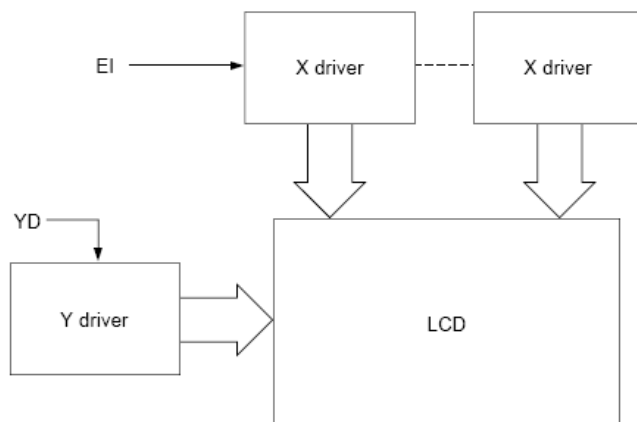


Figure 2. Single-panel display

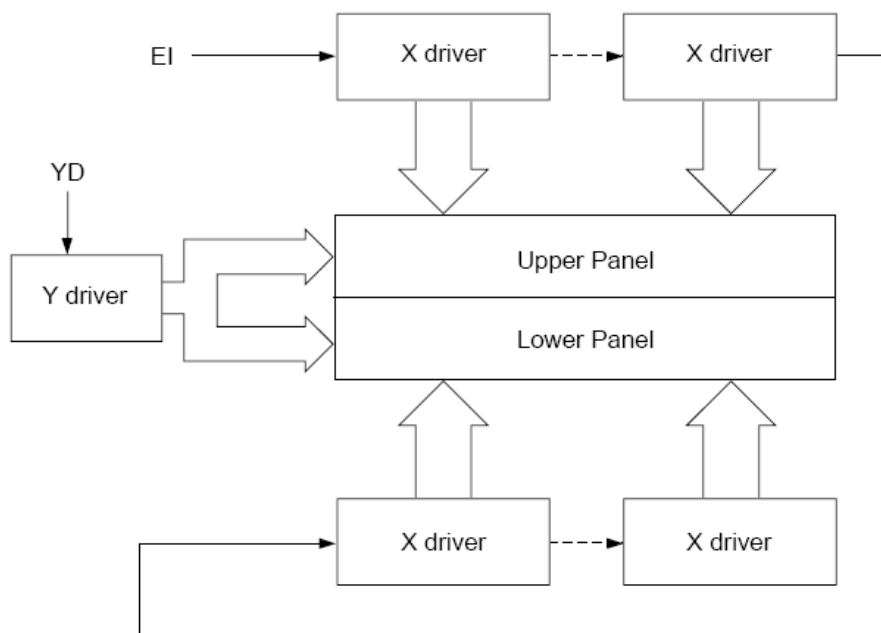


Figure 3. Above and below two-panel display

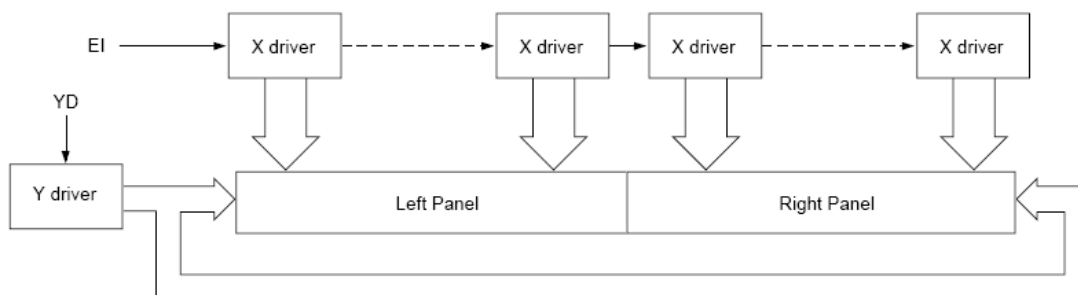


Figure 4. Left-and-right two-panel display

Note:

There are no Seiko Epson LCD units in the configuration shown in Figure 4.

Table 2. LCD parameters

Parameter	W/S = 0		W/S = 1	
	IV = 1	IV = 0	IV = 1	IV = 0
C/R	C/R	C/R	C/R	C/R
TC/R	TC/R	TC/R (See note 1.)	TC/R	TC/R
L/F	L/F	L/F	L/F	L/F
SL1	00H to L/F	00H to L/F + 1 (See note 2.)	(L/F) / 2	(L/F) / 2
SL2	00H to L/F	00H to L/F + 1 (See note 2.)	(L/F) / 2	(L/F) / 2
SAD1	First screen block	First screen block	First screen block	First screen block
SAD2	Second screen block	Second screen block	Second screen block	Second screen block
SAD3	Third screen block	Third screen block	Third screen block	Third screen block
SAD4	Invalid	Invalid	Fourth screen block	Fourth screen block
Cursor movement range	Continuous movement over whole screen		Above-and-below configuration: continuous movement over whole screen	

Notes:

1. See table 26 for further details on setting the C/R and TC/R parameters when using the HDOT SCR command.
2. The value of SL when IV = 0 is equal to the value of SL when IV = 1, plus one.

8.2.1.6. IV

Screen origin compensation for inverse display. IV is usually set to 1.

The best way of displaying inverted characters is to Exclusive-OR the text layer with the graphics background layer. However, inverted characters at the top or

The IV flag causes the SED1335 series to offset the text screen against the graphics back layer by one vertical pixel. Use the horizontal pixel scroll function (HDOT SCR) to shift the text screen 1 to 7 pixels to the right. All characters will then have the necessary surrounding background pixels that ensure easy reading of the inverted characters.

See Section 10.5 for information on scrolling.

IV = 0: Screen top-line correction

IV = 1: No screen top-line correction

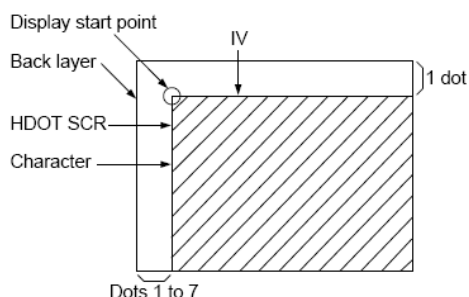


Figure 5. IV and HDOT SCR adjustment

left of the screen are difficult to read as the character origin is at the top-left of its bitmap and there are no background pixels either above or to the left of these characters.

8.2.1.7. FX

Define the horizontal character size. The character width in pixels is equal to FX + 1, where FX can range from 00 to 07H inclusive. If data bit 3 is set (FX is in the range 08 to 0FH) and an 8-pixel font is used, a space is inserted between characters.

Table 3. Horizontal character size selection

HEX	FX				[FX] character width (pixels)
	D3	D2	D1	D0	
00	0	0	0	0	1
01	0	0	0	1	2
↓	↓	↓	↓	↓	↓
07	0	1	1	1	8

Since the SED1335 series handles display data in 8-bit units, characters larger than 8 pixels wide must be formed from 8-pixel segments. As Figure 6 shows, the remainder of the second eight bits are not displayed. This also applies to the second screen layer.

In graphics mode, the normal character field is also eight pixels. If a wider character field is used, any remainder in the second eight bits is not displayed.

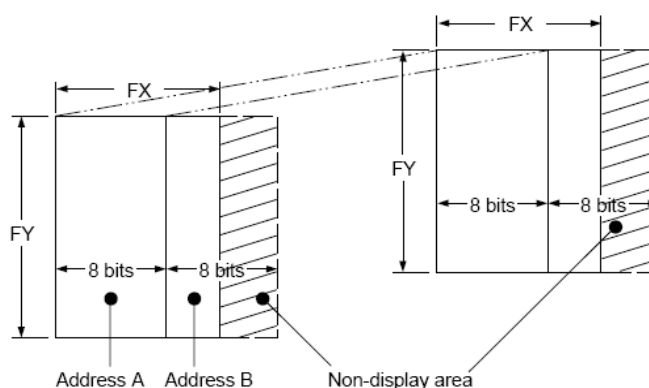


Figure 6. FX and FY display addresses

8.2.1.8. WF

Selects the AC frame drive waveform period. WF is usually set to 1.

WF = 0: 16-line AC drive

WF = 1: two-frame AC drive

In two-frame AC drive, the WF period is twice the frame period.

In 16-line AC drive, WF inverts every 16 lines.

Although 16-line AC drive gives a more readable display, horizontal lines may appear when using high LCD drive voltages or at high viewing angles.

8.2.1.9. FY

Sets the vertical character size. The height in pixels is equal to FY + 1.

FY can range from 00 to 0FH inclusive.

Set FY to zero (vertical size equals one) when in graphics mode.

8.2.1.10. C/R

Sets the address range covered by one display line, that is, the number of characters less one, multiplied by the number of horizontal bytes per character.

C/R can range from 0 to 239.

For example, if the character width is 10 pixels, then the address range is equal to twice the number of characters, less 2. See Section 16.1.1 for the calculation of C/R.

[C/R] cannot be set to a value greater than the address range. It can, however, be set smaller than the address range, in which case the excess display area is blank. The number of excess pixels must not exceed 64.

Table 4. Vertical character size selection

HEX	FY				[FY] character height (pixels)
	D3	D2	D1	D0	
00	0	0	0	0	1
01	0	0	0	1	2
↓	↓	↓	↓	↓	↓
07	0	1	1	1	8
↓	↓	↓	↓	↓	↓
0E	1	1	1	0	15
0F	1	1	1	1	16

Table 5. Display line address range

HEX	C/R								[C/R] bytes per display line
	D7	D6	D5	D4	D3	D2	D1	D0	
00	0	0	0	0	0	0	0	0	1
01	0	0	0	0	0	0	0	1	2
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
4F	0	1	0	0	1	1	1	1	80
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
EE	1	1	1	0	1	1	1	0	239
EF	1	1	1	0	1	1	1	1	240

8.2.1.11. TC/R

Sets the length, including horizontal blanking, of one line. The line length is equal to $TC/R + 1$, where TC/R can range from 0 to 255.

TC/R must be greater than or equal to $C/R + 4$. Provided this condition is satisfied, $[TC/R]$ can be set according to

the equation given in section 16.1.1 in order to hold the frame period constant and minimize jitter for any given main oscillator frequency, f_{OSC} .

Table 6. Line length selection

HEX	TC/R								[TC/R] line length (bytes)
	D7	D6	D5	D4	D3	D2	D1	D0	
00	0	0	0	0	0	0	0	0	1
01	0	0	0	0	0	0	0	1	2
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
52	0	1	0	1	0	0	1	0	83
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FE	1	1	1	1	1	1	1	0	255
FF	1	1	1	1	1	1	1	1	256

8.2.1.12. L/F

Sets the height, in lines, of a frame. The height in lines is equal to $L/F + 1$, where L/F can range from 0 to 255.

Table 7. Frame height selection

HEX	L/F								[L/F] lines per frame
	D7	D6	D5	D4	D3	D2	D1	D0	
00	0	0	0	0	0	0	0	0	1
01	0	0	0	0	0	0	0	1	2
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
7F	0	1	1	1	1	1	1	1	128
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FE	1	1	1	1	1	1	1	0	255
FF	1	1	1	1	1	1	1	1	256

If W/S is set to 1, selecting two-screen display, the number of lines must be even and L/F must, therefore, be an odd number.

8.2.1.13. AP

Defines the horizontal address range of the virtual screen.
APL is the least significant byte of the address.

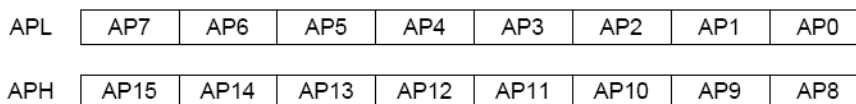


Figure 7. AP parameters

Table 8. Horizontal address range

Hex code				[AP] addresses per line
APH		APL		
0	0	0	0	0
0	0	0	1	1
↓	↓	↓	↓	↓
0	0	5	0	80
↓	↓	↓	↓	↓
F	F	F	E	$2^{16} - 2$
F	F	F	F	$2^{16} - 1$

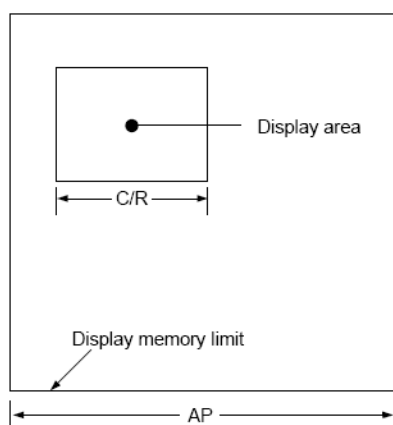


Figure 8. AP and C/R relationship

8.2.2. SLEEP IN

Places the system in standby mode. This command has no parameter bytes. At least one blank frame after receiving this command, the SED1335F halts all internal operations, including the oscillator, and enters the sleep state.

Blank data is sent to the X-drivers, and the Y-drivers have their bias supplies turned off by the YDIS signal. Using the YDIS signal to disable the Y-drivers guards against any spurious displays.

The internal registers of the SED1335 series maintain their values during the sleep state. The display memory control pins maintain their logic levels to ensure that the display memory is not corrupted.

The SED1335 series can be removed from the sleep state by sending the SYSTEM SET command with only the P1 parameter. The DISP ON command should be sent next to enable the display.

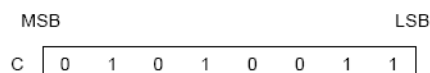


Figure 9. SLEEP IN instruction

1. The YDIS signal goes LOW between one and two frames after the SLEEP IN command is received. Since YDIS forces all display driver outputs to go to the deselected output voltage, YDIS can be used as a power-down signal for the LCD unit. This can be done by having YDIS turn off the relatively high-power LCD drive supplies at the same time as it blanks the display.
2. Since all internal clocks in the SED1335 series are halted while in the sleep state, a DC voltage will be applied to the LCD panel if the LCD drive supplies remain on. If reliability is a prime consideration, turn off the LCD drive supplies before issuing the SLEEP IN command.
3. Note that, although the bus lines become high impedance in the sleep state, pull-up or pull-down resistors on the bus will force these lines to a known state.

8.3. Display Control Commands

8.3.1. DISP ON/OFF

Turns the whole display on or off. The single-byte parameter enables and disables the cursor and layered screens, and sets the cursor and screen flash rates. The cursor can be set to flash over one character or over a whole line.

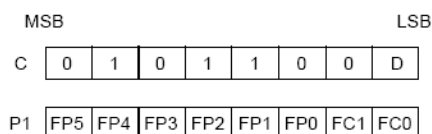


Figure 10. DISP ON/OFF parameters

8.3.1.1. D

Turns the display ON or OFF. The D bit takes precedence over the FP bits in the parameter.

D = 0: Display OFF

D = 1: Display ON

8.3.1.2. FC

Enables/disables the cursor and sets the flash rate. The cursor flashes with a 70% duty cycle (ON/OFF).

Table 9. Cursor flash rate selection

FC1	FC0	Cursor display	
0	0	OFF (blank)	
0	1	ON	No flashing
1	0		Flash at $f_{FR}/32$ Hz (approx. 2 Hz)
1	1		Flash at $f_{FR}/64$ Hz (approx. 1 Hz)

Note: As the MWRITE command always enables the cursor, the cursor position can be checked even when performing consecutive writes to display memory while the cursor is flashing.

8.3.1.3. FP

Each pair of bits in FP sets the attributes of one screen block, as follows.

The display attributes are as follows:

Table 10. Screen block attribute selection

FP1	FP0	First screen block (SAD1)	
FP3	FP2	Second screen block (SAD2, SAD4). See note.	
FP5	FP4	Third screen block (SAD3)	
0	0	OFF (blank)	
0	1	ON	No flashing
1	0		Flash at $f_{FR}/32$ Hz (approx. 2 Hz)
1	1		Flash at $f_{FR}/4$ Hz (approx. 16 Hz)

Note

If SAD4 is enabled by setting W/S to 1, FP3 and FP2 control both SAD2 and SAD4. The attributes of SAD2 and SAD4 cannot be set independently.

8.3.2. SCROLL
8.3.2.1. C

Sets the scroll start address and the number of lines per scroll block. Parameters P1 to P10 can be omitted if not

required. The parameters must be entered sequentially as shown in Figure 11.

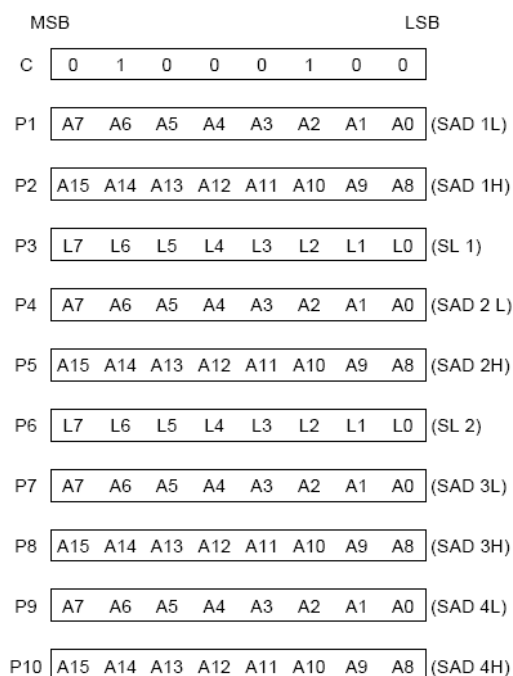


Figure 11. SCROLL instruction parameters

Note: Set parameters P9 and P10 only if both two-screen drive (W/S = 1) and two-layer configuration are selected. SAD4 is the fourth screen block display start address.

Table 11. Screen block start address selection

HEX	SL1, SL2								[SL] screen lines
	L7	L6	L5	L4	L3	L2	L1	L0	
00	0	0	0	0	0	0	0	0	1
01	0	0	0	0	0	0	0	0	1
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
7F	0	1	1	1	1	1	1	1	1
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FE	1	1	1	1	1	1	1	1	0
FF	1	1	1	1	1	1	1	1	1

8.3.2.2. SL1, SL2

SL1 and SL2 set the number of lines per scrolling screen. The number of lines is SL1 or SL2 plus one. The relation-

ship between SAD, SL and the display mode is described below.

Table 12. Text display mode

W/S	Screen	First Layer	Second Layer
0	First screen block	SAD1	SAD2
	Second screen block	SL1	SL2
	Third screen block (partitioned screen)	SAD3 (see note 1) Set both SL1 and SL2 to L/F + 1 if not using a partitioned screen.	
	Screen configuration example:		

Table 12. Text display mode (continued)

W/S	Screen	First Layer	Second Layer	
1	Upper screen	SAD1 SL1	SAD2 SL2	
	Lower screen	SAD3 (See note 2.)	SAD4 (See note 2.)	
	Set both SL1 and SL2 to $((L/F) / 2 + 1)$.			
	Screen configuration example:			

Notes:

1. SAD3 has the same value as either SAD1 or SAD2, whichever has the least number of lines (set by SL1 and SL2).
2. Since the parameters corresponding to SL3 and SL4 are fixed by L/F, they do not have to be set in this mode.

Table 13. Graphics display mode

W/S	Screen	First Layer	Second Layer	Third Layer	
0	Two-layer composition	SAD1 SL1	SAD2 SL2		
	Upper screen	SAD3 (see note 3.) Set both SL1 and SL2 to L/F + 1 if not using a partitioned screen			
	Screen configuration example:				
0	Three-layer configuration	SAD1 SL1 = L/F + 1	SAD2 SL2 = L/F + 1	SAD3 —	
	Screen configuration example:				

Table 13. Graphics display mode (continued)

W/S	Screen	First Layer	Second Layer	Third Layer
1	Upper screen	SAD1 SL1	SAD2 SL2	—
	Lower screen	SAD3 (See note 2.)	SAD4 (See note 2.)	—
	Set both SL1 and SL2 to $((L/F) / 2 + 1)$. Screen configuration example (See note 3.):			

Notes:

1. SAD3 has the same value as either SAD1 or SAD2, whichever has the least number of lines (set by SL1 and SL2).
2. Since the parameters corresponding to SL3 and SL4 are fixed by L/F, they do not have to be set.
3. If, and only if, W/S = 1, the differences between SL1 and $(L/F + 1) / 2$, and between SL2 and $(L/F + 1) / 2$, are blanked.

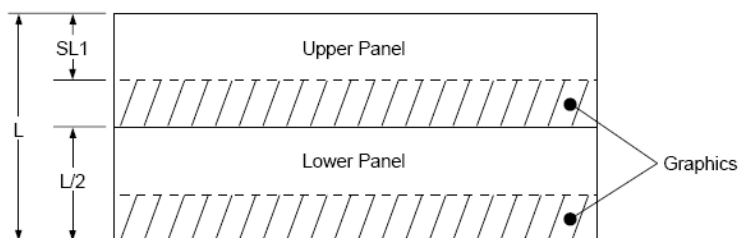


Figure 12. Two-panel display height

8.3.3. CSRFORM

Sets the cursor size and shape. Although the cursor is normally only used in text displays, it may also be used in graphics displays when displaying special characters.

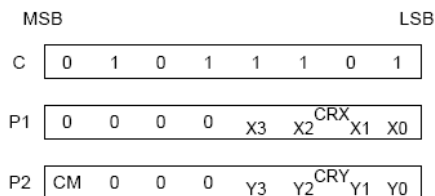


Figure 13. CSRFORM parameter bytes

8.3.3.1. CRX

Sets the horizontal size of the cursor from the character origin. CRX is equal to the cursor size less one. CRX must be less than or equal to FX.

Table 14. Horizontal cursor size selection

HEX	CRX				[CRX] cursor width (pixels)
	X3	X2	X1	X0	
0	0	0	0	0	1
1	0	0	0	1	2
↓	↓	↓	↓	↓	↓
4	0	1	0	0	9
↓	↓	↓	↓	↓	↓
E	1	1	1	0	15
F	1	1	1	1	16

8.3.3.2. CRY

Sets the location of an underscored cursor in lines, from the character origin. When using a block cursor, CRY sets the vertical size of the cursor from the character origin. CRY is equal to the number of lines less one.

Table 15. Cursor height selection

HEX	CRY				[CRY] cursor height (lines)
	Y3	Y2	Y1	Y0	
0	0	0	0	0	Illegal
1	0	0	0	1	2
↓	↓	↓	↓	↓	↓
8	1	0	0	0	9
↓	↓	↓	↓	↓	↓
E	1	1	1	0	15
F	1	1	1	1	16

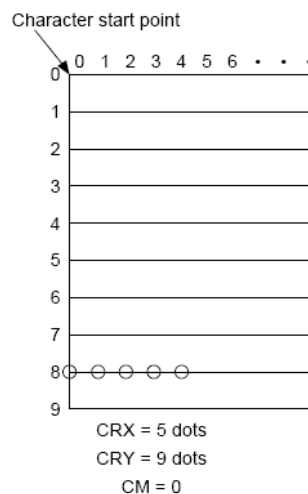


Figure 14. Cursor size and position

8.3.3.3. CM

Sets the cursor shape. Always set CM to 1 when in graphics mode.

CM = 0: Underscore cursor

CM = 1: Block cursor

8.3.4. CSRDIR

Sets the direction of automatic cursor increment. The cursor can move left or right one character, or up or down by the number of bytes specified by the address pitch, AP. When reading from and writing to display memory, this automatic cursor increment controls the display memory address increment on each read or write.



Figure 15. CSRDIR parameters

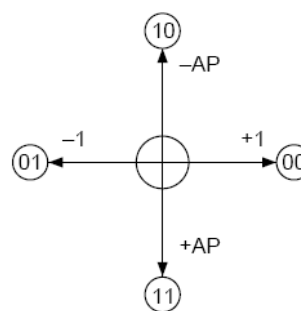


Figure 16. Cursor direction

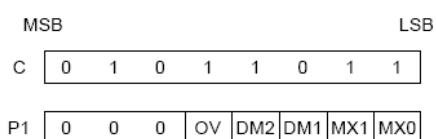
Table 16. Cursor shift direction

C	CD1	CD0	Shift direction
4CH	0	0	Right
4DH	0	1	Left
4EH	1	0	Up
4FH	1	1	Down

Note: Since the cursor moves in address units even if $FX \geq 9$, the cursor address increment must be preset for movement in character units. See Section 9.3.

8.3.5. OVLAY

Selects layered screen composition and screen text/ graphics mode.


Figure 17. OVLAY parameters

8.3.5.1. MX0, MX1

MX0 and MX1 set the layered screen composition method, which can be either OR, AND, Exclusive-OR or Priority-OR. Since the screen composition is organized in layers and not by screen blocks, when using a layer divided into two screen blocks, different composition methods cannot be specified for the individual screen blocks.

The Priority-OR mode is the same as the OR mode unless flashing of individual screens is used.

Table 17. Composition method selection

MX1	MX0	Function	Composition Method	Applications
0	0	$L1 \cup L2 \cup L3$	OR	Underlining, rules, mixed text and graphics
0	1	$(L1 \oplus L2) \cup L3$	Exclusive-OR	Inverted characters, flashing regions, underlining
1	0	$(L1 \cap L2) \cup L3$	AND	Simple animation, three-dimensional appearance
1	1	$L1 > L2 > L3$	Priority-OR	

Notes:

L1: First layer (text or graphics). If text is selected, layer L3 cannot be used.

L2: Second layer (graphics only)

L3: Third layer (graphics only)

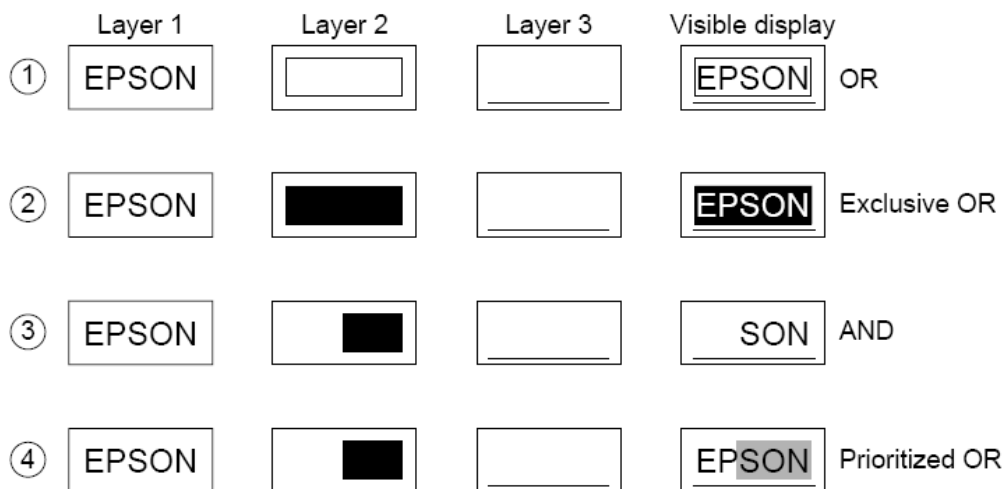


Figure 18. Combined layer display

Notes:

- L1: Not flashing
- L2: Flashing at 1 Hz
- L3: Flashing at 2 Hz

8.3.5.2. DM1, DM2

DM1 and DM2 specify the display mode of screen blocks 1 and 3, respectively.
 DM1/2 = 0: Text mode
 DM1/2 = 1: Graphics mode
 Note 1: Screen blocks 2 and 4 can only display graphics.
 Note 2: DM1 and DM2 must be the same, regardless of the setting of W/S.

8.3.5.3. OV

Specifies two- or three-layer composition in graphics mode.
 OV = 0: Two-layer composition
 OV = 1: Three-layer composition
 Set OV to 0 for mixed text and graphics mode.

8.3.6. CGRAM ADR

Specifies the CG RAM start address.

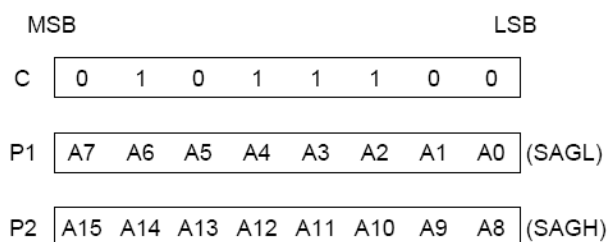


Figure 19. CGRAM ADR parameters

Note

See section 10 for information on the SAG parameters.

8.3.7. HDOT SCR

While the SCROLL command only allows scrolling by characters, HDOT SCR allows the screen to be scrolled horizontally by pixels. HDOT SCR cannot be used on individual layers.

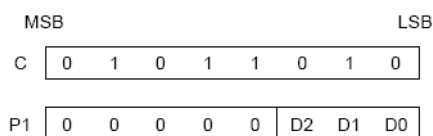


Figure 20. HDOT SCR parameters

8.3.7.1. D0 to D2

Specifies the number of pixels to scroll. The C/R parameter has to be set to one more than the number of horizontal characters before using HDOT SCR. Smooth scrolling can be simulated if the controlling microprocessor repeatedly issues the HDOT SCR command to the SED1335 series. See Section 9.5 for more information on scrolling the display.

Table 18. Scroll step selection (continued)

HEX	P1			Number of pixels to scroll
	D2	D1	D0	
00	0	0	0	0
01	0	0	1	1
02	0	1	0	2
↓	↓	↓	↓	↓
06	1	1	0	6
07	1	1	1	7

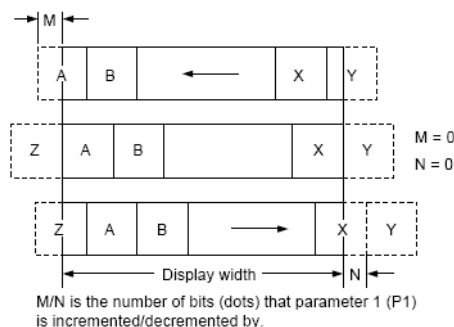


Figure 21. Horizontal scrolling

8.4. Drawing Control Commands

8.4.1. CSRW

The 16-bit cursor address register contains the display memory address of the data at the cursor position as shown in Figure 22.

Note that the microprocessor cannot directly access the display memory.

The MREAD and MWRITE commands use the address in this register.

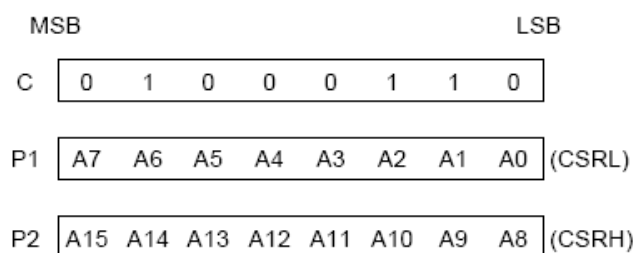


Figure 22. CSRW parameters

The cursor address register can only be modified by the CSRW command, and by the automatic increment after an MREAD or MWRITE command. It is not affected by display scrolling.

If a new address is not set, display memory accesses will be from the last set address or the address after previous automatic increments.

8.4.2. CSRR

Reads from the cursor address register. After issuing the command, the data read address is read twice, for the low byte and then the high byte of the register.

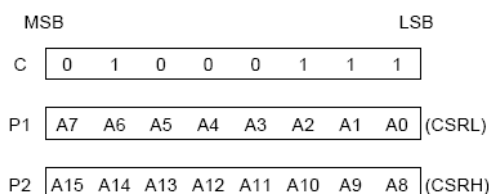


Figure 23. CSRR parameters

8.5. Memory Control Commands

8.5.1. MWRITE

The microprocessor may write a sequence of data bytes to display memory by issuing the MREAD command and then writing the bytes to the SED1335 series. There is no need for further MWRITE commands or for the micro-

processor to update the cursor address register after each byte as the cursor address is automatically incremented by the amount set with CSRDIR, in preparation for the next data write.

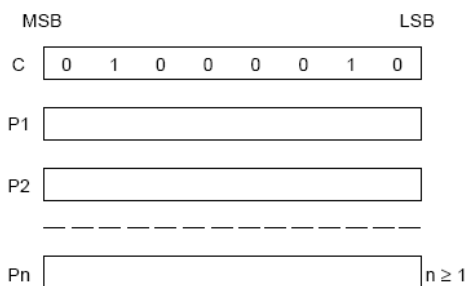


Figure 24. MWRITE parameters

Note:

P1, P2, ..., Pn: display data.

8.5.2. MREAD

Puts the SED1335 series into the data output state. Each time the microprocessor reads the buffer, the cursor address is incremented by the amount set by CSRDIR and the next data byte fetched from memory, so a sequence of

data bytes may be read without further MREAD commands or by updating the cursor address register. If the cursor is displayed, the read data will be from two positions ahead of the cursor.

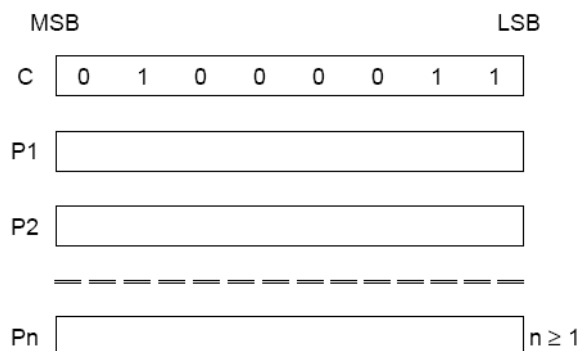


Figure 25. MREAD parameters

9. PIN ASSIGNMENT
CON1: (SED13305F Controller)

Pin No.	Symbol	Level	Function
1.	VSS	0V	Ground
2.	VDD	+5.0V	Power supply for logic
3.	V0	-	Power supply for LCD Driver
4.	/WR	H/L	Write signal
5.	/RD	H/L	Read signal
6.	/CS	H/L	Chip select signal
7.	A0	H/L	Data type selection
8.	RST	H/L	Reset signal
9.	D0	H/L	Data bus 0
10.	D1	H/L	Data bus 1
11.	D2	H/L	Data bus 2
12.	D3	H/L	Data bus 3
13.	D4	H/L	Data bus 4
14.	D5	H/L	Data bus 5
15.	D6	H/L	Data bus 6
16.	D7	H/L	Data bus 7
17.	NC	-	No connection
18.	VOUT	-23.0V	DC-DC output voltage
19.	NC	-	No connection
20.	NC	-	No connection

CON1: (No Controller)

Pin No.	Symbol	Level	Function
1.	FRAME	H/L	Frame signal
2.	LOAD	H/L	Data latch signal
3.	CP	H/L	Clock signal for shifting serial data
4.	M	H/L	Alternate for LCD Driver
5.	VO	-	Power supply for LCD driver
6.	VDD	+5.0V	Power supply for logic
7.	VSS	0V	Ground
8.	VEE	-23.0V	DC-DC output voltage
9.	D0	H/L	Data bus 0
10.	D1	H/L	Data bus 1
11.	D2	H/L	Data bus 2
12.	D3	H/L	Data bus 3
13.	DISPOFF	H/L	H:Dispoff ON,L:Dispoff OFF
14.	NC	-	No connection
15.	NC	-	No connection
16.	NC	-	No connection
17.	NC	-	No connection
18.	VOUT	-23.0V	DC-DC output voltage
19.	NC	-	No connection
20.	NC	-	No connection

CN2:

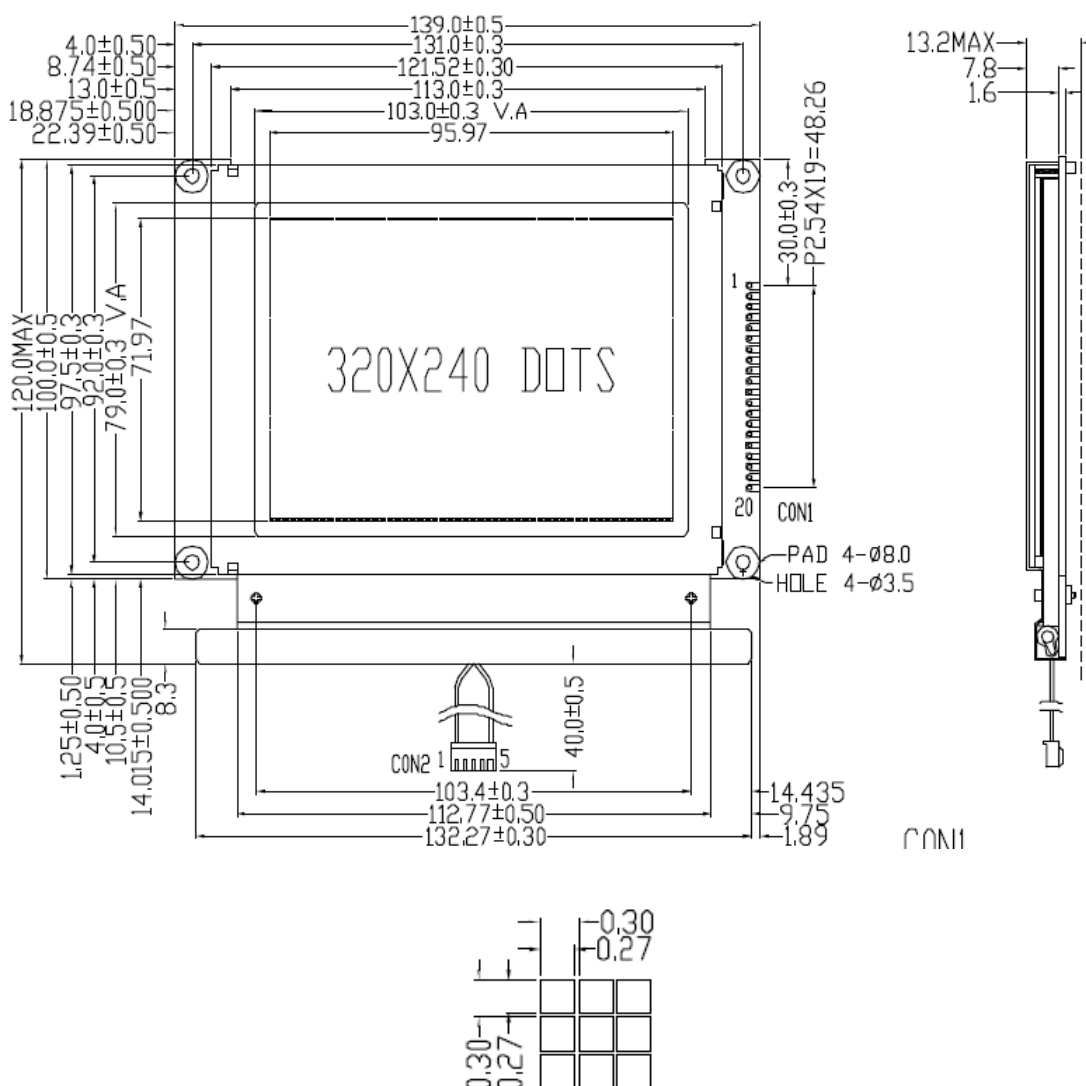
Pin No.	Symbol	Level	Function
1.	VSS	0V	Ground
2.	VDD	+5.0V	Power supply for logic
3.	V0	-	Power supply for LCD Driver
4.	A0	H/L	Data type selection
5.	/WR	H/L	Write signal
6.	/RD	H/L	Read signal
7.	D0	H/L	Data bus 0
8.	D1	H/L	Data bus 1
9.	D2	H/L	Data bus 2
10.	D3	H/L	Data bus 3
11.	D4	H/L	Data bus 4
12.	D5	H/L	Data bus 5
13.	D6	H/L	Data bus 6

14.	D7	H/L	Data bus 7
15.	/CS	H/L	Chip select signal
16.	RST	H/L	Reset signal
17.	VOOUT	-23.0V	DC-DC output voltage
18.	SEL1	H/L	H:6800,L:8080

CON2:

Pin No	Symbol	Level	Function
1.	VFL1	---	Power supply for backlight
2.	NC	--	No connection
3.	NC	---	No connection
4..	NC	---	No connection
5.	VFL2	---	Power supply for backlight

10. OUTLINE DIMENSION



11. RELIABILITY

Content of Reliability Test

Environmental Test				
No.	Test Item	Content of Test	Test Condition	Applicable Standard
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	80 °C 200 hrs	
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 °C 200 hrs	
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70 °C 200 hrs	
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20 °C 200 hrs	
5	High temperature Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	50 °C , 90% RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature humidity stress to the element for a long time.	50 °C , 90% RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -20°C 25°C 70°C $\begin{array}{c} \leftarrow 30\text{min.} \rightleftharpoons 5\text{min.} \rightleftharpoons 30\text{min.} \rightarrow \\ \leftarrow \hspace{10em} \rightarrow \\ \text{1 cycle} \end{array}$	-20°C – 70°C 10 cycles	
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10-22Hz → 1.5mmp-p 22-500Hz → 1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10

9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G half sign wave 1l msedc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V, RS=1.5 k CS=100 pF 1 time	MIL-883B-3015.1

Supply voltage for logic system = 3V. Supply voltage for LCD system = Operating voltage at 25°C.

12. QUALITY GUARANTEE

Acceptable Quality Level

Each lot should satisfy the quality level defined as follows.

- Inspection method : MIL-STD-105E LEVEL II Normal one time sampling
- AQL

Partition	AQL	Definition
A: Major	0.4%	Functional defective as product
B: Minor	1.5%	Satisfy all functions as product but not satisfy cosmetic standard

Definition of 'LOT'

One lot means the delivery quantity to customer at one time.

Conditions of Cosmetic Inspection

Environmental condition

The inspection should be performed at the 1cm of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25°C and normal humidity 60±15%RH).

Inspection method

The visual check should be performed vertically at more than 30cm distance from the LCD panel.

Driving voltage

The VO value which the most optimal contrast can be obtained near the specified VO in the specification. (Within $\pm 0.5V$ of typical value at 25°C.).

13. INSPECTION CRITERIA

13.1 Module Cosmetic Criteria

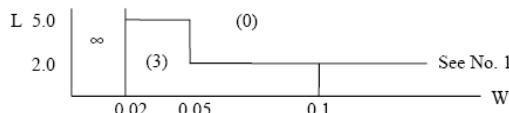
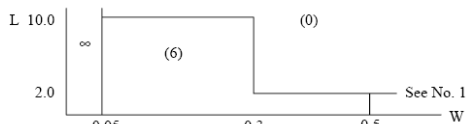
No.	Item	Judgment Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Major
4	Resist flaw on substrate	Invisible copper foil ('0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed '0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount	a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the lead form perfectly. (too much)	Minor
	1. Lead parts	b. Components side (In case of 'Through Hole PCB') Solder to reach the Components side of PCB.	
	2. Flat packages	Either 'Toe' (A) or 'Seal' (B) of the lead to be covered by 'Filet'. Lead form to be assume over solder. A B	
	3. Chips	$(3/2) H \geq h \geq (1/2) H$	Minor

13.2 Screen Cosmetic Criteria (Non-Operating)

No.	Defect	Judgment Criterion	Partition										
1	Spots	In accordance with <i>Screen Cosmetic Criteria (Operating) No.1.</i>	Minor										
2	Lines	In accordance with <i>Screen Cosmetic Criteria (Operating) No.2.</i>	Minor										
3	Bubbles in polarizer	<table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d ≤ 0.3</td> <td>Disregard</td> </tr> <tr> <td>0.3 < d ≤ 1.0</td> <td>3</td> </tr> <tr> <td>1.0 < d ≤ 1.5</td> <td>1</td> </tr> <tr> <td>1.5 < d</td> <td>0</td> </tr> </tbody> </table>	Size : d mm	Acceptable Qty in active area	d ≤ 0.3	Disregard	0.3 < d ≤ 1.0	3	1.0 < d ≤ 1.5	1	1.5 < d	0	Minor
Size : d mm	Acceptable Qty in active area												
d ≤ 0.3	Disregard												
0.3 < d ≤ 1.0	3												
1.0 < d ≤ 1.5	1												
1.5 < d	0												
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor										
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor										
6	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.	Minor										
7	Contamination	Not to be noticeable.	Minor										

3.3. Screen Cosmetic Criteria (Operating)

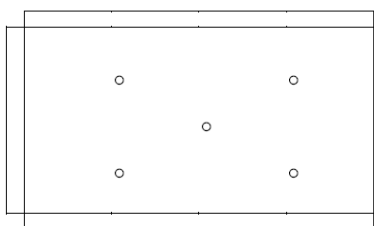
No.	Defect	Judgment Criterion	Partition																				
1	Spots	<p>A) Clear Note :</p> <table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d ≤ 0.1</td> <td>Disregard</td> </tr> <tr> <td>0.1 < d ≤ 0.2</td> <td>3</td> </tr> <tr> <td>0.2 < d ≤ 0.3</td> <td>2</td> </tr> <tr> <td>0.3 < d</td> <td>0</td> </tr> </tbody> </table> <p>Including pin holes and defective dots which must be within one pixel size.</p> <p>B) Unclear Size :</p> <table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d ≤ 0.2</td> <td>Disregard</td> </tr> <tr> <td>0.2 < d ≤ 0.5</td> <td>6</td> </tr> <tr> <td>0.5 < d ≤ 0.7</td> <td>2</td> </tr> <tr> <td>0.7 < d</td> <td>0</td> </tr> </tbody> </table>	Size : d mm	Acceptable Qty in active area	d ≤ 0.1	Disregard	0.1 < d ≤ 0.2	3	0.2 < d ≤ 0.3	2	0.3 < d	0	Size : d mm	Acceptable Qty in active area	d ≤ 0.2	Disregard	0.2 < d ≤ 0.5	6	0.5 < d ≤ 0.7	2	0.7 < d	0	Minor
Size : d mm	Acceptable Qty in active area																						
d ≤ 0.1	Disregard																						
0.1 < d ≤ 0.2	3																						
0.2 < d ≤ 0.3	2																						
0.3 < d	0																						
Size : d mm	Acceptable Qty in active area																						
d ≤ 0.2	Disregard																						
0.2 < d ≤ 0.5	6																						
0.5 < d ≤ 0.7	2																						
0.7 < d	0																						

2	Lines	<p>A) Clear</p>  <p>Note : () - Acceptable Qty in active area L -Length (mm) W - Width (mm) ∞ - Disregard</p> <p>B) Unclear</p> 	Minor
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‘Clear’ = The shade and size are not changed by VO.

‘Unclear’ = The shade and size are changed by VO.

13.4. Screen Cosmetic Criteria (Operating) (Continued)

No.	Defect	Judgement Criterion	Partition
3	Rubbing line	Not to be noticeable.	
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as ‘Spot’. (see <i>Screen Cosmetic Criteria (Operating) No.1</i>)	Minor
7	Uneven brightness (only back-lit type module)	<p>Uneven brightness must be $B_{MAX} / B_{MIN} \leq 2$</p> <ul style="list-style-type: none"> - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points <p>Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.</p>  <p style="text-align: center; font-size: small;">○ : Measuring points</p>	Minor

Note :

(1) Size : $d = (\text{long length} + \text{short length}) / 2$

- (2) The limit samples for each item have priority.
- (3) Complexed defects are defined item by item, but if the number of defects are defined in above table, the total number should not exceed 10.
- (4) In case of 'concentration', even the spots or the lines of 'disregarded' size should be not allowed. Following three situations should be treated as 'concentration'.
 - 7 or over defects in circle of '5mm.
 - 10 or over defects in circle of '10mm.
 - 20 or over defects in circle of '20mm.

14. PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

- (1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- (2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- (5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :
 - Isopropyl alcohol
 - Ethyl alcohol
- (6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
 - Water
 - Ketone
 - Aromatic solvents
- (7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- (8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- (9) Do not attempt to disassemble or process the LCD module.
- (10) NC terminal should be open. Do not connect anything.
- (11) If the logic circuit power is off, do not apply the input signals.
- (12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
 - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature high humidity and low temperatures below 0 C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

15. USING LCD MODULES

Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

- (1) Please keep the temperature within specified range for use and storage.

Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

- (2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).

- (3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.

- (4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming in contact with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

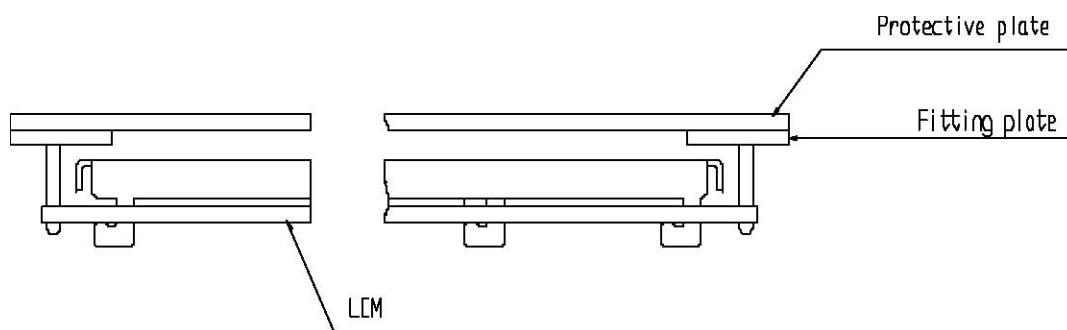
(9) Do not touch the display with bare hands. This will stain the display area and degrade insulation between terminals (some cosmetics are determined to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be 0.1mm.

Precaution for Handling LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the the shape of the tab on the metal frame.

(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

(3) Do not damage or modify the pattern writing on the printed circuit board.

(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.

(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

- (6) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

- (1) Make certain that you are grounded when handling LCM.
- (2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
- (3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
- (4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- (5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
- (6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%~60% is recommended.

Precaution for soldering to the LCM

- (1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
 - Soldering iron temperature : 280 C ± 10 C.
 - Soldering time : 3-4 sec.
 - Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

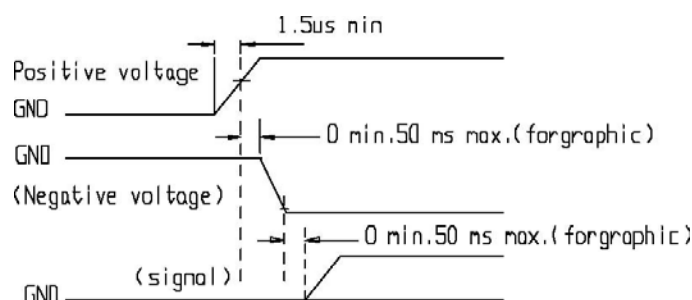
(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

- (1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.
- (2) Driving the LCD in the voltage above the limit shortens its life.
- (3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
- (4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
- (5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40 °C , 50% RH.

(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



Storage

When storing LCDs as spares for some years, the following precaution are necessary.

- (1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for desiccant.
- (2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0 °C and 35 °C.
- (3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

Safety

- (1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- (2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed between YAOYU and customer, YAOYU will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with YAOYU LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to YAOYU within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of YAOYU limited to repair and/or replacement on the terms set forth above. YAOYU will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded.

The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.



Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.