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LCD SPECIFICATIONS

NUMBER：00

MODEL: JM320240E-01GSBLWFA5+TP

History of version

NUMBER	DATA	PAGE	CONTENT
00	2009-03-20		New Sample

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CONTENT

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1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	320 x 240 dots
LCD Type	STN(Blue), Transmissive /Negative
Driver Condition	1/240Duty , 1/17Bias, VOP24.0V, VDD5.0V
Viewing Direction	6 O'clock
Backlight Type	White(Side), VDD5.0V, IDD210mA
MCU Interface	8080/6800 Series
Driver IC	RA8835(LQFP)
Touch Panel Driver IC	ADS7843

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	160.00(L) x 109.00 (W) x 11.00(H)	mm
Viewing Area	122.00(L) x 92.00(W)	mm
Active Area	115.17(L) x 86.37(W)	mm
Dots Size	0.33(L) x 0.33(W)	mm
Dots Pitch	0.36(L) x 0.36(W)	mm

1.3 Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Max.	Unit
System Power Supply Voltage	VDD	-	-0.3	7.0	V
LCD Driver Supply Voltage	$VOUT_{IN}$	-	-0.3	30.0	V
Input Voltage	V_{IN}	-	-0.3	VDD + 0.3	V
Operating Temperature	T_{OP}	-	-20	70	°C
Storage Temperature	T_{ST}	-	-30	80	°C
Storage Humidity	H_D	Ta < 40 °C	20	90	%RH

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1.4 DC Electrical Characteristic

VDD = 5.0V ± 0.2V , GND = 0V , Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	VDD	-	2.7	5.0	5.5	V
Input High Voltage	VIH	-	0.5VDD	-	VDD	V
Input Low Voltage	VIL	-	VSS	-	0.2VDD	V
Output High Voltage	VOH	-	2.4	-	-	V
Output Low Voltage	VOL	-	-	-	VSS+0.4	V
Supply Voltage For LCD	Vdd-V0	VDD-V0 (0°C)	-	24.5	-	V
		VDD-V0 (25°C)	-	24.0	-	
		VDD-V0 (40°C)	-	23.5	-	

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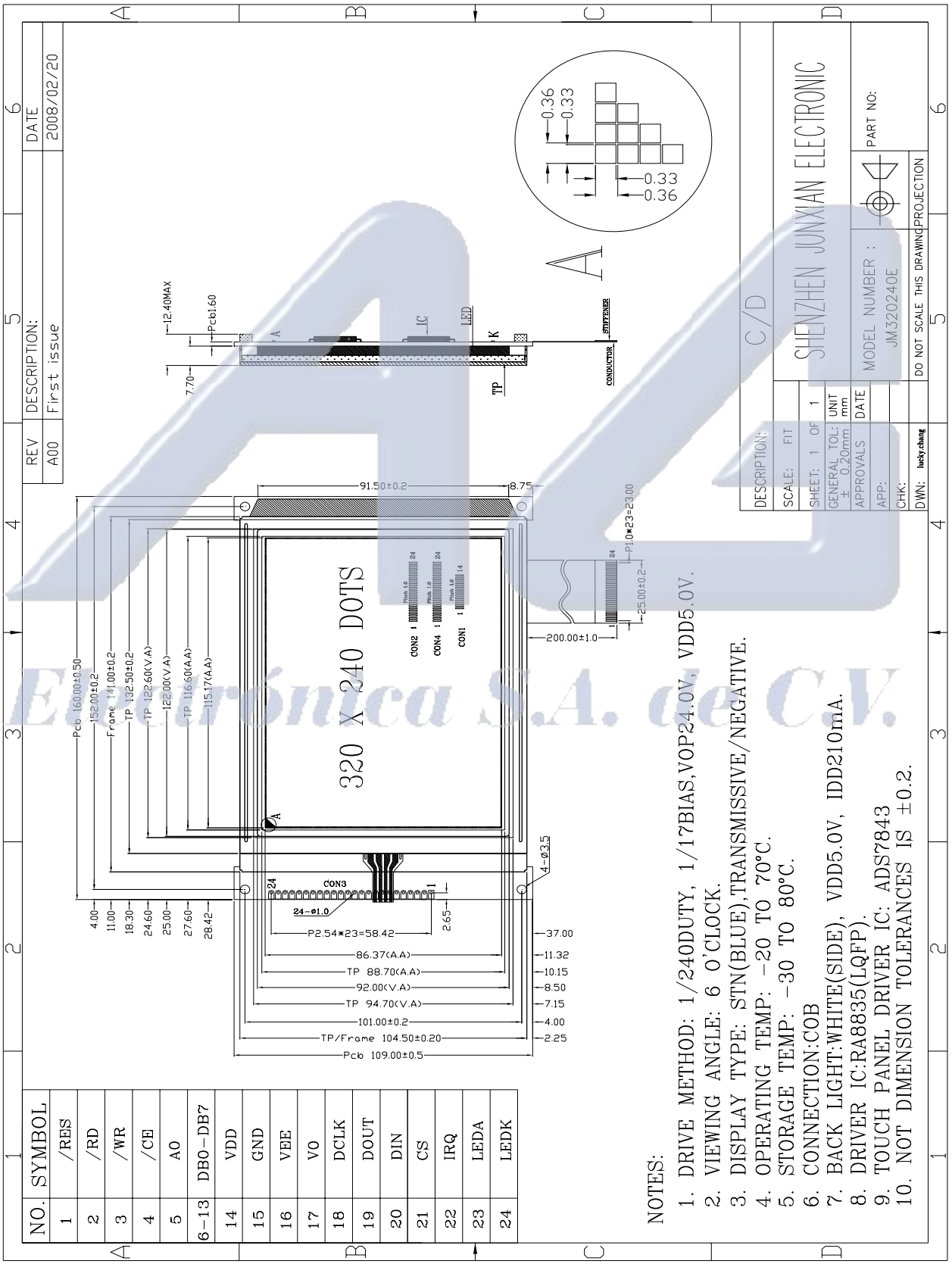
2. MODULE STRUCTURE

2.1 Counter Drawing

2.1.1 LCM Mechanical Diagram



NO.	SYMBOL
1	/RES
2	/RD
3	/WR
4	/CE
5	A0
6-13	DB0-DB7
14	VDD
15	GND
16	VEE
17	V0
18	DCLK
19	DOUT
20	DIN
21	CS
22	IRQ
23	LEDA
24	LEDK

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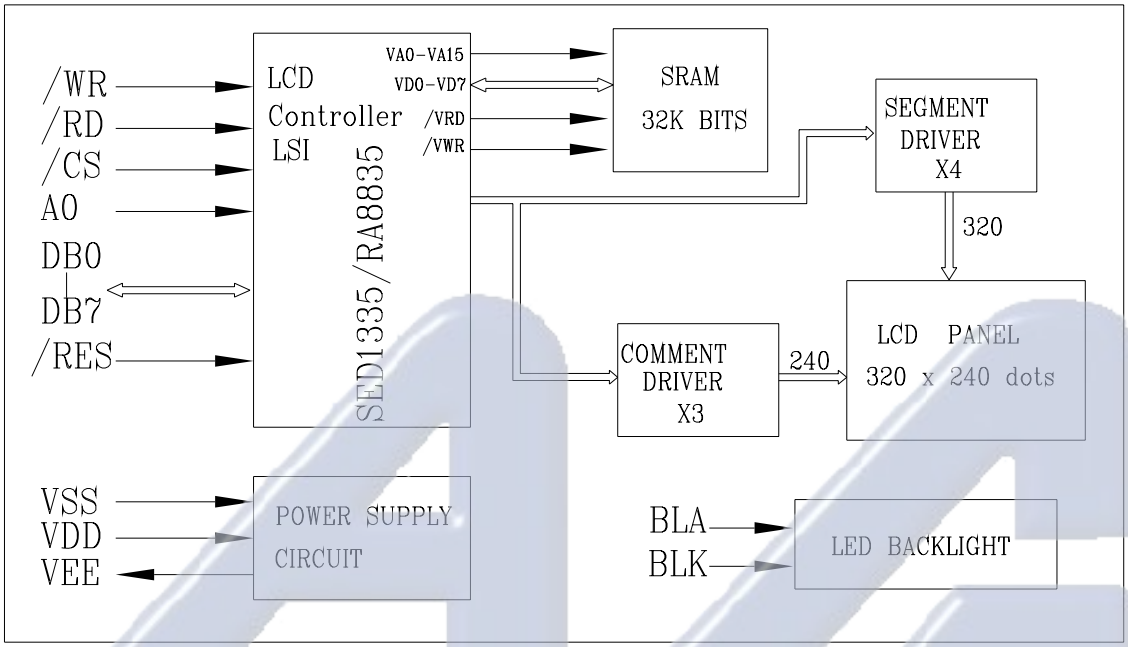
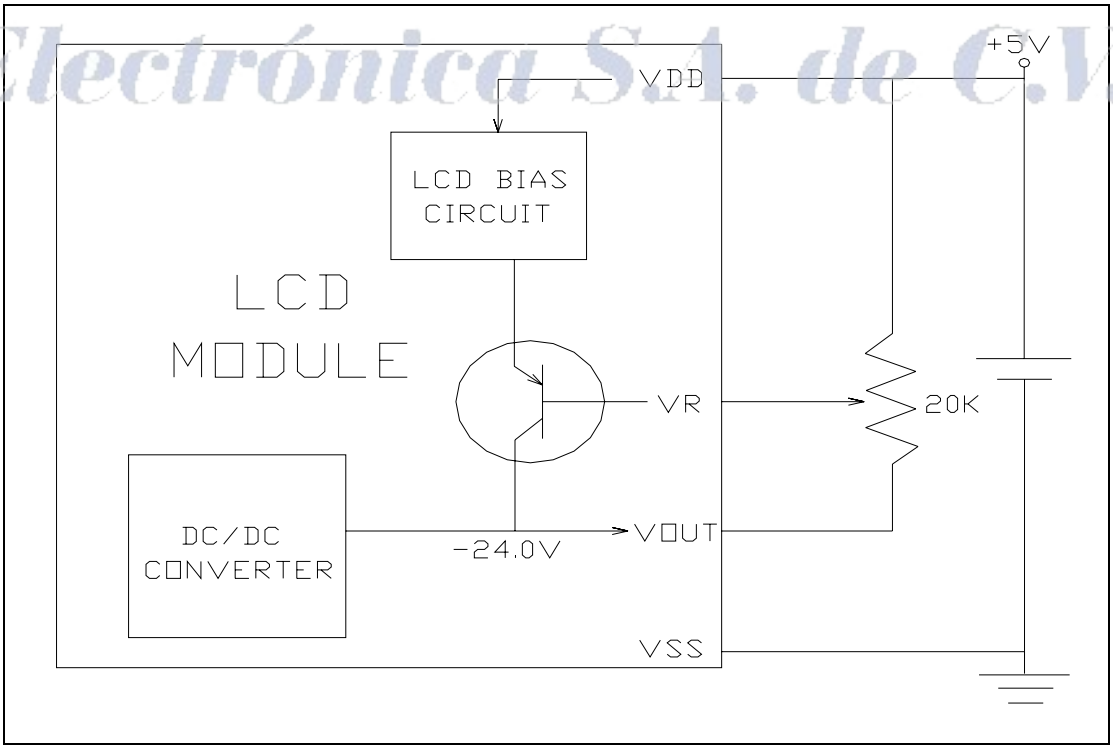
2.1.2 Block Diagram



2.1.3 Power Supply circuit



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2.2 Interface Pin Description

Pin No.	Symbol	Function
1	/RES	Reset Signal(Low Effective)
2	/RD	Read Siganal
3	/WR	Write Signal
4	/CE	Chip Select Signal
5	A0	Command/Data Select Signal. H: Command signal L: Data signal
6	DB0	Data bus bit 0
7	DB1	Data bus bit 1
8	DB2	Data bus bit 2
9	DB3	Data bus bit 3
10	DB4	Data bus bit 4
11	DB5	Data bus bit 5
12	DB6	Data bus bit 6
13	DB7	Data bus bit 7
14	VDD	Power supply input for logic voltage(+5.0V)
15	GND	Ground
16	VEE	LCD Module Negative Output
17	V0	Operation Voltage for LCD
18	DCLK	External Colck Input(TP)
19	DOUT	Serial Data Ootput(TP)
20	DIN	Serial Data Input(TP)
21	CS	Chip select(TP)
22	IRQ	PEN Interrupt(TP)
23	LEDA	Power Supply For LED Backlight（+）(5.0v)
24	LEDK	Power Supply For LED Backlight（-）

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2.3 Backlight Description

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	CONDITION
Supply Voltage	Vf	4.7	5.0	5.3	V	
Forward Current	Ifm		210		mA	Vf=5.0V
Reverse Voltage	Vr				V	
Power Dissipation	Pd				mW	Vf=5.0V
Operation temperature Range	Topr	-20		+70	℃	
Storage temperature Range	Tstg	-30		+80	℃	
Luminance	Lv	470	500		Cd/m2	Vf=5.0V

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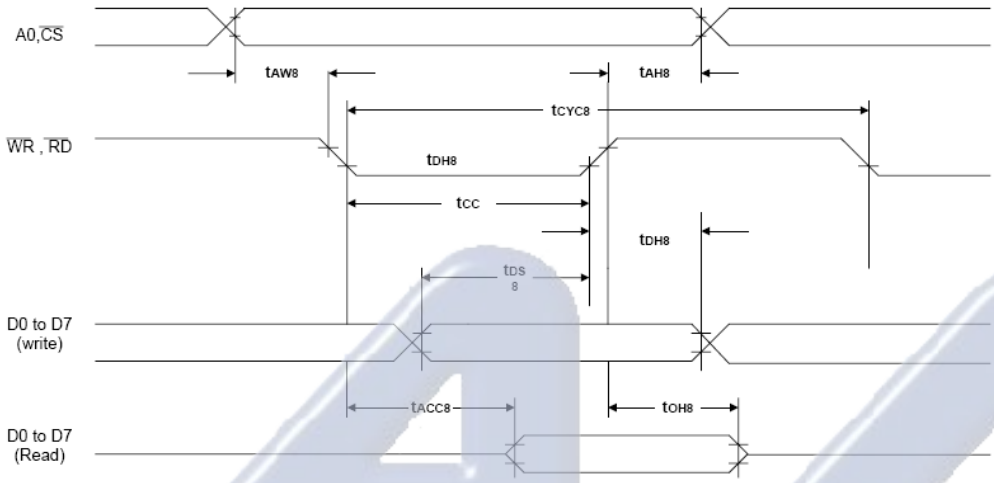
2.4 Timing Characteristics

- 8080 Family Interface Timing



Ta = –20 to 75°C

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 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	note.	—	note.	—	ns	
	t_{CC}	Strobe pulse width	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:

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

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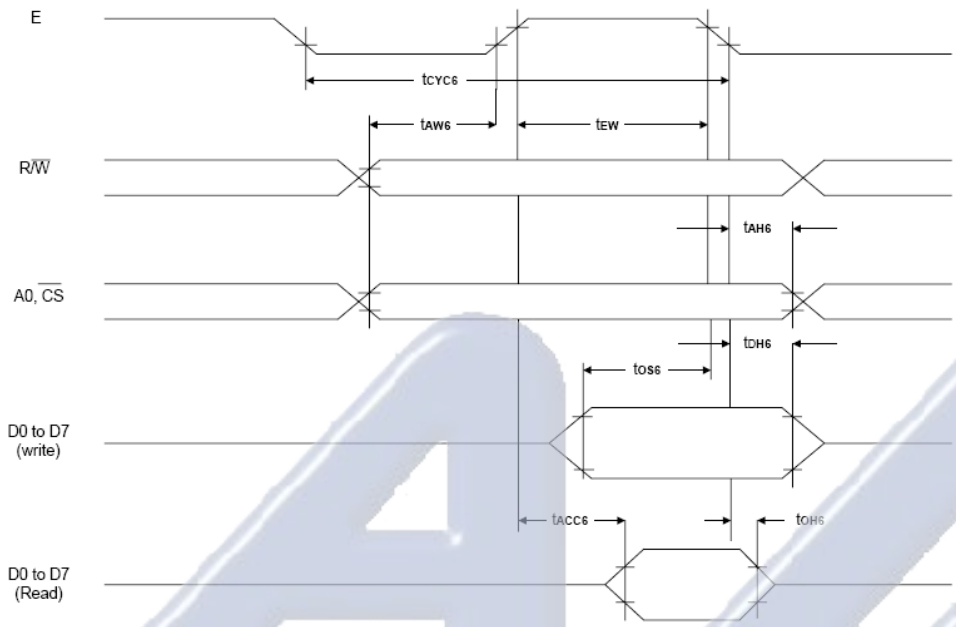
◆6800 Family Interface Timing



Ta = –20 to 75°C

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 2.7 to 4.5V		Unit	Condition
			Min.	Max.	Min.	Max.		
A0, $\overline{CS}$, R/(/W)	t_{CYC6}	System cycle time	note.	—	note.	—	ns	CL = 100 pF
	t_{AW6}	Address setup time	0	—	10	—	ns	
	t_{AH6}	Address hold time	0	—	0	—	ns	
D0 to D7	t_{DS6}	Data setup time	100	—	120	—	ns	
	t_{DH6}	Data hold time	0	—	0	—	ns	
	t_{OH6}	Output disable time	10	50	10	75	ns	
	t_{ACC6}	Access time	—	85	—	130	ns	
E	t_{EW}	Enable pulse width	120	—	150	—	ns	

Note: For memory control and system control commands:

$t_{CYC6} = 2t_C + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$

For all other commands:

$t_{CYC6} = 4t_C + t_{EW} + 30$

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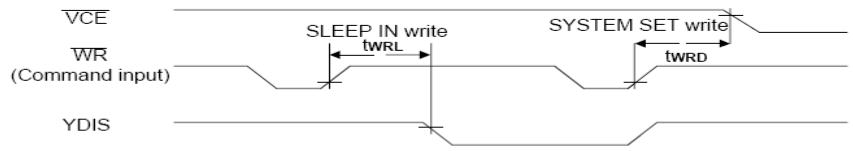
◆ Sleep In Command Timimg

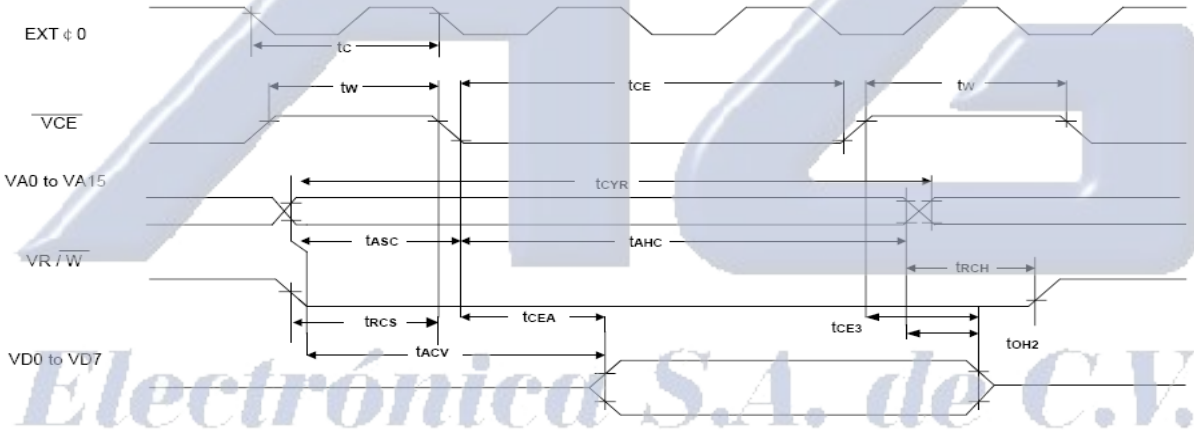


Ta = –20 to 75°C

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 2.7 to 4.5V		Unit	Condition
			Min.	Max.	Min.	Max.		
WR	t_{WRD}	VCE falling-edge delay time	note 1.	—	note 1.	—	ns	CL = 100 pF
	t_{WRL}	YDIS falling-edge delay time	—	note 2.	—	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. $t_{WRL} = 36t_C$. [TC/R] . [L/F] + 70

◆ Display Memory Read Timing



Ta = –20 to 75℃

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 2.7 to 4.5V		Unit	Condition
			Min.	Max.	Min.	Max.		
EXT Φ0	t_C	Clock period	100	—	125	—	ns	CL = 100 pF
VCE	t_W	VCE HIGH-level pulse width	t_C – 50	—	t_C – 50	—	ns	
	t_{CE}	VCE LOW-level pulse width	$2t_C$ – 30	—	2 t_C – 30	—	ns	
VA0 to VA15	t_{CYR}	Read cycle time	$3t_C$	—	$3t_C$	—	ns	
	t_{ASC}	Address setup time to falling edge of VCE	t_C – 70	—	t_C – 100	—	ns	
	t_{AHC}	Address hold time from falling edge of VCE	2 t_C – 30	—	$2t_C$ – 40	—	ns	
VRD	t_{RCS}	Read cycle setup time to falling edge of VCE	t_C – 45	—	t_C – 60	—	ns	
	t_{RCH}	Read cycle hold time from rising edge of VCE	$0.5t_C$	—	$0.5t_C$	—	ns	
VD0 to VD7	t_{ACV}	Address access time	—	$3t_C$ – 100	—	$3t_C$ – 115	Ns	
	t_{CEA}	VCE access time	—	$2t_C$ – 80	—	$2t_C$ – 90	Ns	
	t_{OH2}	Output data hold time	0	—	0	—	ns	
	t_{CE3}	VCE to data off time	0	—	0	—	ns	

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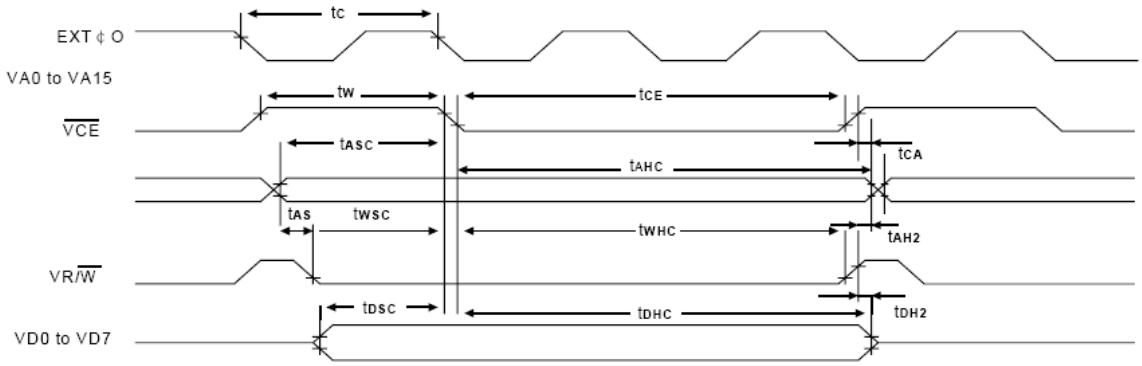
◆ Display Memory Write Timing



Ta = –20 to 75℃

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 2.7 to 4.5V		Unit	Condition
			Min.	Max.	Min.	Max.		
EXT Φ0	t_C	Clock period	100	—	125	—	ns	CL = 100 pF
$\overline{VCE}$	t_W	$\overline{VCE}$ HIGH-level pulse width	t_C – 50	—	t_C – 50	—	ns	
	t_{CE}	$\overline{VCE}$ LOW-level pulse width	$2t_C$ – 30	—	$2t_C$ – 30	—	ns	
VA0 to VA15	t_{CYW}	Write cycle time	3tC	—	$3t_C$	—	ns	
	t_{AHC}	Address hold time from falling edge of $\overline{VCE}$	$2t_C$ – 30	—	$2t_C$ – 40	—	ns	
	t_{ASC}	Address setup time to falling edge of $\overline{VCE}$	t_C – 70	—	t_C – 110	—	ns	
	t_{CA}	Address hold time from rising edge of $\overline{VCE}$	0	—	0	—	ns	
	t_{AS}	Address setup time to falling edge of $\overline{VWR}$	0	—	0	—	ns	
	t_{AH2}	Address hold time from rising edge of $\overline{VWR}$	10	—	10	—	ns	
$\overline{VWR}$	t_{WSC}	Write setup time to falling edge of $\overline{VCE}$	t_C – 80	—	t_C – 115	—	ns	
	t_{WHC}	Write hold time from falling edge of $\overline{VCE}$	$2t_C$ – 20	—	$2t_C$ – 20	—	ns	
VD0 to VD7	t_{DSC}	Data input setup time to falling edge of $\overline{VCE}$	t_C – 85	—	t_C – 125	—	ns	
	t_{DHC}	Data input hold time from falling edge of $\overline{VCE}$	$2t_C$ – 30	—	$2t_C$ – 30	—	ns	
	t_{DH2}	Data hold time from rising edge of $\overline{VWR}$	5	50	5	50	ns	

Note: VD0 to VD7 are latching input/outputs. While the bus is high impedance, VD0 to VD7 retain the write data until the data read from the memory is placed on the bus.

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2.5 Instruction Table

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	40	Initialize device and display	8	9-2-1
	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode	0	9-2-2
Display Control	DISPLAY ON/OFF	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing	1	9-3-1
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions	10	9-3-2
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type	2	9-3-3
	CGRAM ADR	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2	9-3-6
	CSRDIR	1	0	1	0	1	0	0	1	1	CD 1	CD 0	4C to 4F	Set direction of cursor movement	0	9-3-4
	HDOT SCR	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position	1	9-3-7
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format	1	9-3-5
Drawing Control	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address	2	9-r1
	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address	2	9-4-2
Memory Control	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory	—	9-5-1
	MREAD	1	0	1	0	1	0	0	0	0	1	1	43	Read from display memory	—	9-5-2

Notes:

1. In general, the internal registers of the RA8835 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:

   a. CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.

   b. 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.

2. APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.

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2.6 DISPLAY COMMANDS

◆ SYSTEM SET

Initializes the device, sets the window sizes, and selectsthe LCD interface format. Since this command sets thebasic operating parameters of the S1D13305 series, an incorrect SYSTEM SET command may cause othercommands to operate incorrectly.

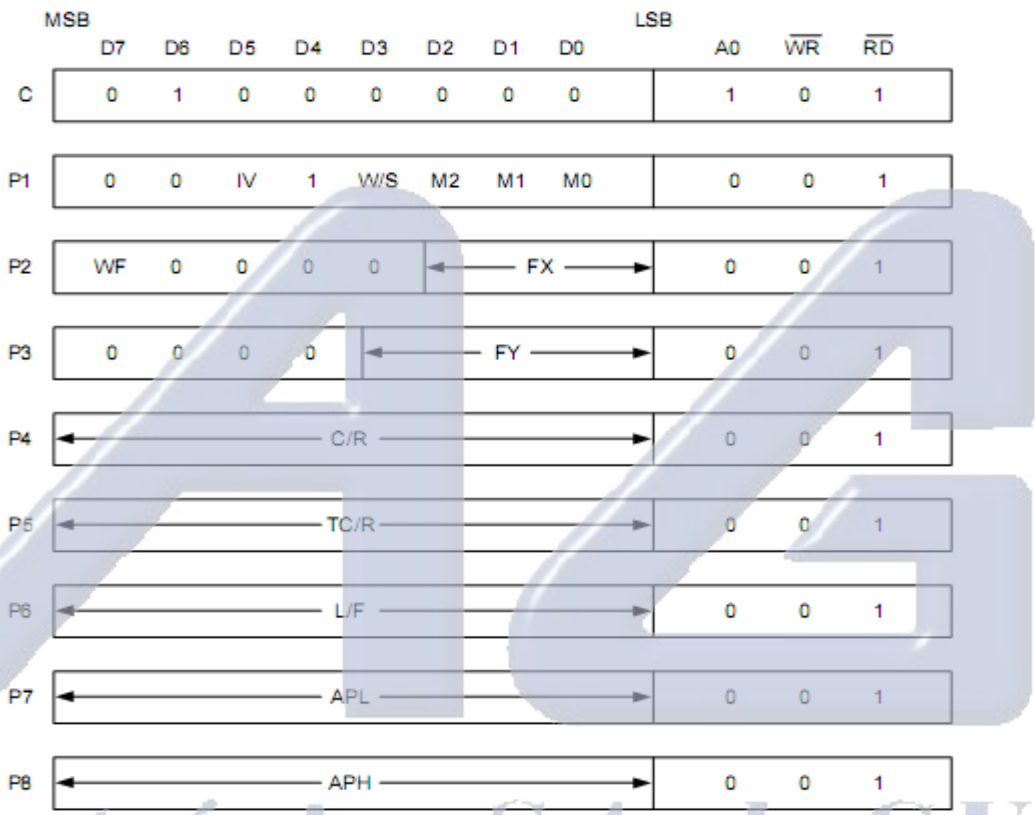

Figure 1. SYSTEM SET instruction

▲ 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.

▲ ***M0***

Select the internal or external character generator ROM. The internal character generator ROM contains 160, 5 X 7 pixel characters, as shown in Figure 8-14. 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

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

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▲ **M1**

Select the memory configuration for user-definable characters. The CG RAM codes select one of the 64 codes shown in figure 7-29.

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.

▲ **M2**

Select 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 RA8835 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)

▲ **W/S**

Select the LCD drive method.

W/S = 0: Single-panel drive
W/S = 1: Dual-panel drive

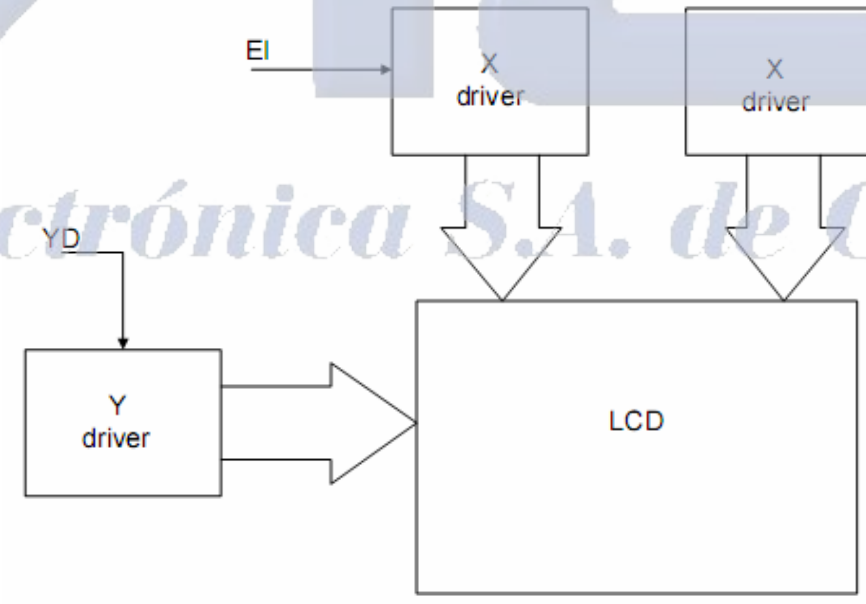

Figure 2: Single-panel Display

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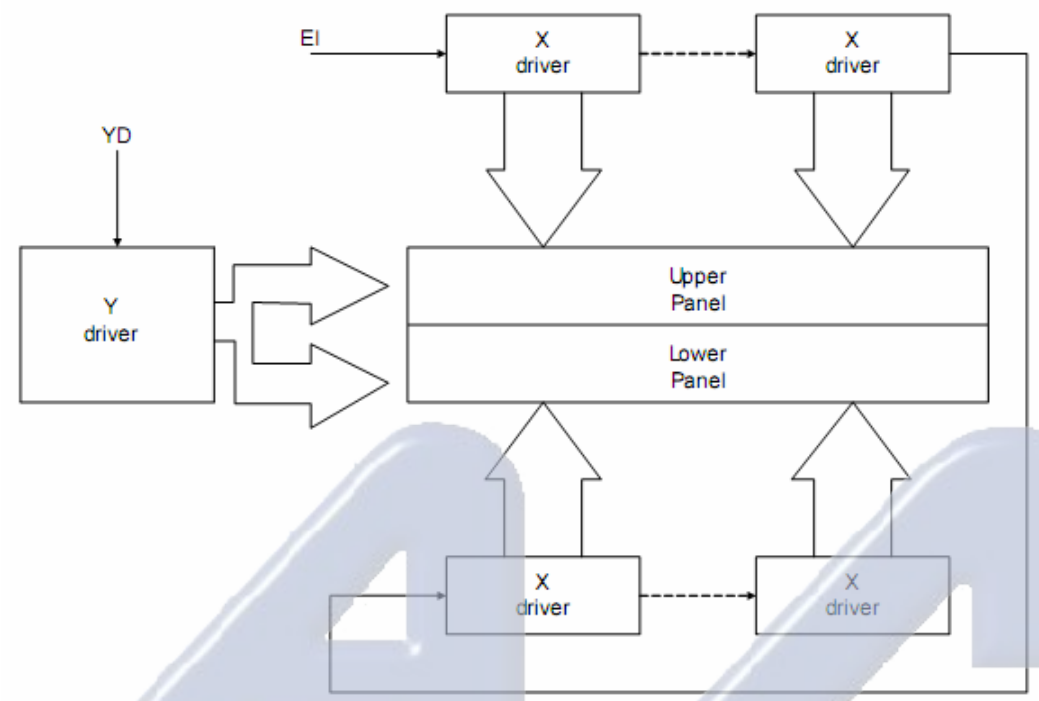

Figure 3: Above and Below Two-panel Display

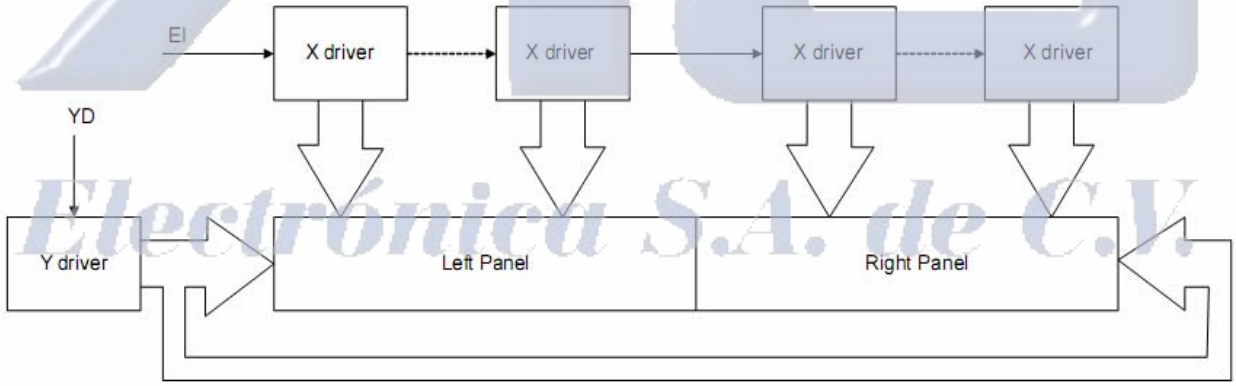

Figure 4: Left-and-Right Two-panel Display

▲ 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 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.

The IV flag causes the RA8835 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 11-5 for information on scrolling.

IV = 0: Screen top-line correction
IV = 1: No screen top-line correction

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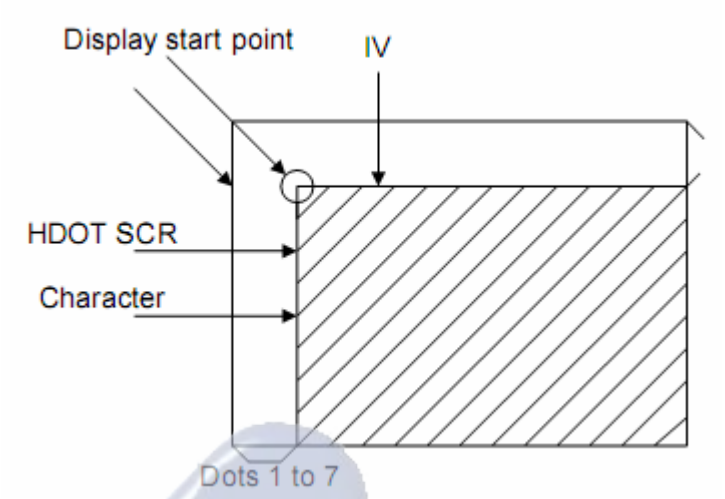

Figure 5: IV and HDOT SCR Adjustment

▲ **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

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

Since the RA8835 series handles display data in 8-bit units, characters larger than 8 pixels wide must be formed from 8-pixel segments. As Figure 6-6 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.

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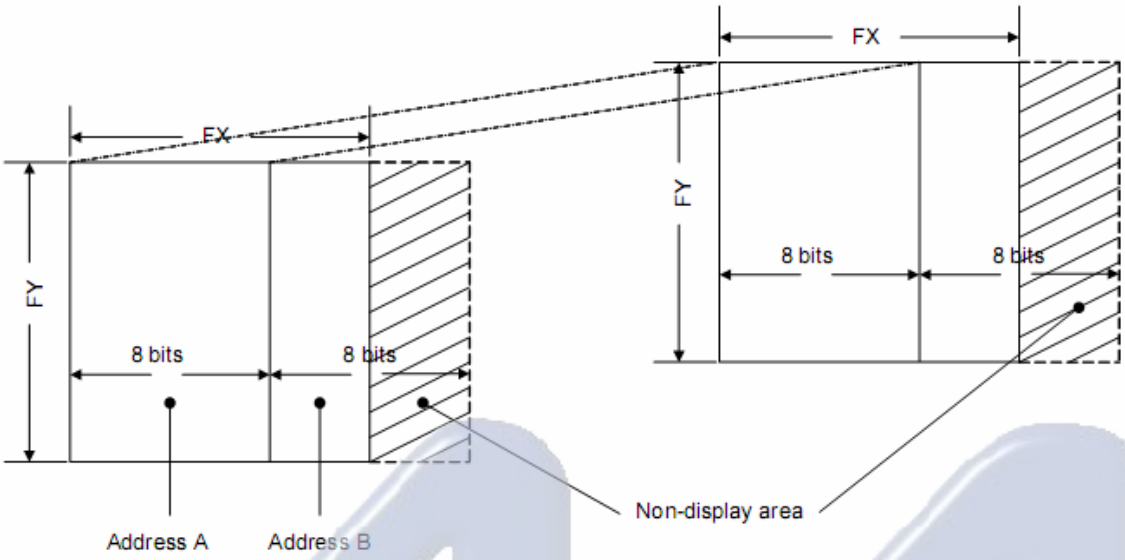

Figure 6 : FX and FY Display Addresses

▲ **WF**

Select 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.

▲ **FY**

Set 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.

Table-4: Vertical Character Size Selection

FY					[FY] character height (pixels)
HEX	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

▲ **C/R**

Set 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 17-1-1 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.

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Table-5: Display Line Address Range

C/R									[C/R] bytes per display line
HEX	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

▲ **TC/R**

Set 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 17-1-1 in order to hold the frame period constant and minimize jitter for any given main oscillator frequency, f_{OSC}.

Table-6: Line Length Selection

TC/R									[TC/R] line length (bytes)
HEX	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

▲ **L/F**

Set 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.

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.

Table-7: Frame Height Selection

L/F									[L/F] lines per frame
HEX	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

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▲ **AP**

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

APL	AP7	AP6	AP5	AP4	AP3	AP2	AP1	AP0
APH	AP15	AP14	AP13	AP12	AP11	AP10	AP9	AP8

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	$2^{16}-1$

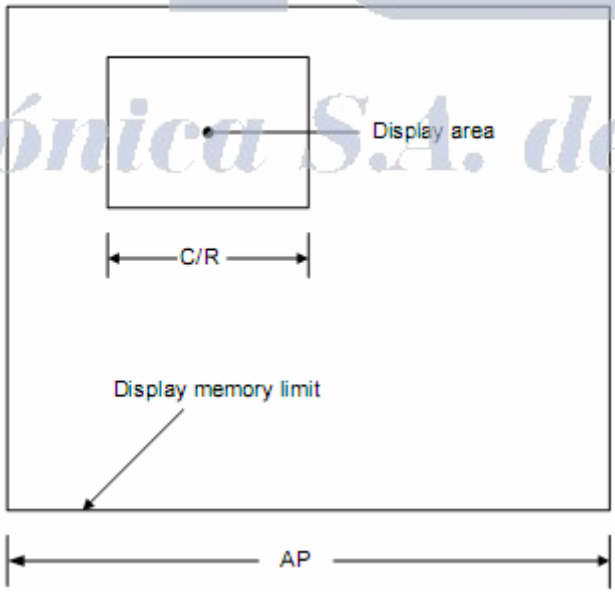

Figure 8: AP and C/R Relationship

▲ **SLEEP IN**

Place the system in standby mode. This command has no parameter bytes. At least one blank frame after receiving this command, the RA8835 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

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YDIS signal. Using the YDIS signal to disable the Y-drivers guards against any spurious displays. The internal registers of the RA8835 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 RA8835 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.

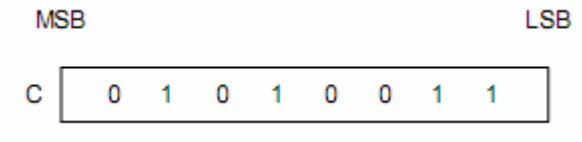

Figure 9: SLEEP IN Instruction

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 RA8835 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.

◆ Display Control Comands

▲ DISP ON/OFF

Turn 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.

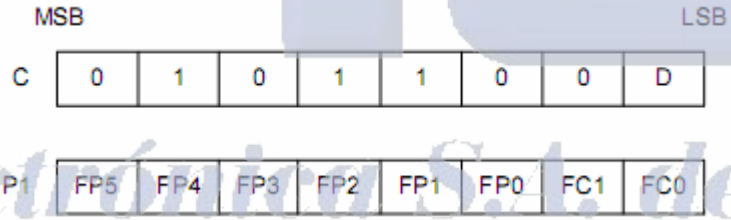

Figure 10: DISP ON/OFF Parameters

▲ D

Turn 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

▲ 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.

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▲ **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.

◆ **SCROLL**

▲ **C**

Set 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.

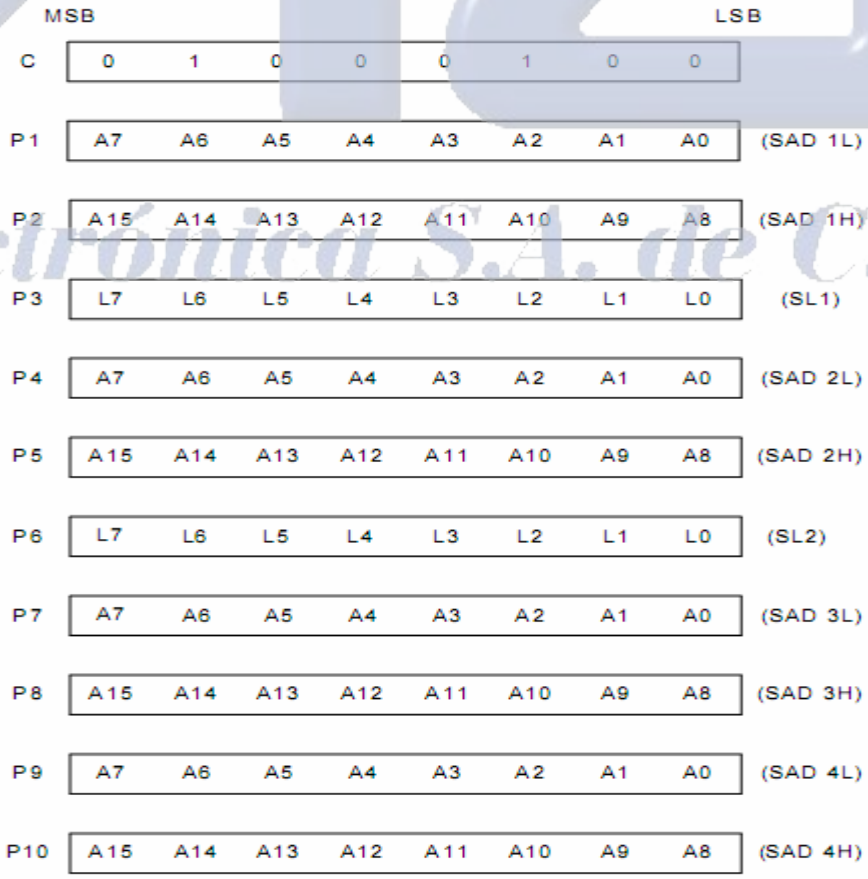

Figure 11: SCROLL Instruction Parameters

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.

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Table-11: Screen Block Start Address Selection

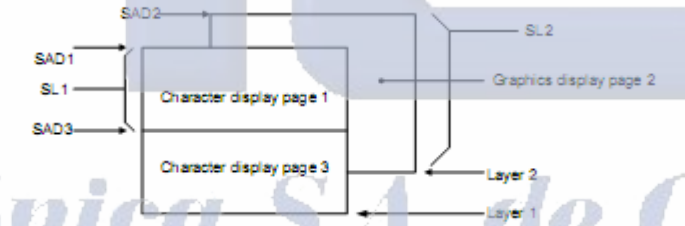
SL1, SL2									[SL] screen lines
HEX	L7	L6	L5	L4	L3	L2	L1	L0	
00	0	0	0	0	0	0	0	0	1
01	0	0	0	0	0	0	0	1	2
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
7F	0	1	1	1	1	1	1	1	128
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FE	1	1	1	1	1	1	1	0	255
FF	1	1	1	1	1	1	1	1	256

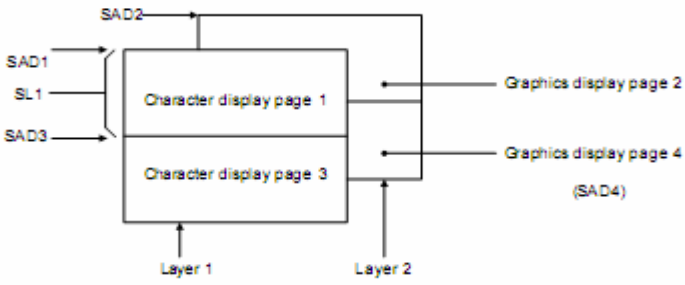
▲ **SL1,SL2**

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

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Table-13: Graphics Display Mode

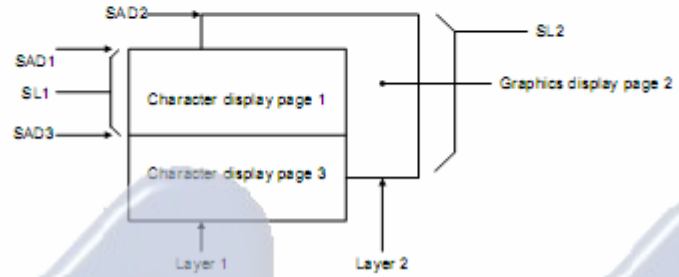
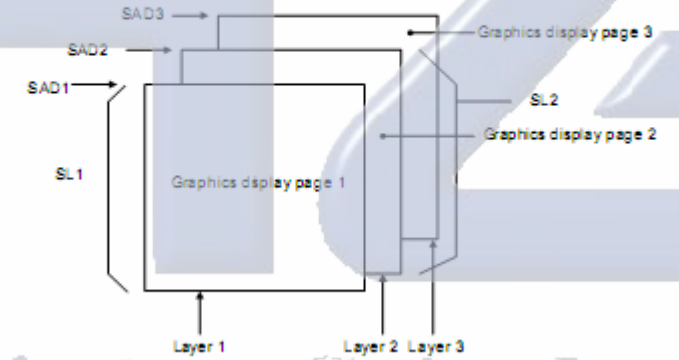
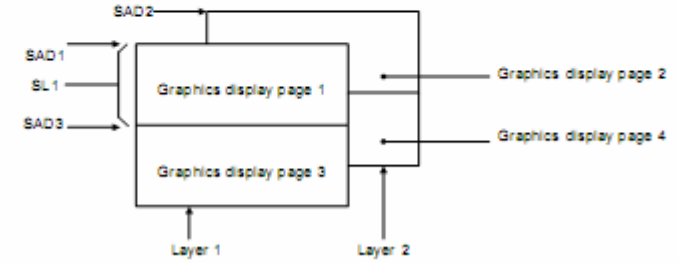
W/S	Screen	First Layer	Second Layer	Third Layer
0	Two-layer composition	SAD1 SL1	SAD2 SL2	—
	Upper screen	SAD3 (see note 3) Set both SL1 and SL2 to L/F + 1 if not using a partitioned screen		—
	Screen configuration example:  			
0	Three-layer configuration	SAD1 SL1 = L/F + 1	SAD2 SL1 = L/F + 1	SAD3 —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

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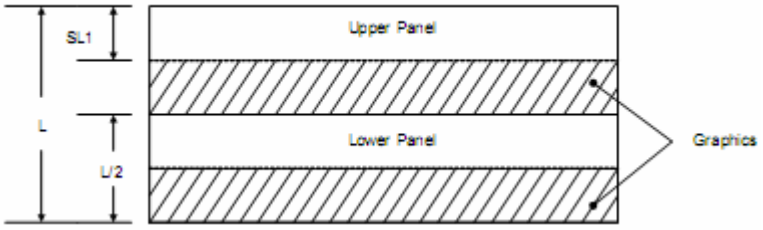

Figure 12: Two-panel Display Height

◆ CSRFORM

Set 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.

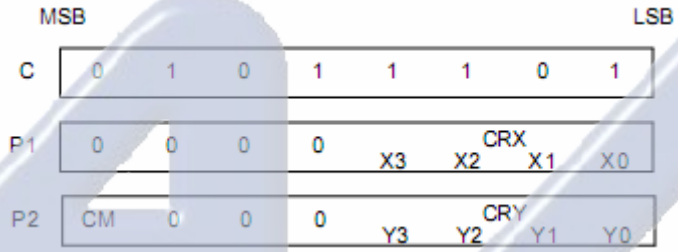

Figure 13: CSRFORM Parameter Bytes

▲ CRX

Set 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

CRX					[CRX] cursor width (pixels)
HEX	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

▲ CRY

Set 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.

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Table-15: Cursor Height Selection

CRY					[CRY] cursor height (lines)
HEX	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

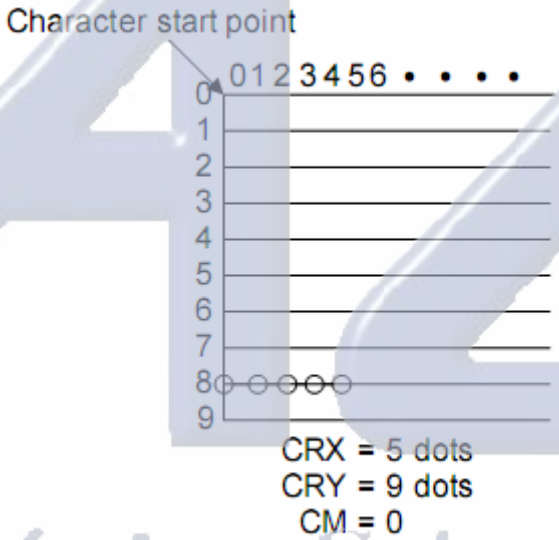

Figure 14: Cursor Size and Position

▲ **CM**

Set the cursor shape. Always set CM to 1 when in graphics mode.
CM = 0: Underscore cursor
CM = 1: Block cursor

◆ **CSRDIR**

Set 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.

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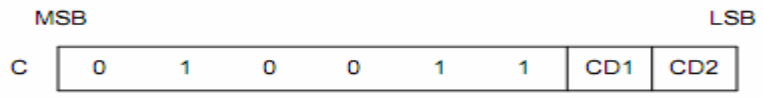

Figure 6-15: CSRDIR Parameters

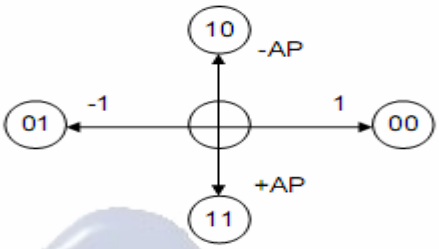

Figure 16: Cursor Direction

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 ≥ 9 , the cursor address increment must be preset for movement in character units. See Section 10-3.

- **OVLAY**

Selects layered screen composition and screen text/ graphics mode.

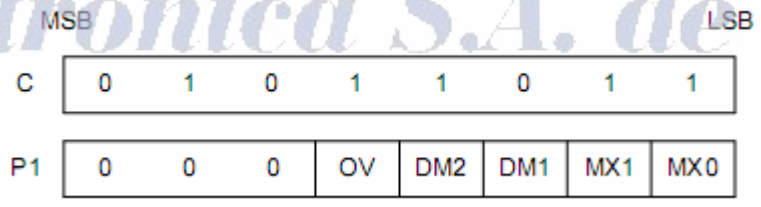

Figure 17: OVLAY Parameters

- **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.

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Table-17: Composition Method Selection

MX1	MX0	Function	Composition Method	Applications
0	0	L1 ∪ L2 ∪ L3	OR	Underlining, rules, mixed text and graphics
0	1	(L1 ⊕ L2) ∪ L3	Exclusive-OR	Inverted characters, flashing regions, underlining
1	0	(L1 ∩ L2) ∪ 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)

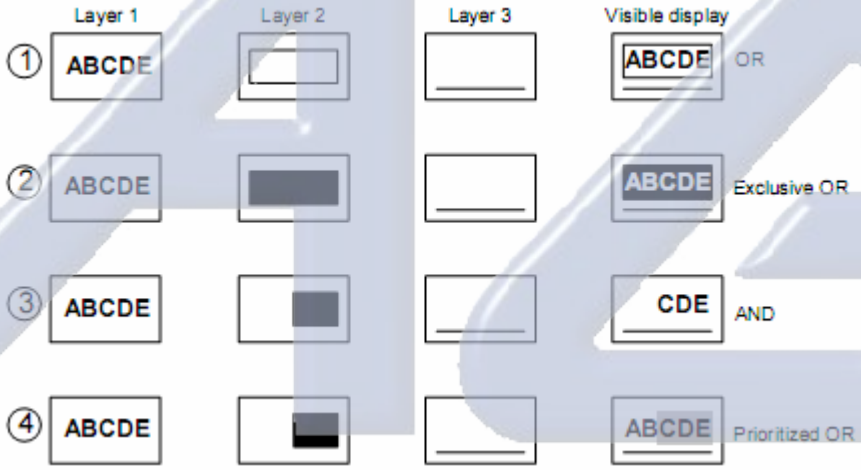

Figure 18: Combined Layer Display

Notes:

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

▲ **DMX0 ,DMX1**

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.

▲ **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.

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◆ CGRAM ADR

Specifies the CG RAM start address.

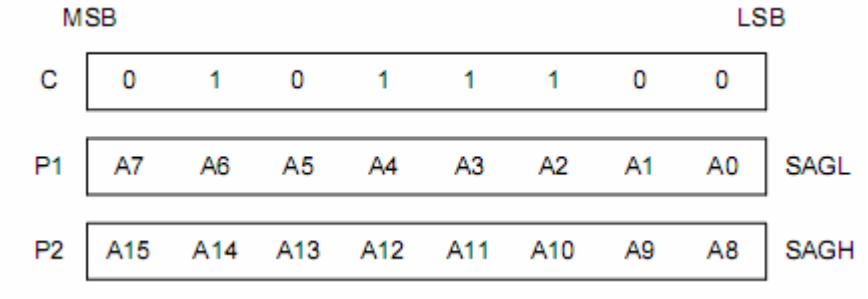

Figure 19: CGRAM ADR Parameters

◆ 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.

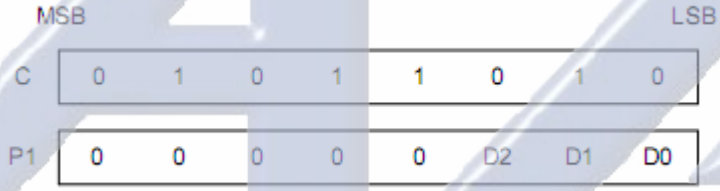

Figure 20: HDOT SCR Parameters

▲ D1 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 RA8835 series. See Section 9-5 for more information on scrolling the display.

Table-18: Scroll Step Selection

P1				Number of pixels to scroll
HEX	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

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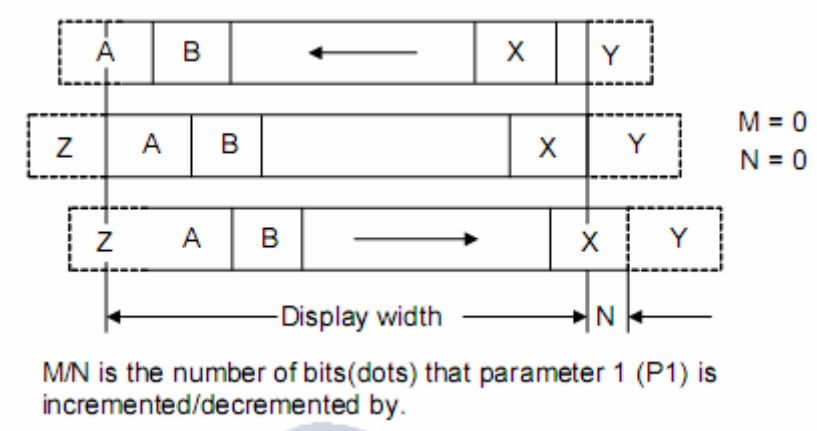

Figure 21 Horizontal Scrolling

- **CSRW**

The 16-bit cursor address register contains the display memory address of the data at the cursor position as shown in Figure 6-22. Note that the microprocessor cannot directly access the display memory. The MREAD and MWRITE commands use the address in this register.

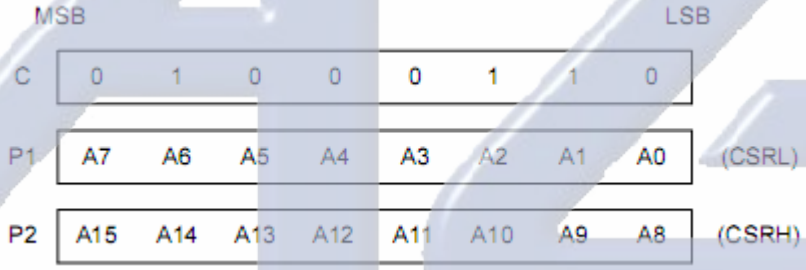

Figure 22: CSRW Parameters

- **CSRR**

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

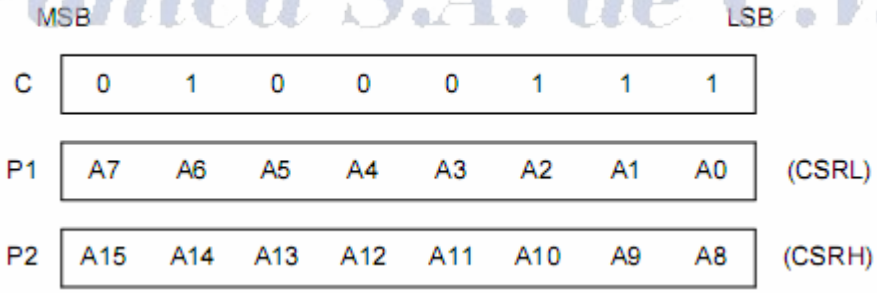

Figure 23: CSRR Parameters

- **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 RA8835 series. There is no need for further MWRITE commands or for the microprocessor 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.

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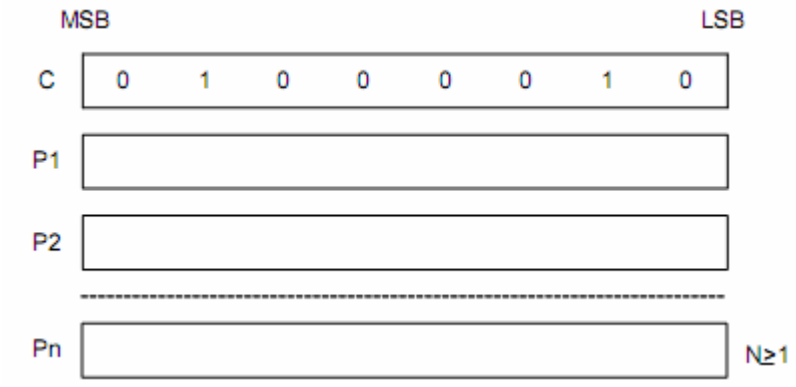

Figure 24: MWRITE Parameters

- **MREAD**

Put the RA8835 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.

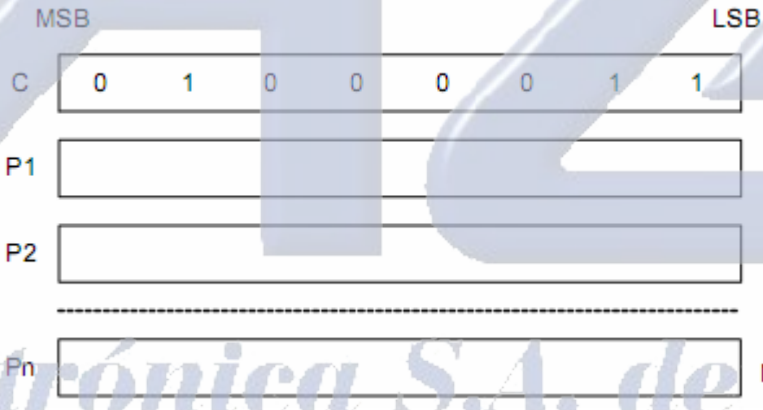

Figure 25: MREAD Parameters

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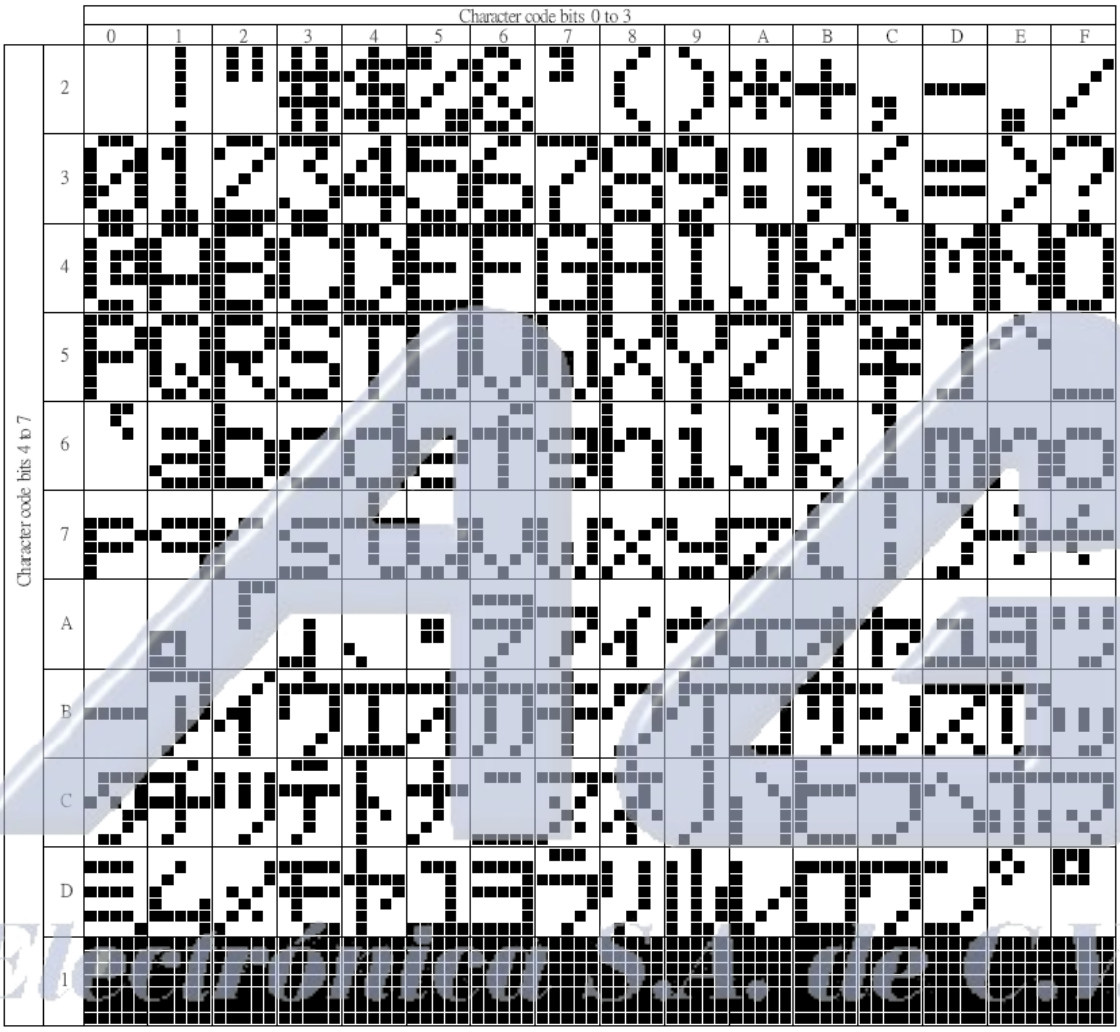

Figure 8-14: On-chip Character Set

Note: The shaded positions indicate characters that have the whole 6 x 8 bitmap blackened.

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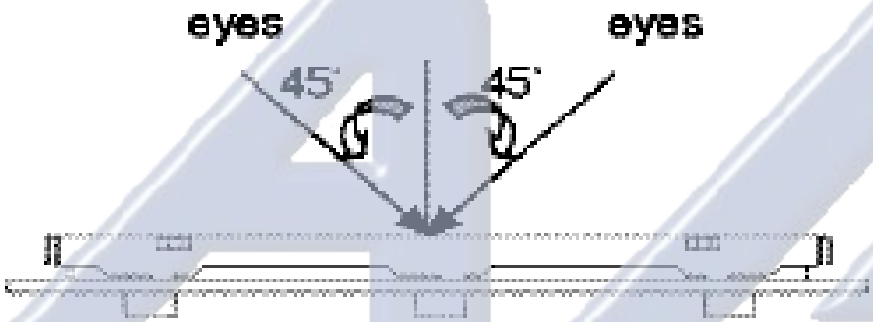
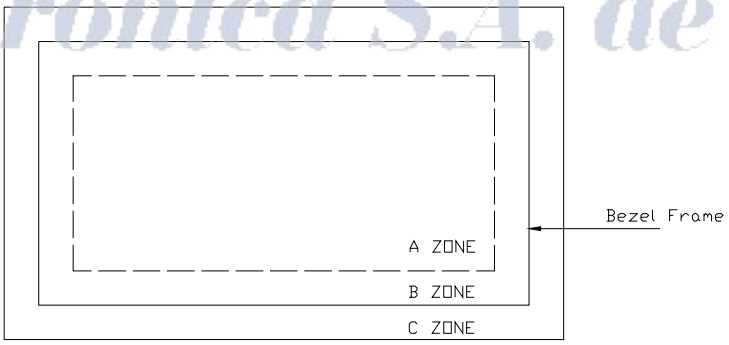
3: INSPECTION SPECIFICATION

◆The LCD shall be inspected under 40W white fluorescent light.
The distance between the eyes and the samples shall be more than 30cm.
All directions for inspecting the sample should be within 45 degree against perpendicular line.



◆ Definition of Applicable Zone



A Zone: Active Display Area
B Zone: Area from Bezel Frame to A Zone
C Zone: Rest Area of Bezel
A Zone + B Zone=Effective Viewing Area

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◆ Specification:

NO	Item	Criterion	level
01	Product condition	1.1 The part number is inconsistent with work order of Production.	Major
		1.2 Mixed production types.	Major
		1.3 Assembled in inverse direction.	Major
02	Quantity	2.1 The quantity is inconsistent with work order of production.	Major
03	Outline dimension	3.1 Product dimension and structure must conform to Structure diagram.	Major
04	Electrical Testing	4.1 Missing line character、dot and icon.	Major
		4.2 No function or no display.	Major
		4.3 Output data is error.	Major
		4.4 LCD viewing angle defect.	Major
		4.5 Current consumption exceeds product specifications.	Major
05	Black or white dot、scratch、contamination Round type	5.1 Round type: 5.1.1 display only : ·White and black spots on display ≦ 0.25mm, no more than Four white or black spots present. ·Densely spaced : NO more than two spots or lines within3mm	Minor

◆ Standards

NO	PARAMETER	CRITERIA
1	Black and White Spots, Foreign Substances	Round Shape

Round Shape

Zone / DIMENSION(MM)	Acceptable Number A	B	C
D≤0.1	*	*	*
0.1<D≤0.2	5	5	*
0.2<D≤0.3	0	1	*
0.3<D	0	0	*

D=(long+short)/2 * Disregard

Line Shape

Zone X(mm)	Y(mm)	Acceptable Number A	B	C
-	0.02≥W	*	*	*
2.0≥L	0.03≥W	3	3	*
1.0≥L	0.04≥W	1	2	*
1.0≥L	0.05≥W	0	2	*
-	0.05<W	Not acceptable		

X: Length Y: Width * Disregard

Total defects shall not exceed 5.

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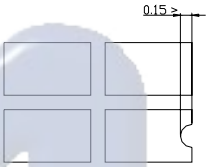
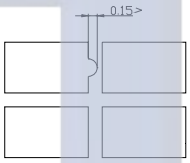
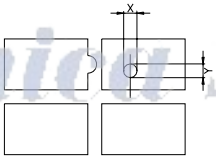
<table>
<tr>
<td>2</td>
<td>Air Bubbles
(Between glass and polarizer)</td>
<td>
<table>
<tr><th rowspan="2">Dimension(mm) \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D≤0.1</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.1<D≤0.2</td><td>5</td><td>5</td><td>*</td></tr>
<tr><td>0.2<D≤0.3</td><td>0</td><td>1</td><td>*</td></tr>
<tr><td>0.3<D</td><td>0</td><td>0</td><td>*</td></tr>
</table>
*: Disregard
Total defects shall not exceed 3.
</td>
</tr>
<tr>
<td>3</td>
<td>The Shape of Dot</td>
<td>
(1) Dot Shape(with dent)


As per the sketch of left hand.
(2) Dot Shape(with Projection)


Should not connect to next dot.
(3) Pin Hole


(X+Y)/2<0.2mm (less than 0.1mm is not counted
Total defects shall not exceed 5.
</td>
</tr>
</table>

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4 PRECAUTIONS IN USING LCM

◆ **LIQUID CRYSTAL DISPLAY (LCD)**

LCD is made up of glass, organic sealant, organic fluid, and polymer based polarizers. The following precautions should be taken when handing,

(1). Keep the temperature within range of use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel off or bubble.
(2). Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface. Wipe gently with cotton. Chamois or other soft material soaked in petroleum benzin.
(3). Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
(4). Glass can be easily chipped or cracked from rough handing. especially at corners and edges.
(5). Do not drive LCD with DC voltage.

◆ **Liquid Crystal Display Modules**

▲ Mechanical Considerations

LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.

(1). Do not tamper in any way with the tabs on the tabs on the metal frame.
(2). Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattem.
(3). Do not touch the elastomer connector, especially insert an backlight panel (for example, EL).
(4). When mounting a LCM make sure that the PCB is not under any tress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
(5). Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and

▲ Static Electricity

LCM contains CMOS LSI's and the same precaution for such devices should apply, namely

(1). The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
(2). The modules should be kept in antistatic bags or other containers resistant to static for storage.
(3). Only properly grounded soldering irons should be used.
(4). If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.
(5). The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.
(6). Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

▲ Soldering

(1). Solder only to the I/O terminals.
(2). Use only soldering irons with proper grounding and no leakage.
(3). Soldering temperature: 280 ℃±10℃
(4). Soldering time: 3 to 4 sec.
(5). Use eutectic solder with resin flux fill.
(6). If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed after wards.

▲ Operation

(1). The viewing angle can be adjusted by varying the LCD driving voltage V0.
(2). Driving voltage should be kept within specified range; excess voltage shortens display life.
(3). Response time increases with decrease in temperature.
(4). Display may turn black or dark blue at temperatures above its operational range; this is (however

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not pressing on the viewing area) may cause the segments to appear “fractured”.

(5). Mechanical disturbance during operation (such as pressing on the viewing area) nay cause the segments to appear “fractured”.

▲ Storage

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

▲ Limited Warranty

Unless otherwise agreed between HAN-G and customer, HAN-G will repiace or repair any of its LCD and LC, which is found to be defective electrically and visually when inspected in accordance with HAN-G acceptance standards, for a period on one year fron data of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of HAN-G is limited to repair and/or replacement on the terms set forth above. HAN-G will not responsible for any subsequent or consequential events.