深圳市华远显示器件有限公司

SHENZHEN HUAYUAN DISPLAY CO.,LTD.

液晶显示模块规格书

Specification for Liquid Crystal Display Module

HYG32024025G-bT91L-VB

Prepared By	Reviewed By	Approved By
Date:	Date:	Date:

REVISION HISTORY

The following table tracks the history of the changes made to this document.

SN	Rev.	Content	Date	Design
1	R00	Origin Released	2011-12-30	

CONTENTS

1. 0 GENERAL DESCRIPTION

The HYG32024025G-bT91L-VB is a 320x240 dots dot-matrix LCD module. It has a STN panel composed of 320 segments and 240 commons. The LCM can be easily accessed by microcontroller via 8080 series interface.

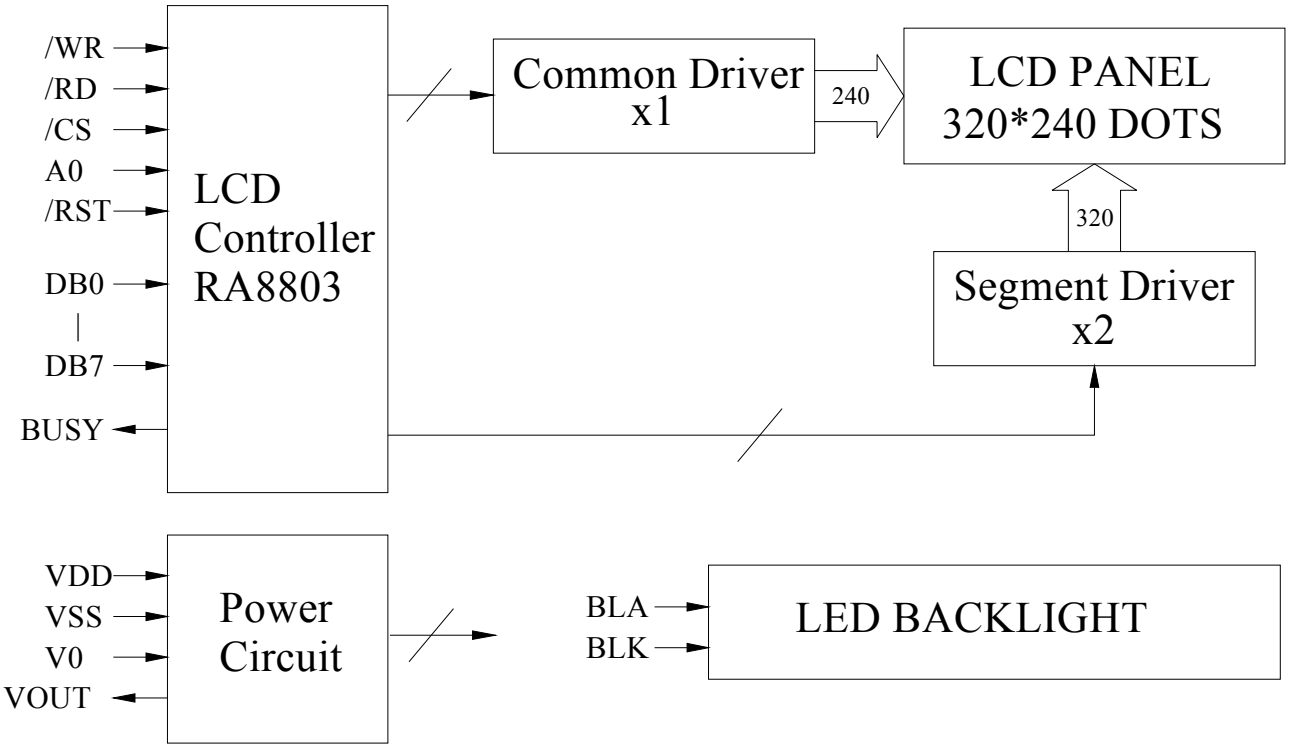
2. 0 FEATURES

Display Format	320 x 240 dots
LCD Type	STN-BLUE-NEGATIVE
Polarizer Mode	TRANSMISSIVE
Drive Method	1/240 Duty, 1/16 Bias
Viewing Direction	9 O'clock
Controller	RA8803P1N-S
Interface	8080 Series 8-Bit Parallel Interface
Backlight	White LED Backlight

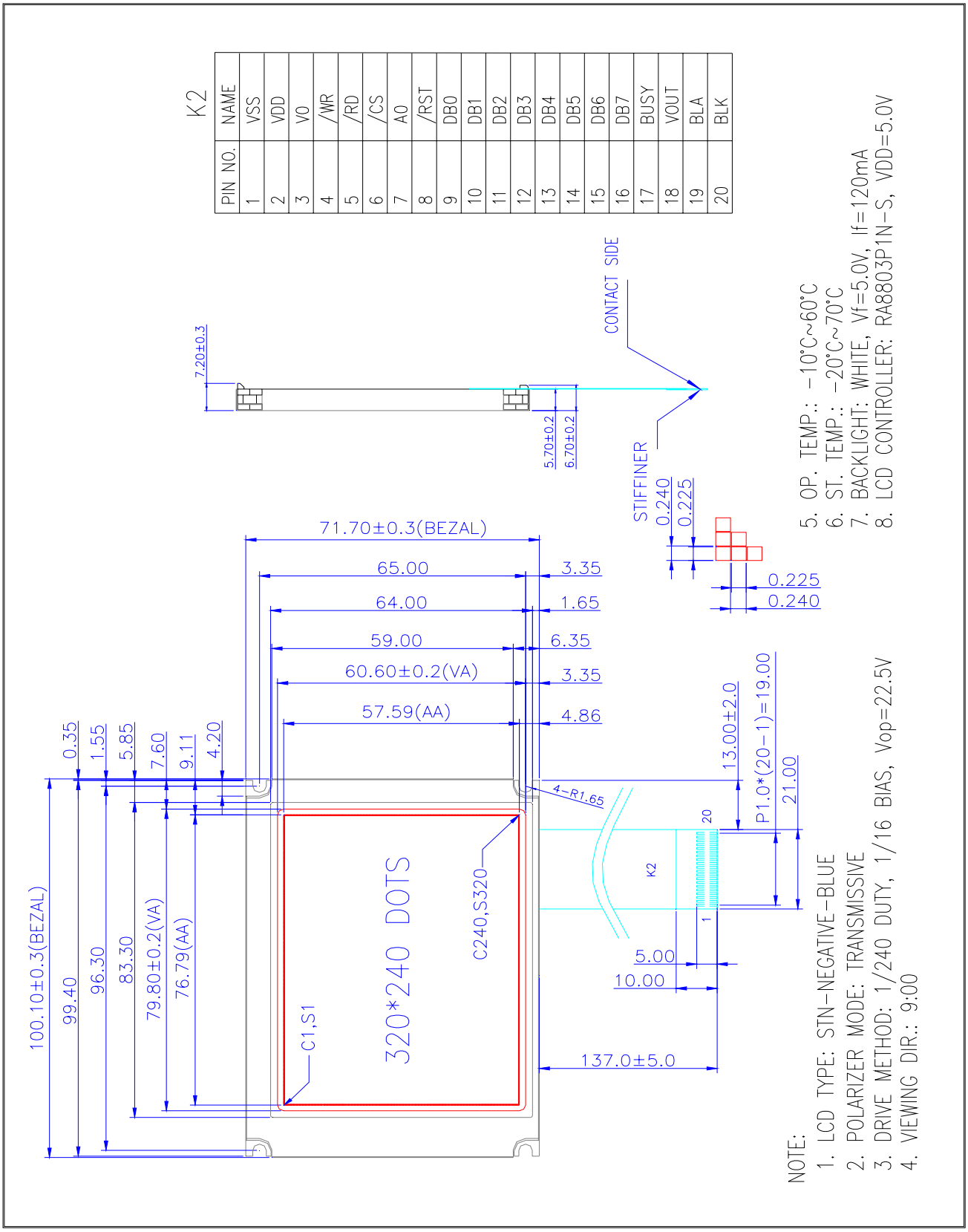
3. 0 MECHANICAL SPECIFICATION

Item	Description	Unit
Module Dimension	100.10(W) × 71.70(H) × 7.2(Max)(T)	mm
Viewing Area	79.80(W) × 60.60(H)	mm
Active Area	76.785(W) × 57.585(H)	mm
Dot Size	0.225(W) × 0.225(H)	mm
Dot Pitch	0.240(W) × 0.240(H)	mm
Character Size	——	mm

4. 0 BLOCK DIAGRAM



5. 0 EXTERNAL DIMENSIONS



6. 0 INTERFACE PIN DESCRIPTIONS

PIN No.	Symbol	Level	Description
1	V_{SS}	P	Ground
2	V_{DD}	P	Power supply for logic(+5.0V)
3	V0	P	Power supply for LCD
4	/WR	H/L	**Write Control.** This signal acts as the active-LOW.
5	/RD	H/L	**Read Control.** This signal acts as the active-LOW.
6	/CS	H/L	**Chip Select.** This signal acts as the active-LOW.
7	A0	H/L	**Register/Memory Select** The MPU will access Register when A0 is Low and access Data Memory when A0 is High.
8	/RST	H/L	**Reset Signal** This is a reset signal used to reset RA8803, Active low.
9	DB0	H/L	Data bit 0
10	DB1	H/L	Data bit 1
11	DB2	H/L	Data bit 2
12	DB3	H/L	Data bit 3
13	DB4	H/L	Data bit 4
14	DB5	H/L	Data bit 5
15	DB6	H/L	Data bit 6
16	DB7	H/L	Data bit 7
17	BUSY	H/L	**Busy Signal** This is a busy output to indicate the RA8803 is in busy state. It could be setup active high or low.
18	VOUT	P	Built-in DC-DC Voltage Output (+27.0V)
19	BLA	P	Power supply for LED Backlight (+5.0V)
20	BLK	P	Power supply for LED Backlight (0V)

7. 0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V_{DD}-V_{SS}	-0.3	6.5	V
Supply Voltage (LCD)	V_0- V_{SS}	--	25.0	V
Input Voltage	VI	-0.3	V_{DD}+0.3	V
Operating Temperature	Topr	-10	+60	℃
Storage Temperature	Tstg	-20	+70	℃

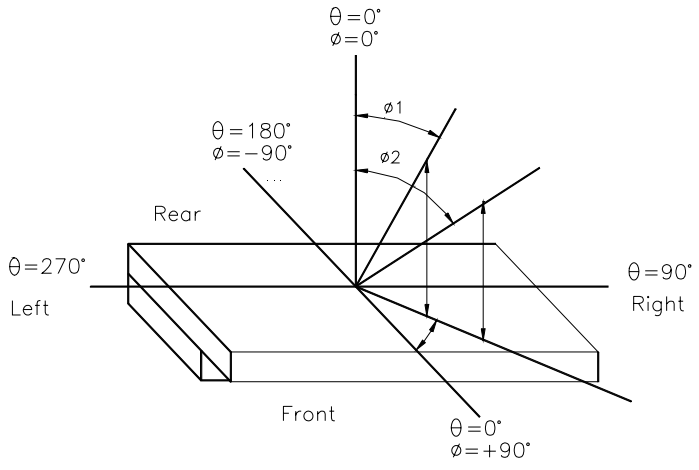
8. 0 ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for Logic	V_{DD}	--	4.8	5.0	5.2	V
LCD Operating Voltage	V0-V_{SS}	-10℃				V
		+25℃	22.2	22.5	22.7	V
		+60℃				V
Input voltage H level	V_{IH}		0.8V_{DD}	--	V_{DD}	V
Input voltage L level	V_{IL}		V_{SS}	--	0.2V_{DD}	V
Output High Voltage	V_{OH}		0.8V_{DD}	--	V_{DD}	V
Output Low Voltage	V_{OL}		V_{SS}	--	0.2V_{DD}	V

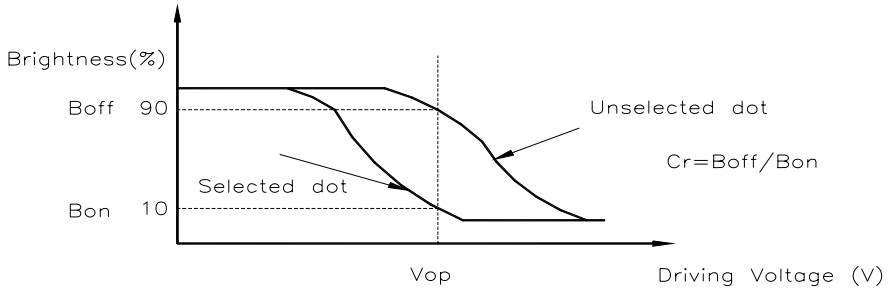
9. 0 OPTICAL CHARACTERISTICS

Item	Symbol	Condition		Min	Typ	Max	Unit
Response time	Ton	θ=0 ° and Ta=-20℃			--		ms
		θ=0 ° and Ta=+25℃		-	--		ms
		θ=0 ° and Ta=+70℃			--		ms
	Toff	θ=0 ° and Ta=-20℃			--		ms
		θ=0 ° and Ta=+25℃			--		ms
		θ=0 ° and Ta=+70℃			--		ms
Contrast ration	CR(MAX)	Ta=25℃		5	10		---
Viewing Angle	Ø	Deg θ=0 °	CR≥2.0 Ta=25℃		50		Deg
		Deg θ=90 °			35		
		Deg θ=180 °			30		
		Deg θ=270 °			35		
Crosstalk		Ta=25℃			1.2		---

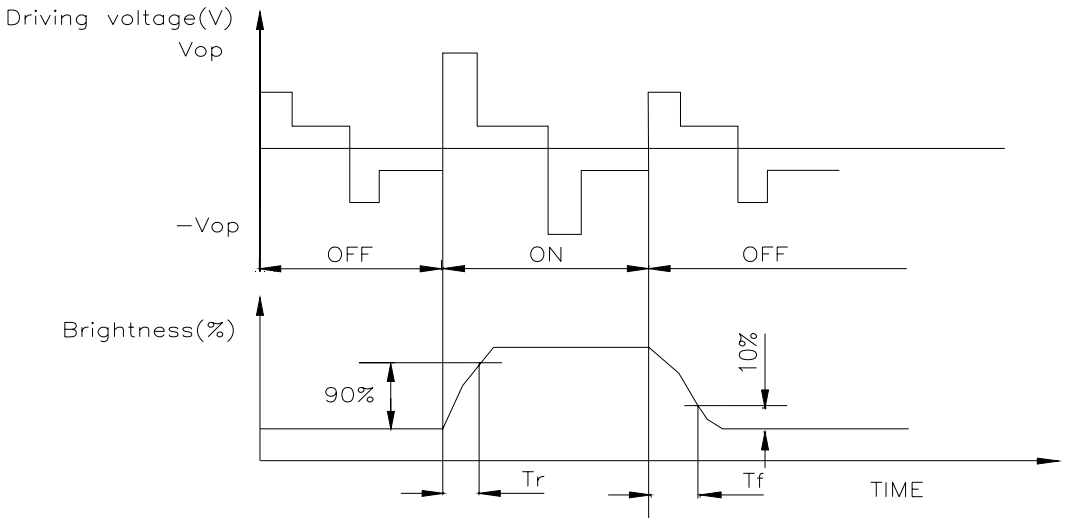
9.1 Viewing Angle θ , Ø and Viewing Angle Range: Δ Ø =|Ø2-Ø1|



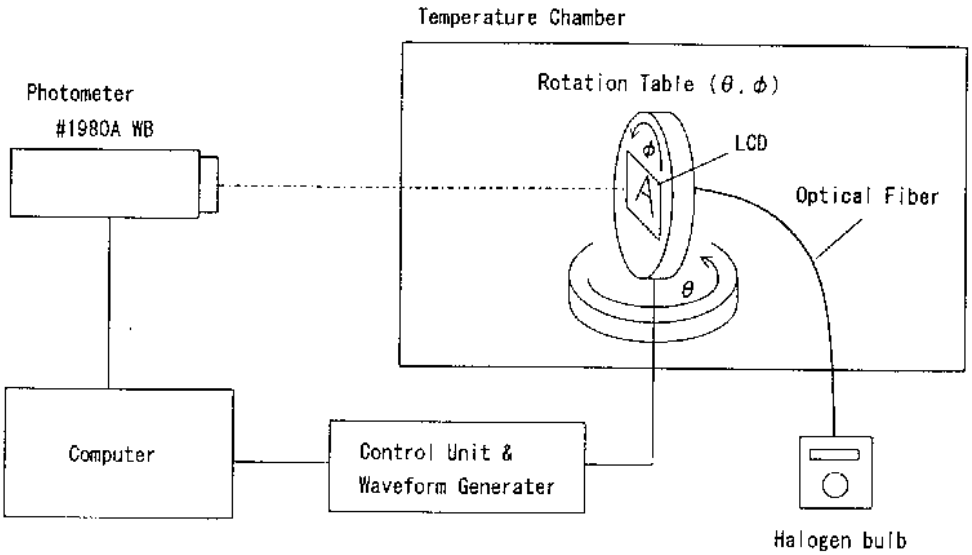
9.2 Contrast ratio(CR)



9.3 Response Time



9.4 Optical Measurement System



10. 0 TIMING CHARACTERICS

10.1 MPU Interface of 8080 Series

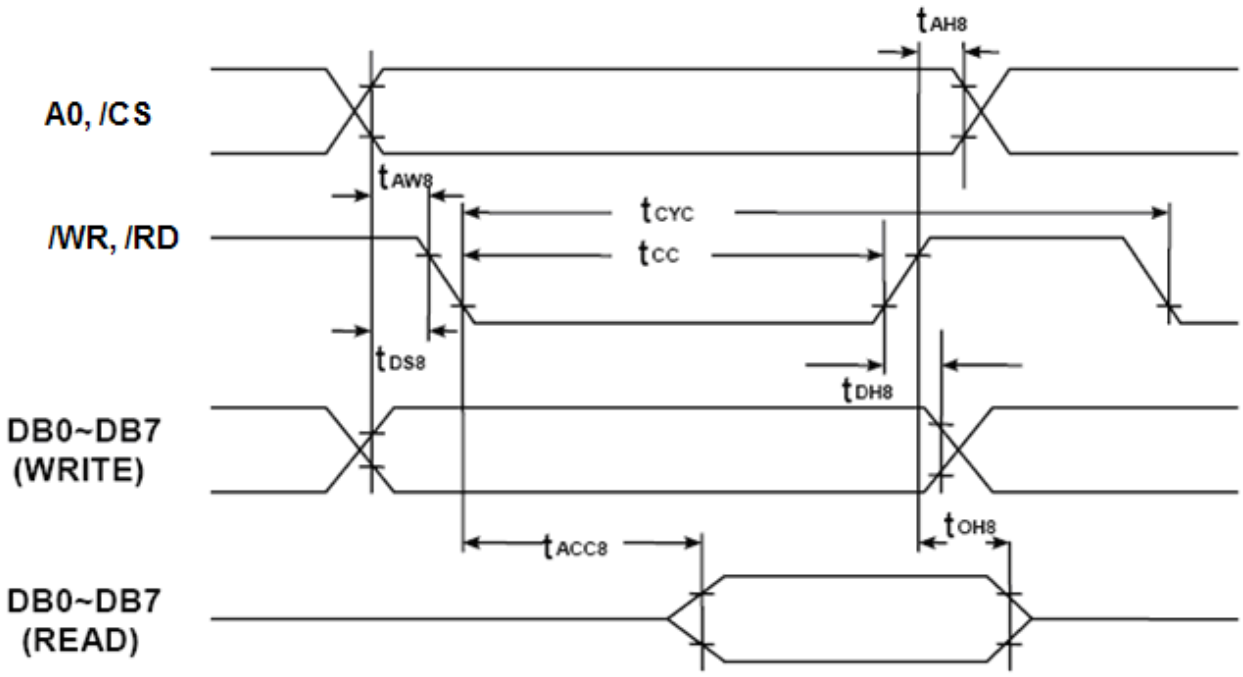


Figure10-1：8-Bit 8080 MPU Access RA8803 Register/Memory

Signal	Symbol	Parameter	Rating		Unit	Condition
			Min	Max		
A0, /CS	tAH8	Address hold time	10	--	ns	System Clock: 8MHz Voltage: 3.3V
	tAw8	Address setup time	63	--	ns	
/WR, /RD	tCYC	System cycle time	800	--	ns	
	tCC	Strobe pulse width	400	--	ns	
DB0 to DB7	tDS8	Data setup time	63	--	ns	
	tDH8	Data hold time	10	--	ns	
	tACC8	RD access time	--	330	ns	
	tOH8	Output disable time	10	--	ns	

10.2 MPU Interface of 6800 Series

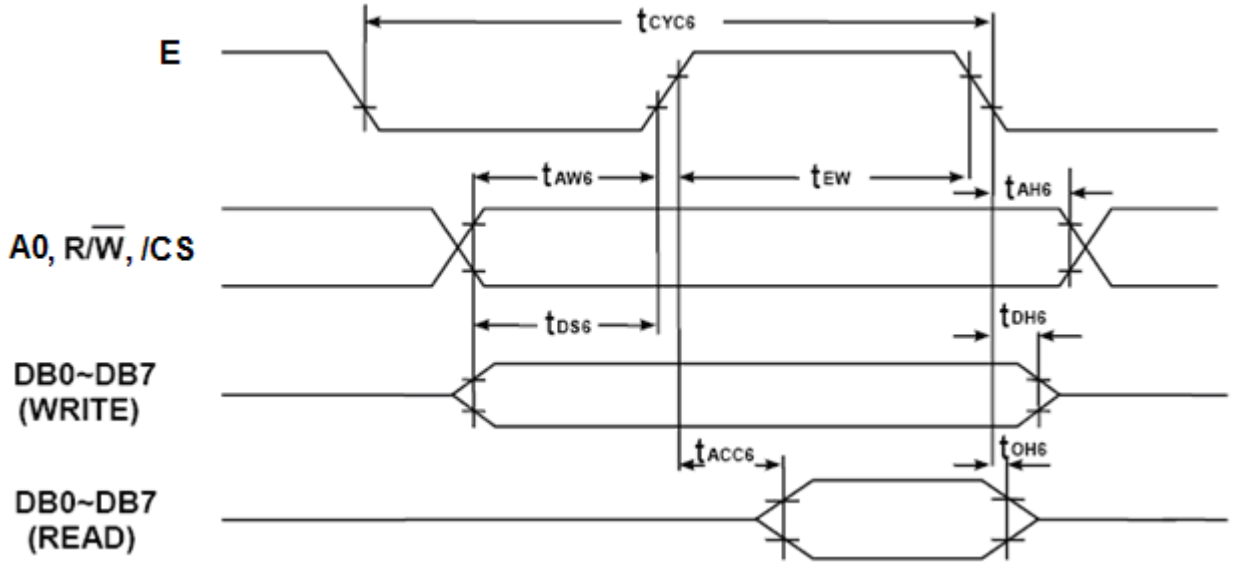


Figure10-2：8-Bit 6800 MPU Access RA8803 Register/Memory

Signal	Symbol	Parameter	Rating		Unit	Condition
			Min	Max		
A0, /CS , R/W	tAH6	Address hold time	10	--	ns	System Clock: 8MHz Voltage: 3.3V
	tAw6	Address setup time	63	--	ns	
	tCYC6	System cycle time	800	--	ns	
E	tEW	Enable pulse width	400	--	ns	
DB0 to DB7	tDS6	Data setup time	63	--	ns	
	tDH6	Data hold time	10	--	ns	
	tACC6	Access time	--	330	ns	
	tOH6	Output disable time	10	--	ns	

11. 0 BACKLIGHT CHARACTERISTICS

11.1 ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

Item	Symbol	Condition	Rating	Unit
Reverse Voltage	Vr		5	V
Absolute maximum forward current	Ifm		160	mA
Forward Current	If	Vf=5.0V	120	mA
Power Description	Pd		360	mW
Operating temperature range	Topr		-10~+60	^{0}C
Storage temperature range	Tst		-20~+70	^{0}C

11.2 ELECTRICAL/OPTLCAL CHARACTERISTICS

(Ta=25℃)

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Voltage	Vf	4.8	5.0	5.1	V	If=120mA
Reverse Current	Ir		120		uA	Vr=5 V
Dominant wave length	λp	--	--	--	nm	If=120mA
Spectral Line Half width	Δ λ		--			If=120 mA
Luminance	Lv		--		cd/m^2	If=120 mA
Color Coordinate	X		WHITE			If=120 mA
	Y					

12. 0 OPERATING PRINCIPLES & METHODS

12.1 DISPLAY WINDOW AND ACTIVE WINDOW

The RA8803 provides two windows for real application -- Display Window and Active Window. The Display Window is the actual resolution of LCD panel. Active is a sub-window in Display Window. The boundary of cursor shift depends on the active window.

For RA8803, if LCD panel resolution is 320x240 pixel then the display window size is 320x240. We can create an active window in the display window like Figure 12-1. This figure show the display size is 320x240, and a 160x160 active window is on the upper-middle.

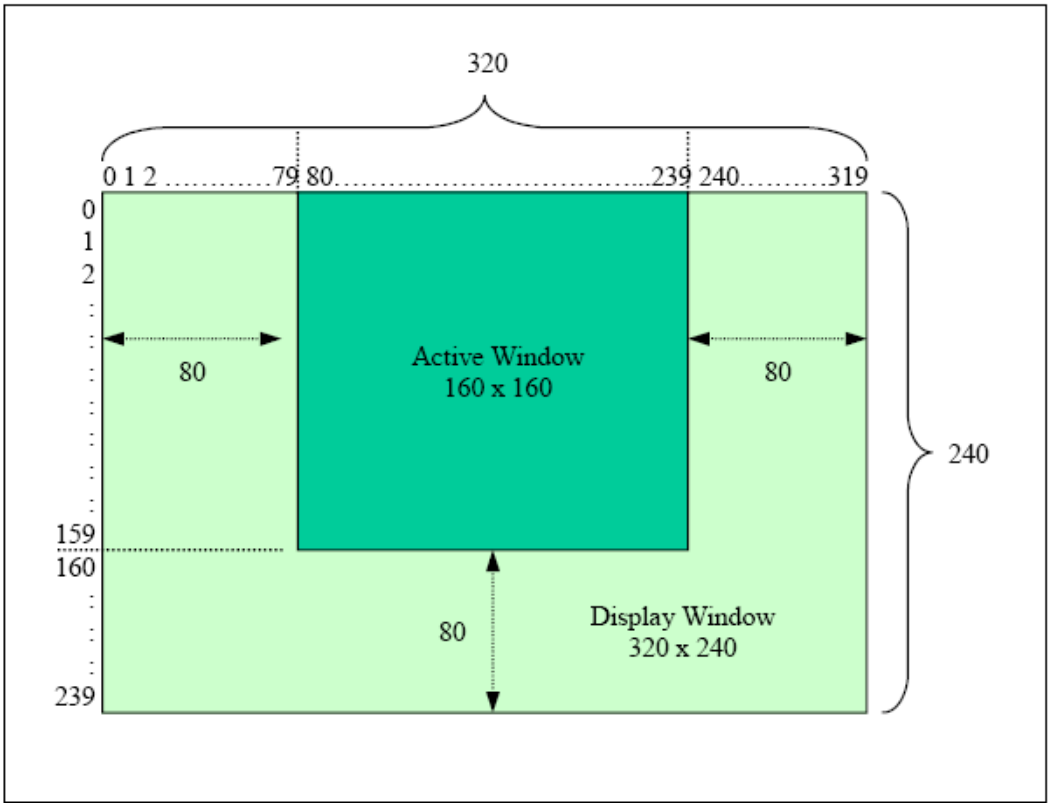


Figure 12-1: RA8803 Display Window and Active Window

Registers for Display Resolution

Normally the REG[40h], REG[50h], REG[41h] and REG[51h] set to ”00h”. And the content of REG[20h], EG[30h], REG[21h] and REG[31h] are depend on the resolution of LCD module. The following are reference table of different LCD module.

Segment	Common	REG[20h] AWRR	REG[30h] AWBR	REG[21h] DWRR	REG[31h] DWBR
160	80	13h	4Fh	13h	4Fh
160	128	13h	7Fh	13h	80h
160	160	13h	9Fh	13h	9Fh
240	64	1Dh	3Fh	1Dh	3Fh
240	128	1Dh	7Fh	1Dh	80h
240	160	1Dh	9Fh	1Dh	9Fh
320	240	27h	EFh	27h	EFh

Note:

Normally the REG[31h] value is Common-1, only when Common is 128, then the REG[31h] is 80h. If Common is 128 and keep the REG[31h] to 7Fh, then you have to set up the REG[81h] to 0Ch.

12.2 TWO LAYER DISPLAY

The RA8803 embedded two DDRAM for two layers display. The Register MAMR is used to show the visible display for page1(layer1) and page2(layer2). It provides six display modes:

1. Display Page1
2. Display Page2
3. Display Page1 OR Page2
4. Display Page1 XOR Page2
5. Display Page1 NOR Page2
6. Display Page1 AND Page2

Please refer Figure 12-2 and Register description of MAMR Bit[6..4] and Bit[3..2].

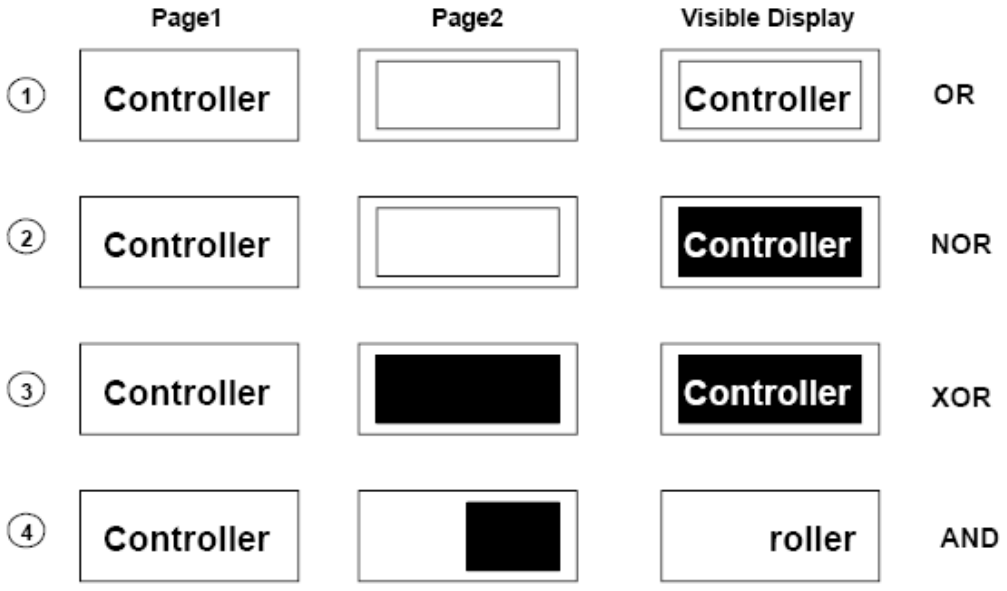


Figure 12-2 : Two Layers Display

12.3 TEXT MODE

The text mode of RA8803 supports full size(Chinese) and half size display. The full size character consists of 16x16 dots matrix and half size is 8x16 dots. The Figure 12-3 is an example to show the Full size and half size character.

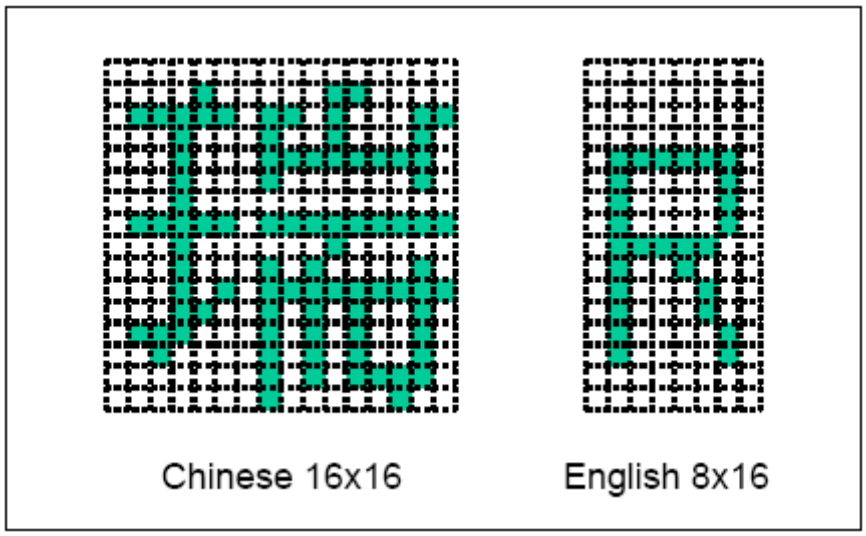


Figure 12-3: Full and Half Size Font

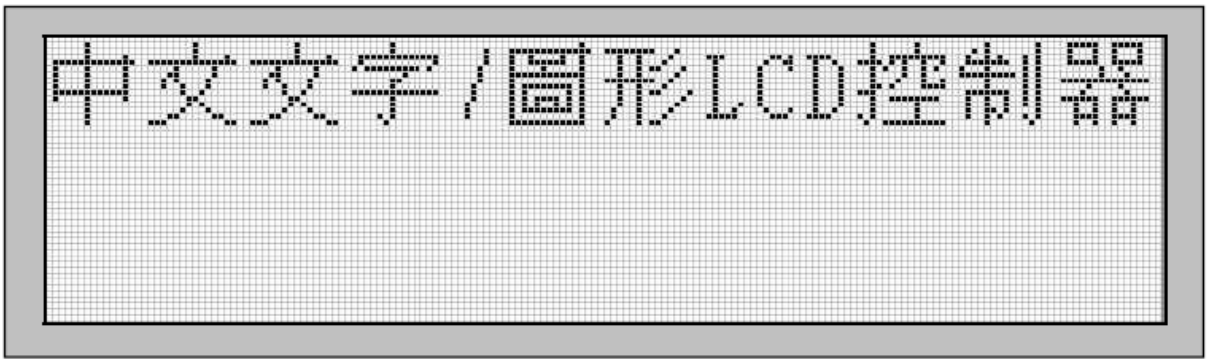


Figure 12-4: Mixed Display Mode of Full and Half Size Font

In the past, if user wants to show the Chinese character has to in the graphics mode and use bit map data to fill the Chinese font one byte by one byte. But the RA8803 embedded hardware Chinese engine could accept two bytes Chinese BIG5 or GB code from MPU and show the character in text mode directly. Before the MPU pass 2bytes Chinese code to RA8803/8822, the user need to assign the cursor to the right position like traditional text mode. Because each Chinese code is 2byte, so if the MPU interface is use 8-bit then the MPU has to send twice(High byte and Low byte). If want to show English or numeric then MPU only need to send one byte ASCII code.

The RA8803 supports maximum 320x240 pixel resolution of display. Therefore the maximum full size character number at one page is 20x15, and half size character is 40x15.

12-4 GRAPHICS MODE

The RA8803 graphics mode is use bit map to fill the data on the Display RAM. The Figure 7-5 is an example to show how to set graphics mode.

1. Setup REG. WLCR, CG = 0
2. Write bit map to Display Memory directly.

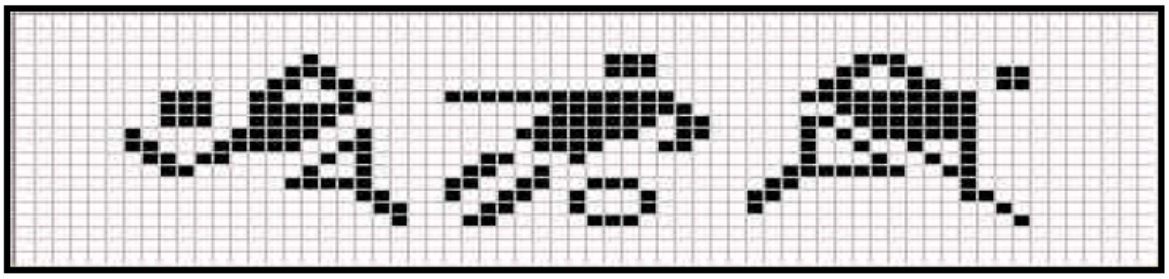


Figure 12-5: Graphics Mode

The RA8803 support maximum resolution is 320x240 pixel, therefore it need 9.6Kbyte (320x240/8 = 9600) Display Data RAM (DDRAM) to store each pixel data.

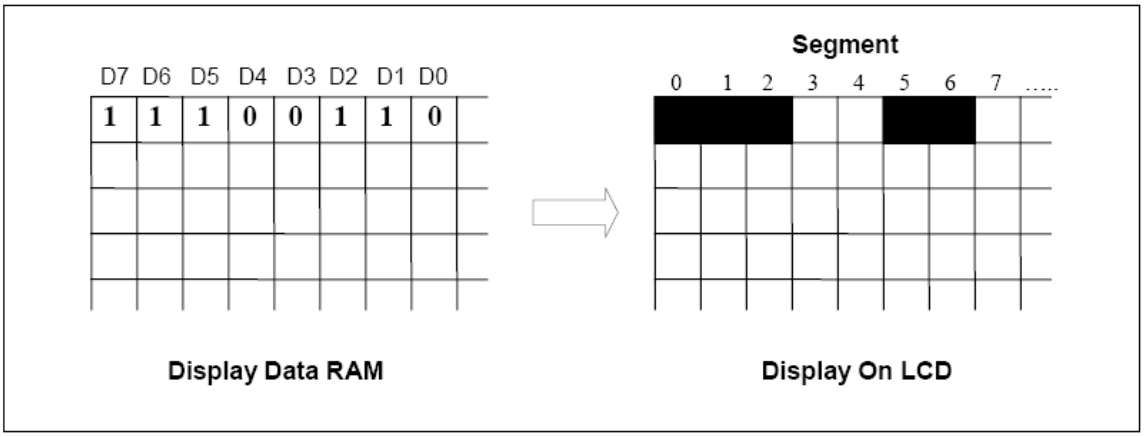


Figure 12-6: The Mapping of Display Data to LCD Panel

The RA8803 provide an Auto-Write feature to fill a data to all of the DDRAM. At first, user write the data to Register PNTR then initial the Auto-Write function (Register FNCR Bit3). RA8803 will fill the data to DDRAM in very short time. Normally this feature is used to clear screen or want to fill fixed pattern or background on screen.

12-5 GRAY LEVEL

The RA8803 also provide 4 level gray display effects. It used time-sharing to show the data in page1 and page2. The gray level of each pixel depends on the value of page1 and page2. For the same position, the value of [page1, page2] could be [0,0], [1,0], [0,1] or [1,1]. Therefore if the display times are different then you will see the different gray level on the screen. Of course you have to speed up the display frame rate and system clock to get more good quality and to avoid screen flash. The following are the related registers and example.

REG [12h] Memory Access Mode Register (MAMR)

Bit	Description	Default	Access
6-4	**Display Layer Selection** 0 0 0 : Gray Mode. In this mode, each pixel gray of LCD depends on the value of Page1 & Page2. Page1 Page2 Gray --- 0 0 Level1 1 0 Level2 0 1 Level3 1 1 Level4	1h	R/W

REG [E0h] Pattern Data Register (PNTR)

Bit	Description	Default	Access
7-0	**Display Times of Gray Mode** For Gray Mode(Register MAMR bit[6..4] = 000), These register used to control the display times. If the frame rate is fixed, the number of "1" and "0" are represent the display ratio of 1 and 0.	0h	R/W

If the REG[E0h] PNTR = 55h, AAh, 0Fh, F0h, CCh, 33h or 99h that means the number of "1" and "0" are same in register data. Therefore the Gray effect of Level2 and Level3 are same. So if register value of PNTR is set as above then it only provides three level of Gray. The number of "1" must more than "0" for four gray level. For example PNTR = F8h, FCh, FEh etc…

Figure 12-7 is a basic concept to show four gray levels on screen. The upper area of Page1 fills "00" and lower fill "FF". The left area of Page2 fills "00" and right fill "FF". Once we enable the Gray mode then we can see an obvious 4-Gray block on the screen like Figure 9-29.

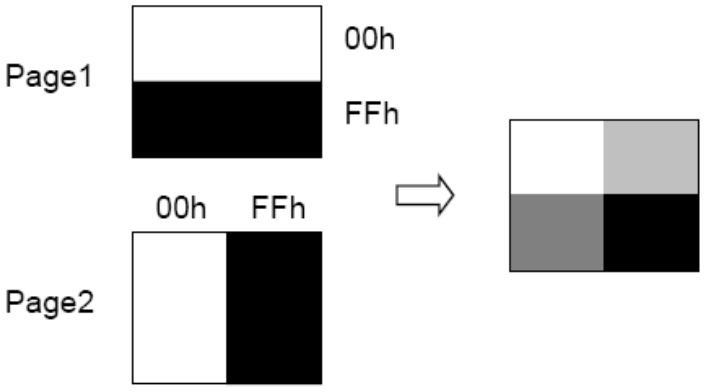


Figure12-7: Gray

13. 0 REGISTER DESCRIPTION

13.1 REGISTER LIST TABLE

Reg. No	Reg. Name	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Default Data
00h	WLCR	R/W	PW1	PW0	SR	--	CG	DP	DK	DV	C9h
01h	MISC	R/W	--	CKN	--	PLR	--	--	CKB1	CKB0	F0h
02h	APSR	R/W	--	--	SP1	SP0	OAR	--	SRFS	--	10h
03h	ADSR	R/W	--	--	--	--	DADR	AUCM	AUSG	SGCM	80h
10h	WCCR	R/W	ARI	ALG	WDI	WBC	AWI	CP	CK	CSD	6Fh
11h	DWLR	R/W	CR3	CR2	CR1	CR0	DY3	DY2	DY1	DY0	22h
12h	MAMR	R/W	GIM	RM2	RM1	RM0	OP1	OP2	WM1	WM0	91h
20h	AWRR	R/W	--	--	X5	X4	X3	X2	X1	X0	27h
21h	DWRR	R/W	--	--	A5	A4	A3	A2	A1	A0	27h
30h	AWBR	R/W	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	EFh
31h	DWBR	R/W	B7	B6	B5	B4	B3	B2	B1	B0	EFh
40h	AWLR	R/W	--	--	SS5	SS4	SS3	SS2	SS1	SS0	00h
41h	DWLR	R/W	--	--	C5	C4	C3	C2	C1	C0	00h
50h	AWTR	R/W	SC7	SC6	SC5	SC4	SC3	SC2	SC1	SC0	00h
51h	DWTR	R/W	D7	D6	D5	D4	D3	D2	D1	D0	00h
60h	CPXR	R/W	--	--	RS5	RS4	RS3	RS2	RS1	RS0	00h
61h	BGSG	R/W	--	--	DS5	DS4	DS3	DS2	DS1	DS0	00h
70h	CPYR	R/W	RC7	RC6	RC5	RC4	RC3	RC2	RC1	RC0	00g
71h	BGCM	R/W	CB7	CB6	CB5	CB4	CB3	CB2	CB1	CB0	00h
72h	EDCM	R/W	CD7	CD6	CD5	CD4	CD3	CD2	CD1	CD0	EFh
80h	BTMR	R/W	BT7	BT6	BT5	BT4	BT3	BT2	BT1	BT0	33h
81h	FRCA	R/W	--	--	--	--	--	--	--	--	00h
90h	SCCR	R/W	CK7	CK6	CK5	CK4	CK3	CK2	CK1	CK0	04h
91h	FRCB	R/W	--	--	--	--	--	--	--	--	00h
A0h	INTR	R/W	INK	INT	INX	INY	MSK	MST	MSX	MSY	00h
A1h	KSCR	R/W	KEN	KSZ	KDT1	KDT0	--	KF2	KF1	KF0	00h
A2h	KSDR	RO	KS7	KS6	KS5	KS4	KS3	KS2	KS1	KS0	00h
A3h	KSER	RO	KD7	KD6	KD5	KD4	KD3	KD2	KD1	KD0	00h
B0h	INTX	R/W	--	--	IX5	IX4	IX3	IX2	IX1	IX0	27h
B1h	INTY	R/W	IY7	IY6	IY5	IY4	IY3	IY2	IY1	IY0	EFh
C0h	TPCR	R/W	AZEN	AZOE	--	SCAN	AS3	AS2	AS1	AS0	00h
C1h	TPSR	R/W	ARDY	ADET	1	1	AF1	AF0	--	--	0Fh
C8h	TPXR	RO	TPX9	TPX8	TPX7	TPX6	TPX5	TPX4	TPX3	TPX2	00h

Reg. No	Reg. Name	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Default Data
C9h	TPYR	RO	TPY9	TPY8	TPY7	TPY6	TPY5	TPY4	TPY3	TPY2	00h
CAh	TPZR	RO	TPX1	TPX0	--	--	TPY1	TPY0	--	--	00h
D0h	LCCR	R/W	DZEN	--	--	DAC4	DAC3	DAC2	DAC1	DAC0	8Fh
E0h	PNTR	R/W	FD7	FD6	FD5	FD4	FD3	FD2	FD1	FD0	00h
F0h	FNCR	R/W	TNS	BNK	RM1	RM0	FDA	ASC	ABS1	ABS0	92h
F1h	FVHT	R/W	FH1	FH0	FV1	FV0	1	1	1	1	0Fh

13.2 REGISTER DESCRIPTION

REG [00h] Whole Chip LCD Controller Register (WLCR)

Bit	Description	Text/Graph	Default	Access
7-6	**Power Mode** 11: Normal Mode. All of the functions of RA8803 are available in this mode. 00: Off Mode. When RA8803 is in off mode, all of functions enter power-off mode, except the wake-up trigger block. If wake-up event occurred, RA8803 would wake-up and return to Normal mode.	--	3h	R/W
5	**Software Reset** 1 : Reset all registers except flushing RAM 0 : Normal Operation	--	0h	R/W
4	Reserved.	--	0h	R/W
3	**Display Mode Selection** 1 : Character Mode. The written data will be treated as a GB/BIG/ASCII code. 0 : Graphical Mode. The written data will be treated as a bit-map pattern.	--	1h	R/W
2	**Set Display On/Off Selection** The bit is used to control LCD Driver Interface signals --DISP_OFF. 1 : DISP_OFF pin output high(Display On). 0 : DISP_OFF pin output low(Display Off).	Text/Graph	0h	R/W
1	**Blink Mode Selection** 1 : Blink Full Screen. The blink time is set by register BTMR. 0 : Normal Display.	Text/Graph	0h	R/W
0	**Inverse Mode Selection** 1 : Normal Display 0 : Inverse Full Screen. It will cause the display inversed.	Text/Graph	1h	R/W

REG [01h] Misc. Register (MISC)

Bit	Description	Default	Access
7	Reserved.	1h	R/W
6	**Clock Output (Pin CLK_OUT) Control** 1 : Enable 0 : Disable	1h	R/W
5	Reserved.	1h	R/W
4	**Interrupt (INT) and Busy Polarity** 1 : Set Active High 0 : Set Active Low	1h	R/W
3-2	Reserved.	0h	R/W
1-0	**Clock Speed Selection** 0 0 : 3MHz 0 1 : 4MHz 1 0 : 8MHz 1 1 : 12MHz	0h	R/W

REG [02h] Advance Power Setup Register (APSR)

Bit	Description	Default	Access
7-6	Reserved	0h	R/W
5-4	**ROM/RAM Reading Speed** 0 0 : Speed0 (30ns@Vdd=3.3V) 0 1 : Speed1 (60ns@Vdd=3.3V) 1 0 : Speed2 (90ns@Vdd=3.3V) 1 1 : Speed3 (120ns@Vdd=3.3V)	1h	R/W
3	**Font ROM Readable for MPU** 1 : Enable 0 : Disable	0h	R/W
2	Reserved	0h	R/W
1	**Scrolling Reset for Start** 0 : Disable 1 : Enable	0h	R/W
0	Reserved	0h	R/W

REG [03h] Advance Display Setup Register (ADSR)

Bit	Description	Default	Access
7-4	Reserved	8h	R/W
3	**Set Display RAM Order (Byte)** 1 : Inverse Data of Byte 0 : Normal Mode	0h	R/W
2	**Common Auto Scrolling** 1 : Enable 0 : Disable	0h	R/W
1	**Segment Auto Scrolling** 1 : Enable 0 : Disable	0h	R/W
0	**Common or Segment Scrolling Selection** 1 : Segment Scrolling 0 : Common Scrolling In Extension Mode(bit[6:4] of REG[12h] = "110" or "111"), this bit must be high.	0h	R/W

REG [10h] Whole Chip Cursor Control Register (WCCR)

Bit	Description	Text/Graph	Default	Access
7	**Auto Increase Cursor Position in Reading DDRAM Operation.** 1 : Enable (Auto Increase) 0 : Disable	Text/Graph	0h	R/W
6	**Chinese/English Character Alignment** 1 : Enable 0 : Disable The bit only valid in character mode, that can align full-size and half-size mixed font.	Text	1h	R/W
5	**Store Current Data to DDRAM** 1 : Store Current Data to DDRAM Directly 0 : Store Current Data to DDRAM Inversely	Text/Graph	1h	R/W
4	**Bold Font (Character Mode Only)** 1 : Bold Font 0 : Normal Font	Text	0h	R/W
3	**Auto Increase Cursor Position in Writing DDRAM Operation.** 1 : Enable (Auto Increase) 0 : Disable	Text/Graph	1h	R/W

Bit	Description	Text/Graph	Default	Access
2	**Cursor Display** 1 : Set Cursor Display On 0 : Set Cursor Display Off	Text/Graph	1h	R/W
1	**Cursor Blinking** 1 : Blink Cursor. The blink time is determined by BTMR. 0 : Normal	Text/Graph	1h	R/W
0	**Cursor Width** 1 : Cursor width is auto adjust by input data. When half size font, the width is one bit(8 Pixel). When full size font, the width is two bit(16 Pixel). 0 : Cursor is fixed at one byte width(8 Pixel).	Text	1h	R/W

REG [11h] Distance of Words or Lines Register (DWLR)\

Bit	Description	Default	Access
7-4	Set Cursor Height	2h	R/W
3-0	Set Line Distance	2h	R/W

REG [12h] Memory Access Mode Register (MAMR)

Bit	Description	Default	Access
7	**In Graphic Mode, Cursor Auto Shifting Direction** 1 : Horizontal moving first then Vertical. 0 : Vertical moving first then Horizontal.	1h	R/W
6-4	**Display Layer Selection** 0 0 1 : Only Show Page1 0 1 0 : Only Show Page2 0 1 1 : Show Two Layer Mode. The display rule depends on Bit3 and Bit2 as following. 0 0 0 : Gray Mode. In this mode, each pixel gray of LCD depends on the value of Page1 & Page2. Page1 Page2 Gray ---------- 0 0 Level1 1 0 Level2 0 1 Level3 1 1 Level4	1h	R/W

Bit	Description	Default	Access
	1 1 0：Extension Mode(1), the panel will show both Page1 and Page2. The RA8803 is available for 640x240 dots panel. 1 1 1：Extension Mode(2), the panel will show both Page1 and Page2. The RA8803 is available for 320x480 dots panel.		
3-2	**Two Layer Mode Selection** 0 0 : Page1 RAM "OR" Page2 RAM 0 1 : Page1 RAM "XOR" Page2 RAM 1 0 : Page1 RAM "NOR" Page2 RAM 1 1 : Page1 RAM "AND" Page2 RAM Please refer to Figure 7-10 for more explanation.	0h	R/W
1-0	**MPU Read/Write Layer Selection** 0 0 : Access Page0 (512B SRAM) Display Data RAM. 0 1 : Access Page1 (9.6KB SRAM) Display Data RAM. 1 0 : Access Page2 (9.6KB SRAM) Display Data RAM. 1 1 : Access Page1 and Page2 Display Data RAM at the same time. The Page0 are used for create some temporary characters. Please refer to AP Note for more details.	1h	R/W

REG [20h] Active Window Right Register (AWRR)

Bit	Description	Default	Access
7-6	Reserved	0h	R
5-0	Active Window Right Position → Segment-Right	27h	R/W

REG [30h] Active Window Bottom Register (AWBR)

Bit	Description	Default	Access
7-0	Active Window Bottom Position → Common-Bottom	EFh	R/W

REG [40h] Active Window Left Register (AWLR)

Bit	Description	Default	Access
7-6	Reserved	0h	R
5-0	Active Window Left Position → Segment-Left	0h	R/W

REG [50h] Active Window Top Register (AWTR)

Bit	Description	Default	Access
7-0	Active Window Top Position → Common-Top	0h	R/W

Note: REG [20h, 30h, 40h, 50h] are used for the function of change the line and page. Users can use these four Registers to set a block as an active window. When data goes beyond the right boundary of active window (The value is set by REG [20h, 30h, 40h, 50h]), then the cursor will automatically change the line and write in data continuously. It means the cursor will move to the left boundary of active window, which is set by REG [40h]. When the data comes to the bottom line of the right side (set by REG [20h and 30h]), then the cursor will be moved to the first line of the left side automatically and continue to put in data. (set by REG [40h, 50h]).

REG [21h] Display Window Right Register (DWRR)

Bit	Description	Default	Access
7-6	Reserved	0h	R
5-0	**Set Display Window Right Position → Segment-Right** Segment-Right = (Segment Number / 8) – 1 RA8803: If LCD panel resolution is 320*240, the value of the register is: (320 / 8) - 1 = 39 = 27h	27h	R/W

REG [31] Display Window Bottom Register (DWBR)

Bit	Description	Default	Access
7-0	**Set Display Window Bottom Position → Common-Bottom** Common_ Bottom = LCD Common Number –1 RA8803: If LCD panel resolution is 320*240, the value of the register is: 240 – 1 = 239 = EFh	EFh	R/W

REG [41] Display Window Left Register (DWLR)

Bit	Description	Default	Access
7-0	**Display Window Left Position → Segment-Left** Usually set “0h”.	0h	R/W

REG [51] Display Window Top Register (DWTR)

Bit	Description	Default	Access
7-0	**Display Window Top Position → Common-Top** Usually set “0h”.	0h	R/W

Note:

REG[21h, 31h, 41h, 51h] are used to set Display Window Resolution. Users can set the viewing scope of Display RAM. Column Address of RA8803 can be set between 0~27h, and Row Address can be set between 0~EFh. Users can set start and end address first, and then by adding shift function to present the effect of rolling.

For some registers setting, please refer the following rule:

1. DWRR≥ AWRR≥ CPXR≥ AWLR≥ DWLR
2. DWBR≥ AWBR≥ CPYR≥ AWTR≥ DWTR

REG [60h] Cursor Position X Register (CPXR)

Bit	Description	Default	Access
7-6	Reserved	0h	R
5-0	**Cursor Position of Segment**	0h	R/W

REG [61h] Begin Segment Position Register (BGSG)

Bit	Description	Default	Access
7-6	Reserved	0h	R/W
5-0	**Segment Start Position of Scrolling Mode**	0h	R/W

REG [70h] Cursor Position Y Register (CPYR)

Bit	Description	Default	Access
7-0	**Cursor Position of Common**	0h	R/W

REG [71h] Scrolling Action Range, Begin Common Register (BGCM)

Bit	Description	Default	Access
7-0	**Common Start Position of Scrolling Mode**	0h	R/W

REG [72h] Scrolling Action Range END Common Register (EDCM)

Bit	Description	Default	Access
7-0	**Common Ending Position of Scrolling Mode**	EFh	R/W

REG [80h] Blink Time Register (BTMR)

Bit	Description	Default	Access
7-0	**Cursor Blink Time** Blinking Time = Bit [7..0] x (1/Frame_Rate) The setup of Frame Rate is depends on the LCD panel.	33h	R/W

REG [81h] Frame Rate Polarity Change at Common_A Register (FRCA)

Bit	Description	Default	Access
7-0	**Reserved** If the Common number of module is 128 then suggest set to "0Ch". Refer the Section 5-3.	0h	R/W

REG [91h] Frame Rate Polarity Change at Common_B Register (FRCB)

Bit	Description	Default	Access
7-0	**Reserved**	0h	R/W

REG [90h] Shift Clock Control Register (SCCR)

Bit	Description	Default	Access
7-0	**Shift Clock Cycle** SCCR = (SCLK x DW) / (Seg x Com x FRM) SCLK : RA8803 System Clock (Unit : Hz) DW : Bus Width of LCD Driver(Unit : Bit) Seg : Segment Number of LCD Panel(Unit : Pixel) Com : Common Number of LCD Panel (Unit : Pixel) FRM : Frame Rate of LCD Panel(Unit : Hz) Note: SYS_DW=0, If LCD Data Bus is 4it then SCCR has to ≥ 4. SYS_DW=1, If LCD Data Bus is 8it then SCCR has to ≥ 2.	4h	R/W

REG [A0h] Interrupt Setup & Status Register (INTR)

Bit	Description	Default	Access
7	**Key Scan Interrupt Flag** 1 : Key Scan Detects Key Input 0 : Key Scan doesn't Detect Key Input	0h	R (Read Clear)
6	**Touch Panel Detect** 1 : Touch Panel Touched 0 : Touch Panel Untouched	0h	R (Read Clear)
5	**Cursor Column Status** 1 : The Cursor Column is equal to INTX 0 : The Cursor Column is not equal to INTX	0h	R (Read Clear)
4	**Cursor Row Status** 1 : The Cursor Row is equal to INTY 0 : The Cursor Row is not equal to INTY	0h	R (Read Clear)

Bit	Description	Default	Access
3	**Key Scan Interrupt Mask** 1 : Enable Key Scan Interrupt. Enable BUSY signal. 0 : Disable Key Scan Interrupt	0h	R/W
2	**Touch Panel Interrupt Mask** 1 : Generate interrupt output if touch panel was detected. Enable BUSY signal. 0 : Don't generate interrupt output if touch panel was detected.	0h	R/W
1	**Register[B0h] INTX Event Mask** 1 : Enable INTX Interrupt. Enable BUSY signal. 0 : Disable INTX Interrupt	0h	R/W
0	**Register[B1h] INTY Event Mask** 1 : Enable INTY Interrupt. Enable BUSY signal. 0 : Disable INTY Interrupt	0h	R/W

Note: Any Bit of Bit3~Bit0 set to "1", then the BUSY Signal will be enable. The Polarity of BUSY depends on the Bit4 of Register [01h].

REG [A1h] Key Scan Controller Register (KSCR)

Bit	Description	Default	Access
7	**Key Scan Enable Bit** 1 : Enable 0 : Disable	0h	R/W
6	**Key Scan Matrix Selection** 1 : 4x4 Matrix 0 : 8x8 Matrix	0h	R/W
5-4	**Key Scan Data Sampling Times** 0 0 : 2h 0 1 : 4h 1 0 : 8h 1 1 : 16h	0h	R/W
3	Reserved	0h	R/W
2-0	**Key Scan Frequency Selection** 0 0 0 : 2 x FRM 0 0 1 : 4 x FRM 0 1 0 : 8 x FRM 0 1 1 : 16 x FRM 1 0 0 : 32 x FRM 1 0 1 : 64 x FRM 1 1 0 : 128 x FRM 1 1 1 : 256 x FRM	0h	R/W

REG [A2h] Key Scan Data Register (KSDR)

Bit	Description	Default	Access
7-0	**Key Scan KC[7~0] Output**	0h	R

REG [A3h] Key Scan Data Expand Register (KSER)

Bit	Description	Default	Access
7-0	**Key Scan KR[7~0] Input**	0h	R

REG [B0h] Interrupt Column Setup Register (INTX)

Bit	Description	Default	Access
7-6	Reserved	0h	R
5-0	**Column Address of Interrupt** If Cursor Position X Register (CPXR)=INTX, then an interrupt occurred.	27h	R/W

REG [B1h] Interrupt Row Setup Register (INTY)

Bit	Description	Default	Access
7-0	**Row Address of Interrupt** If Cursor Position Y Register (CPYR)=INTY, then an interrupt has occurred.	EFh	R/W

REG [C0h] Touch Panel Control Register (TPCR)

Bit	Description	Default	Access
7	**Touch Panel Enable Bit** 1 : Enable 0 : Disable	1h	R/W
6	**Touch Panel Data Output Control** 1 : Enable the Touch Panel Data Output 0 : Disable the Touch Panel Data Output	1h	R/W
5	Reserved	0h	R/W
4	**Touch Panel Scan** 1 : Disable 0 : Enable	1h	R/W
3-0	**Switch Control of Touch Panel** Bit3: control SW3 ON/OFF(1/0) Bit2: control SW2 ON/OFF(1/0) Bit1: control SW1 ON/OFF(1/0) Bit0: control SW0 ON/OFF(1/0)	See as below	R/W

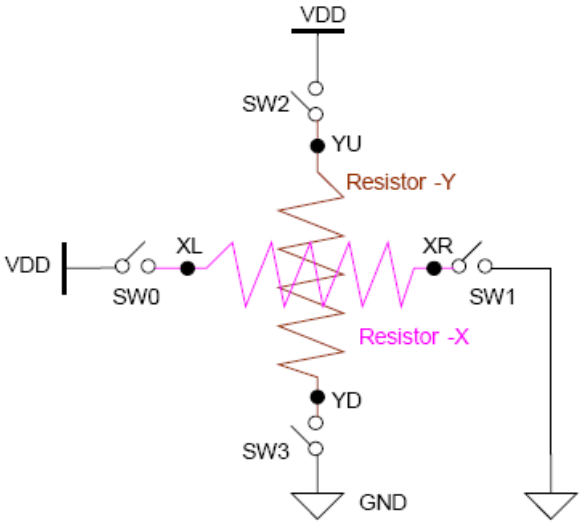


Figure 13-1 : Control Switch of Touch Panel

REG [C1h] Touch Panel Status Register (TPSR)

Bit	Description	Default	Access
7	**ADC Data Convert State** 1 : Convert Complete 0 : Convert Incomplete	0h	R
6	**Touch Event Indicate** 1 : Touched 0 : Un-touch	0h	R
5	This bit Must be “1” when system initial.	0h	R/W
4	This bit Must be “1” when system initial.	0h	R/W
3-2	**ADC Convert Speed** 0 0 : SCLK/32 0 1 : SCLK/64 1 0 : SCLK/128 1 1 : SCLK/256	2h	R/W
1-0	Reserved	2h	R/W

REG [C8h] Touch Panel Segment High Byte Data Register (TPXR)

Bit	Description	Default	Access
7-0	Touch Panel Segment Data Bit[9..2]	80h	R

REG [C9h] Touch Panel Common High Byte Data Register (TPYR)

Bit	Description	Default	Access
7-0	Touch Panel Common Data Bit[9..2]	80h	R

REG [CAh] Touch Panel Segment/Common Low Byte Data Register (TPZR)

Bit	Description	Default	Access
7-6	Touch Panel Segment Data Bit[1..0]	0h	R
5-4	Reserved	0h	--
3-2	Touch Panel Common Data Bit[1..0]	0h	R
1-0	Reserved	0h	--

REG [D0h] LCD Contrast Control Register (LCCR)

Bit	Description	Default	Access
7	**DAC Function** 1 : Disable 0 : Enable	1h	R/W
6-5	Reserved	0h	--
4-0	**DAC Driving Current** 0 0 0 0 0b □ 0μA±0.2μA (Min. Current) **:** **:** 1 1 1 1 1b □ 540μA±140 μA (Max. Current)	0Fh	R/W

REG [E0h] Pattern Data Register (PNTR)

Bit	Description	Default	Access
7-0	**(1) Data Written to DDRAM** When REG[F0h] bit3 is '1', it will read the data from Register [E0h] and fill the whole DDRAM. After the movement of filling the Active window, REG [F0h] bit3 will become "0". **(2) Display Times of Gray Mode** For Gray Mode(Register MAMR bit[6..4] = 000), These register used to control the display times. If the frame rate is fixed, the number of "1" and "0" are represent the display ratio of 1 and 0.	0h	R/W

REG [F0h] Font Control Register (FNCR)

Bit	Description	Text/Graph	Default	Access
7	**Font ROM Transfer Circuit** 1 : Enable 0 : Bypass	--	1h	R/W
6	When bit5~4 set as "00" → ROM Mode0, this bit could be used to select the upper or lower part of 256KB ROM. 1 : Select lower part of 256KB ROM 0 : Select upper part of 256KB ROM	--	0h	R/W

Bit	Description	Text/Graph	Default	Access
5-4	**Select Font ROM Type** 0 0 : Select GB font ROM (256KB, Mode0) 0 1 : Select BIG5 font ROM (512KB, Mode1) 1 0 : Support GB font ROM (512KB, Mode2)	--	1h	R/W
3	**Fill PNTR Data to DDRAM** 1 : Fill Data to DDRAM Enable 0 : No Action When this bit is "1", RA8803 will automatically read PNTR data, and fill it to DDRAM (Range:[AWLR, AWTR] ~ [AWRR, AWBR]), and then this bit will be cleaned to "0".	Graph	0h	R/W
2	**ASCII Code Selection** 1 : All input data will be decoded as ASCII (00~FFh) 0 : The RA8803 will check the first byte data first. If the first byte is 00~9Fh then regarded as ASCII (Half-size). If first byte is A0~FFh then regarded as GB/BIG5 (Full-size).	Text	0h	R/W (Auto Clear)
1-0	**ASCII Blocks Select** 0 0 : Map to ASCII block 0, Latin_1 0 1 : Map to ASCII block 1, Latin_2 1 0 : Map to ASCII block 2, Latin_3 1 1 : Map to ASCII block 3, Latin_4	--	2h	R/W

REG [F1h] Font Size Control Register (FVHT)

Bit	Description	Default	Access
7-6	Set Character Horizon Size 0 0 : One Time 0 1 : Two Times 1 0 : Three Times 1 1 : Four Times	0h	R/W
5-4	Set Character Vertical Size 0 0 : One Time 0 1 : Two Times 1 0 : Three Times 1 1 : Four Times	0h	R/W
3-0	Reserved	Fh	R/W

14. 0 QUALITY GUARANTEE

14.1 ACCEPTABLE QUALITY LEVEL

Inspection items	Sampling procedures	AQL
Visual-operating (Electro-optical)	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	0.65
Visual-not operating	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	1.5
Dimension measurement	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	1.5

14.2 Conditions of Cosmetic Inspection

- Environmental condition

The inspection should be performed at the 1m of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25℃ 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

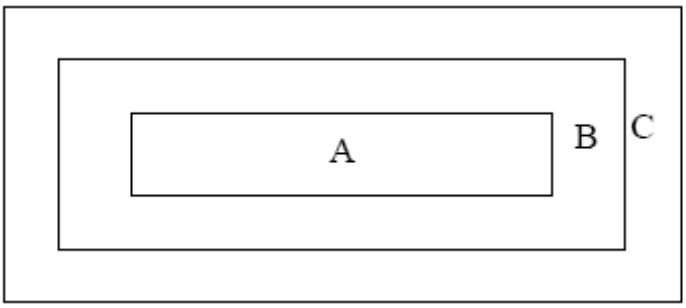
The V0 value which the most optimal contrast can be obtained near the specified V0 in the specification. (Within ±0.5V of the typical value at 25℃.).

14.3 Definition of inspection zone in LCD

Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)



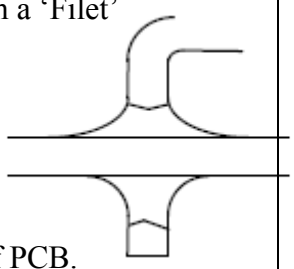
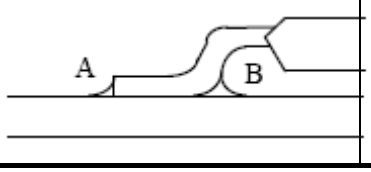
Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

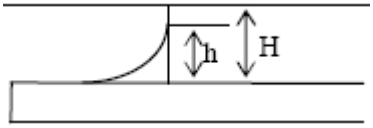
14.4 Inspection Standard

- **Major Defect**

Item No	Items to be inspected	Inspection Standard	Classification of defects
1	All functional defects	1) No display 2) Display abnormally 3) Missing vertical，horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting.	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	

- **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 Minor
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 1. Lead parts	a. Soldering side of PCB Solder to form a ‘Filet’ all around the lead. Solder should not hide the lead form perfectly. (too much) b. Components side (In case of ‘Through Hole PCB’) Solder to reach the Components side of PCB. 	Minor
	2. Flat packages	Either ‘Toe’ (A) or ‘Seal’ (B) of the lead to be covered by ‘Filet’. Lead form to be assume over solder. 	Minor

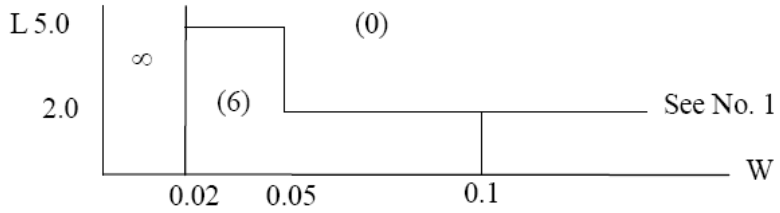
No.	Item	Judgment Criterion	Partition
8	3. Chips	(3/2) H ≥ h ≥ (1/2) H 	Minor

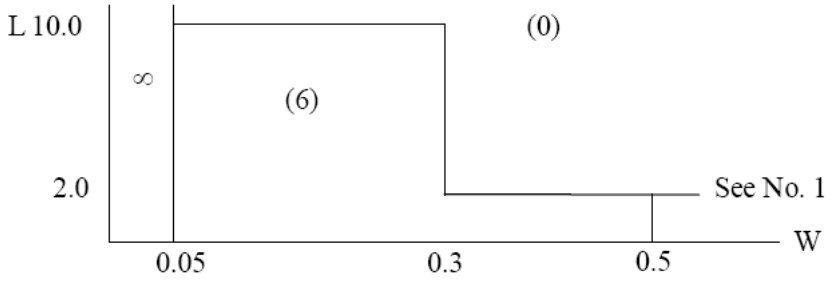
● Screen Cosmetic Criteria (Non-Operating)

No.	Defect	Judgement Criterion	Partition
1	Spots	In accordance with *Screen Cosmetic Criteria (Operating) No.1*.	Minor
2	Lines	In accordance with *Screen Cosmetic Criteria (Operating) No.2*.	Minor
3	Bubbles in polarizer	<table><tr><td>Size : d</td><td>mm</td><td>Acceptable Qty in active area</td></tr><tr><td>d</td><td>≤ 0.3</td><td>Disregard</td></tr><tr><td>0.3 < d</td><td>≤ 1.0</td><td>3</td></tr><tr><td>1.0 < d</td><td>≤ 1.5</td><td>1</td></tr><tr><td>1.5 < d</td><td></td><td>0</td></tr></table>	Minor
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

Note: Size : d = (long length + short length) / 2

● Screen Cosmetic Criteria (Operating)

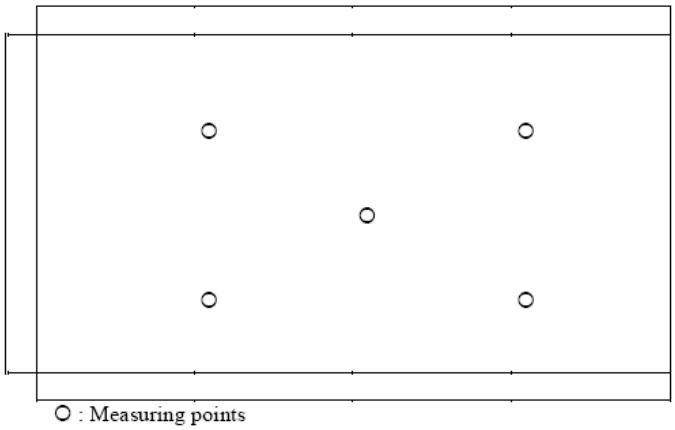
<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.1</td><td>Disregard</td></tr>
<tr><td>0.1 < d ≤ 0.2</td><td>6</td></tr>
<tr><td>0.2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

Note :
( ) - Acceptable Qty in active area
L - Length (mm)
W - Width (mm)
∞ - Disregard
B) Unclear
 

‘Clear’ = The shade and size are not changed by Vop.
‘Unclear’ = The shade and size are changed by Vop.</td><td>Minor</td></tr>
</table>

Note: Size : d = (long length + short length) / 2

● Screen Cosmetic Criteria (Operating) (Continued)

No.	Defect	Judgment Criterion	Partition
3	Rubbing line	Not to be noticeable.	Minor
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 pot'. (see *Screen Cosmetic Criteria (Operating) No.1*)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX / BMIN ≤ 2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.  O : Measuring points	Minor

Note :

(1) The limit samples for each item have priority.

(2) Complex defects are defined item by item, but if the numbers of defects are defined in above table, the total number should not exceed 10.

(3) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed. Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of Æ5mm.
- 10 or over defects in circle of Æ10mm.
- 20 or over defects in circle of Æ20mm.

15. 0 RELIABILITY

15.1 Content of Reliability Test

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	+70℃±2℃/200 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6. Current Idd is twice higher than initial value.
2	Low Temperature Storage	-20℃±2℃/200 hours	
3	High Temperature Operating	+60℃±2℃/120 hours	
4	Low Temperature Operating	-10℃±2℃/120 hours	
5	Temperature Cycle	-10℃±2℃~25~60℃±2℃×10cycles (30min.) (5min.) (30min.)	
6	High Temperature / Humidity operation	50℃±5℃×90%RH/120 hours	
7	Vibration Test	Frequency ： 10Hz~55Hz~10Hz Amplitude： 1.5mm, X， Y， Z direction for total 3hours (Packing condition)	
8	Drooping test	Drop to the ground from 1m height, one time, and every side of carton. (Packing condition)	
9	Static electricity test	Voltage:±8KV R: 330Ω C: 150pF Air discharge, 10time	

Remark:

1. The test samples should be applied to only one test item.
2. Sample size for each test item is 5~10pcs.
3. For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
5. EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
6. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

16. 0 PRECAUTIONS FOR USING LCD MODULES

16.1 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.

16.2 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.

16.3 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.

17. 0 USING LCD MODULES

17.1 About 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 polarizer 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 polarizer and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropyl alcohol.

(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 polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

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

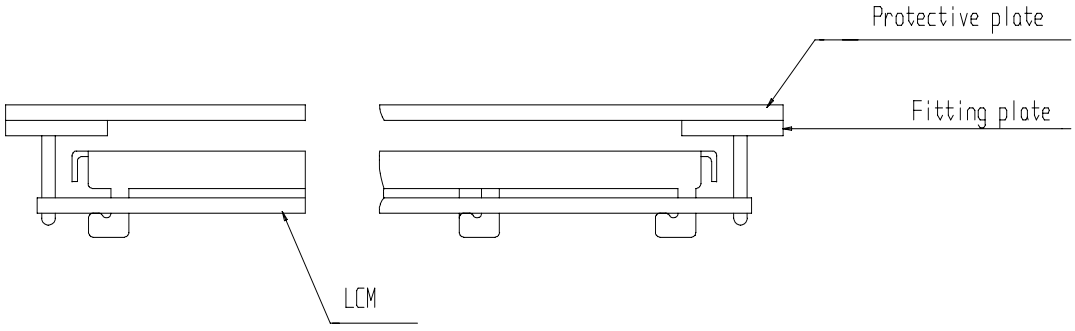
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinate to the polarizer).

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

17.2 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.

17.3 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 handing 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 commutation 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.

17.4 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 dur 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.

17.5 Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (V0). Adjust V0 to show the best contrast.

(2) Driving the LCD in the voltage above the limit shortens its life.

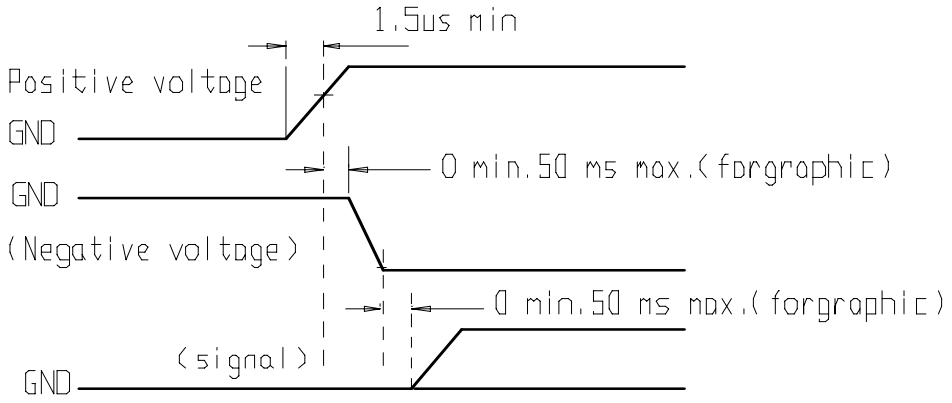
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

(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.



17.6 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.)

(4) Environmental conditions :

- Do not leave them for more than 168hrs. at 60°C.
- Should not be left for more than 48hrs. at -20°C.

17.7 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 leakes out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

17.8 Limited Warranty

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

17.9 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, conductors and terminals.

18. 0 APPENDIX

18.1 Initialization Code

```
#pragma disable
void LCD_CmdWrite(uchar uc_Comm)
{
    LCD_A0 = 0;
    LCD_RD = 1;
    LCD_CS = 0;

    DataPort = uc_Comm;//Reg Addr
    LCD_WR = 0;
    LCD_WR = 1;

    LCD_CS = 1;
}

#pragma disable
void LCD_RegWrite(uchar uc_Addr, uchar uc_Dat)
{
    LCD_CmdWrite(uc_Addr);
    LCD_CmdWrite(uc_Dat);
}

#pragma disable
void LCD_DataWrite(uchar uc_Dat)
{
    LCD_A0 = 1;
    LCD_RD = 1;
    LCD_CS = 0;

    DataPort = uc_Dat;
    LCD_WR = 0;
    LCD_WR = 1;

    LCD_CS = 1;
}
```

```
//RA8803 Initialization
void LCD_Initial(void)
{
    LCD_RegWrite(WLCR, 0xC1); //(Reg No.:00H)Normal Power, Graphic Mode, Display Off
    LCD_RegWrite(MISC, 0xF2);    //(Reg No.:01H)8MHz
    LCD_RegWrite(APSR, 0x10);    //(Reg No.:02H)Advance Power Setup Register
    LCD_RegWrite(ADSR, 0x80);    //(Reg No.:03H)Advance Display Setup Register
    LCD_RegWrite(WCCR, 0x28);    //(Reg No.:10H)DDRAM Address Auto increase, Cursor Off
    LCD_RegWrite(DWLR, 0x00);    //(Reg No.:11H)Set Line Distance:1

    LCD_RegWrite(AWRR, 0x27);    //(Reg No.:20H)Active Window Right Register(39)
    LCD_RegWrite(AWBR, 0xEF);    //(Reg No.:30H)Active Window Bottom Register(239)
    LCD_RegWrite(AWLR, 0x00);    //(Reg No.:40H)Active Window Left Register(0)
    LCD_RegWrite(AWTR, 0x00);    //(Reg No.:50H)Active Window Top Register(0)

    LCD_RegWrite(DWRR, 0x27);    //(Reg No.:21H)/Display Window Right Register(39)
    LCD_RegWrite(DWBR, 0xEF);    //(Reg No.:31H)Display Window Bottom Register(239)
    LCD_RegWrite(DWLR, 0x00);    //(Reg No.:41H)Display Window Left Register(0)
    LCD_RegWrite(DWTR, 0x00);    //(Reg No.:51H)Display Window Left Register(0)

    LCD_RegWrite(SCCR, 0x06);     //(Reg No.:90H)Frame Rate
    LCD_RegWrite(INTR, 0x00);    //(Reg No.:A0H)Interrupt Setup & Status Register
    LCD_RegWrite(KSCR, 0x00);    //(Reg No.:A1H)Key Scan Controller Register
    LCD_RegWrite(TPCR, 0x10);    //(Reg No.:C0H)Touch Panel Control Register
    LCD_RegWrite(TPSR, 0x3A);    //(Reg No.:C1H)ADC Status Register

    LCD_RegWrite(PNTR, 0x00);    //(Reg No.:E0H)Pattern Data Register, Fill Data=00
    LCD_RegWrite(FNCR, 0xA8);    //(Reg No.:F0H)GB Code or BIG5 Code

    LCD_RegWrite(LCCR, 0x07);    //(Reg No.:D0H)DAC On

    LCD_RegWrite(WLCR, 0xC5);    //(Reg No.:00H)Normal Power, Graphic Mode, Display On
}
```

18.2 Power Supply Circuit Diagram