HITACHI

KAOHSIUNG HITACHI ELECTRONICS CO., LTD.

FOR MESSRS: DATE: Mar. 10th 2010

CUSTOMER'S ACCEPTANCE SPECIFICATION

TX06D126VM0AAA

Contents

ACCEPTED BY:_____ PROPOSED BY: Kenchen

2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 2.4” QVGA of 4:3 format amorphous silicon TFT. The pixel format is vertical stripe and sub pixels are arranged as R (red), G (green), B (blue) sequentially. This display is RoHS compliant, COG (chip on glass) technology and LED backlight are applied on this display.

Part Name	TX06D126VM0AAA
Module Dimensions	41.92(W) mm x 61.45(H) mm x 2.55 (D) mm typ.
LCD Active Area	36.72(W) mm x48.96(H) mm
Pixel Pitch	0.153 (W) mm x 0.153 (H) mm
Resolution	240 x 3(RGB)(W) x 320(H) dots
Color Pixel Arrangement	R, G, B Vertical stripe
LCD Type	Transmissive Color TFT; Normally black
Display Type	Active Matrix
Number of Colors	65.5K Colors (8 bit, 16 bit CPU interface) 262k Colors (9 bit, 18 bit CPU interface)
Backlight	3 LEDs series (20mA)
Weight	13g
LCD Driver	R61505W Renesas SP deiver
Interface	8-bit / 9-bit / 16-bit / 18-bit CPU bus (80 series)
Power Supply Voltage	Logic and analog voltage VDD = Vcc = Vci = 2.8 ± 0.08V Interface voltage 1.75V $\leqq$ I/O Vcc $\leqq$ VDD
Viewing Direction	Super wide version (In-Plane Switching)

4. ABSOLUTE MAXIMUM RATINGS

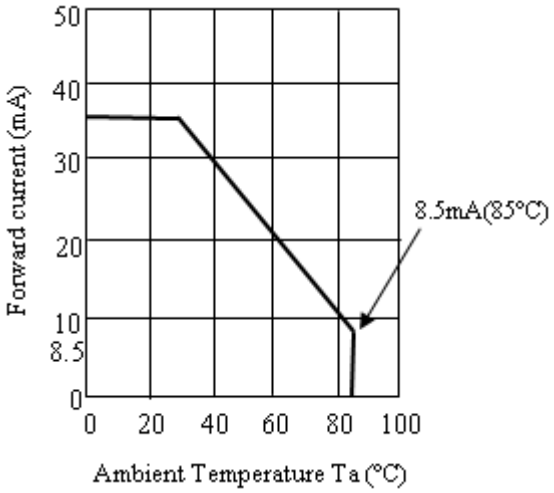
Item	Symbol	Min.	Max.	Unit	Remarks
Logic & Analog Voltage	VDD=Vcc=Vci	-0.3	4.6	V	-
Interface Voltage	I/O Vcc	-0.3	4.6	V	-
Input Voltage	Vi	-0.3	I/OVcc+0.3	V	Note 1
Operating Temperature	Top	-20	70	˚C	Note 2
Storage Temperature	Tst	-30	80	˚C	-
LED Reverse Voltage	VR	-	5	V	-
LED Forward Current	IF	-	35	mA	Note 3

Note 1: The rating is defined for the input voltages such as RESET*, RD*, WR*, CS*, RS, Vsync*, IM0, IM3 and DB17~0 data bus.

Note 2: The maximum rating is defined as above based on the temperature on the panel surface, which might be different from ambient temperature after assembling the panel into the application. Moreover, some temperature-related phenomenon as below needed to be noticed:

- Background color, contrast and response time would be different in temperatures other than 25˚C.
- Operating under high temperature will shorten LED lifetime.

Note 3: The derating curve of forward current is shown as below.



5. ELECTRICAL CHARACTERISTICS

$T_a = 25\ ^\circ C,\ \mathrm{VSS} = 0\mathrm{V}$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Logic&Analog Voltage	VDD	-	2.72	2.8	2.88	V	Note 1
Interface Voltage	I/OVcc	-	1.75	-	VDD	V	-
Input Voltage (RESET pin only)	VI	"H" level	0.9xI/OVcc	-	I/OVcc	V	-
		"L" level	0	-	0.1xI/OVcc		
Input Voltage (Except RESET pin)	Vi	"H" level	0.8xI/OVcc	-	I/OVcc	V	Note 2
		"L" level	0	-	0.2xI/OVcc		
Output Voltage	Vo	"H" level	0.8xI/OVcc	-	-	V	Note 3
		"L" level	-	-	0.2xI/OVcc		
Leak Current (In/ouput)	ILi	-	-1.0	-	1.0	μA	
Power Supply Current	Icc	All White	-	4.0	7.5	mA	Note 4
		Partial	-	1.0	4.0	mA	Note 5
		DSTB	-	0.1	1.0	μA	Note 6
LED Forward Voltage	VLED	Each LED	2.8	3.2	3.5	V	-
LED Forward Current	ILED	Each LED	-	20	35	mA	-
Frame Frequency	fFLM	-	75	85	(95)	Hz	-

Note 1: VDD≧I/OVcc.

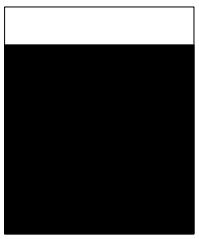
Note 2: The rating is defined for the input voltages such as RD*, WR*, CS*, RS, Vsync*, IM0, IM3 and DB17~0 data bus.

Note 3: The rating is defined for FMARK and DB17~0.

Note 4: An all white check pattern is used when measuring Icc under the condition VDD=I/OVcc=2.8V, fFLM=85 Hz.

Note 5: A partial pattern as below is displayed when measuring Icc.

40 Lines: White
280 Lines: Black
fFLM = 85 Hz
8-color mode



Note 6: Under deep standby mode to measure Icc.

6. OPTICAL CHARACTERISTICS

The optical characteristics are measured based on the conditions as below:

- Supplying the signals and voltages defined in the section of electrical characteristics.
- The backlight unit needs to be turned on for 30 minutes.
- The ambient temperature is 25°C.
- In the dark room around 500~1000 lx, the equipment has been set for the measurements as shown in Fig 6.1.

$T_a = 25\ ^\circ C$, 9.4.2 sequence, VDD=I/OVcc=2.8V

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White		-	$\phi = 0^\circ, \theta = 0^\circ$, ILED= 20 mA	170	250	-	cd/m^2	Note 1
Brightness Uniformity		-		70	80	-	%	Note 2
Contrast Ratio		CR		200	400	-	-	Note 3
Response Time (Rising + Falling)		$T_r + T_f$	$\phi = 0^\circ, \theta = 0^\circ$	-	40	70	ms	Note 4
Viewing Angle		$\theta_1 + \theta_2$	$\phi = 0^\circ$, CR ≥ 10	-	160	-	Degree	Note 5
			$\phi = 90^\circ$, CR ≥ 10	-	160	-		
Color Chromaticity	Red	X	$\phi = 0^\circ, \theta = 0^\circ$	TBD	TBD	TBD	-	Note 6
		Y		TBD	TBD	TBD		
	Green	X		TBD	TBD	TBD		
		Y		TBD	TBD	TBD		
	Blue	X		TBD	TBD	TBD		
		Y		TBD	TBD	TBD		
	White	X		TBD	TBD	TBD		
		Y		TBD	TBD	TBD		

Note 1: The brightness is measured from the panel center point, P5 in Fig. 6.2, for the typical value.

Note 2: The brightness uniformity is calculated by the equation as below:

$$\text{Brightness uniformity} = \frac{\text{Min. Brightness}}{\text{Max. Brightness}} \times 100\%$$

, which is based on the brightness values of the 9 points measured by BM-5 as shown in Fig. 6.2.

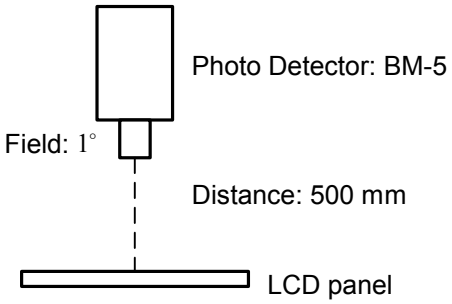


Fig. 6.1

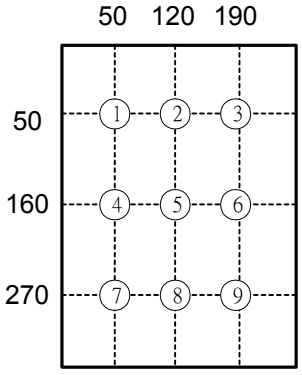


Fig. 6.2

Note 3: The Contrast Ratio is measured from the center point of the panel, P5, and defined as the following equation:

$$CR = \frac{\text{Brightness of White}}{\text{Brightness of Black}}$$

Note 4: The definition of response time is shown in Fig. 6.3. The rising time is the period from10% brightness to 90% brightness when the data is from white to black. Oppositely, Falling time is the period from 90% brightness rising to 10% brightness.

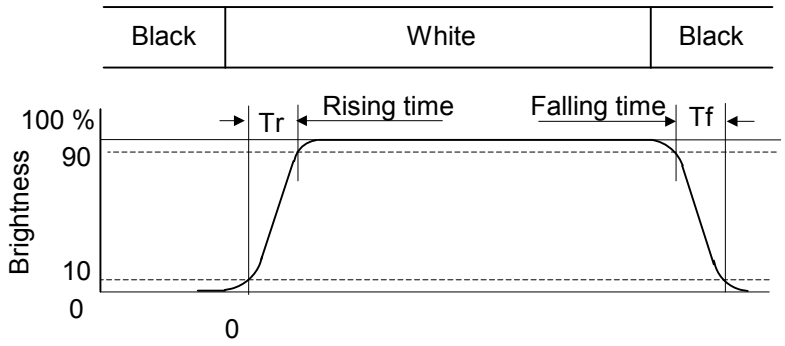


Fig . 6.3

Note 5: The definition of viewing angle is shown in Fig. 6.4. Angle ϕ is used to represent viewing directions, for instance, $\phi = 270^\circ$ means 6 o'clock, and $\phi = 0^\circ$ means 3 o'clock. Moreover, angle θ is used to represent viewing angles from axis Z toward plane XY.

The display is super wide viewing angle version, so that the best optical performance can be obtained from every viewing direction.

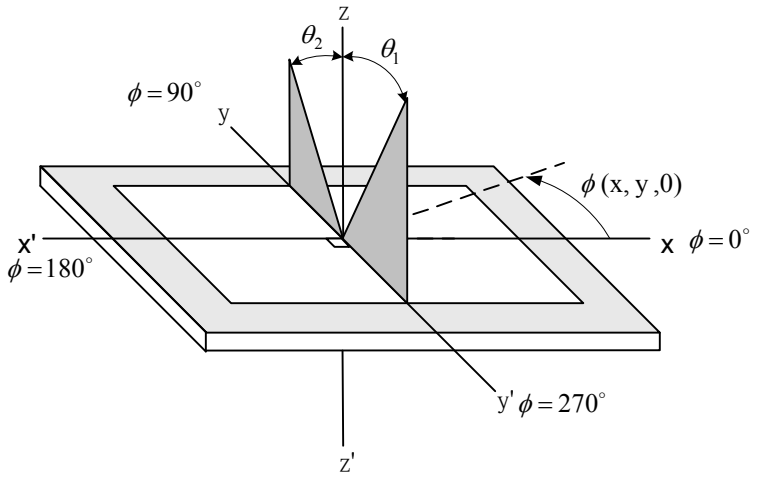
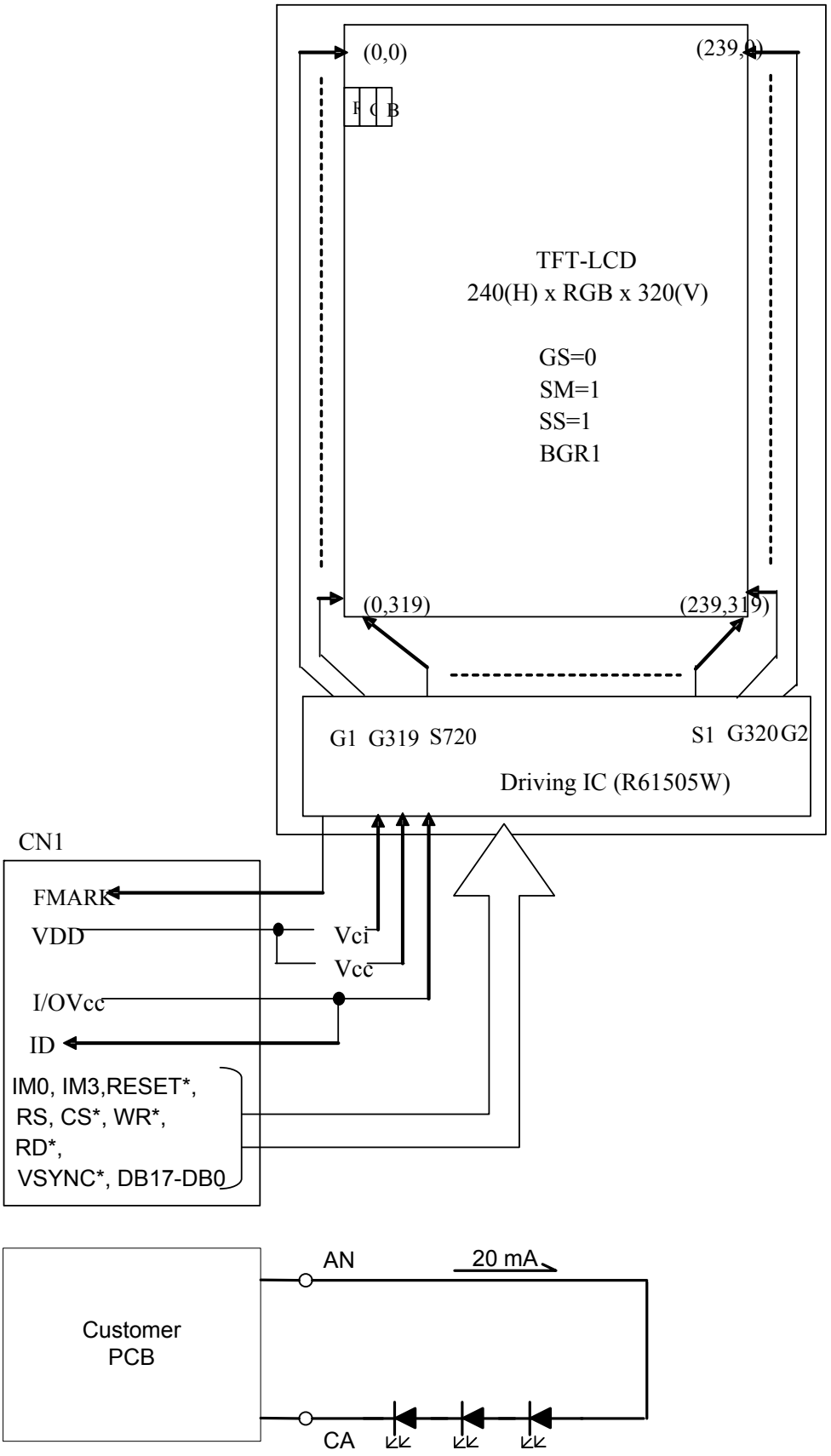


Fig 6.4

Note 6: The color chromaticity is measured from the center point of the panel, P5, as shown in Fig. 6.2.

7. BLOCK DIAGRAM



8. RELIABILITY TESTS

Test Item	Condition	
High Temperature	1) Operating 2) 80°C	240 hrs
Low Temperature	1) Operating 2) -30°C	240 hrs
High Temperature	1) Storage 2) 80°C	240 hrs
Low Temperature	1) Storage 2) -30°C	240 hrs
Thermal Shock	1) Non-Operating 2) -40°C ↔ 85°C 3) 0.5 hr ↔ 0.5 hr	240 hrs
High Temperature & Humidity	1) Operating 2) 60°C & 90%RH 3) Without condensation	240 hrs
High Temperature & Humidity	1) Storage 2) 60°C & 90%RH 3) Without condensation	240 hrs

Note 1: Display functionalities are inspected under the conditions defined in the specification after the reliability tests.

Note 2: The display is not guaranteed for use in corrosive gas environments.

9. LCD INTERFACE

9.1 INTERFACE PIN CONNECTIONS

The display interface connector (CN1) is FH26-39S-0.3SHW(5) (Hirose). Pin assignment is as below:

Pin No.	Symbol	Power I/O	Signal
1	GND	Power	Ground
2	GND	Power	Ground
3	ID	O	ID (=I/OVcc)
4	IM0	I	MPU Interface Switching
5	IM3	I	MPU Interface Switching
6	RESET*	I	Reset
7	DB17	I/O	Data Bus (Instruction & Display Data)
8	DB16	I/O	Data Bus (Instruction & Display Data)
9	DB15	I/O	Data Bus (Instruction & Display Data)
10	DB14	I/O	Data Bus (Instruction & Display Data)
11	DB13	I/O	Data Bus (Instruction & Display Data)
12	DB12	I/O	Data Bus (Instruction & Display Data)
13	DB11	I/O	Data Bus (Instruction & Display Data)
14	DB10	I/O	Data Bus (Instruction & Display Data)
15	DB9	I/O	Data Bus (Instruction & Display Data)
16	DB8	I/O	Data Bus (Instruction & Display Data)
17	DB7	I/O	Data Bus (Instruction & Display Data)
18	DB6	I/O	Data Bus (Instruction & Display Data)
19	DB5	I/O	Data Bus (Instruction & Display Data)
20	DB4	I/O	Data Bus (Instruction & Display Data)
21	DB3	I/O	Data Bus (Instruction & Display Data)
22	DB2	I/O	Data Bus (Instruction & Display Data)
23	DB1	I/O	Data Bus (Instruction & Display Data)
24	DB0	I/O	Data Bus (Instruction & Display Data)
25	RD*	I	Read
26	WR*	I	Write
27	RS	I	Data / Command Identification
28	CS*	I	Chip Select
29	I/OVcc	Power	Power Supply for Interface
30	I/OVcc	Power	Power Supply for Interface
31	VDD	Power	Power Supply for Logic and Analog
32	VDD	Power	Power Supply for Logic and Analog
33	NC	-	Non Connect
34	AN	Power	Power Supply for LED
35	CA	Power	Ground for LED
36	VSYNC*	I	Line Synchronous Signal
37	FMARK	O	Frame Head Pulse Signal
38	NC	-	Open or Ground (Hitachi test only)
39	GND	Power	Ground

9.2 CPU INTERFACE MODE

9.2.1 CPU interface mode selection

Pin No.	Signal	80-System Bus Interface			
		18- bit 262K colors	16- bit 65K colors	9- bit 262K colors	8- bit 65K colors
4	IM0	GND	GND	I/O Vcc	I/O Vcc
5	IM3	I/O Vcc	GND	I/O Vcc	GND

9.2.2 The map of unused data bus

Bus Interface		18-bit	16-bit	9-bit	8-bit
Valid Data bus		DB17-0	DB17-10, DB8-1	DB17-9	DB17-10
Input Voltage		I/O Vcc	GND	I/O Vcc	GND
Pin No.	Signal	MAP			
7	DB17				
8	DB16				
9	DB15				
10	DB14				
11	DB13				
12	DB12				
13	DB11				
14	DB10				
15	DB9		GND or I/O Vcc		GND or I/O Vcc
16	DB8			GND or I/O Vcc	GND or I/O Vcc
17	DB7			GND or I/O Vcc	GND or I/O Vcc
18	DB6			GND or I/O Vcc	GND or I/O Vcc
19	DB5			GND or I/O Vcc	GND or I/O Vcc
20	DB4			GND or I/O Vcc	GND or I/O Vcc
21	DB3			GND or I/O Vcc	GND or I/O Vcc
22	DB2			GND or I/O Vcc	GND or I/O Vcc
23	DB1			GND or I/O Vcc	GND or I/O Vcc
24	DB0		GND or I/O Vcc	GND or I/O Vcc	GND or I/O Vcc

9.2.3 Data format of CPU interface

Data Bus		DB																	
		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
18bit	Transfer 1	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
16bit	Transfer 1	R5 =R0	R4	R3	R2	R1	G5	G4	G3	*	G2	G1	G0	B5 =B0	B4	B3	B2	B1	*
9bit	Transfer1	R5	R4	R3	R2	R1	R0	G3	G2	G1	*								
	Transfer 2	G2	G1	G0	B5	B4	B3	B2	B1	B0	*								
8bit	Transfer 1	R5 =R0	R4	R3	R2	R1	G3	G2	G1	*									
	Transfer 2	G2	G1	G0	B5 =B0	B4	B3	B2	B1	*									

Note1: Unused pins of DB marked "*", please connect to GND or I/O Vcc.

9.3 INTERFACE TIMING

9.3.1 18-bit / 16-bit timing of 80 series bus interface

I/O Vcc = 1.75 to Vcc

Item		Symbol	Min.	Typ.	Max.	Unit
Bus cycle time	Write	tCYCW	79	-	-	ns
	Read	tCYCR	630	-	-	ns
Write low-level pulse width		PWLW	42	-	-	ns
Read low-level pulse width		PWLR	420	-	-	ns
Write high-level pulse width		PWHW	27	-	-	ns
Read high-level pulse width		PWHR	210	-	-	ns
Rise & falling time (Read & Write)		tWRr, tWRf	-	-	23	ns
Set up time	Write (RS to CS*, WR*)	tAS	0	-	-	ns
	Read (RS to CS*, RD*)	tAS	11	-	-	ns
Address hold time		tAH	3	-	-	ns
Write data set up time		tDSW	27	-	-	ns
Write data hold time		tH	11	-	-	ns
Read data delay time		tDDR	-	-	315	ns
Read data hold time		tDHR	4	-	-	ns

9.3.2 9-bit / 8-bit timing of 80 series bus interface

I/O Vcc = 1.75 to Vcc

Item		Symbol	Min.	Typ.	Max.	Unit
Bus cycle time	Write	tCYCW	74	-	-	ns
	Read	tCYCR	630	-	-	ns
Write low-level pulse width		PWLW	32	-	-	ns
Read low-level pulse width		PWLR	420	-	-	ns
Write high-level pulse width		PWHW	27	-	-	ns
Read high-level pulse width		PWHR	210	-	-	ns
Rise & falling time (Read & Write)		tWRr, tWRf	-	-	23	ns
Set up time	Write (RS to CS*, WR*)	tAS	0	-	-	ns
	Read (RS to CS*, RD*)	tAS	11	-	-	ns
Address hold time		tAH	3	-	-	ns
Write data set up time		tDSW	27	-	-	ns
Write data hold time		tH	11	-	-	ns
Read data delay time		tDDR	-	-	315	ns
Read data hold time		tDHR	4	-	-	ns

9.3.3 Reset timing

Item	Symbol	Min.	Typ.	Max.	Unit
Reset wait time	tRW	1	-	-	ms
Reset low-level width	tRES	1	-	-	ms
Reset rise time	trRES	-	-	9	ms

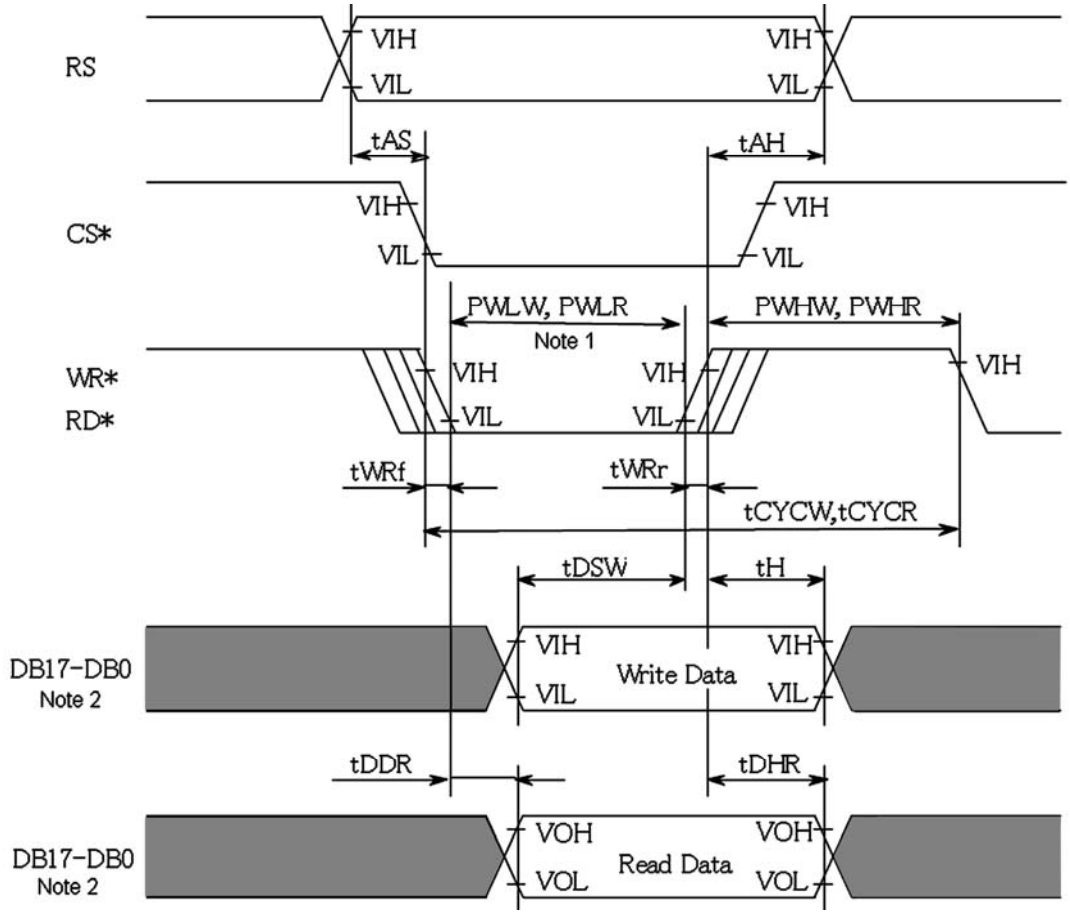


Fig. 9.1 Timing of data bus

Note 1: The period of PWLW and PWLR should be kept after CS* under low-level condition. For read and write data functionalities, please refer to the relationship of DB set up & hold time and WR* & RD* low-level pulse width.

Note 2: Unused DB [17:0] pins shall be fixed to “loVcc or GND”.

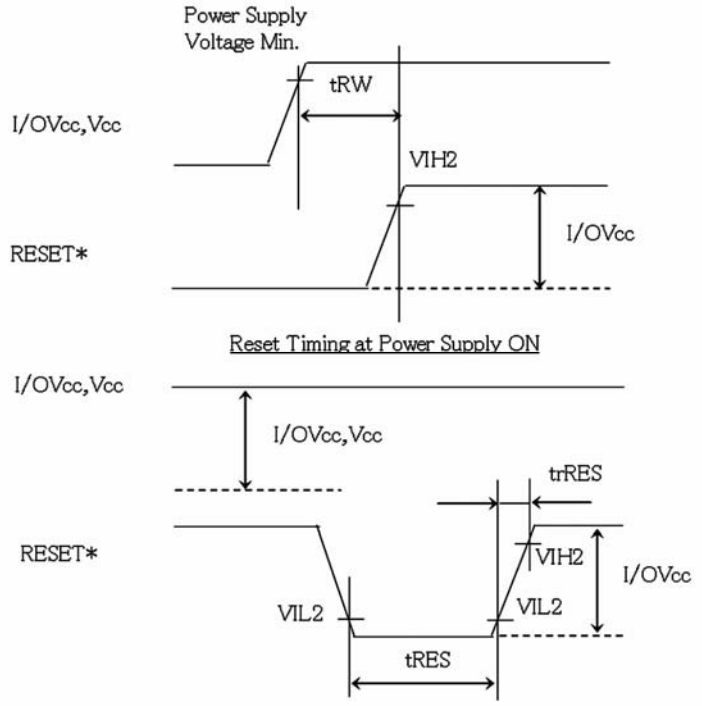
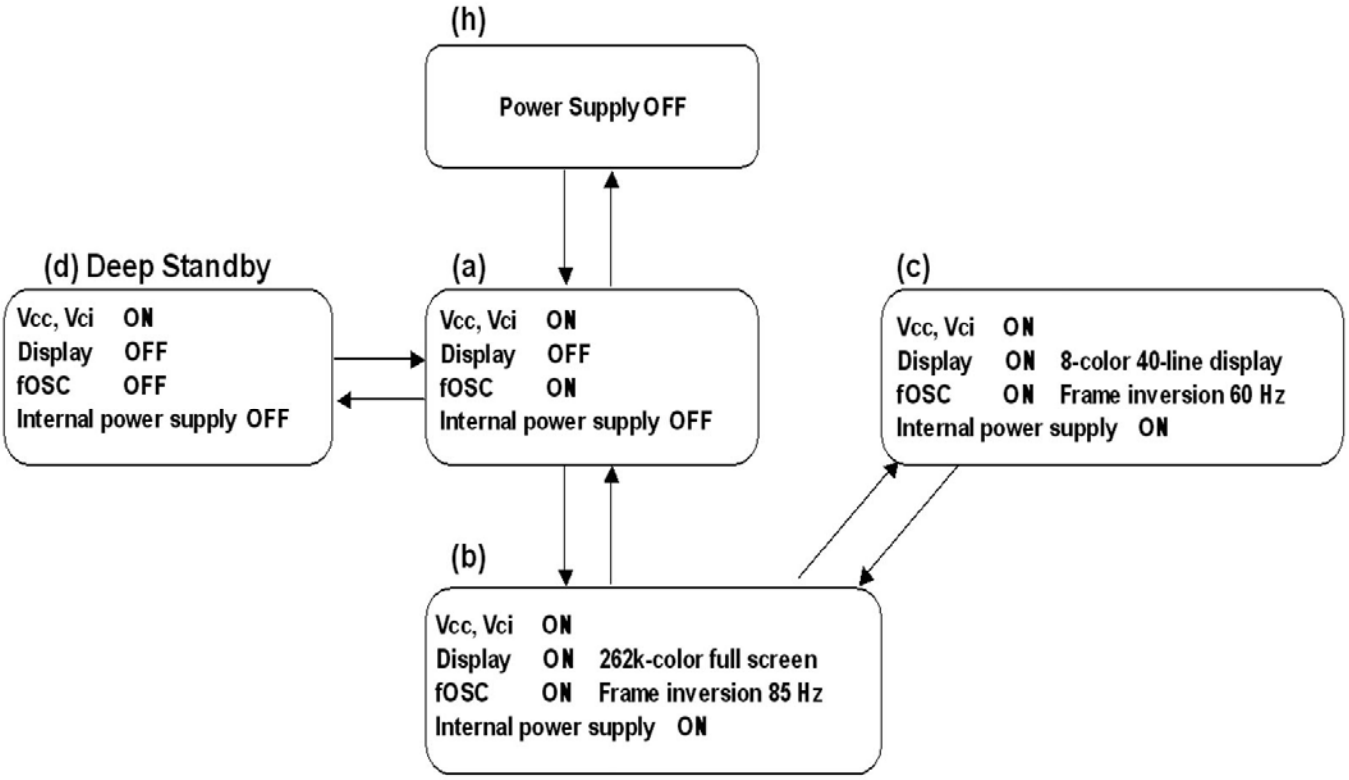


Fig. 9.2 Timing of Reset

9.4 REGISTER SETTING FLOW

9.4.1 Stage chart



9.4.2 Sequence

State (h) -> (a)

1	Power Supply ON	Vcc, Vci ON	
2		ioVcc ON	
3		reset* = "L"	
4	Reset	wait	1 ms Min.
5		reset* = "H"	
6		wait	2 ms

State (a) -> (h)

1	Power Supply OFF	Vcc, Vci OFF	
2		ioVcc OFF	

State (b) -> (a)

1	Display OFF	R07h	0x0000
2	Amplifier OFF	R12h	0x0180
3		wait	120 ms

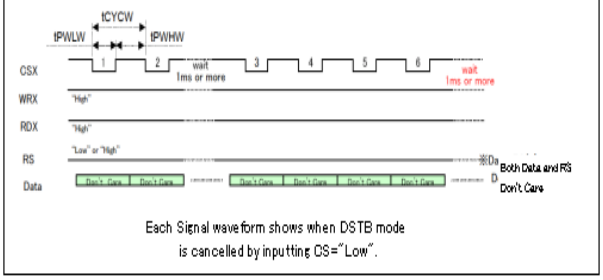
State (a) -> (d)

1	Deep standby	R10h	0x0004

State (d) -> (a)

1	DSTB mode cancellation (1)	CS="L"		Sequential Control
2	DSTB mode cancellation (2)	CS="L"		
3		wait	1 ms Min.	
4	DSTB mode cancellation (3)	CS="L"		*1
5	DSTB mode cancellation (4)	CS="L"		
6	DSTB mode cancellation (5)	CS="L"		
7	DSTB mode cancellation (6)	CS="L"		
8		wait	1 ms Min.	

*1 Example



Each Signal waveform shows when DSTB mode is cancelled by inputting CS="Low".

State (a) -> (b)

1	Oscillation (600k Hz) set	RA4h	0x0001	
2		wait	1 ms	
3	Gate scan control	R60h	0x2700	
4	Display control	R08h	0x0808	
5	Gamma setting	R30h	0x0204	
6		R31h	0x880E	
7		R32h	0x0B06	
8		R33h	0x0507	
9		R34h	0x3211	
10		R35h	0x0704	
11		R36h	0x860B	
12		R37h	0x0E08	
13		R38h	0x0502	
14		R39h	0x1132	
15	fFLM=85 Hz	R90h	0x0015	
16		R10h	0x0530	
17		R11h	0x0237	
18	Power supply start	R12h	0x01BC	
19		wait	100 ms	
20		R13h	0x0F00	
21	Driver output control	R01h	0x0500	
22	LCD drive AC control	R02h	0x0000	
23	Entry mode	R03h	0x1030	
24	ISC control	R09h	0x0001	
25	FMARK	R0Ah	0x0008	
26	External display interface	R0Ch	0x0000	
27	Frame marker control	R0Dh	0x0000	
28		R0Eh	0x0000	
29	H RAM address S	R50h	0x0000	
30	H RAM address E	R51h	0x00EF	
31	V RAM address S	R52h	0x0000	
32	V RAM address E	R53h	0x013F	
33	First screen display control	R61h	0x0000	
34	Base image display control	R6Ah	0x0000	
35		R91h	0x0001	
36	Gate output position control	R92h	0x0100	
37	Source output position control	R93h	0x0001	
38	GRAM address set	R20h	0x0000	
39		R21h	0x0000	
40	GRAM write	R22h	-	
41		Display data write		Image size: 240x320
42	Display ON	R07h	0x0100	

41	Image refresh	R20h	0x0000	
42		R21h	0x0000	
43		R22h	-	
44		Display data write		

State (b) -> (c)

1	Display OFF	R07h	0x0000	
2		wait	25ms	2 frames Min.
3	H RAM address S	R50h	0x0000	
4	H RAM address E	R51h	0x00EF	
5	V RAM address S	R52h	0x0000	
6	V RAM address E	R53h	0x0027	
7	Partial 1 display position	R80h	0x0000	
8	Partial 1 RAM address S	R81h	0x0000	
9	Partial 1 RAM address E	R82h	0x0027	
10	PTS on	R09h	0x0401	
11	Frame frequency control	R90h	0x001E	fFLM=60 Hz
12		R11h	0x0457	
13		wait	35ms	2 frames Min.
14	GRAM address	R20h	0x0000	
15		R21h	0x0000	
16	GRAM write	R22h	-	
17		Display data write		Image size: 240x40
18	8-color mode display ON	R07h	0x1008	
19	Image refresh	R20h	0x0000	
20		R21h	0x0000	
21		R22h	-	
22		Display data write		Image size: 240x40

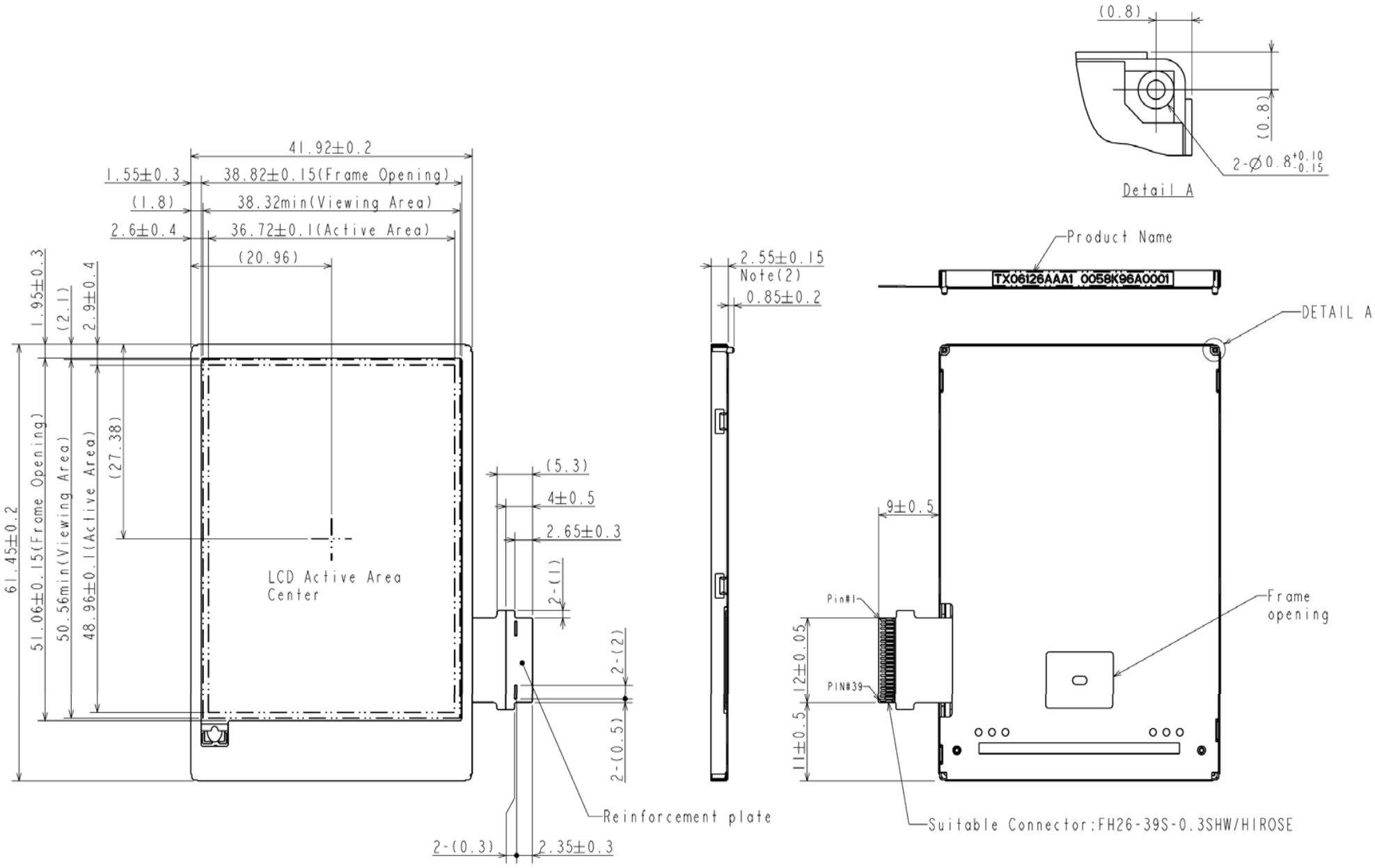
State (c) -> (b)

1	Display OFF	R07h	0x0000	
2		wait	35ms	2 frames Min.
3	PTS off	R09h	0x0001	
4	H RAM address S	R50h	0x0000	
5	H RAM address E	R51h	0x00EF	
6	V RAM address S	R52h	0x0000	
7	V RAM address E	R53h	0x013F	
8	Partial 1 display position	R80h	0x0000	
9	Partial 1 RAM address S	R81h	0x0000	
10	Partial 1 RAM address E	R82h	0x0000	
11	Frame frequency control	R90h	0x0015	fFLM=85 Hz
12		R11h	0x0237	
13		wait	25ms	2 frames Min.
14	GRAM address	R20h	0x0000	
15		R21h	0x0000	
16	GRAM write	R22h	-	
17		Display data write		Image size: 240x320
18	Display ON	R07h	0x0100	
19	Image refresh	R20h	0x0000	
20		R21h	0x0000	
21		R22h	-	
22		Display data write		Image size: 240x320

State (b): Refresh

1	Gate scan control	R60h	0x2700	
2	Display control	R08h	0x0808	
3	Gamma setting	R30h	0x0204	
4		R31h	0x880E	
5		R32h	0x0B06	
6		R33h	0x0507	
7		R34h	0x3211	
8		R35h	0x0704	
9		R36h	0x860B	
10		R37h	0x0E08	
11		R38h	0x0502	
12		R39h	0x1132	
13	fFLM=60 Hz	R90h	0x0015	
14		R10h	0x0530	
15		R11h	0x0237	
16	Power supply start	R12h	0x01BC	
17		R13h	0x0F00	
18	Driver output control	R01h	0x0500	
19	LCD drive AC control	R02h	0x0000	
20	Entry mode	R03h	0x1030	
21	ISC control	R09h	0x0001	
22	FMARK	R0Ah	0x0008	
23	External display interface	R0Ch	0x0000	
24	Frame marker control	R0Dh	0x0000	
25		R0Eh	0x0000	
26	H RAM address S	R50h	0x0000	
27	H RAM address E	R51h	0x00EF	
28	V RAM address S	R52h	0x0000	
29	V RAM address E	R53h	0x013F	
30	First screen display control	R61h	0x0000	
31	Base image display control	R6Ah	0x0000	
32		R91h	0x0001	
33	Gate output position control	R92h	0x0100	
34	Source output position control	R93h	0x0001	
35	GRAM address set	R20h	0x0000	
36	GRAM write	R21h	0x0000	
37	GRAM write	R22h	-	
38		Display data write		Image size: 240x40
39	Display ON	R07h	0x0100	

10. OUTLINE DIMENSIONS



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11. APPEARANCE STANDARD

(1) Ambient illumination for the inspection with LCD and backlight ON : 300~500[lx]

Ambient illumination for the inspection with LCD and backlight OFF : 1000~1500[lx]

(2) Inspection distance(viewing distance to LCD module) : Approximately 30 cm

(3) Viewing angle : $\leqq 30^\circ$

(4) Refer to the Measurement Conditions described in Item 6.1 for all other conditions.

- The distance between inspector's eyes and display is 30 cm.
- The viewing zone is defined with angle θ shown in Fig. 11.1 The inspection should be performed within 30° when display is shut down. The inspection should be performed within 5° when display is power on.

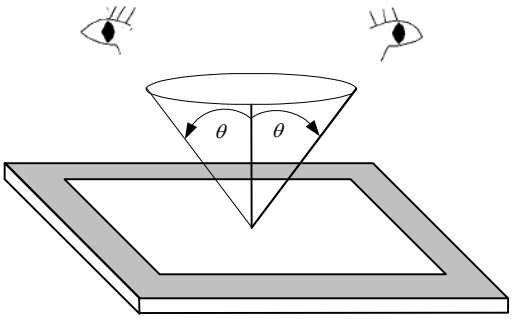


Fig. 11.1

11.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 3 areas as shown in Fig.11.2 for appearance specification in next section. A zone is the LCD active area (dot area); B zone is the viewing area as defined in section 10 except active area; C zone is the LCD outline including FPC and plastic frame but active and viewing area.

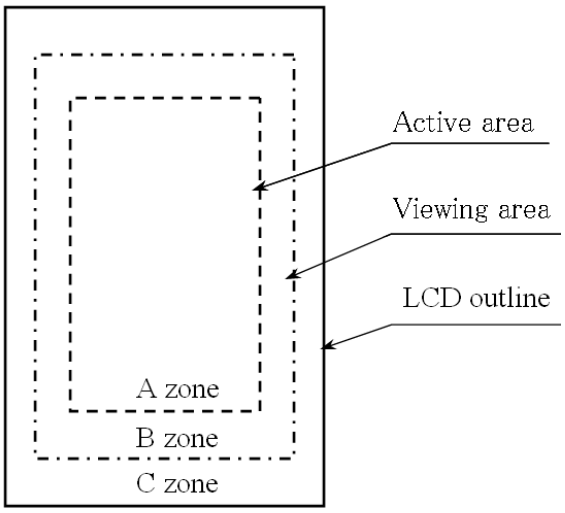


Fig. 11.2

11.2 LCD APPEARANCE SPECIFICATION

The specification as below is defined as the amount of unexpected phenomenon or material in different zones of LCD panel. The definitions of length, width and average diameter using in the table are shown in Fig. 11.3 and Fig. 11.4.

<table>
<tr><th>Item</th><th colspan="4">Criteria</th><th>Applied zone</th></tr>
<tr><td rowspan="4">Scratches</td><td>Length (mm)</td><td>Width (mm)</td><td>Maximum number</td><td>Minimum space</td><td rowspan="4">A, B</td></tr>
<tr><td>Ignored</td><td>W≦0.02</td><td>Ignored</td><td>-</td></tr>
<tr><td>L≦40</td><td>0.02＜W≦0.04</td><td>10</td><td>-</td></tr>
<tr><td>L≦20</td><td>W≦0.04</td><td>10</td><td>-</td></tr>
<tr><td>Dent</td><td colspan="4">Serious one is not allowed</td><td>A</td></tr>
<tr><td>Wrinkles in polarizer</td><td colspan="4">Serious one is not allowed</td><td>A</td></tr>
<tr><td rowspan="4">Bubbles on polarizer</td><td colspan="2">Average diameter (mm)</td><td colspan="2">Maximum number</td><td rowspan="4">A,B</td></tr>
<tr><td colspan="2">D≦0.15</td><td colspan="2">Ignored</td></tr>
<tr><td colspan="2">0.15＜D≦0.2</td><td colspan="2">2</td></tr>
<tr><td colspan="2">0.2＜D<0.3</td><td colspan="2">1</td></tr>
<tr><td rowspan="14">1) Stains
2) Foreign Materials
3) Dark Spot</td><td colspan="3">Filamentous (Line shape)</td><td rowspan="5">A, B</td></tr>
<tr><td>Length (mm)</td><td>Width (mm)</td><td>Maximum number</td></tr>
<tr><td>L≦2.0</td><td>W≦0.01</td><td>Ignored</td></tr>
<tr><td>L≦2.0</td><td>0.01＜W≦0.05</td><td>2</td></tr>
<tr><td>L≦2.5</td><td>0.05＜W</td><td>1</td></tr>
<tr><td colspan="3">Round (Dot shape)</td><td rowspan="6">A, B</td></tr>
<tr><td>Average diameter (mm)</td><td>Maximum number</td><td>Minimum Space</td></tr>
<tr><td>D＜0.1</td><td>Ignored</td><td>-</td></tr>
<tr><td>0.1≦D＜0.2</td><td>2</td><td>10 mm</td></tr>
<tr><td>0.2≦D</td><td>0</td><td>30 mm</td></tr>
<tr><td colspan="3">Those wiped out easily are acceptable</td></tr>
<tr><td rowspan="7">Dot-Defect
(Note 1)</td><td></td><td>Type</td><td>Maximum number</td><td rowspan="7">A</td></tr>
<tr><td rowspan="2">Bright dot-defect</td><td>1 dot</td><td>1</td></tr>
<tr><td>2 adjacent dot or above</td><td>Not allowed</td></tr>
<tr><td>In total</td><td>1</td></tr>
<tr><td rowspan="2">Dark dot-defect</td><td>1 dot</td><td>2</td></tr>
<tr><td>2 adjacent dot or above</td><td>1</td></tr>
<tr><td>In total</td><td>3</td></tr>
<tr><td colspan="2">In total</td><td>4</td></tr>
</table>

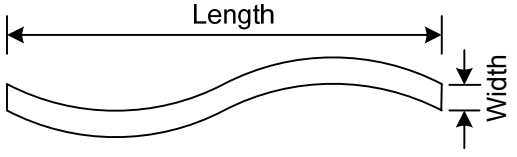
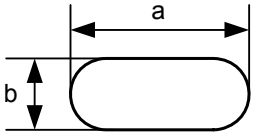


Fig. 11.3



Average diameter = $\frac{a+b}{2}$

Fig. 11.4

Note 1: The definitions of dot defect are as below:

- The defect area of the dot must be bigger than half of a dot.
- For bright dot-defect, showing black pattern, the dot's brightness must be over 30% brighter than others.
- For dark dot-defect, showing white pattern, the dot's brightness must be under 70% darker than others.
- The definition of 1-dot-defect is the defect-dot, which is isolated and no adjacent defect-dot.
- The definition of adjacent dot is shown as Fig. 11.5.

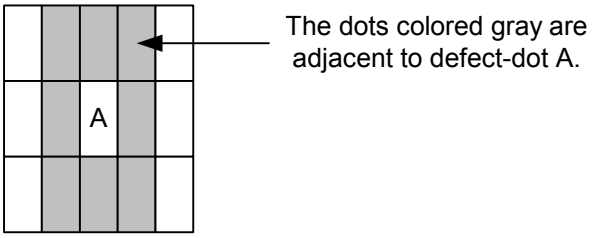


Fig. 11.5

12. PRECAUTIONS

12.1 GENERAL ATTENTION

1) The LCD module covered by this specification has been designed specifically for a mobile phone application. Customer should always comply with this specification when using this LCD module not only for a mobile phone but also for other application. We do not recommend customer to use it for other applications. Deviations from this specification will void any warranty stated or implied, including quality and safety sections. Furthermore, this module has not been explicitly developed for medical equipment critically related to human life such as life support apparatus.

2) Never attempt to disassemble this LCD module. There is danger such as a burn, an electric shock, and an injury. Moreover, when module is disassembled, we do not guarantee these specifications including quality and safety.

12.2 PRECAUTIONS of ESD

1) Before handling the display, please ensure your body has been connected to ground to avoid any damages by ESD. Also, do not touch display's interface directly when assembling.

2) Please remove the protection film very slowly before turning on the display to avoid generating ESD.

12.3 PRECAUTIONS of HANDLING

1) In order to keep the appearance of display in good condition, please do not rub any surfaces of the displays by using sharp tools harder than 3H, especially touch panel, metal frame and polarizer.

2) Please do not stack the displays as this may damage the surface. In order to avoid any injuries, please avoid touching the edge of the glass or metal frame and wore gloves during handling.

3) Touching the polarizer or terminal pins with bare hand should be avoided to prevent staining and poor electrical contact.

4) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean display's surfaces.

5) Please use soft cloth or absorbent cotton with ethanol to clean the display by gently wiping. Moreover, when wiping the display, please wipe it by horizontal or vertical direction instead of circling to prevent leaving scars on the display's surface, especially polarizer.

6) Please wipe any unknown liquids immediately such as saliva, water or dew on the display to avoid color fading or any permanent damages.

7) Maximum pressure to the surface of the display must be less than $1{,}96 \times 10^4$ Pa. If the area of applied pressure is less than 1 cm^2, the maximum pressure must be less than 1.96N.

8) Do not subject the LCD module to a humid environment for any extended period. If the ambient storage temperature is over 35℃, steps should be taken to avoid high humidity. The polarizer can deteriorate under high temperatures and high humidity. Additionally, this can also cause the polarizer to bubble and peel. Please store/operate the LCD module within the specified temperatures and humidity ranges.

9) Condensation on the LCD module may cause staining, dirtying or damage to the polarizer. If it is necessary to move the display from an area of lower ambient temperature to a higher one, it is required to let them normalize to the new ambient temperature before unpacking or use.

10) As the display is made of glass, it is possible to break under shock loads, especially the periphery can be easily cracked or chipped in handling. Please handle the module with care and prevent it from being dropped.

11) Never bend nor scratch the interface part. These actions can cause poor electrical contact.

12) Since the top and bottom areas of bent FPC tend to be easily damaged, be very careful not to push or hold in those areas.

13) Be careful not to apply local stress to the back of the LCD module. This will potentially cause scratching to the backlight guide, or result in a non-uniformity issue. Pay extra attention to the interface connector portion at the time of connector insertion.

12.4 PRECAUTIONS OF OPERATING

1) Please input signals and voltages to the displays according to the values defined in the section of electrical characteristics to obtain the best performance. Any voltages over than absolute maximum rating will cause permanent damages to this display. Also, any timing of the signals out of this specification would cause unexpected performance.

2) When the display is operating at significant low temperature, the response time will be slower than it at 25C°. In high temperature, the color will be slightly dark and blue compared to original pattern. However, these are temperature-related phenomenon of LCD and it will not cause permanent damages to the display when used within the operating temperature.

3) The use of screen saver or sleep mode is recommended when static images are likely for long periods of time. This is to avoid the possibility of image sticking.

4) Spike noise can cause malfunction of the circuit. The recommended limitation of spike noise is no bigger than $\pm$ 100 mV.

5) Be aware of the possibility of condensation under a sudden temperature change. Formation of dewdrops can cause damage to polarizer or electrical contacts and result inferior displaying or malfunction. And even after the condensation has dispersed, smears or spots may occur on the display surface.

6) As the LCD module provides a high frequency circuit, sufficient countermeasures against electromagnetic noise, such as shielding, may be required.

7) Do not connect nor disconnect the module to or from main system with power applied.

8) Provide light shielding so that the driver is not exposed to light. Exposure to strong light may cause malfunction of the driver.

12.5 PRECAUTIONS of STORAGE

If the displays are going to be stored for years, please be aware the following notices.

1) Please store the displays in a dark room to avoid any damages from sunlight and other sources of UV light.

2) The recommended long term storage temperature is between 10C°~30C° and 55%~75% humidity to avoid causing bubbles between polarizer and LCD glasses, and polarizer peeling from LCD glasses.

3) It would be better to keep the displays in the container, which is shipped from Hitachi, and do not unpack it.

4) Please do not stick any labels on the display surface for a long time, especially on the polarizer.

12.6 SAFETY

This LCD module is a glass product. In case of damage, ensure operators wear a pair of protective gloves whilst handling it. Additionally, if any liquid (liquid crystal) accidentally comes into contact with skin, immediately wash it off with soap and water.

12.7 MECHANICAL DESIGN

The design of the mobile phone case for this LCD module should be well studied so that any shock will not be transferred to the LCD module. When the mobile phone is dropped and the case provides insufficient shock absorption, the LCD module may become damaged.

12.8 ENVIRONMENTAL PROTECTION

1) Abide by national laws, legislation and local regulation when disposing of this LCD module.

2) This LCD module complies with RoHS Directive.

13. DESIGNATION of LOT MARK

The lot mark is showing in Fig.13.1. Please refer to Fig. 13.2 and Fig. 13.3 for the detail defination.

TX06126AAA1 0001K9C10001

Fig. 13.1

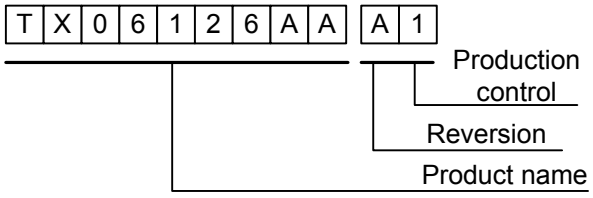


Fig. 13.2

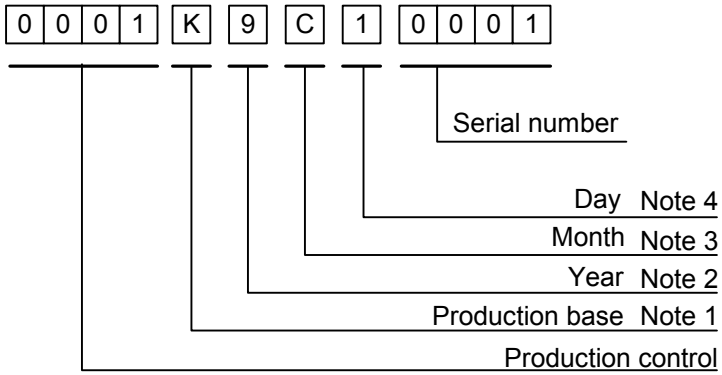


Fig. 13.3

Note 1:

Production base	Symbol
Hitachi Displays	H
Hitachi Display Device (Suzhou)	S
Wistron Optronics (Kunshan) Corp.	K

Note 2:

Year	Symbol
2009	9
2010	0
2011	1

Note 3:

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Symbol	1	2	3	4	5	6	7	8	9	A	B	C

Note 4:

Day	1	2	3	4	5	6	7	8	9	10	11	12	13
Symbol	1	2	3	4	5	6	7	8	9	A	B	C	D
Day	14	15	16	17	18	19	20	21	22	23	24	25	26
Symbol	E	F	G	H	J	K	L	M	N	P	Q	R	S
Day	27	28	29	30	31								
Symbol	T	U	V	W	X								