

**Display Elektronik GmbH**

# DATA SHEET

**TFT MODULE**

**DEM 240400A TMH-PW-N**

**3,0" TFT**

*Product Specification*

*Ver.: 0*

**08.03.2011**

Revise Records

Rev.	Date	Contents	Written	Approved
0	08.03.2011	Preliminary Specification	CL	MH

Special Notes

Note1.	
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## 2. GENERAL DESCRIPTION

MAIN TECHNICS:	COG
DISPLAY CONTENT:	GRAPHIC TFT
DISPLAY TYPE:	262K COLORS-NEGATIVE-TRANSMISSIVE
DRIVER METHOD:	1/240 DUTY
VIEWING DIRECTION :	12:00
CONTROLLER:	ILI9327 (ILITEK)
BACKLIGHT :	LED WHITE
OPERATING TEMPERATURE:	-10°C to +60°C
STORAGE TEMPERATURE:	-20°C to +70°C

## 3. MECHANICAL SPECIFICATIONS

ITEM	CONTENT	UNIT
PIXEL'S NUMBER	240 x RGB x 400	PIXEL
MODULE DIMENSION	45.04 x 185.10 x 3.75	mm
ACTIVE AREA	38.88 x 64.80	mm
PIXEL SIZE	0.162 x 0.162	mm

## 4. ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Transmittance	T%	Viewing normal angle $\theta_x$ $= \theta_y = 0^\circ$	-	6.1	-	%	All left side data are based on CMO's following condition – 1.CG : NTSC 60% 2.LC : TN 3.Light Source : CMO LED BLU 4.Film : Nitto Linear
Contrast Ratio	CR		-	300	-		
Response Time (by Quick)	$T_R$		-	10	20	ms	
	$T_F$		-	20	30	ms	
Viewing Angle	Hor.	$\theta_{x+}$	-	45	-	deg.	Under C light Simulation
		$\theta_{x-}$	-	45	-		
	Ver.	$\theta_{y+}$	-	35	-		
		$\theta_{y-}$	-	15	-		
CF only Chromaticity	Red	$X_R$	0.613	0.643	0.673		
		$Y_R$	0.291	0.321	0.351		
	Green	$X_G$	0.269	0.299	0.329		
		$Y_G$	0.541	0.571	0.601		
	Blue	$X_B$	0.104	0.134	0.164		
		$Y_B$	0.104	0.134	0.164		
	White	$X_W$	0.270	0.300	0.330		
		$Y_W$	0.304	0.334	0.364		

\*Note (1) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L63 / L0$$

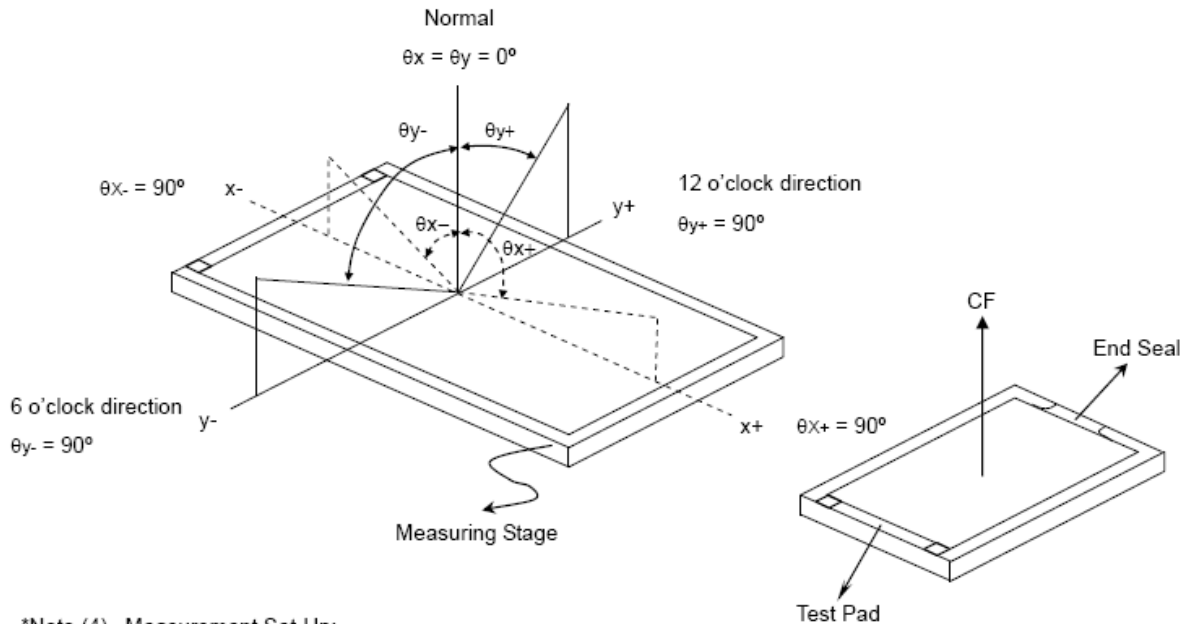
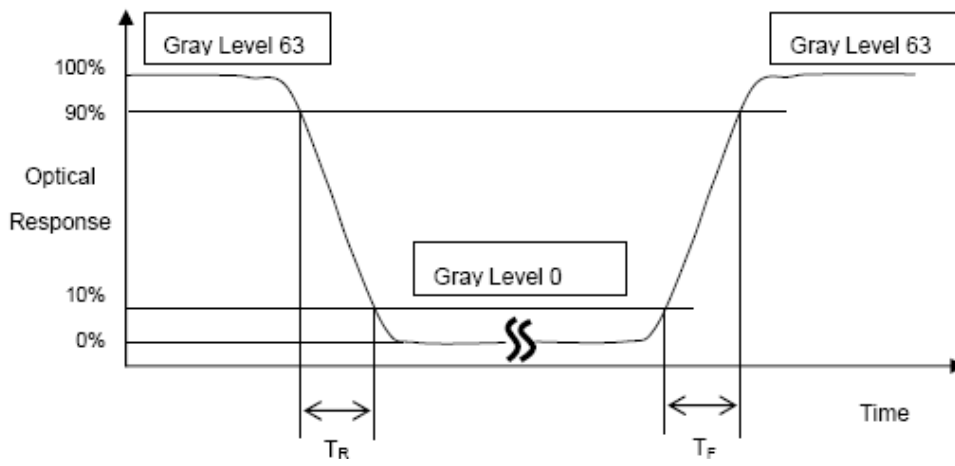
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

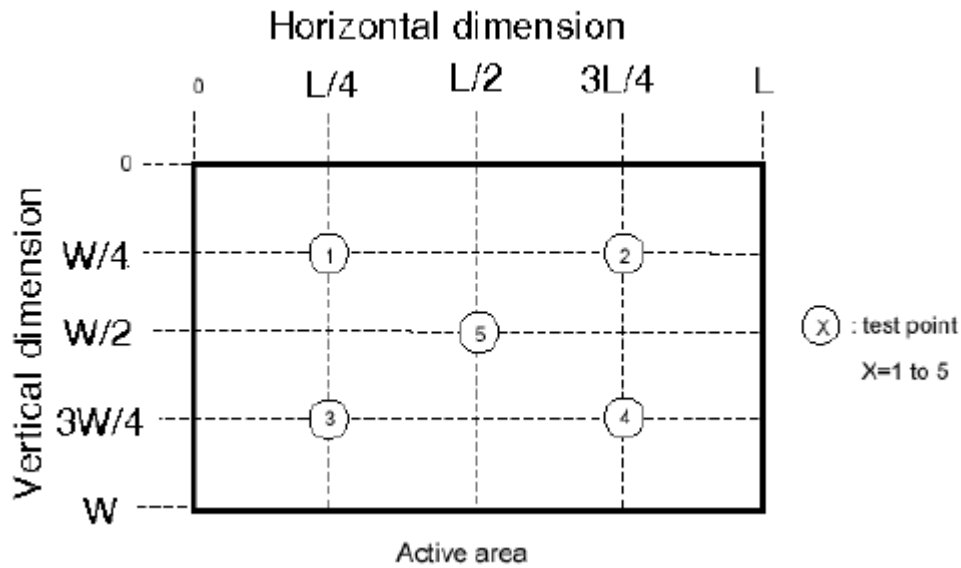
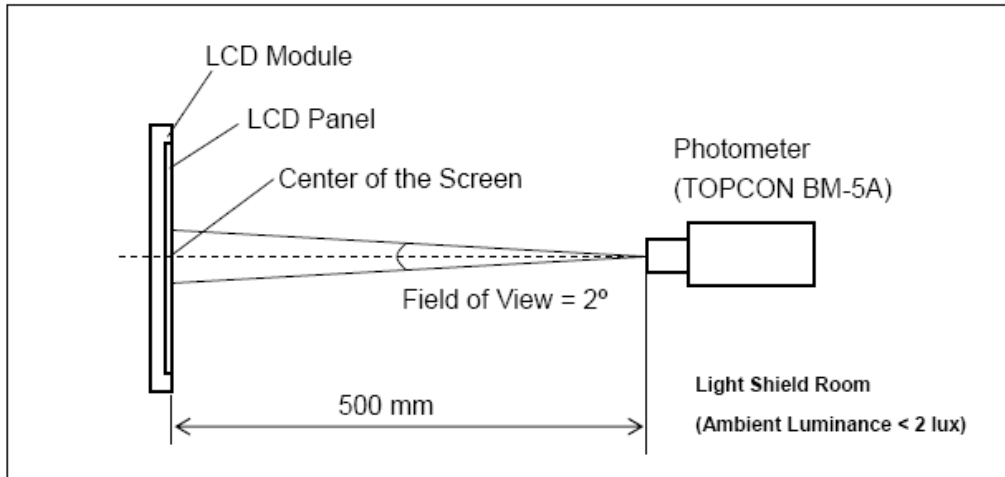
CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (5).

\*Note (2) Definition of Response Time ( $T_R$ ,  $T_F$ ):

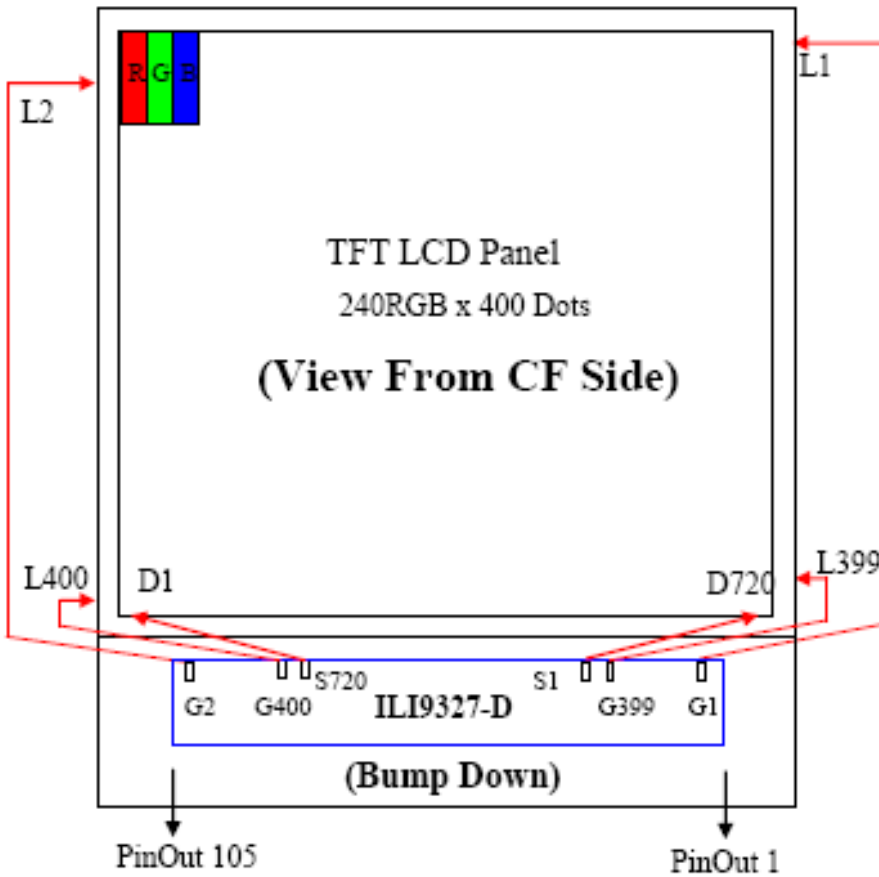


\*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



### 5. BLOCK DIAGRAM



### 6. ELECTRONIC CHARACTERISTICS

#### 6.1 MAXIMUM VALUES

ITEM	SYMBOL	STANDARD VALUE		UNIT
		MIN	MAX	
Logic supply voltage	V <sub>DD</sub>	-0.3	+4.6	V
Operating Temperature	T <sub>op</sub>	-10	+60	°C
Storage Temperature	T <sub>st</sub>	-20	+70	°C



6.2 DC CHARACTERISTICS

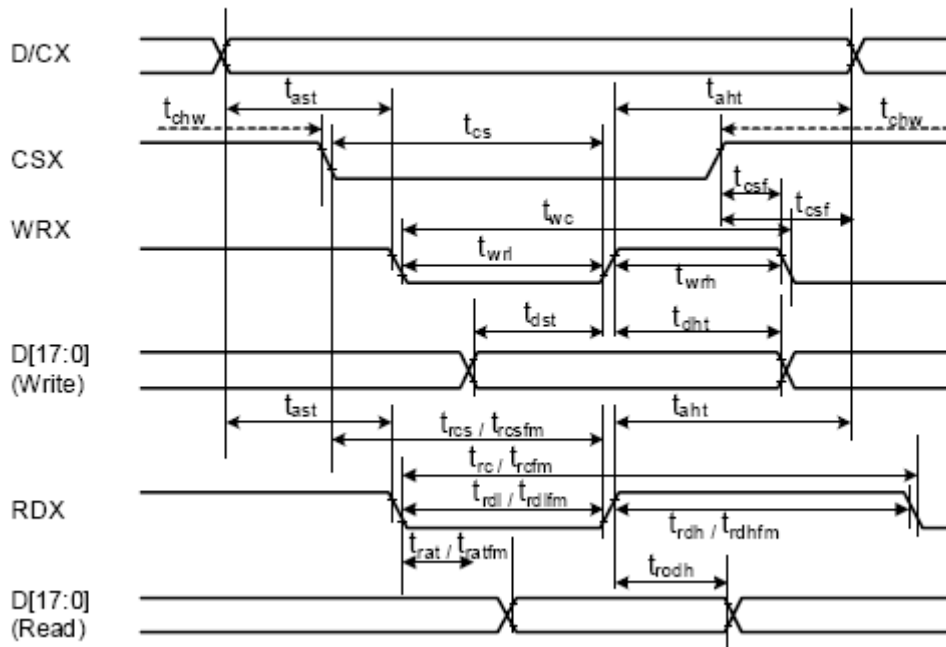
(VCC=VCI=2.50 ~ 3.3V, IOVCC = 1.65 ~ 3.3V, Ta= -40 ~ 85 °C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Analog Power Supply Voltage	VCI	Analog Operation Voltage	2.5	2.8	3.6	V
I/O pin Power Supply Voltage	IOVCC	I/O pin Operation Voltage	1.65	2.8	3.6	V
Input high voltage	V <sub>IH</sub>	IOVCC = 1.65V ~ 3.3V	0.7*IOVCC	-	IOVCC	V
Input low voltage	V <sub>IL</sub>	IOVCC = 1.65V ~ 3.3V	0.0	-	0.3*IOVCC	V
Output high voltage	V <sub>OH</sub>	I <sub>out</sub> = -0.1 mA	0.8*IOVCC	-	IOVCC	V
Output low voltage	V <sub>OL</sub>	I <sub>out</sub> = +0.1 mA	0.0	-	0.2*IOVCC	V
I/O leakage current	I <sub>LI</sub>	V <sub>in</sub> =0 ~ IOVCC	-0.1		0.1	uA
Current consumption during normal operation (VCC, VCI, IOVCC)	I <sub>OP</sub>	VCC=VCI=IOVCC=2.8V, Ta=25°C, GRAM data=0000h, Frame rate=60Hz, line inversion	-	TBD	-	mA
Current consumption during standby operation (VCC, VCI, IOVCC)	I <sub>ST</sub>	VCC=VCI=IOVCC=2.8V, Ta=25°C, CPU interface	-	50	TBD	uA
LCD Drive Power Supply Current (DDVDH-GND)	I <sub>CCD</sub>	VCC=VCI=IOVCC=2.8V, Ta=25°C, GRAM data=0000h, Frame rate=60Hz, line inversion		7.0	-	mA
LCD Drive voltage	DDVDH		4.5		6	Volt
Output deviation voltage	I <sub>DEV</sub>				20	mV
Output offset voltage	I <sub>OFFSET</sub>	Note1			35	mV

Note 1: The Max. value is between with measure point and gamma setting value.

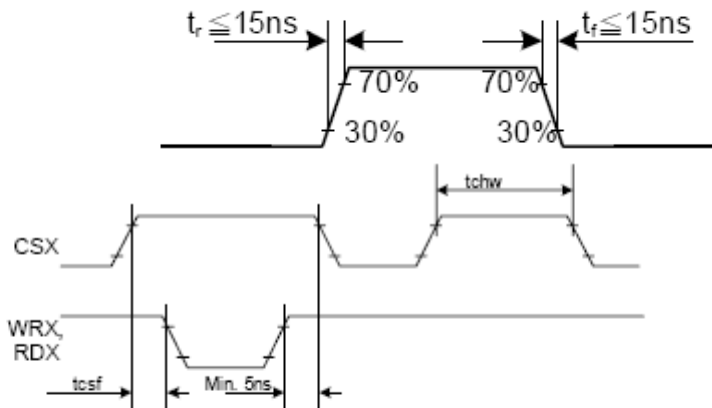
6.3 TIMING CHARACTERISTICS

DBI Type B (18/16/9/8 bit) Interface Timing Characteristics



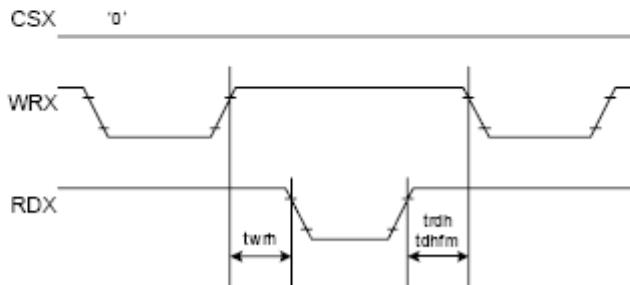
Signal	Symbol	Parameter	min	max	Unit	Description
D/CX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	10	-	ns	
CSX	tchw	CSX "H" Pulse Width	0	-	ns	
	tcs	Chip Select setup time (Write)	20	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	80	-	ns	
	twrh	Write Control pulse H duration	25	-	ns	
	twrl	Write Control pulse L duration	25	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration (ID)	90	-	ns	
	trdl	Read Control pulse L duration (ID)	45	-	ns	
RDX (FM)	trcfm	Read cycle (FM)	450	-	ns	
	trdhfm	Read Control pulse H duration (FM)	90	-	ns	
	trdlfm	Read Control pulse L duration (FM)	355	-	ns	
DB[17:0], DB[15:0], DB[8:0], DB[7:0]	tdst	Data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Data hold time	10	-	ns	
	trat	Read access time (ID)	-	40	ns	
	tratfm	Read access time (FM)	-	340	ns	
	todh	Output disable time	20	-	ns	

Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VDD=2.5V to 3.0V, DGND=0V



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

**7. PIN DESCRIPTION**

Pin No.	Symbol	Description
1	LCM_ID	Ground
2-5	NC	NC
6	GND	Ground
7	IOVCC	Power supply to interface pins:+3.2V
8	VCC/VCI	Power supply:+3.2V
9	TE	Tearing effect output pin to synchronies MCU to frame writing
10	CSB	Chip select signal
11	RS	Register select signal
12	WR	Serves as a write
13	RD	Serves as a read signal
14-29	DB0-DB15	data bus
30	RESET	L: initialization is executed
31	GND	Ground
32	LED+	Backlight LED anode
33	LED1-	Backlight LED cathode (K1)
34	LED2-	Backlight LED cathode (K2)
35	LED3-	Backlight LED cathode (K3)
36	LED4-	Backlight LED cathode (K4)

**8. INSTRUCTION DESCRIPTION**

Operational Code (Hex)	Command	Command(C) /Read(R) /Write(W)	Number Of Parameter	MIPI DCS Type1 Requirement	ILI9327 Implementation
00h	nop	C	0	Yes	Yes
01h	soft_reset	C	0	Yes	Yes
06h	get_red_channel	R	1	No	No
07h	get_green_channel	R	1	No	No
08h	get_blue_channel	R	1	No	No
0Ah	get_power_mode	R	1	Yes	Yes
0Bh	get_address_mode	R	1	Yes (Bit[7:0])	Yes (Bit[7:3]) , Only
0Ch	get_pixel_format	R	1	Yes	Yes
0Dh	get_display_mode	R	1	Yes	Yes
0Eh	get_signal_mode	R	1	Yes	Yes
0Fh	get_diagnostic_result	R	1	Bit7/6 : Yes Bit5/4 : Optional	Yes (Bit7/6 Only)
10h	enter_sleep_mode	C	0	Yes	Yes
11h	exit_sleep_mode	C	0	Yes	Yes
12h	enter_partial_mode	C	0	Yes	Yes
13h	enter_normal_mode	C	0	Yes	Yes
20h	exit_invert_mode	C	0	Yes	Yes
21h	enter_invert_mode	C	0	Yes	Yes
28h	set_display_off	C	0	Yes	Yes
29h	set_display_on	C	0	Yes	Yes
2Ah	set_column_address	W	4	Yes	Yes
2Bh	set_page_address	W	4	Yes	Yes
2Ch	write_memory_start	W	Variable	Yes	Yes
2Eh	read_memory_start	R	Variable	Yes	Yes
30h	set_partial_area	W	4	Yes	Yes
33h	set_scroll_area	W	6	Yes	Yes
34h	set_tear_off	C	0	Yes	Yes
35h	set_tear_on	W	1	Yes	Yes
36h	set_address_mode	W	1	Yes (Bit7-0)	Yes (Bit[7:3], Bit[1:0] Only)
37h	set_scroll_start	W	2	Yes	Yes
38h	exit_idle_mode	C	0	Yes	Yes
39h	enter_idle_mode	C	0	Yes	Yes
3Ah	set_pixel_format	W	1	Yes	Yes
3Ch	write_memory_continue	W	Variable	Yes	Yes
3Eh	read_memory_continue	R	Variable	Yes	Yes
44h	set_tear_scanline	W	2	Yes	Yes
45h	get_scanline	R	2	Yes	Yes
51h	Write Display Brightness	W	1	-	Yes
52h	Read Display Brightness	R	1	-	Yes
53h	Write CTRL Display	W	1	-	Yes
54h	Read CTRL Display	R	1	-	Yes
55h	Write Content Adaptive Brightness Control	W	1	-	Yes
56h	Read Content Adaptive Brightness Control	R	1	-	Yes
5Eh	Write CABC Minimum Brightness	W	1	-	Yes
5Fh	Read CABC Minimum Brightness	R	1	-	Yes

A1h	read_DDB_start	R	1	Yes	Yes
B0h	Command Access Protect	R/W	1	-	Yes
B1h	Low Power Mode Control	R/W	1	-	Yes
B3h	Frame Memory Access and Interface Setting	R/W	4	-	Yes
B4h	Display Mode and Frame Memory Write Mode Setting	R/W	1	-	Yes
B5h	Sub-Panel Control Register	R/W	1	-	Yes
B8h	Backlight Control 1	R/W	1	-	Yes
B9h	Backlight Control 2	R/W	1	-	Yes
BAh	Backlight Control 3	R/W	1	-	Yes
BBh	Backlight Control 4	R/W	1	-	Yes
BCh	Backlight Control 5	R/W	1	-	Yes
BEh	Backlight Control 7	R/W	1	-	Yes
BFh	Backlight Control 8	R/W	1	-	Yes
C0h	Panel Driving Setting	R/W	6		Yes
C1h	Display_Timing_Setting for Normal/Partial Mode	R/W			Yes
C3h	Display_Timing_Setting for Idle Mode	R/W			Yes
C4h	Source/VCOM/Gate Timing Setting	R/W			Yes
C5h	Frame Rate Control	R/W			Yes
C6h	Interface Control	R/W			Yes
C8h	Gamma Setting	R/W			Yes
C9h	Gamma Setting for Red/Blue Color	R/W			Yes
D0h	Power_Setting	R/W			Yes
D1h	VCOM Control	R/W			Yes
D2h	Power_Setting for Normal Mode	R/W			Yes
D3h	Power_Setting for Partial Mode	R/W			Yes
D4h	Power_Setting for Idle Mode	R/W			Yes
E0h	NV Memory Write	R/W			Yes
E1h	NV Memory Control	R/W			Yes
E2h	NV Memory Status Read	R/W			Yes
E3h	NV Memory Protection	R/W			Yes
EAh	3-Gamma Function Control	R/W			Yes
EFh	Device Code Read	R/W			Yes

## 9. BACKLIGHT PARAMETERS

### 9.1 ABSOLUTE MAXIMUM RATINGS

(Unless specified, The Ambient temperature Ta=25°C)

Item	Symbol	Condition	Rating	Unit
Operating temperature range	Topr		-10~+60	°C
Storage temperature range	Tst		-20~+70	°C

### 9.2 ELECTRICAL/OPTICAL CHARACTERISTICS

(Unless specified, The Ambient temperature Ta=25°C)

Item	Symbol	min	typ	max	Unit	Condition
Forward Voltage	Vf	2.9	3.2	3.5	V	If=60mA
Luminance	Lv	3200			cd/m <sup>2</sup>	If=60mA
color coordinate	X	0.26		0.31		If=60 mA
	Y	0.26		0.31		

## **10. Product Quality & Reliability**

### **10.1 Standard for Quality Test**

#### 10.1.1 Inspection :

Before delivering, the supplier should take the following tests, and affirm the quality of product.

#### 10.1.2 Electro-Optical Characteristics:

According to the individual specification to test the product.

#### 10.1.3 Test of Appearance Characteristics:

According to the individual specification to test the product.

#### 10.1.4 Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

#### 10.1.5 Delivery Test:

Before delivering, the supplier should take the delivery test.

A. Test method: According to GB/2828, General Inspection Level take a single time.

B. The defects classify of AQL as following:

Major defect: AQL=0.25

Minor defect: AQL=1.0

Total defects: AQL=1.0

### **10.2 Standard for inspection**

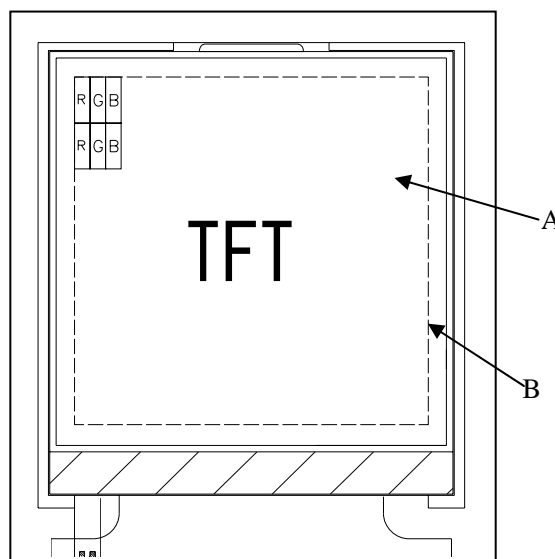
#### 10.2.1 Manner of appearance test:

- The test must be under a 40W fluorescent light, and the distance of view must be at 30~35 cm.
- When test the model of transmissive product must add the reflective plate.
- The test direction is base on about around 45° of vertical line.

#### 10.2.2 Definition of area: A B

A Area : Viewing area.

B Area : Out of viewing area.(Outside viewing area)

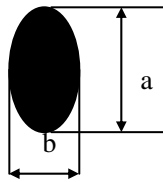


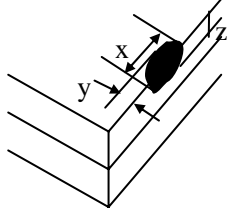
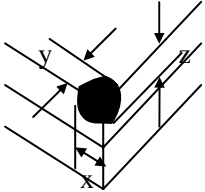
10.2.3 Basic principle:

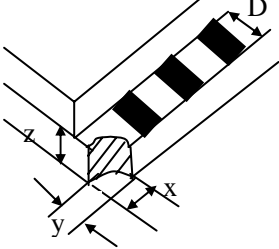
- A. In principle the defect out of Area A should be acceptable if the defect does not affect assemblage and the quality of productions.
- B. If defects that can not describe clearly, acceptable samples will be the standard.
- C. The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.
- D. Must add new item on time when it is necessary.

10.2.4 Standard of inspection

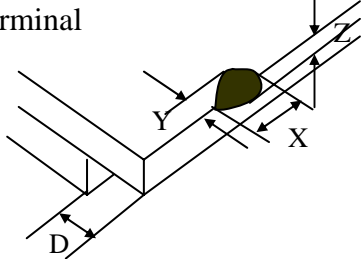
Defect	Inspect item	Criteria
1 Minor	Scratch and fold on polarizer. Scratch on glass. Glass fiber etc. ( by bare eyes , defect outside A area is acceptable )	1) width $\leq$ 0.02 mm length ignore acceptable 2) 0.02 mm < width $\leq$ 0.05 mm length $\leq$ 3 mm two are acceptable 3) width > 0.05 mm reject

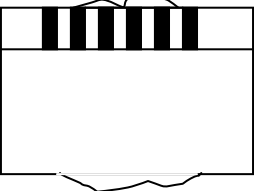
Defect	Inspect item	Criteria
2 Minor	Chip on glass(round type) Chip on polarizer(round type) Air bubble between polarizer and glass  $\Phi = (a + b) / 2$	$\Phi \leq 0.1$ mm acceptable $0.1 < \Phi \leq 0.2$ mm two are acceptable 1.The distance between any two dots should be more than 5mm. 2.Defect outside A area is acceptable. 3.If the air bubble is black, it can be judged as black spot.

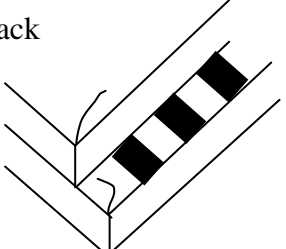
Defect	Inspect item	Criteria
3 Minor	<p>Chip out</p>  <p>x: length y: width z: thickness</p>	<p><math>x \leq 3 \text{ mm}</math> <math>z \leq t</math> <math>y \leq 1/3 s</math> reject</p> <p>t: glass thickness. S: distance between glass edge and inside of edge sealing</p>
4 Minor	<p>Chip on corner of neat edge</p>  <p>X: length      Y: width S: width of edge sealing</p>	<p><math>x \leq 3 \text{ mm}</math> <math>y \leq 3 \text{ mm}</math> <math>z \leq t</math></p> <p>any chip exposes the silver dot      acceptable reject</p>

Defect	Inspect item	Criteria
5 Minor	<p>Chip on corner of terminal edge</p>  <p>D: terminal length</p>	<p><math>x &lt; 0.3 \text{ mm}</math> or <math>y &lt; 0.3 \text{ mm}</math> ignore</p> <p><math>x \leq 3 \text{ mm}</math> <math>y &lt; D</math> two are acceptable</p>



Defect	Inspect item	Criteria
6 Minor	Chip on opposite side of terminal 	$a \geq 80\text{mm}$ , $x \geq 7\text{mm}$ reject $a < 80\text{mm}$ , $x > 5\text{mm}$ reject $y > 1/2D$ reject $z > 1/2t$ , $y > 1/4D$ reject D: terminal length

Defect	Inspect item	Criteria
7 Minor	Cutting/breaking defect (flare) 	According to the dimension of drawing

Defect	Inspect item	Criteria
8 Minor	Crack 	Any crack trend to extend      reject

Defect	Inspect item	Criteria
9 Major	Liquid leakage, open sealant	reject

Defect	Inspect item	Criteria
10 Minor	Rainbow	According to samples

Defect	Inspect item	Criteria
11 Major	FPC, TCP, FLEX are broken or not connected firmly	reject

Defect	Inspect item	Criteria
12 Minor	The component on PCB or FPC is missing ,soldered unfirmly or bridged	reject

Defect	Inspect item	Criteria
13 Minor	The soldering tin is not enough	The height that soldering tin covers the bump of component is 1/2 less than the height of bump reject

Defect	Inspect item	Criteria
14 Minor	The soldering tin overflows	The soldering tin covers whole bump reject
Defect	Inspect item	Criteria
15 Minor	The component is broken	reject

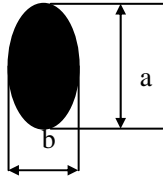
Defect	Inspect item	Criteria
16 Minor	The shape of pinouts is not the same as that in the criterion	It makes the LCM work badly reject

Defect	Inspect item	Criteria
17 Minor	The pinout is broken	reject

Defect	Inspect item	Criteria
18 Minor	The frame is scratched visibly	Length ignore Width >0.5mm reject

Defect	Inspect item	Criteria
19 Minor	The frame is rusted (accumulation)	When the shape is as dot,reference to defect 23 When the shape is as line,reference to defect 24

Defect	Inspect item	Criteria
20 Minor	Scratch and fold on touchpanel. ( by bare eyes ,defect outside A area is acceptable )	1) width≤0.02 mm acceptable 2) 0.02 mm<width≤0.05 mm length≤5 mm two are acceptable 3) width>0.05 mm reject

Defect	Inspect item	Criteria
21 Minor	Black & white dots on touchpanel (round type) Air bubble on touchpanel  $\Phi=(a + b)/2$	1) $\Phi \leq 0.1$ mm acceptable 2) $0.1 < \Phi \leq 0.3$ mm three are acceptable 3) $\Phi > 0.3$ mm reject 1.The distance between any two dots should be more than 5mm. 2.Defect outside A area is acceptable. 3.If the air bubble is black, it can be judged as black spot.

Defect	Inspect item	Criteria
22 Minor	Touchpanel warps	According to the dimension of drawing.

Defect	Inspect item	Criteria
23 Minor	Dirty on rear of touchpanel	It's visible at condition of $30 \pm 5$ cm, $45^\circ$

**10.3 RELIABILITY**

<b>Item</b>	<b>Condition</b>	<b>Criterion</b>
<b>High temperature operation</b>	<b>60°C , 96 hrs</b>	<b>-Cosmetic defects are not allowed after the test(Polarizer change is exceptional) -Contrast ratio change over 50% of initial value should not be happened -The current consumption should be below double of initial value -Brightness decrease should be lower than 50% of initial value</b>
<b>Low temperature operation</b>	<b>-10°C , 96 hrs</b>	
<b>Moisture storage</b>	<b>60°C , 90%RH, 96 hrs</b>	
<b>High temperature storage</b>	<b>70°C , 96 hrs</b>	
<b>Low temperature storage</b>	<b>-20°C , 96 hrs</b>	
<b>Thermal shock</b>	<b>-20°C (30 minute) 25°C (5 minute) 70°C (30 minute) CYCLES: 10</b>	
<b>LIFE TIME</b>	<b>50,000 hours, 25±10°C, 45±20% RH</b>	

## **11. PRECAUTIONS IN USING**

### **11.1 Liquid crystal display (LCD)**

The LCD panel is made up of glass, organic fluid and polarizer. When handling, please pay attention to the following items:

- 1) Keep the operation and storage temperature of the LCD within the range specified in the LCD specification. Otherwise, excessive temperature and humidity would cause polarization degradation, bubble generation or polarizer peel-off.
- 2) Prevent it from mechanical shock by dropping it from a high place, etc.
- 3) Don't contact, push or rub the exposed polarizers with anything harder than HB pencil lead.
- 4) Avoid using chemicals such as acetone, toluene, ethanol and isoropylalcohol to clean the front/rear polarizers and reflectors, which will cause damage to them.
- 5) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause deformation or color fading. The LCM is assembled and adjusted with a high degree of precision.
- 6) Do not put or attach anything on the display area. Avoid touching the display area with bare hand.

### **11.2 Precaution for handling LCD modules**

The LCM is assembled and adjusted with a high degree of precision, do not applying excessive shocks to it or making any alterations or modifications to it, the following precautions should be taken when handing.

- 1) Do not drop, bend or twist the module.
- 2) Do not alter or making any modification on the shape of the metal frame.
- 3) Do not change the shape, the pattern wiring or add any extra hole on the PCB.
- 4) Do not modify or touch the zebra rubber strip(conductive rubber) with another object.
- 5) Do not change the positions of components on the PCB.

### **11.3 Electro-static discharge control**

Careful attention should be paid to control the electrostatic discharge of the modules, since the modules contain no. of CMOS LSI.

- 1) Make sure you are grounded properly when remove the module from its antistatic bag. Be sure that the module and have the same electric potential.
- 2) Only properly grounded soldering iron should be used.
- 3) Modules should be stored in antistatic bag or other containers resistant to static after remove from its original package.
- 4) When using the electric screw-driver is used, make sure the screw driver had been ground potentiality to minimize the transmission of EM wave produced by commutator sparks.
- 5) In order to reduce the generation of static electricity, a relative humidity of 50-60% is recommended.

**11.4 Precaution for soldering**

- 1) Soldering should apply to I/O terminals only.
- 2) Soldering temperature is  $280^{\circ}\text{C}+(-)10^{\circ}\text{C}$ .
- 3) Soldering time 3-4 seconds.
- 4) Eutectic solder (rosin flux filled) should be used.
- 5) If soldering flux is used, be sure to remove any remaining flux after finishing the soldering operation and LCD surface should be covered during soldering to prevent any damage to flux spatters.
- 6) When remove the lead wires from the I/O terminals, use proper de-soldering methods, e.g. suction type de-soldering irons. Do not repeat wiring by soldering more than three times at the pads and plated though holes may be damaged.

**11.5 Precaution for operation**

- 1) Adjust liquid crystal driving voltage ( $V_o$ ) to varies viewing angle and obtain the contrast.
- 2)  $V_o$  should be kept in proper range stated in the specification. Excess voltage will shorten the LCD life.
- 3) Response time is greatly delayed at low temperature. It will recover when go back to normal temperature.
- 4) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore it should be used under the relative condition of 50% RH.

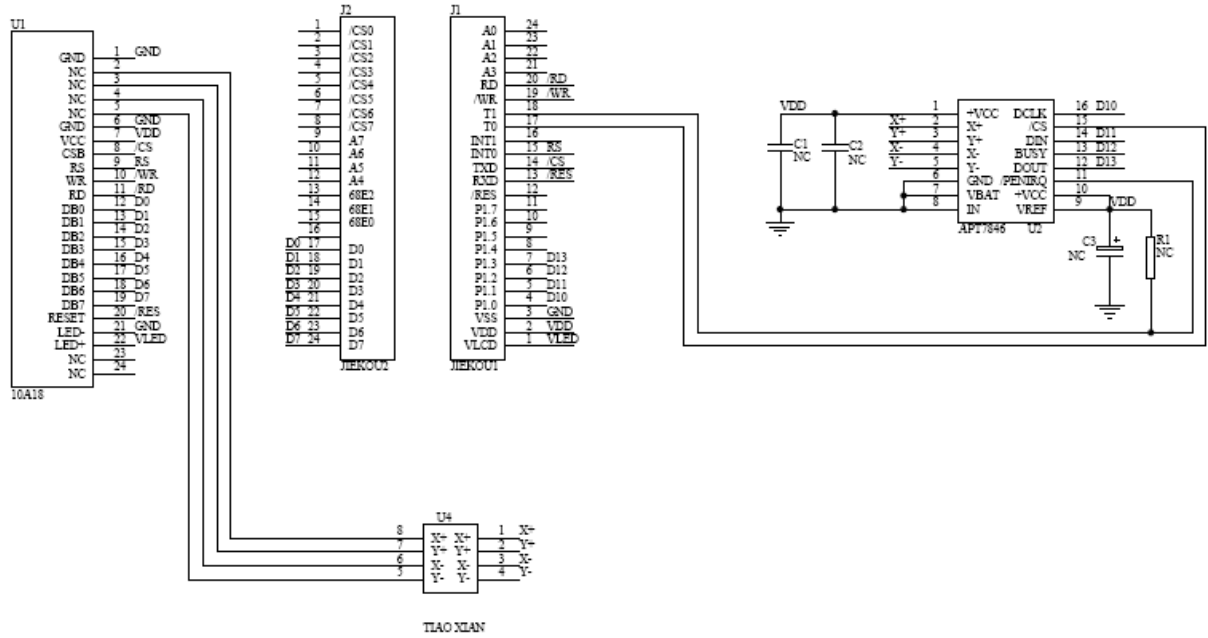
**11.6 Storage**

When long term storage is required, following precautions are necessary:

- 1) Storage them in a sealed polyethylene bag (antistatic), seal the opening, and store it where it is not subjected to direct sunshine, or to the light of fluorescent lamp. If properly sealed, there is no need for desiccant.
- 2) Store them in the temperature range of  $-20^{\circ}\text{C}\sim 70^{\circ}\text{C}$  and at low humidity is recommended.

## 12. APPLICATION

### 12.1 REFERENCE CIRCUIT



**12.2 APPENDIX****INITIALIZATION FOR REFERENCE (MPU: AT89C512):**

```
void LCD_Init()
{
  /******* Start Initial Sequence *****/
  LCD_CtrlWrite(0x00E9);
  LCD_DataWrite(0x0020);

  LCD_CtrlWrite(0x0011); //Exit Sleep
  delay(100);

  LCD_CtrlWrite(0x003A);
  LCD_DataWrite(0x0055);

  LCD_CtrlWrite(0x00D1);
  LCD_DataWrite(0x0000);
  LCD_DataWrite(0x005B);
  LCD_DataWrite(0x0015);

  LCD_CtrlWrite(0x00D0);
  LCD_DataWrite(0x0007);
  LCD_DataWrite(0x0002);
  LCD_DataWrite(0x0088);

  LCD_CtrlWrite(0x0036);
  LCD_DataWrite(0x0008);

  LCD_CtrlWrite(0x00C1);
  LCD_DataWrite(0x0010);
  LCD_DataWrite(0x0010);
  LCD_DataWrite(0x0002);
  LCD_DataWrite(0x0002);

  LCD_CtrlWrite(0x00C0);
  LCD_DataWrite(0x0001);
  LCD_DataWrite(0x0035);
  LCD_DataWrite(0x0000);
  LCD_DataWrite(0x0000);
  LCD_DataWrite(0x0001);
  LCD_DataWrite(0x0002);
```



```
LCD_CtrlWrite(0x00C5); //Set frame rate  
LCD_DataWrite(0x0002);
```

```
LCD_CtrlWrite(0x00D2); //power setting  
LCD_DataWrite(0x0001);  
LCD_DataWrite(0x0044);
```

```
LCD_CtrlWrite(0x00C8); //Set Gamma  
LCD_DataWrite(0x0000);  
LCD_DataWrite(0x0056);  
LCD_DataWrite(0x0045);  
LCD_DataWrite(0x0004);  
LCD_DataWrite(0x0003);  
LCD_DataWrite(0x0001);  
LCD_DataWrite(0x0023);  
LCD_DataWrite(0x0012);  
LCD_DataWrite(0x0077);  
LCD_DataWrite(0x0040);  
LCD_DataWrite(0x0009);  
LCD_DataWrite(0x0006);  
LCD_DataWrite(0x0088);  
LCD_DataWrite(0x0088);  
LCD_DataWrite(0x0088);
```

```
LCD_CtrlWrite(0x0029); //display on  
}
```