

**Laurel Electronics Co., Ltd.**

## SPECIFICATION FOR TFT LCD MODULE

MODEL NO.: LT024A-01B

2.4", 240(RGB) x 320 PIXELS TFT LCD MODULE

REVISION	PREPARED	CHECKED	APPROVED
0.1	Y.D.Y.	L.Y.J.	L.Y.

### RECORD OF REVISION

Date	Revision	Page	Revision Items
2017-04-27	0.1	-	New release

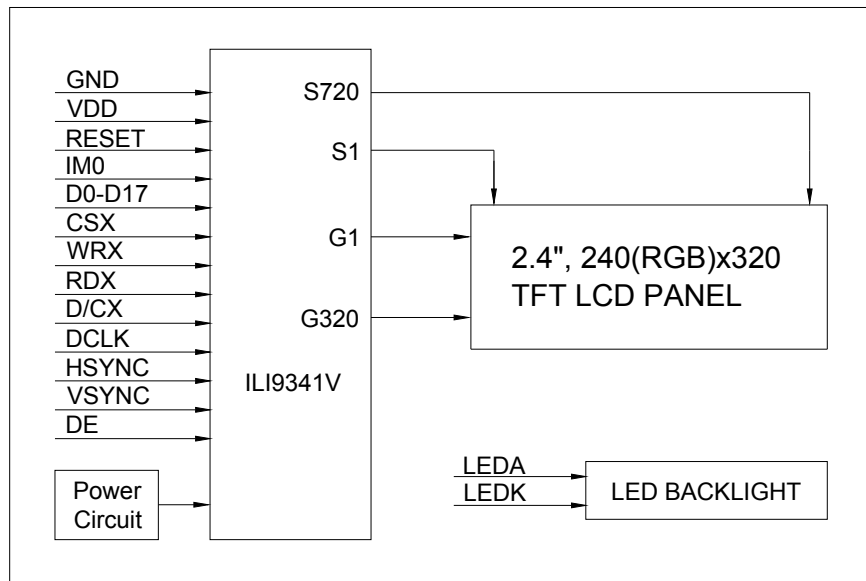
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### 1. General Description

Item	Specifications	Unit
LCD Type	TFT, Transmissive, Normally White	-
Number of Dots	240x3(RGB)x320	dot
Display Color	262K	-
Color Configuration	RGB-Stripe	-
Screen Size	2.4(Diagonal)	inch
Active Area (W×H)	36.72×48.96	mm
Dot Pitch (W×H)	0.051×0.153	mm
Outline Dimensions (W×H×T)	42.72×60.26×2.6	mm
Viewing Direction	12:00 (Gray Scale Inversion Direction)	O'clock
Controller	ILI9341V	-
VDD	2.8	V
Interface	8/16-bit 8080	-
Backlight	White LED	-
Touch Panel	None	-
Operating Temperature	-20 to +70	°C
Storage Temperature	-30 to +80	°C
Weight	13	g

### 2. Block Diagram



### 3. Interface Specification

Pin No.	Symbol	Description														
1 to 3	NC	No Connection														
4	IM0	Select the MCU interface mode. IM[3:1] is fixed to 100.														
		<table border="1"> <thead> <tr> <th rowspan="2">IM0</th> <th rowspan="2">Interface Mode</th> <th colspan="2">Data Bus in Use</th> </tr> <tr> <th>Register/Content</th> <th>GRAM</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>8080 MCU 16-bit</td> <td>D[8:1]</td> <td>D[17:10], D[8:1]</td> </tr> <tr> <td>1</td> <td>8080 MCU 8-bit</td> <td>D[17:10]</td> <td>D[17:10]</td> </tr> </tbody> </table>	IM0	Interface Mode	Data Bus in Use		Register/Content	GRAM	0	8080 MCU 16-bit	D[8:1]	D[17:10], D[8:1]	1	8080 MCU 8-bit	D[17:10]	D[17:10]
		IM0			Interface Mode	Data Bus in Use										
			Register/Content	GRAM												
0	8080 MCU 16-bit	D[8:1]	D[17:10], D[8:1]													
1	8080 MCU 8-bit	D[17:10]	D[17:10]													
5	NC	No Connection														
6	RESET	Reset signal. Active “L”.														
7	VSYNC	Frame synchronizing signal for RGB interface operation.														
8	HSYNC	Line synchronizing signal for RGB interface operation.														
9	DCLK	Dot clock signal for RGB interface operation.														
10	DE	Data enable signal for RGB interface operation.														
11	D17	Data input														
12	D16	Data input														
13	D15	Data input														
14	D14	Data input														
15	D13	Data input														
16	D12	Data input														
17	D11	Data input														
18	D10	Data input														
19	D9	Data input														
20	D8	Data input														
21	D7	Data input														
22	D6	Data input														
23	D5	Data input														
24	D4	Data input														
25	D3	Data input														
26	D2	Data input														
27	D1	Data input														
28	D0	Data input														
29	RDX	Serves as a read signal and MCU read data at the rising edge.														
30	WRX	Serves as a write signal and writes data at the rising edge.														
31	DCX	This pin is used to select “Data or Command” in the parallel interface. DCX=1: Data is selected; DCX=0: Command is selected.														
32	CSX	Chip select input pin. Active “Low”.														
33	VSS	Power ground														
34	VDD	Power supply (2.8V)														
35	LEDK	LED backlight cathode														
36	LEDA	LED backlight anode														

Note: Connect Pin 7 to Pin 10 to VSS or VDD. Connect unused data bus pins to VSS.

### 4. Absolute Maximum Ratings (Note 1)

Item	Symbol	Min.	Max.	Unit	Remark
Supply Voltage (Logic)	VDD	-0.3	4.6	V	
Input Signal Voltage	VI	-0.3	VDD+0.3	V	
Supply Voltage (LED)	If	-	25	mA	
Operating Temperature	Top	-20	70	°C	Note 2, 3
Storage Temperature	Tstg	-30	80	°C	Note 2, 3

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. A module should be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme condition, the module may be permanently destroyed.

Note 2: 90% RH Max. (Max. wet-bulb temperature is 60°C)

Max. wet-bulb temperature is at 60°C or less. No condensation (no drops of dew).

Note 3: In case of temperature below 0°C, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one.

### 5. Electrical Characteristics

#### 5.1 TFT LCD

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power Voltage	VDD	2.5	2.8	3.3	V	-
Input Logic High Voltage	VIH	0.7VDD	-	VDD	V	-
Input Logic Low Voltage	VIL	0	-	0.3VDD	V	-
Output Logic High Voltage	VOH	0.8VDD	-	VDD	V	IOL=-1.0mA
Output Logic Low Voltage	VOL	0	-	0.2VDD	V	IOL=1.0mA
Current for LCD	IDD	-	15	25	mA	VDD=2.8V

#### 5.2 LED Backlight

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
LED Current	IL	-	15.0	20.0	mA	
LED Voltage	VL	-	11.6	12.4	V	Note 1
LED Life Time	-	20,000	-	-	Hr	Note 2

Note 1: The LED voltage is defined by the number of LED at Ta=25°C and IL=15mA.

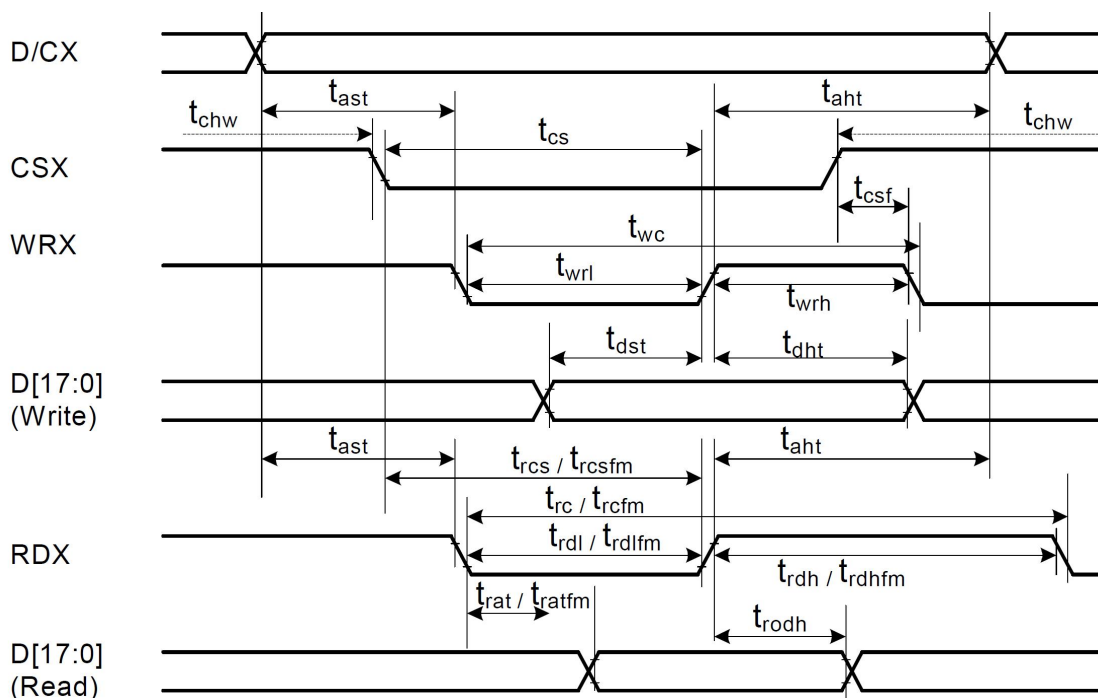
Note 2: The LED life time is defined as the time period in which the brightness decreases to 50% of initial brightness under operating condition Ta=25°C and IL=15mA. The LED life time could be decreased if operating current is larger than 15mA.



**5.3 AC Characteristics (VDD=2.8V, Ta=25°C)**

Symbol	Signal	Parameter	Min.	Max.	Unit	Remark
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	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	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX(FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX(ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF; For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: Rising time tr and falling time tf should not be larger than 15ns.

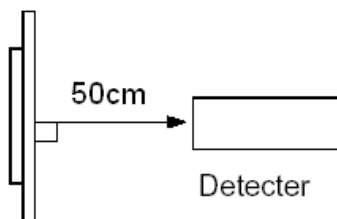


### 6. Optical Specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Brightness	Bp	$\Theta=0^\circ$	-	160	-	cd/m <sup>2</sup>	1	
Uniformity	$\Delta Bp$	$\Phi=0^\circ$	70%	-	-	-	1, 2	
Viewing Angle	Hor	$Cr \geq 10$	-	$\Theta_R$	50	-	degree	3
				$\Theta_L$	50	-		
	Ver			$\Theta_U$	40	-		
				$\Theta_D$	55	-		
Contrast Ratio	Cr	$\Theta=0^\circ$	320	400	-	-	4	
Response Time	Tr + Tf	$\Phi=0^\circ$	-	30	45	ms	5	
Color Coordinate	Wx	$\Theta=0^\circ$	0.26	0.31	0.36	-	1, 6	
	Wy	$\Phi=0^\circ$	0.28	0.33	0.38	-		

Test conditions: VDD=2.8V, IL=15mA (LED backlight current), the ambient temperature is 25°C.

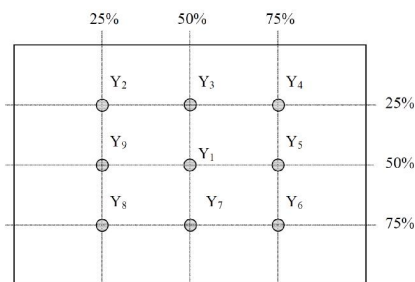
Note 1: The optical characteristics should be measured in dark room after 15 minutes operation. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment BM-7.



Note 2:  $\Delta Bp = Bp (\text{Min.}) / Bp (\text{Max.}) \times 100 (\%)$

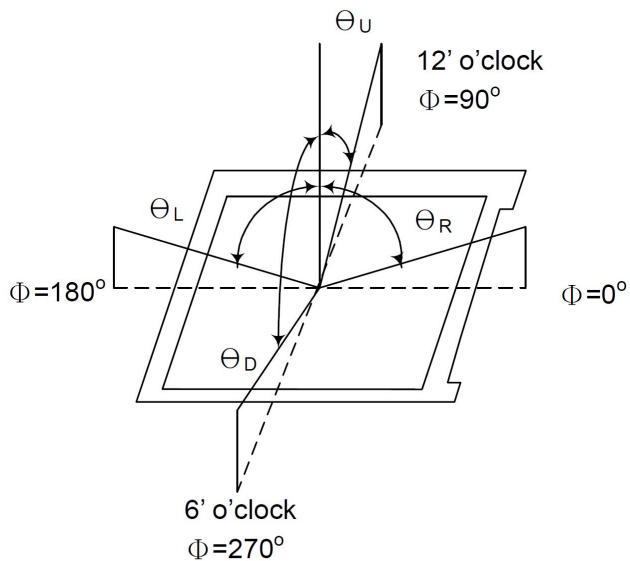
Bp (Max.) = Maximum brightness in 9 measured spots

Bp (Min.) = Minimum brightness in 9 measured spots.





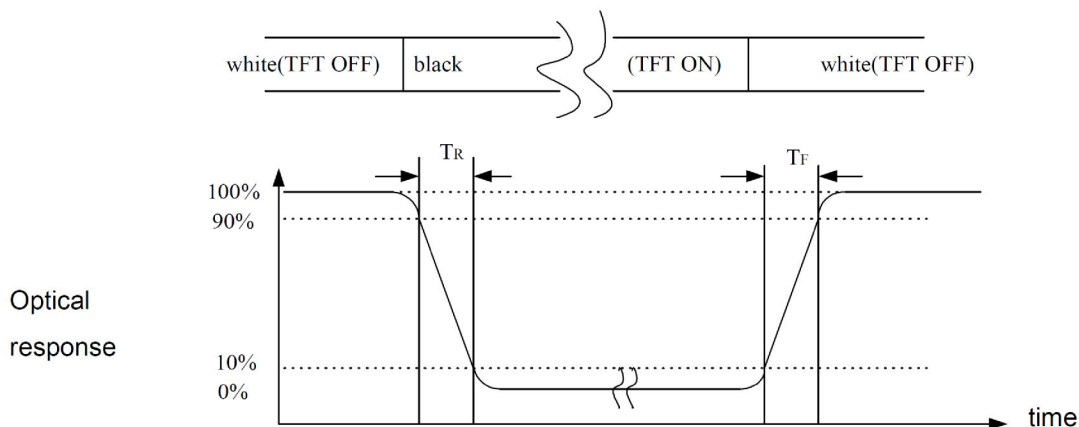
Note 3: Definition of Viewing Angle



Note 4: Definition of Contrast Ratio

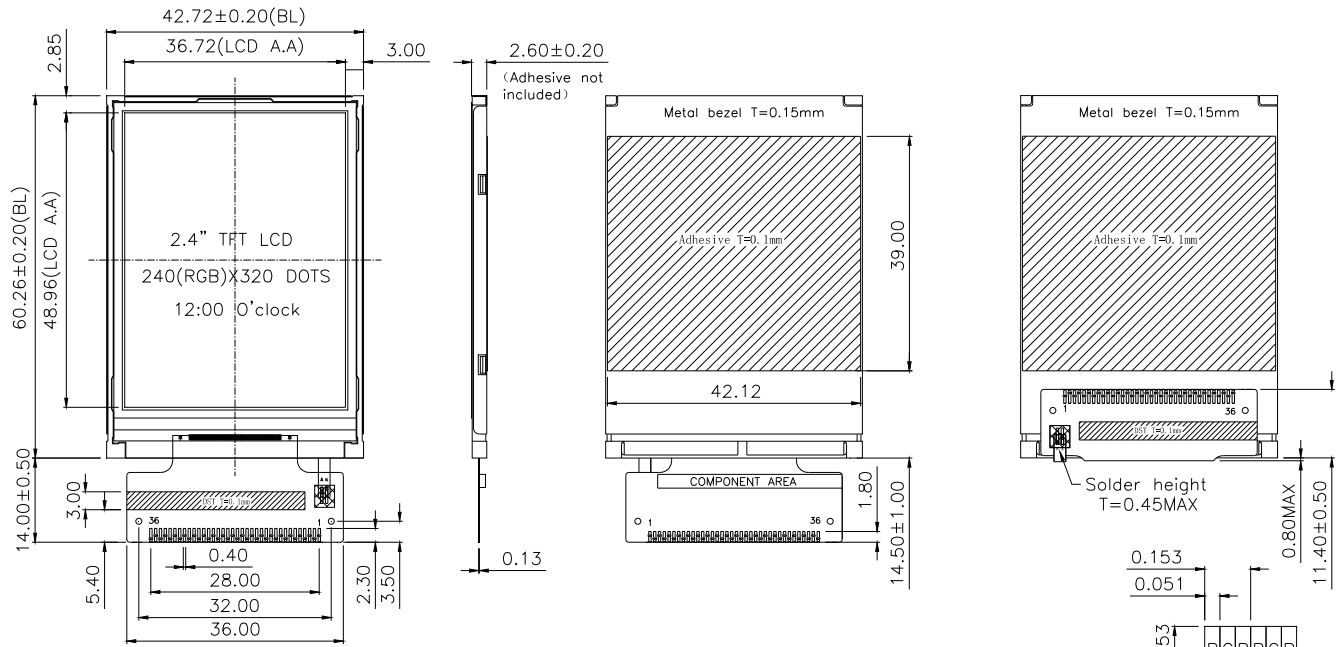
$$\text{Contrast Ratio (Cr)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: Definition of Response Time

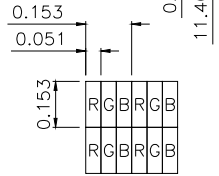
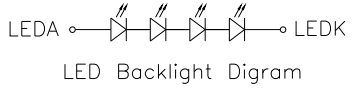


Note 6: Definition of color chromaticity (CIE1931)  
Color coordinates measured at center point of LCD.

### 7. Outline Dimension



- Notes:
- 2.4" Transmissive, Normally-White TFT LCD Module
  - View Direction: 12:00(Gray Scale Inversion direction)
  - LCD Drivers: ILI9341V
  - Interface: 8/16-Bit MCU
  - Operation Temp.: -20°C~70°C
  - Storage Temp.: -30°C~80°C
  - VDD=2.8V



PIN	SYMBOL
1	NC
2	NC
3	NC
4	IM0
5	NC
6	RESET
7	VSYNC
8	HSYNC
9	DOTCLK
10	DE
11	D17
12	D16
13	D15
14	D14
15	D13
16	D12
17	D11
18	D10
19	D9
20	D8
21	D7
22	D6
23	D5
24	D4
25	D3
26	D2
27	D1
28	D0
29	RDX
30	WRX
31	DCX
32	CSX
33	VSS
34	VDD
35	LEDK
36	LEDA

M[3:1]=100

DWN.	HJW	TITLE	LCM OUTLINE DIMENSION		
CHK.	LYJ	PART NO.	LT024A-01B		
APPD.	LY	DWG. NO.	LT024A-01B-WXA		
REV.	A	UNIT	mm	PROJECTION	
DATE	2017.04.21	SCALE	NTS	SHEET	1 OF 1

## 8. PRECAUTIONS FOR USE OF LCD MODULE

### 8.1 Handling Precautions

- 1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 2) If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth. If the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 3) Do not apply excessive force on the surface of display or the adjoining areas of LCD module 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 of LCD module becomes contaminated, blow 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 alcoholSolvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
  - Water
  - Ketone
  - Aromatic Solvents
- 6) When mounting the LCD module make sure that it is free of twisting, warping, and distortion. Distortion has great influence upon display quality. Also keep the stiffness enough regarding the outer case.
- 7) Be sure to avoid any solvent such as flux for soldering never stick to Heat-Seal. Such solvent on Heat-Seal may cause connection problem of heat-Seal and TAB.
- 8) Do not forcibly pull or bend the TAB I/O terminals.
- 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 module.
  - Tools required for assembly, such as soldering irons, must be properly grounded.
  - To reduce the amount of static electricity generated, do not conduct assembly 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.

### 8.2 Storage Precautions

- 1) When storing the LCD module, avoid exposure to direct sunlight or to the light of fluorescent lamps and high temperature/high humidity. Whenever possible, the LCD module should be stored in the same conditions in which they were shipped from our company.

2) Exercise care to minimize corrosion of the electrodes. Corrosion of the electrodes is accelerated by water droplets or a current flow in a high humidity environment.

### **8.3 Design Precautions**

1) The absolute maximum ratings represent the rated value beyond which LCD module can not exceed. When the LCD modules are used in excess of this rated value, their operating characteristics may be adversely affected.

2) To prevent the occurrence of erroneous operation caused by noise, attention must be paid to satisfy VIL, VIH specification values, including taking the precaution of using signal cables that are short.

3) The liquid crystal display exhibits temperature dependency characteristics. Since recognition of the display becomes difficult when the LCD is used outside its designated operating temperature range, be sure to use the LCD within this range. Also, keep in mind that the LCD driving voltage levels necessary for clear displays will vary according to temperature.

4) Sufficiently notice the mutual noise interference occurred by peripheral devices.

5) To cope with EMI, take measures basically on outputting side.

6) If DC is impressed on the liquid crystal display panel, display definition is rapidly deteriorated by the electrochemical reaction that occurs inside the liquid crystal display panel. To eliminate the opportunity of DC impressing, be sure to maintain the AC characteristics of the input signals sent to the LCD Module.

### **8.4 Others**

1) Liquid crystals solidify under low temperatures (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 LCD module is subjected to a strong shock at a low temperature.

2) 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.

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

- Terminal electrode sections.
- Part of pattern wiring on TAB,