Willtron Co., Ltd.
20F-8, NO. 7 , Sec. 3, New Taipei Blvd., Xinzhuang Dist., New Taipei City
Web: http://www.willtron.com.tw/
Tel: +886 2 8522-7038 Fax: +886 2 8522-7069

SPECIFICATION

Product Model:WT-H-B24M36-4L03G

For Customer's Acceptance:

Approved By	Comment		
PREPARED	CHECKED	VERIFIED BY QA DEPT	VERIFIED BY R&D DEPT

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Date	Rev.	Reason
06/29/2017	V0	NEW ISSUE

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1. General Description

The WT-H-B24M36-4L03G is a diagnolly 2.4inch color tft lcd module measured active display area with 240*(RGB)*320 resolution. Each pixel is divided into Red, Green and Blue sub-pixels and dots which are arranged in vertical stripes.LCD color is determined with 262,000 colors signal for each pixel.

2. General Features

Item	Display Panel	Remark
Display Mode	Normally White, Transmissive LCD	
Viewing Direction	6 O'CLOCK	
Input Signals	MCU	
Outside Dimensions	42.72mm(W)*58.59mm(H)*2.20mm(T)	
Effective Area	-	
Active Area	36.72mm(W)×48.96mm(H)	
Number of Pixels	240×RGB×320Pixels	
Pixel Pitch	0.153mm(H)×0.153mm(W)	
Pixel Arrangement	MCU	
Drive IC	NV3029	

3. Absolute Maximum Ratings

The following are maximum values which, if exceeded may cause operation or damage to the unit.

ITEM	Symbol	Min.	Typ.	Max.	Unit	Remark
Power for Circuit Driving	VDD		2.8		V	
Power for Circuit Logic	VCI		2.8		V	
LC Operating Voltage *1)	Vop		2.8		V	
LED Forward Voltage	V_f	-	3.2	-	V	
LED Forward Current	Ir	-	80	-	mA	
LED Luminance	B_P	180	200	-	cd/m^2	
Storage Humidity	H_{ST}	10	-	90	%RH	At 25±5℃
Storage Temperature	T_{ST}	-30	-	80	℃	
Operating Ambient Humidity	H_{OP}	10	-	90	%RH	
Operating Ambient temperature	T_{OP}	-20	-	70	℃	

Note:

*1) Liquid Crystal driving voltage.
Due to the characteristics of LC Material, this voltage vary with environmental temperature.

*2) Temp. >60℃, Absolute humidity shall be less than 90%RH at 60℃

*3) Temp. ≤60℃, 90%RH MAX.

4. Electrical Specification
Main Window Display

(Unless specified, the ambient temperature Ta=25℃)

Properties		Sym.	Min	Typ.	Max	Unit	Note
Power for Circuit Driving		VDD	2.6	2.8	3.0	V	Note
Power for Circuit Logic		VCI	2.6	2.8	3.0	V	Note
BLU Driving Logic		Vbat	-	-	-	V	
Logic Input Voltage	Low Voltage	VIL	0	-	0.2VDD	V	
	High Voltage	VIH	0.8VDD	-	VDD	V	
Logic Output Voltage	Low Voltage	VOL	0	-	0.1VDD	V	
	High Voltage	VOH	0.9VDD	-	VDD	V	
Power Consumption	White	P_w	T.B.D	T.B.D	T.B.D	mW	
	Black	P_b	T.B.D	T.B.D	T.B.D	mW	
	Vertical Stripe	P_v	T.B.D	T.B.D	T.B.D	mW	

Note:

The recommended operating conditions refer to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be without the absolute maximum ratings.
Accordingly, please make sure that the module is used within this range. And these current values are measured under the condition that all devices are stopped, each component is stable and logic signal is input.

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5. Optical Specification

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Threshold Voltage		Vsat		2.0	2.2	2.4	V	Fig.1
		Vth		1.1	1.3	1.5	V	
Viewing Angle	Horizontal	Θ3	CR>10	45	55		°	Note 1
		Θ9		45	55		°	
	Vertical	Θ12		20	30		°	
		Θ6		45	55		°	
Contrast Ratio		CR	Θ= 0°	300	350			Note 2
Transmittance		T(%)	Θ= 0°	5.5	5.8			Note 3
NSTC		%	Θ= 0°		50%			
Reproduction Of color	Red	Rx	Θ= 0°	0.611	0.626	0.641		Note 4 *Color filter Glass with ITO
		Ry		0.295	0.310	0.325		
	Green	Gx		0.281	0.296	0.311		
		Gy		0.503	0.518	0.533		
	Blue	Bx		0.127	0.142	0.157		
		By		0.126	0.141	0.156		
White		Wx	Θ= 0°	0.280	0.295	0.310		
		Wy		0.312	0.327	0.342		
Response Time		Tr+Tf	Θ= 0°		30	40	ms	Note 5

Note:

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface

2. Contrast measurements shall be made at viewing angle of Θ= 0° and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. 2) Luminance Contrast Ratio (CR) is defined mathematically.

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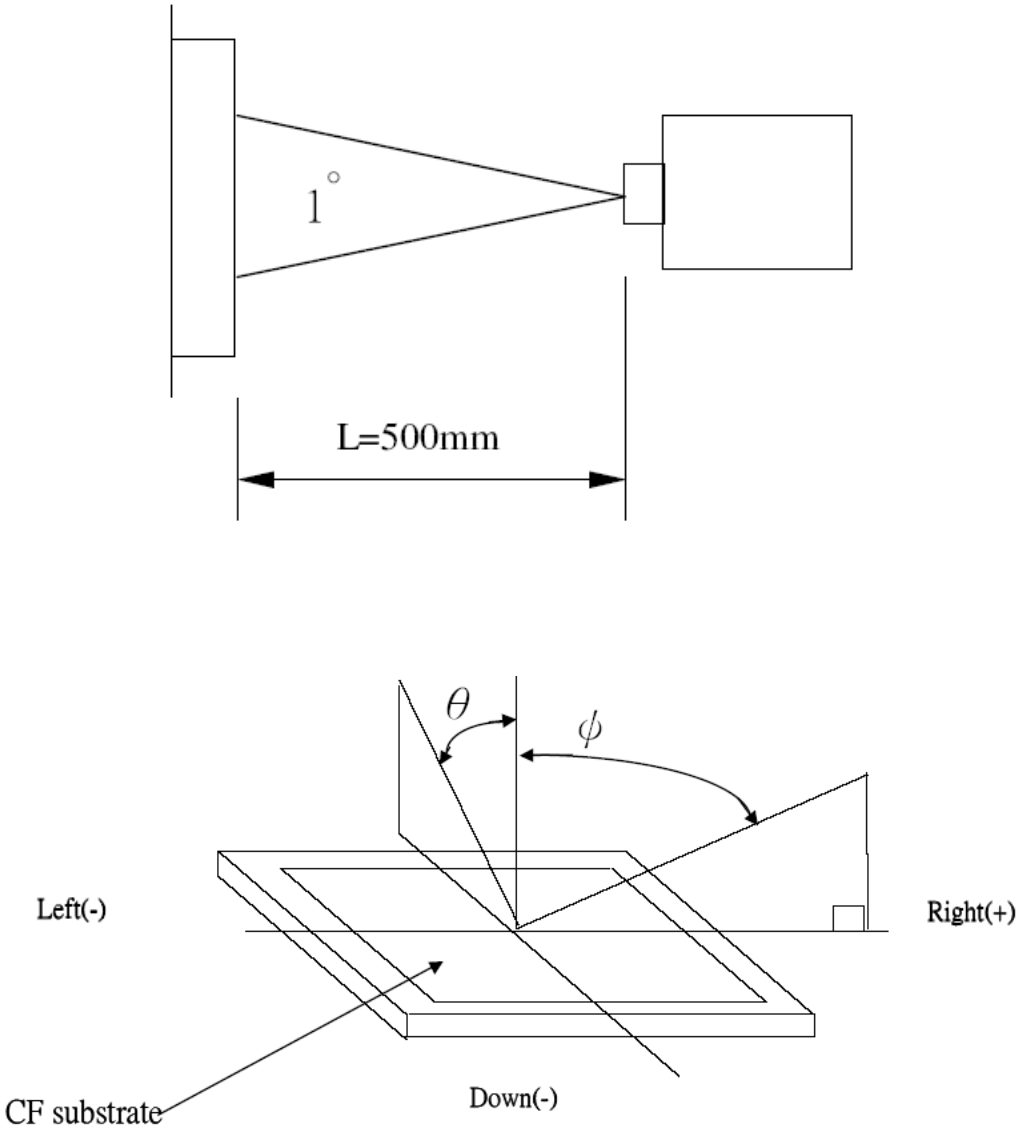

Fig.1 Definition of Viewing Angle

Note.3 Using LC+ EWV Polarizer+Corresponding Backlight, reference only, Measure device：BM-5A (TOPCON)，viewing cone= 1 °，I_L=20mA。

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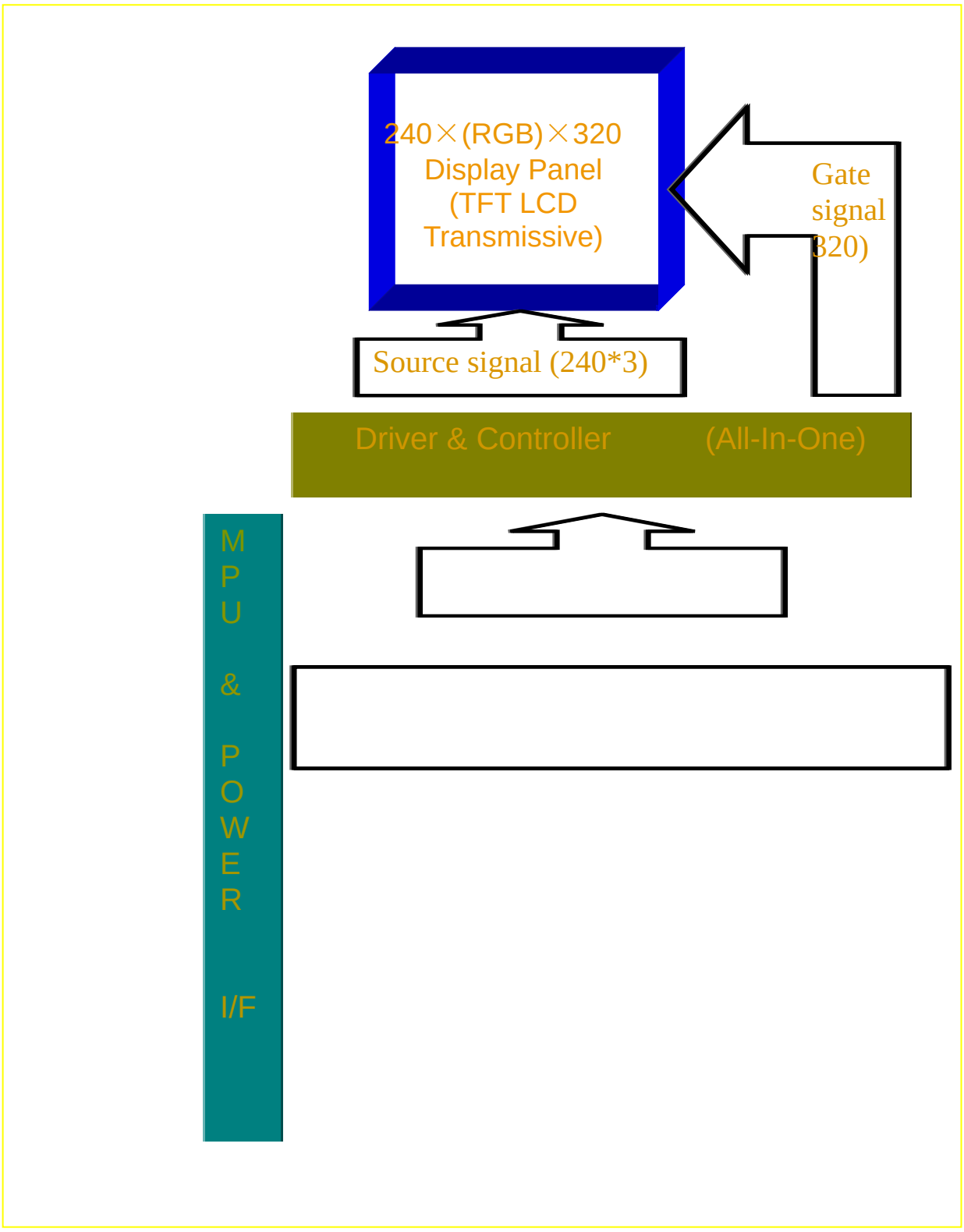
6. Block Diagram



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7. Pin Description

Pin NO.	Symbol	Description
1	NC	Floating this pin.
2	NC	Floating this pin.
3	NC	Floating this pin.
4	NC	Floating this pin.
5	NC	Floating this pin.
6	RESET	This signal will reset the device and it must be applied to properly initialize the chip.
7	NC	Floating this pin.
8	NC	Floating this pin.
9	NC	Floating this pin.
10	NC	Floating this pin.
11	DB7	MCU parallel interface data bus.
12	DB6	MCU parallel interface data bus.
13	DB5	MCU parallel interface data bus.
14	DB4	MCU parallel interface data bus.
15	DB3	MCU parallel interface data bus.
16	DB2	MCU parallel interface data bus.
17	DB1	MCU parallel interface data bus.
18	DB0	MCU parallel interface data bus.
19	NC	Floating this pin.
20	NC	Floating this pin.
21	NC	Floating this pin.
22	NC	Floating this pin.
23	NC	Floating this pin.
24	NC	Floating this pin.
25	NC	Floating this pin.
26	NC	Floating this pin.
27	NC	Floating this pin.
28	NC	Floating this pin.
29	RD	Read enable in 8080 MCU parallel interface.
30	WR	Write enable in MCU parallel interface.
31	RS	Display data/command selection pin in parallel interface.
32	CS	Chip selection pin
33	GND	Ground for digital circuits.
34	VDD	Power supply for digital interface
35	LED-K	LED BACKLIGHT(CATHODE)
36	LED-A	LED BACKLIGHT(ANODE)

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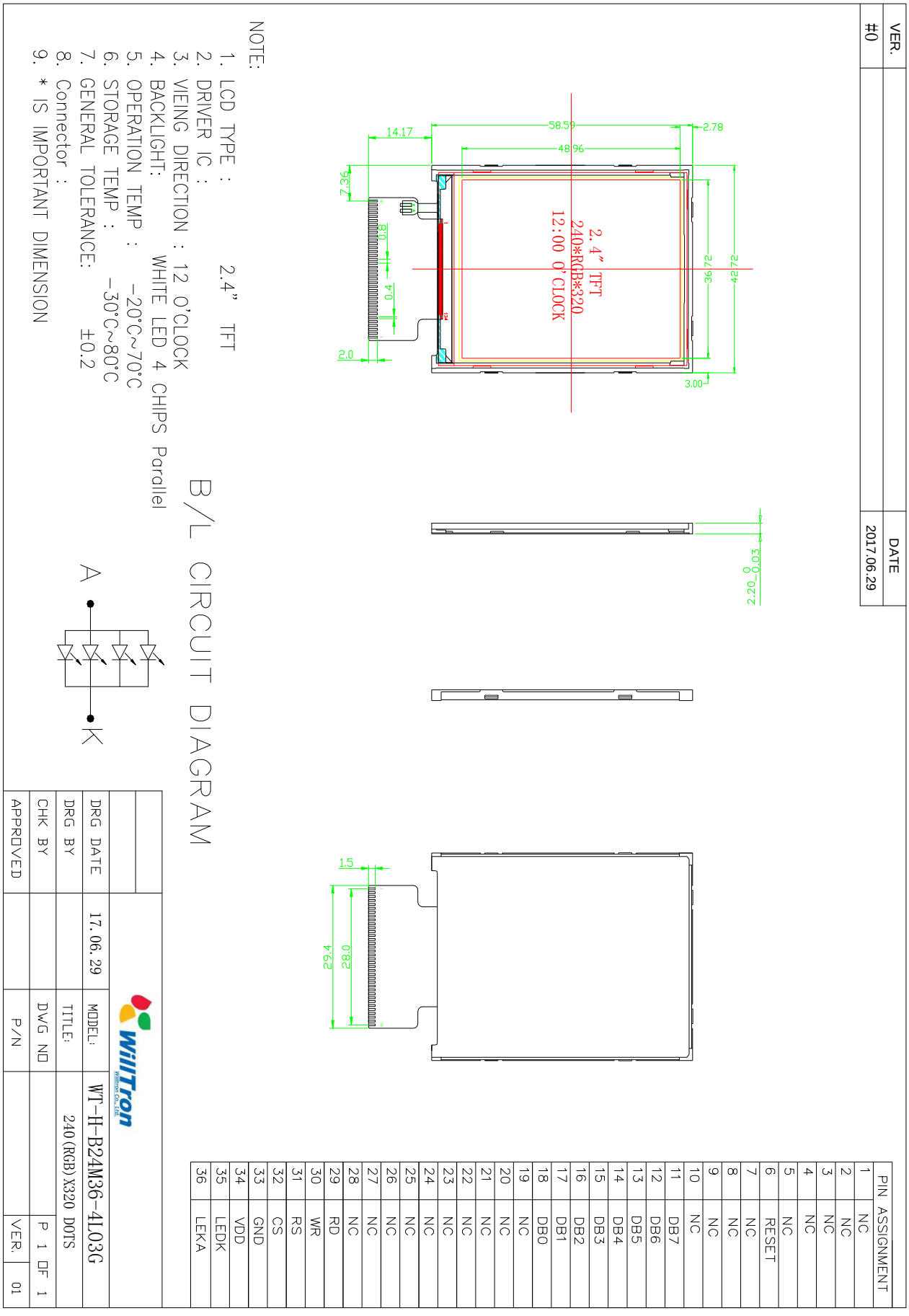
8. Outline Dimension



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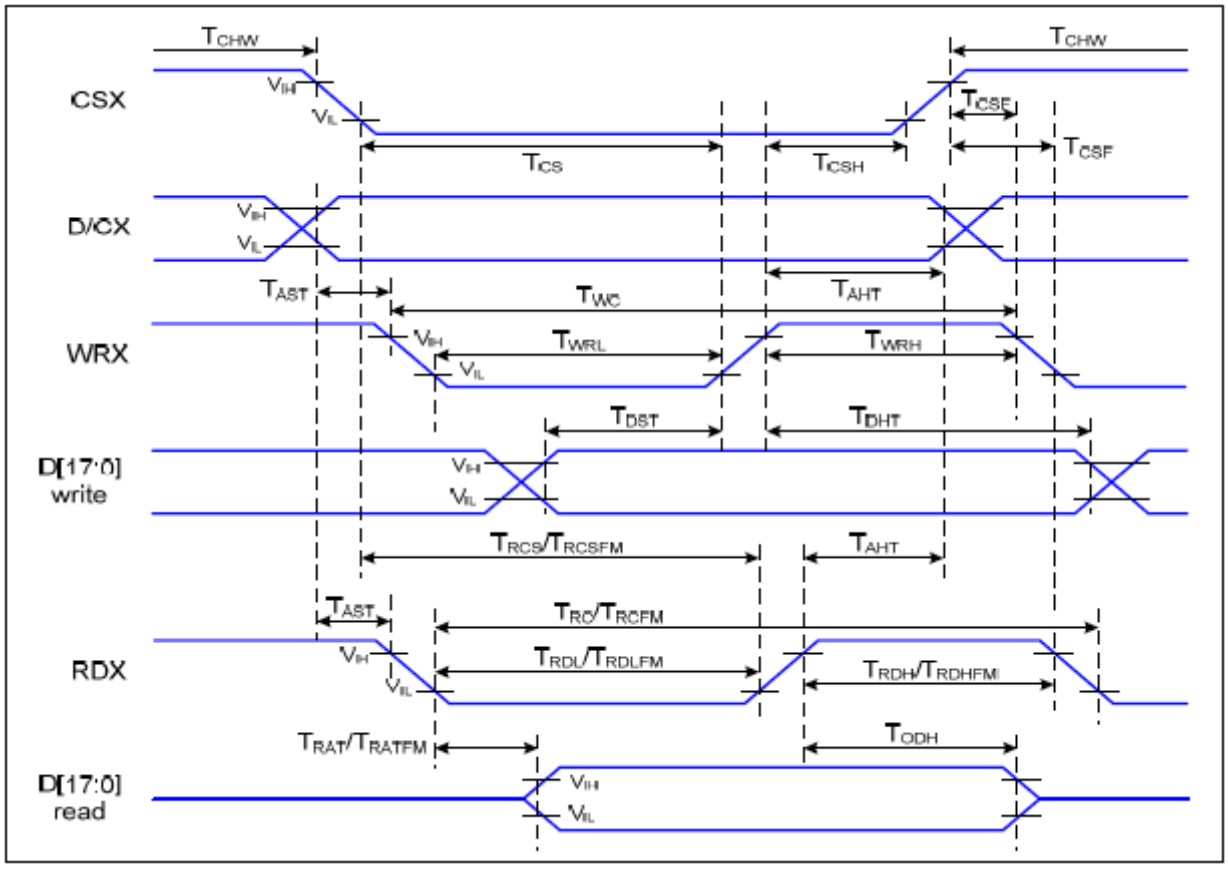
9. Timing Characteristics

12.2 DC Characteristic

Vci = 2.4 ~ 3.3V, IOVcc = 1.65~3.3V, Ta = -40 ~ 85 °C

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.	Note
Input high voltage	V_{IH}	V	IOVcc = 1.65V ~ 3.3 V	0.8* IOVcc	-	IOVcc	2,3
Input low voltage	V_{IL}	V	IOVcc = 1.65V ~ 3.3 V	– 0.3V	-	0.2* IOVcc	2,3
Output high voltage (D0-17 pins, FMARK)	V_{OH}	V	IOH = -0.1mA	0.8 * IOVcc	-	-	2
Output low voltage (D0-17 pins, FMARK)	V_{OL}	V	IOVcc = 1.65 ~ 2.4 V I_{OL} = 0.1mA	-	-	0.2* IOVcc	2
I/O leak current	Ili	µA	Vin = 0 ~ IOVcc	-1		1	4
Current consumption during normal operation (Vci-GNDD)+(IOVcc-GND)	IOP(Vci)	mA	Vci=IOVcc=Vci=2.8V, Ta=25C, Fosc=6MHZ(320 Line)GRAM data =0000h, Frame rate=70HZ, REV=0, SAP=100,AP=100,DC0 =000,DC1=010,B/C=0, VC=001,VRH=0011, VCM=10011,VDV=100 00,VCOMG=1,CL=0, NO panel load	-	TBD	-	
Current consumption during standby operation (Vci-GNDD)+(IOVcc-GND)	IOP(Vci)	µA		-	45		5,6

9.1. 80-System bus interface operation



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9.2. Timing Characteristics

Normal Write Mode(HWM='0'), IOVcc=1.65V~3.6V,Vcc=2.5V~3.6V

Parameter	Symbol	Unit	Min.	Max.	Unit
Bus cycle time write	t_{CYCW}	ns	**100**	-	-
Bus cycle time read	t_{CYCR}	ns	**160**	-	-
Write low-level pulse width	PW_{LW}	ns	**35**	-	-
Read low-level pulse width	PW_{LR}	ns	**45**	-	-
Write high-level pulse width	PW_{HW}	ns	**35**	-	-
Read high-level pulse width	PW_{HR}	ns	**90**	-	-
Write/Read rise/fall time	$t_{WR,WRf}$	ns	-	-	**25**
Setup time Write	t_{AS}	ns	**0**	-	-
Setup time Read	t_{AS}	ns	**10**	-	-
Address hold time	t_{AH}	ns	**2**	-	-
Write data setup time	t_{DSW}	ns	**25**	-	-
Write data hold time	t_{H}	ns	**5**	-	-
Read data delay time	t_{DDR}	ns	-	-	**100**
Read data hold time	t_{DHR}	ns	**5**	-	-

9. 3 Reset Operation

(VCC=1.65~3.1 V)

Table 13-6

Item	Symbol	Unit	Min.	Typ.	Max.
Reset low-level width	tRES	ms	1	—	—
Reset rise time	trRES	µs	—	—	10

10. Reliability and Inspection Standard

No.	Test Item		Test Conditions	Remark
1	High Temperature	Storage	70℃, 120Hr	Note
		Operation	60℃, 120Hr	Note
2	Low Temperature	Storage	-30℃, 120Hr	Note
		Operation	-20℃, 120Hr	
3	High Temperature and High Humidity		60℃, 90%RH, 120Hr	Note

4	Temperature Cycle	Storage	-10℃(1Hr)→25℃(5min)→60℃(1Hr) 32 Cycles	Note
		Operation	-20℃(1Hr)→25℃(5min)→60℃(1Hr) 25 Cycles	
5	Peeling Off (Storage)		≧500gf/cm	Note
6	FPC Bending Test		≧6,000 times, 2/sec	Note
7	Vibration Test(Storage)		50HZ, 30min, Amplitude: 2 cm, X/Y/Z directions	Note
8	Drop Test		60cm/ 3Corner/ 8Face, 1Cycle	Note
9	Electrostatic Discharge		+/-200V,200pf(0ohm) 1 time/each terminal	

Note:

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>1MΩ) 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 judged 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) After the reliability test, the test samples should be inspected after 2 hours at least.
7) Functional test is OK. Missing segment, shorts, unclear segment, non display, display abnormally, liquid crystal leak are not allowed.
8) After testing, the current Idd should be within initial value ±20%.
9) No low temperature bubbles ,end seal loose and fall, frame rainbow, ACF bubble growing are allowable in the appearance test.

11. Inspection Criterion

11.1. Sampling Method

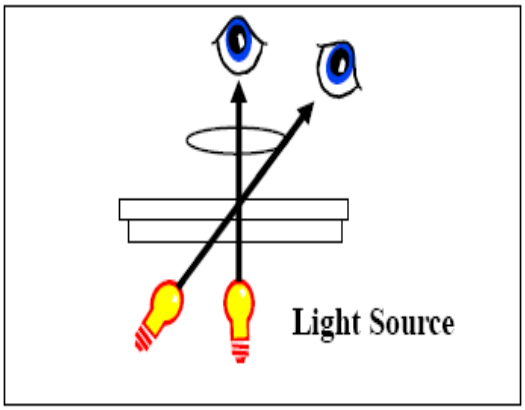
Unless otherwise agreed upon in writing, the sampling inspection shall be applied to the Customer's incoming inspection.

1) Lot size: Quantity per shipment lot
2) Sampling type: Normal inspection , single sampling
3) Inspection level: Ⅱ
4) Sampling table: MIL-STD-105D
5) Acceptable Quality Level(AQL): Major=0.65 Minor=1.5

11.2. Inspection Method

1) Ambient Condition:
   a. Temperature: Room temperature 25±5℃
   b. Illumination: Single fluorescent lamp non-directive(300 to 700 Lux)
2) Viewing distance
   The distance between the LCD and the inspector's eyes shall be at least 30-50cm.
3) Viewing Angle

The inspection shall be conducted within normal viewing angle range.

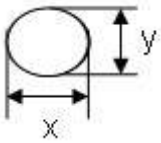


12.3. Inspection Criteria

12.3.1. Major defect

No.	Item	Inspection Standard	Classification of defects
1	All functional defects	1) No display 2) Display abnormally 3) Open or missing segment 4) Short circuit 5) Excess power consumption 6) Backlight no lighting, flickering and abnormal lighting	Major
2	Missing	Missing component	Major
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	Major

12.3.2. Cosmetic Defect

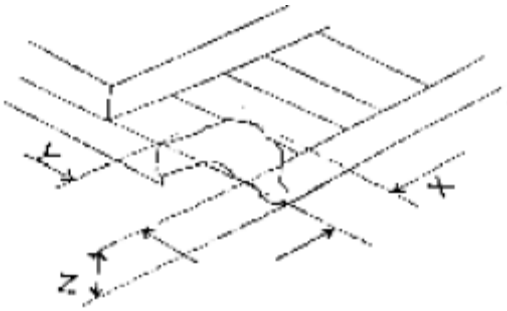
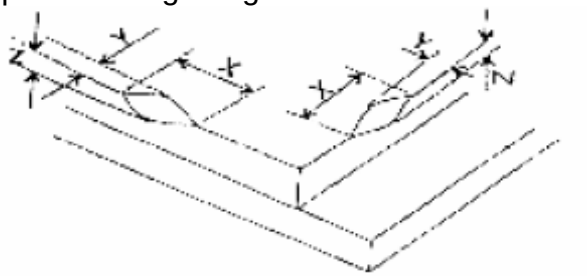
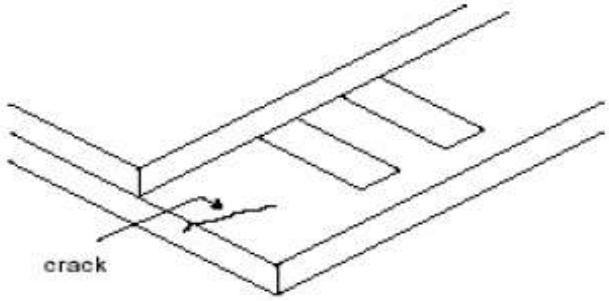
<table>
<tr><th>No.</th><th>Item</th><th colspan="2">Inspection Standard</th><th>Classification of defects</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">(spot defect) Black and White spot pinhole</td><td>For dark/white spot, size Φ is defined as Φ=(x+y)/2</td><td> 
</td><td rowspan="2">Minor</td></tr>
<tr><td colspan="2"><table>
<tr><th>Size Φ (mm)</th><th>Acceptable Quantity</th></tr>
<tr><td>Φ≤0.1</td><td>Ignore</td></tr>
<tr><td>0.10≤Φ≤0.15</td><td>2</td></tr>
<tr><td>0.15≤Φ≤0.2</td><td>1</td></tr>
<tr><td>0.2<Φ</td><td>0</td></tr>
</table></td></tr>
</table>

<table>
<tr>
<td>2</td>
<td>(line defect) Black and White line Polarizer scratch</td>
<td>
Define: 

<table>
<tr><th>Width(mm)</th><th>Length(mm);Acceptable Qty</th></tr>
<tr><td>Φ≤0.03</td><td>Ignore</td></tr>
<tr><td>0.03<W≤0.05</td><td>L≤3.0; N≤2</td></tr>
<tr><td>0.05<W≤0.1</td><td>L≤2.0; N≤2</td></tr>
<tr><td>0.1<W</td><td>Define as spot defect</td></tr>
</table>
</td>
<td>Minor</td>
</tr>
<tr>
<td>3</td>
<td>Polarizer defect</td>
<td>
Dent or bubble(between the polarizer and glass)
<table>
<tr><th>Size Φ(mm)</th><th>Acceptable Qty</th></tr>
<tr><td>Φ≤0.10</td><td>Ignor</td></tr>
<tr><td>0.10<Φ≤0.20</td><td>2</td></tr>
<tr><td>0.20<Φ≤0.30</td><td>1</td></tr>
<tr><td>0.30<Φ</td><td>0</td></tr>
</table>
</td>
<td>Minor</td>
</tr>
</table>

12.3.3. Cosmetic Defect

No.	Item	Inspection Standard	Classification of defects

<table>
<tr>
<td rowspan="3">1</td>
<td rowspan="3">Glass defect</td>
<td>1) Chip on the corner
 
<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0</td><td>≤S</td><td>≤T</td></tr></table>
Remark: S=contact pad length;
T=the thickness of glass
Chips on the corner of terminal shall not be allowed to extend into the ITO pad or expose perimeter seal. Acceptable Quantity N≤2.</td>
<td>Minor</td>
</tr>
<tr>
<td>2) Chip on the edge of glass
 
<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>Ignore</td><td>≤0.5</td><td>≤T</td></tr></table>
Acceptable Quantity: N≤2</td>
<td>Minor</td>
</tr>
<tr>
<td>3) Creak
Creaks tend to break are not allowed.
 
</td>
<td>Minor</td>
</tr>
</table>

■ PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

(1) The display panel is made of glass and polarizer. As glass is fragile, it tends to become or

chipped during handling especially on the edges. Please avoid dropping or jarring. 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. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on. 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.

(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
Do not scrub hard to avoid damaging the display surface.

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
- Water
- Ketone
- Aromatic solvents
Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contacting oil and fats.

(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) Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.
- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist LCM.

Storage Precautions

When storing the LCD modules, the following precaution is necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.
(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).

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.