US Micro Products
Electronic Products for the OEM

TFT-LCD PRODUCT SPECIFICATION

PART NUMBER:	**USMP-TT024Q-01B**
DESCRIPTION:	2.4" TFT LCD with 240 x 320 resolution, White LED B/L and 8-bit interface for i-80system Interface.

ISSUE DATE	APPROVED BY (Customer Use Only)	CHECKED BY	PREPARED BY
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History of Version

Date	Ver.	Edi.	Description	Page	Design by
2009/7/21	01	001	New Drawing	-	Binbin
2009/7/30	01	002	Modify FPC Pins	Page11,Appendix	Binbin
2009/8/3	01	003	Modify FPC Pins	Appendix	Binbin
2009/10/28	01	004	New Sample	-	violin

Total: 24 Page

Contents

1. SPECIFICATIONS

1.1 Features

Main LCD Panel

Item	Standard Value
Display Type	240 * (R、G、B) * 320 Dots
LCD Type	a-Si TFT , Positive , Transmissive
Screen size(inch)	2.4 (Diagonal)
Viewing Direction	12 O'clock
Color configuration	R.G.B. vertical stripe
Backlight	White LED
Interface	8-bit interface for i-80system
Other(controller / driver IC)	ST7781

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	42.32 (W) * 60.06 (L) * 2.4 (H)	mm

LCD Panel

Item	Standard Value	Unit
Viewing Area	38.32 (W) * 50.56 (L)	mm
Active Area	36.72 (W) * 48.96 (L)	mm

Note : For detailed information please refer to LCM drawing

1.3 Absolute Maximum Ratings

Module

Item	Symbol	Condition	Min.	Max.	Unit
System Power Supply Voltage	VDD	-	-0.3	+4.6	V
	VGH-VGL	-	-0.3	+30	V
Input Voltage	VIN	-	0.5	VDD+0.5	V
Output Volatage	VO	-	0.5	VDD+0.5	V
Operating Temperature	T_{OP}	-	-20	+70	°C
Storage Temperature	T_{ST}	-	-30	+80	°C
Storage Humidity	H_D	Ta ≦ 40 °C	20	90	%RH

1.4 DC Electrical Characteristics

Module GND = 0V, Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power Supply Voltage1	VDD	-	-	2.8	-	V
Input High Voltage	V_{IH}	-	0.7*VDD	-	VDD	V
Input Low Voltage	V_{IL}	-	0	-	0.3*VDD	V
Output High Voltage	V_{OH}	IOH=-0.1mA	0.8*VDD	-	VDD	V
Output Low Voltage	V_{OL}	IOL=+0.1mA	0	-	0.2*VDD	V
Supply Current	IDD	VDD= 2.8V, Pattern=black *1	-	6.5	10	mA

Note1 : Maximum current display

1.5 Optical Characteristics

TFT LCD Panel VDD = 2.8V, Ta=25°C

Item		Symbol	Condition	Min.	Typ.	Max.	unit	
Response time		Tr + Tf	Ta = 25°C θX, θY = 0°	-	35	55	ms	Note2
Viewing angle	Top	θY+	CR ≥ 10	-	50	-	Deg.	Note4
	Bottom	θY-		-	45	-		
	Left	θX-		-	50	-		
	Right	θX+		-	50	-		
Contrast ratio		CR	Ta = 25°C θX , θY = 0°	190	210	-	-	Note3
Color of CIE Coordinate (With B/L)	White	X		0.229	0.279	0.329	-	Note1
		Y		0.264	0.314	0.364		
	Red	X		0.573	0.623	0.673		
		Y		0.287	0.337	0.387		
	Green	X		0.287	0.337	0.387		
		Y		0.545	0.585	0.535		
	Blue	X		0.098	0.148	0.198		
		Y		0.034	0.084	0.134		
Average Brightness Pattern=white display (With B/L)		IV	IF= 60mA	140	180	-	cd/m^2	Note1
Uniformity (With B/L)		△B	IF=60mA	80	-	-	%	Note1

Note1:

1：△B=B(min) / B(max) × 100%

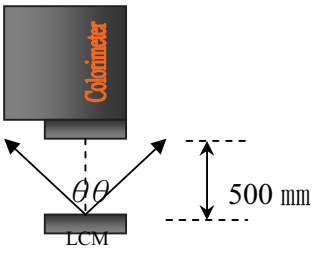
2：Measurement Condition for Optical Characteristics:

a：Environment: 25℃±5℃ / 60±20%R.H，no wind，dark room below 10 Lux at typical lamp current and typical operating frequency.

b：Measurement Distance: 500 ± 50 ㎜ ，(θ= 0°)

c：Equipment: TOPCON BM-7 fast，(field 1°)，after 10 minutes operation.

d：The uncertainty of the C.I.E coordinate measurement ±0.01，Average Brightness ± 4%



Colorimeter=BM 7 fast

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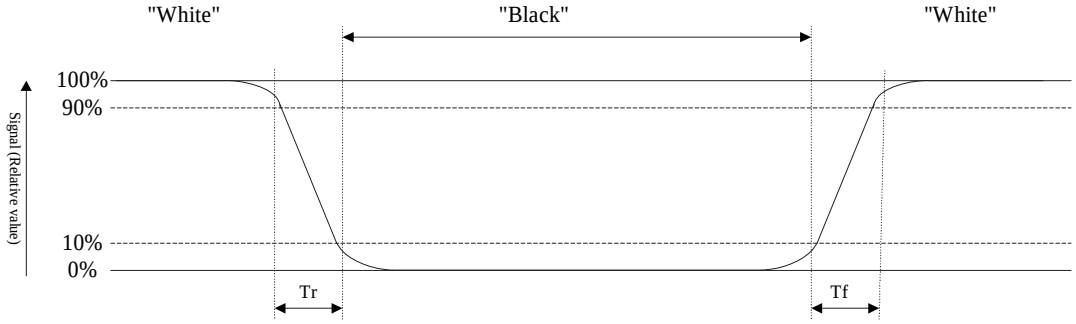
Note2: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of Amplitudes.

Refer to figure as below:



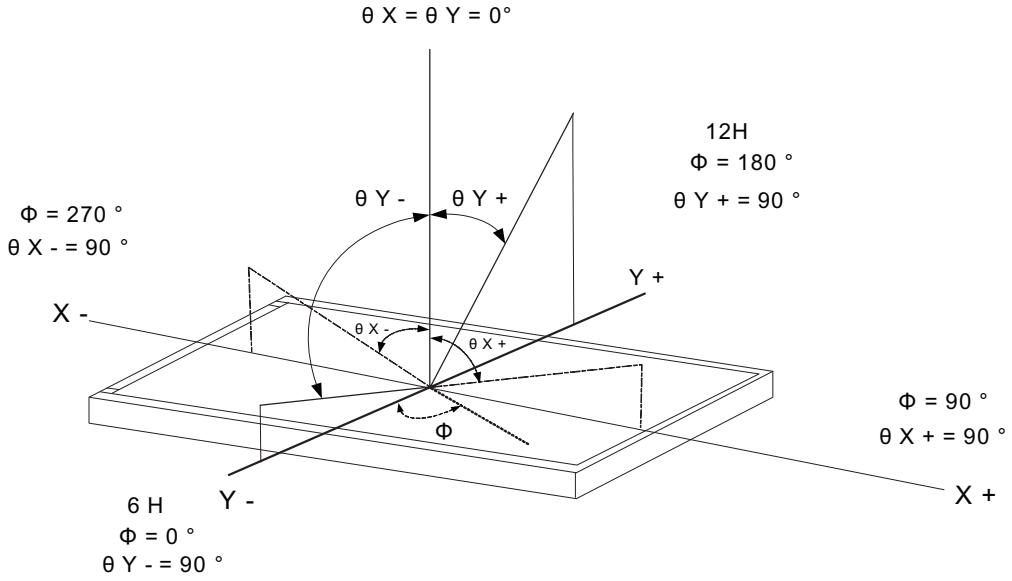
Note3: Definition of contrast ratio:

Contrast ratio is calculated with the following formula

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at “White” state}}{\text{Photo detector output when LCD is at “Black” state}}$$

Note4: Definition of viewing angle:

Refer to figure as below:



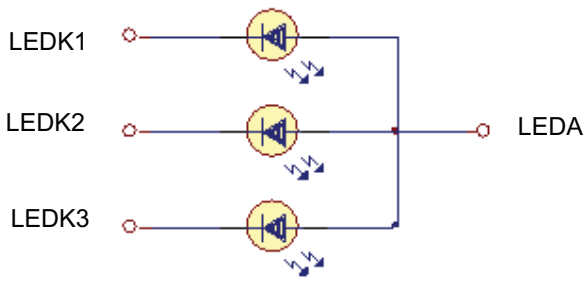
1.6 Backlight Characteristics

Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	IF	Ta =25℃	-	90	mA
Forward Voltage	VF	Ta =25℃	-	4	V
Reverse Voltage	VR	Ta =25℃	-	5	V

Electrical / Optical Characteristics

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	VF	IF= 60mA	-	3.5	-	V
Average Brightness (without LCD & T/P)	IV	IF= 60mA	2500	2800	-	cd/m^2
Color of CIE Coordinate (without LCD & T/P)	X		0.24	-	0.30	-
	Y		0.24	-	0.30	
Color	White					



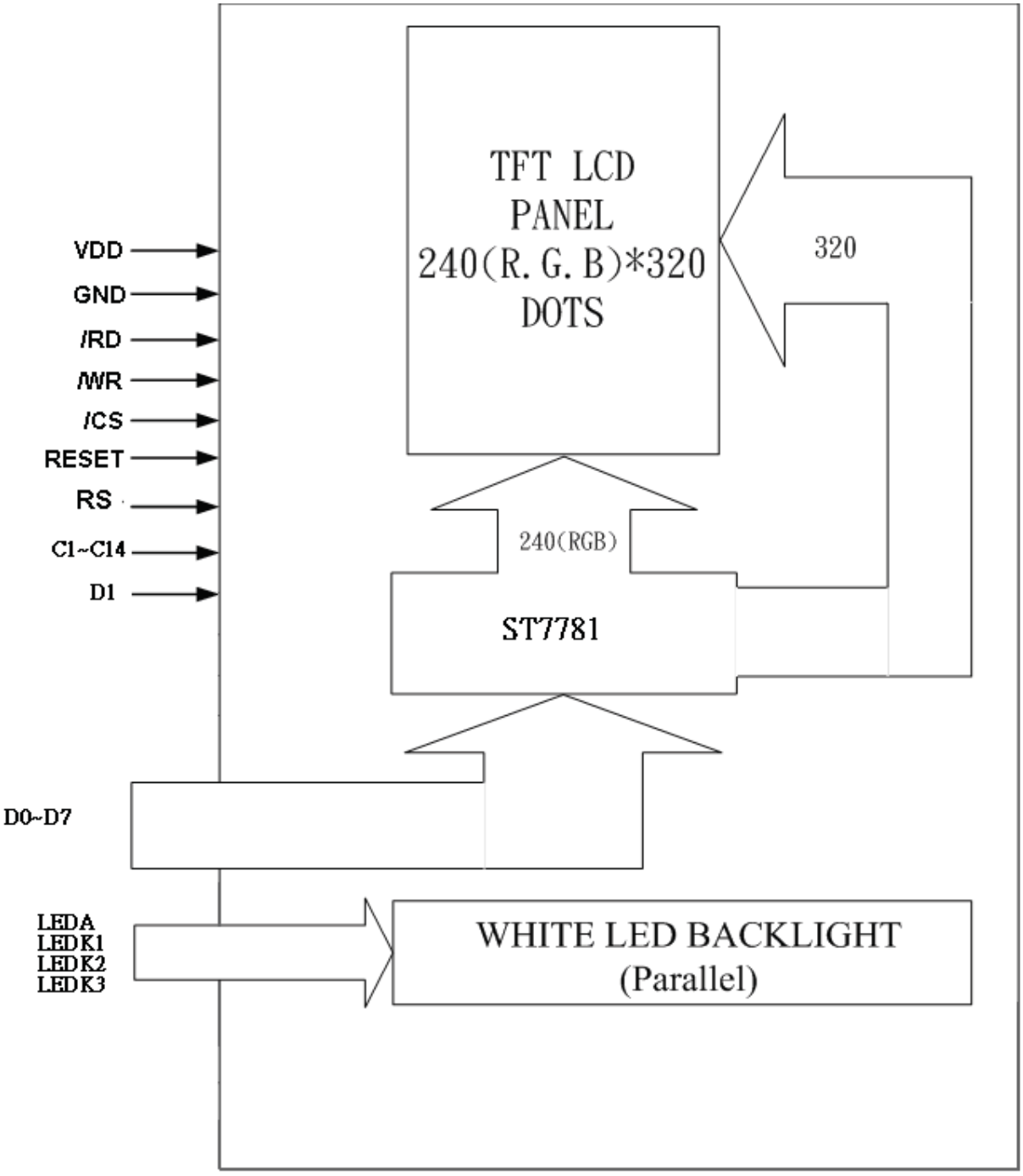
2. MODULE STRUCTURE

2.1 Counter Drawing

2.1.1 LCM Mechanical Diagram

* See Appendix

2.1.2 Block Diagram



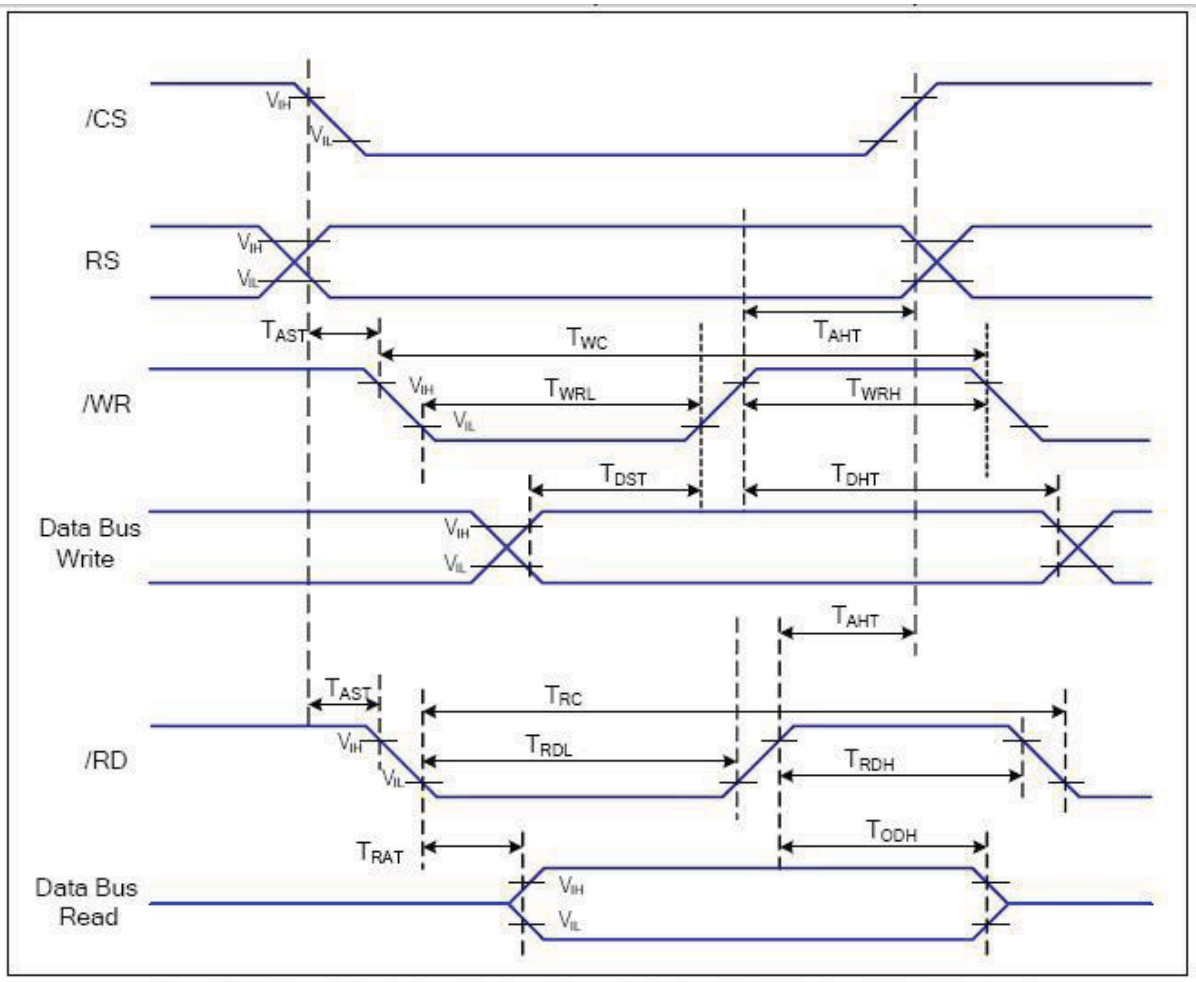
2.2 Interface Pin Description

Pin No.	Symbol	Function
1	GND	System ground.(0V)
2	RESET	Reset input pin. When RESET is “L”, initialization is executed.
3	D7	Bi-directional data bus.
4	D6	Bi-directional data bus.
5	D5	Bi-directional data bus.
6	D4	Bi-directional data bus.
7	D3	Bi-directional data bus.
8	D2	Bi-directional data bus.
9	D1	Bi-directional data bus.
10	D0	Bi-directional data bus.
11	/RD	Read signal input, active ”L”.
12	/WR	Write signal input, active ”L”.
13	RS	Command/Display data selection. 0:Command 1:Display data
14	/CS	Chip select signal, active ”L”.
15	VDD C1	Place a 1uF/10V capacitor to GND.
16	VCOMH C2	VCOMH pad. Place a 1uF/10V capacitor to GND.
17	VCOML C3	VCOML pad. Place a 1uF/10V capacitor to GND.
18	GVDD C4	GVDD pad. Place a 1uF/10V capacitor to GND.
19	VCL C5	VCL pad. Place a 1uF/10V capacitor to GND.
20	AVDD C6	AVDD pad. Place a 1uF/10V capacitor to GND.
21	VCI1 C7	VCI1 pad. Place a 1uF/10V capacitor to GND.
22	C8N	Place a 1uF/10V capacitor between C8N and C8P.
23	C8P	
24	C9N	Place a 1uF/10V capacitor between C9N and C9P.
25	C9P	
26	VGL C10 D1	VGL pad. Place a Diode(VF<0.47V IF=200mA) to GND （ “+”connect to VGL & “-”connect to GND）.Place a 1uF/25V capacitor to GND.

Pin No.	Symbol	Function
27	VGH C11	VGH pad. Place a 1uF/25V capacitor to GND.
28	C12N	Place a 1uF/10V capacitor between C12N and C12P.
29	C12P	
30	C13N	Place a 1uF/25V capacitor between C13N and C13P.
31	C13P	
32	C14N	Place a 1uF/25V capacitor between C14N and C14P.
33	C14P	
34	LEDA	Power supply for LED Backlight Anode input.
35	LEDK1	Power supply for LED Backlight Cathode input.
36	LEDK2	Power supply for LED Backlight Cathode input.
37	LEDK3	Power supply for LED Backlight Cathode input.
38	VDD	Power supply.(2.8V) .

2.3 Timing Characteristics

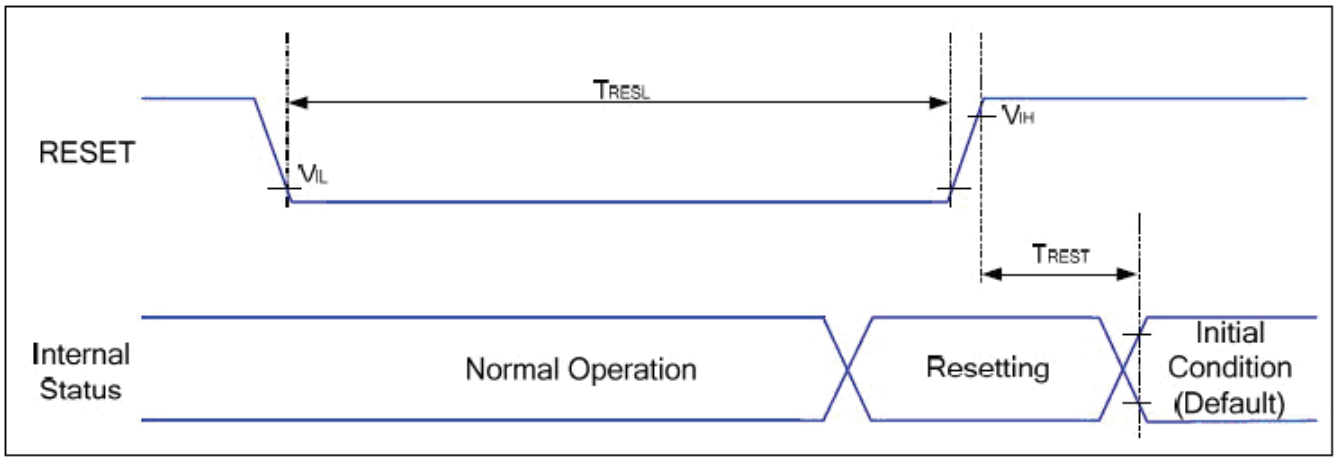
80-System Bus Interface



VDD=2.8V GND=0V Ta=25℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
RS	T_{AST}	Address Setup Time	10	-	ns	
	T_{AHT}	Address Hold Time (Write/Read)	5	-	ns	
/WR	T_{WC}	Write Cycle	100	-	ns	
	T_{WRH}	Control Pulse "H" Duration	50	-	ns	
	T_{WRL}	Control Pulse "L" Duration	50	-	ns	
/RD	T_{RC}	Read Cycle	300	-	ns	
	T_{RDH}	Control Pulse "H" Duration	150	-	ns	
	T_{RDL}	Control Pulse "L" Duration	150	-	ns	
D0~D7	T_{DST}	Data Setup Time	10	-	ns	T_{RAT}, T_{RATFM}: 3K ohm Pullup or Down and 30pF Parallel Cap. To GND. T_{ODH}: 3K ohm Pullup or Down.
	T_{DHT}	Data Hold Time	15	-	ns	
	T_{RAT}	Read Access Time	-	100	ns	
	T_{ODH}	Output Disable Time	50	-	ns	

LCD Reset

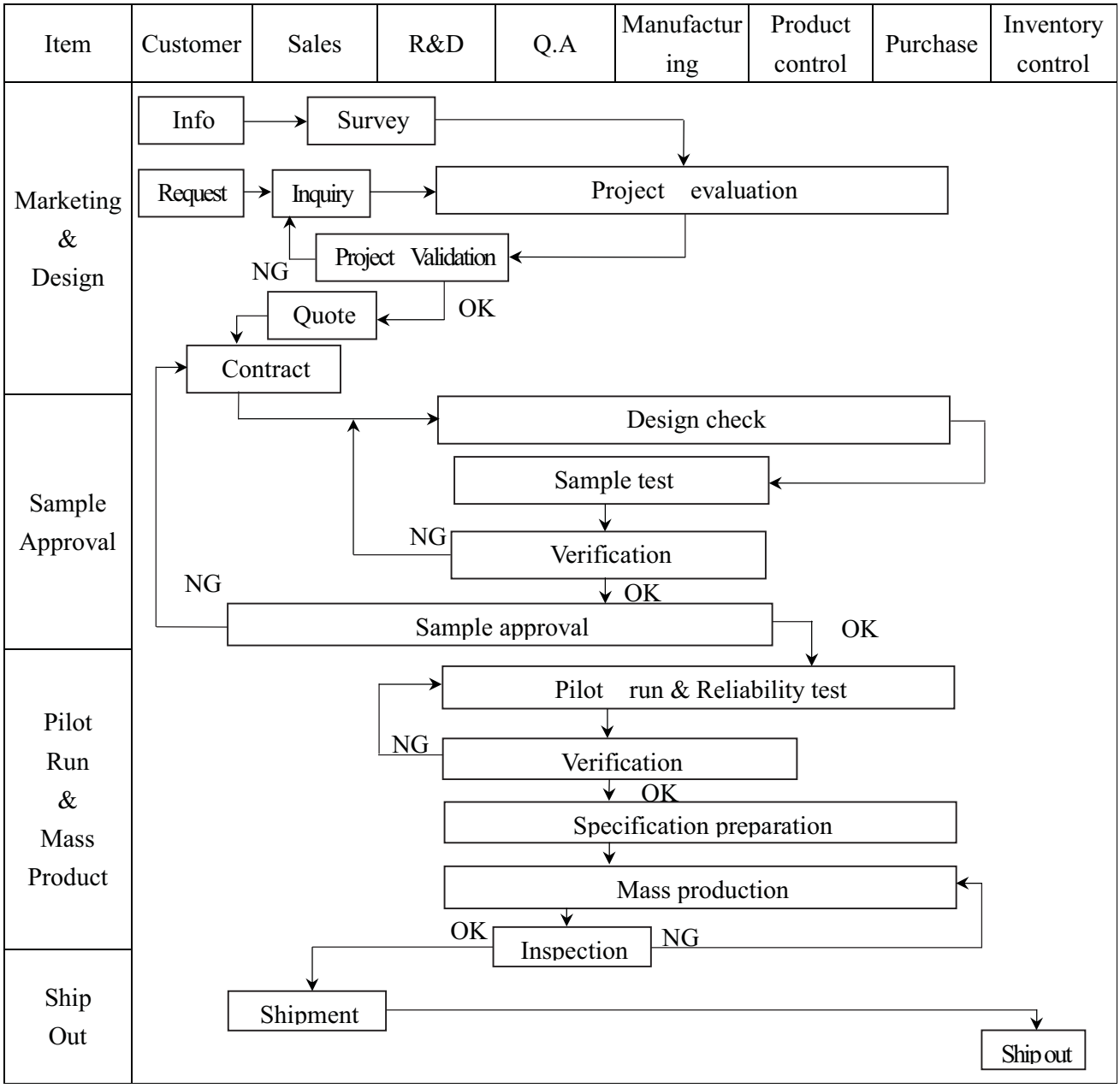


VDD=2.8V GND=0V Ta=25℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
RESET	T_{RESL}	Reset Low Level Width	1	-	ms	-
	T_{REST}	Reset Complete Time	1		ms	

3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart



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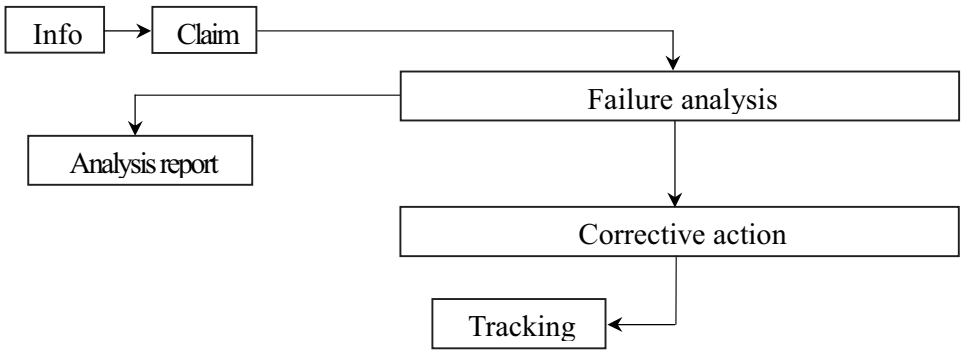
<table>
<tr><th>Item</th><th>Customer</th><th>Sales</th><th>R&D</th><th>Q.A</th><th>Manufactu ring</th><th>Product control</th><th>Purchase</th><th>Inventory control</th></tr>
<tr><td>Sales Service</td><td colspan="8"> 
</td></tr>
<tr><td>Q.A Activity</td><td colspan="8">1. ISO 9001 Maintenance Activities
2. Process improvement proposal
3. Equipment calibration
4. Education And Training Activities
5. Standardization Management</td></tr>
</table>

3.2 Inspection Specification

◆Scope ：The document shall be applied to TFT-LCD Module for less than 3.5″ (Ver.B01).

◆Inspection Standard：MIL-STD-105E Table Normal Inspection Single Sampling Level Ⅱ.

◆Equipment：Gauge、MIL-STD、Sample

◆Defect Level：Major Defect AQL： 0.4 ； Minor Defect AQL： 1.5

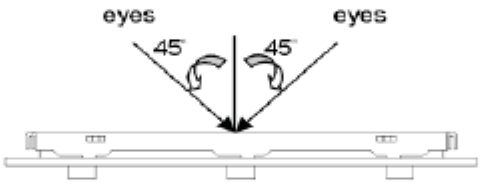
◆OUT Going Defect Level：Sampling.

◆Standard of the product appearance test：

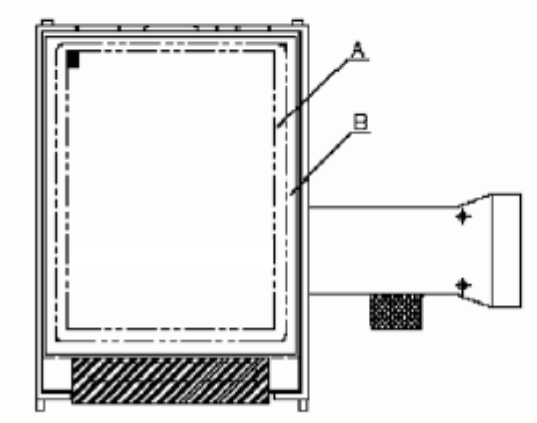
a. Manner of appearance test：

(1). The test best be under 20W×2 fluorescent light，and distance of view must be at 30 cm.

(2). The test direction is base on about around 45° of vertical line.



(3). Definition of area.



A area：viewing area

B area：Outside of viewing area

(4). Standard of inspection： (Unit：mm)

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◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.02)

NO	Item	Criterion	Level
01	Product condition	1.1 The part number is inconsistent with work order of production.	Major
		1.2 Mixed product types.	Major
		1.3 Assembled in inverse direction.	Major
02	Quantity	2.1 The quantity is inconsistent with work order of production.	Major
03	Outline dimension	3.1 Product dimension and structure must conform to structure diagram.	Major
04	Electrical Testing	4.1 Missing line character and icon.	Major
		4.2 No function or no display.	Major
		4.3 Display malfunction.	Major
		4.4 LCD viewing angle defect.	Major
		4.5 Current consumption exceeds product specifications.	Major
05	Dot defect (Bright dot、Dark dot) On -display	<table><tr><th colspan="2">Item</th><th>Acceptance (Q'ty)</th></tr><tr><td rowspan="4">Dot Defect</td><td>Bright Dot</td><td>≦ 2</td></tr><tr><td>Dark Dot</td><td>≦ 3</td></tr><tr><td>Joint Dot</td><td>≦ 2</td></tr><tr><td>Total</td><td>≦ 3</td></tr></table> 5.1 Inspection pattern：full white , full black , Red , Green and blue screens. 5.2 It is defined as dot defect if defect area ＞1/2 dot. 5.3 The distance between two dot defect ≧5 mm.	Minor

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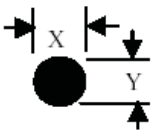
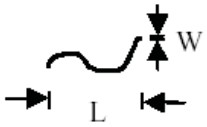
◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.02)

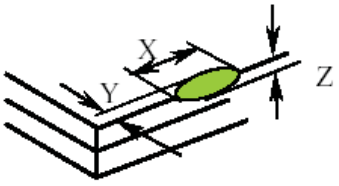
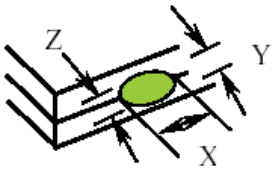
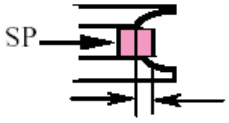
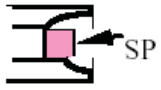
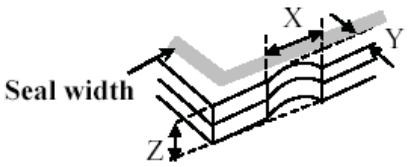
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td>06</td><td>Black or white dot、scratch、contamination

Round type
 

Φ=(x+y) / 2

Line type
 
</td><td>6.1 Round type (Non-display or display) :
<table><tr><th>Dimension (diameter : Φ)</th><th>Acceptance (Q'ty)</th></tr><tr><td>Φ ≦ 0.15</td><td>Ignore</td></tr><tr><td>0.15 < Φ ≦ 0.20</td><td>2</td></tr><tr><td>0.20 < Φ ≦ 0.30</td><td>2</td></tr><tr><td>Φ > 0.30</td><td>0</td></tr><tr><td>Total</td><td>3</td></tr></table>
6.2 Line type(Non-display or display) :
<table><tr><th>Length (L)</th><th>Width (W)</th><th>Acceptance (Q'ty)</th></tr><tr><td>---</td><td>W ≦ 0.03</td><td>Ignore</td></tr><tr><td>L ≦5.0</td><td>0.03 < W ≦ 0.05</td><td>3</td></tr><tr><td>---</td><td>W >0.05</td><td>As round type</td></tr><tr><td colspan="2">Total</td><td>3</td></tr></table></td><td>Minor</td></tr>
<tr><td>07</td><td>Polarizer Bubble</td><td><table><tr><th>Dimension (diameter : Φ)</th><th>Acceptance (Q'ty)</th></tr><tr><td>Φ ≦ 0.20</td><td>Ignore</td></tr><tr><td>0.20 < Φ ≦ 0.50</td><td>3</td></tr><tr><td>Φ > 0.50</td><td>0</td></tr><tr><td>Total</td><td>3</td></tr></table></td><td>Minor</td></tr>
</table>

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.02)

NO	Item	Criterion	Level
08	The crack of glass	Symbols : X : The length of crack　Y : The width of crack. Z : The thickness of crack　W : terminal length t : The thickness of glass　a : LCD side length 8.1 General glass chip : 8.1.1 Chip on panel surface and crack between panels:    【OK】  【NG】  	Minor

X	Y	Z
≦ a	Crack can't enter viewing area	≦1/2 t
≦ a	Crack can't exceed the half of SP width.	1/2 t < Z ≦2 t

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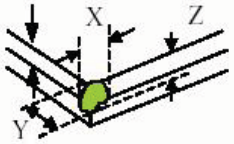
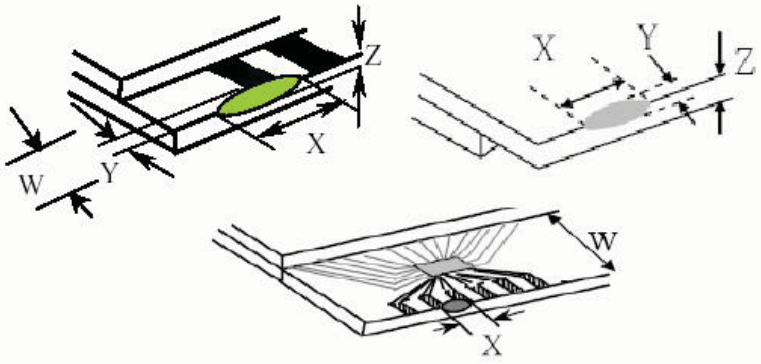
◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver. 02)

<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td>08</td><td>The crack of glass</td><td>
Symbols :

X : The length of crack　　Y : The width of crack.
Z : The thickness of crack　　W : terminal length
t : The thickness of glass　　a : LCD side length

8.1.2 Corner crack :


<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≦1/5 a</td><td>Crack can't enter viewing area</td><td>Z ≦ 1/2 t</td></tr>
<tr><td>≦1/5 a</td><td>Crack can't exceed the half of SP width.</td><td>1/2 t < Z ≦ 2 t</td></tr>
</table>
8.2 Protrusion over terminal :
8.2.1 Chip on electrode pad :


<table>
<tr><th></th><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>Front</td><td>≦ a</td><td>≦ 1/2 W</td><td>≦ t</td></tr>
<tr><td>Back</td><td>≦ a</td><td>≦ W</td><td>≦ 1/2 t</td></tr>
</table>
</td><td>Minor</td></tr>
</table>

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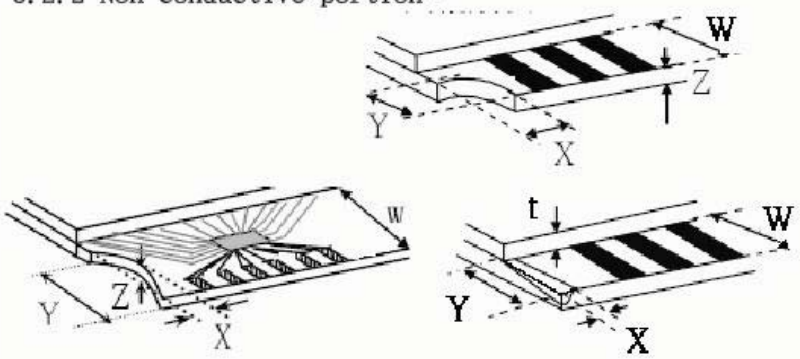
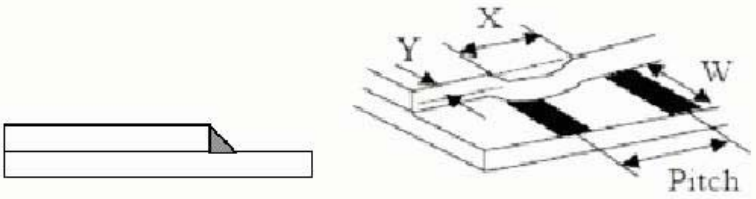
◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver. 02)

NO	Item	Criterion	Level
08	The crack of glass	Symbols : X : The length of crack Y : The width of crack. Z : The thickness of crack W : terminal length t : The thickness of glass a : LCD side length 8.2.2 Non-conductive portion :  X ≦ 1/3 a; Y ≦ W; Z ≦ t ⊙ If the chipped area touches the ITO terminal, over 2/3 of the ITO must remain and be inspected according to electrode terminal specifications. 8.2.3 Glass remain :  X ≦ a; Y ≦ 1/3 W; Z ≦ t	Minor

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◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.02)

NO	Item	Criterion	Level
09	Backlight elements	9.1 Backlight can't work normally.	Major
		9.2 Backlight doesn't light or color is wrong.	Major
		9.3 Illumination source flickers when lit.	Major
10	General appearance	10.1 Pin type、quantity、dimension must match type in structure diagram.	Major
		10.2 No short circuits in components on PCB or FPC .	Major
		10.3 Parts on PCB or FPC must be the same as on the production characteristic chart .There should be no wrong parts , missing parts or excess parts.	Major
		10.4 Product packaging must the same as specified on packaging specification sheet.	Minor
		10.5 The folding and peeled off in polarizer are not acceptable.	Minor
		10.6 The PCB or FPC between B/L assembled distance(PCB or FPC) is ≦1.5 mm.	Minor

4. RELIABILITY TEST

4.1 Reliability Test Condition

Ver.02

NO.	TEST ITEM	TEST CONDITION	
1	High Temperature Storage Test	Keep in +80 ±2℃ 96 hrs Surrounding temperature, then storage at normal condition 4hrs.	
2	Low Temperature Storage Test	Keep in -30 ±2℃ 96 hrs Surrounding temperature, then storage at normal condition 4hrs.	
3	High Temperature / High Humidity Storage Test	Keep in +60℃ / 90% R.H duration for 96 hrs Surrounding temperature, then storage at normal condition 4hrs. (Excluding the polarizer)	
4	ESD Test	Air Discharge: Apply 2KV with 5 times Discharge for each polarity +/-	Contact Discharge: Apply 250V with 5 times discharge for each polarity +/-
		1. Temperature ambiance : 15℃～35℃ 2. Humidity relative : 30%～60% 3. Energy Storage Capacitance(Cs+Cd) : 150pF±10% 4. Discharge Resistance(Rd) : 330Ω±10% 5. Discharge, mode of operation : Single Discharge (time between successive discharges at least 1 sec) (Tolerance if the output voltage indication : ±5%)	
5	Temperature Cycling Storage Test	-30℃ → +25℃ → +80℃ → +25℃ (30mins) (5mins) (30mins) (5mins) 10 Cycle Surrounding temperature, then storage at normal condition 4hrs.	
6	Vibration Test (Packaged)	1. Sine wave 10～55 Hz frequency (1 min) 2. The amplitude of vibration :1.5 mm 3. Each direction (X、Y、Z) duration for 2 Hrs	
7	Drop Test (Packaged)	Packing Weight (Kg) / Drop Height (cm) 0 ~ 45.4 / 122 45.4 ~ 90.8 / 76 90.8 ~ 454 / 61 Over 454 / 46 Drop direction :※1 corner / 3 edges / 6 sides each 1times	

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5. PRECAUTION RELATING PRODUCT HANDLING

5.1 SAFETY

5.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.
5.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

5.2 HANDLING

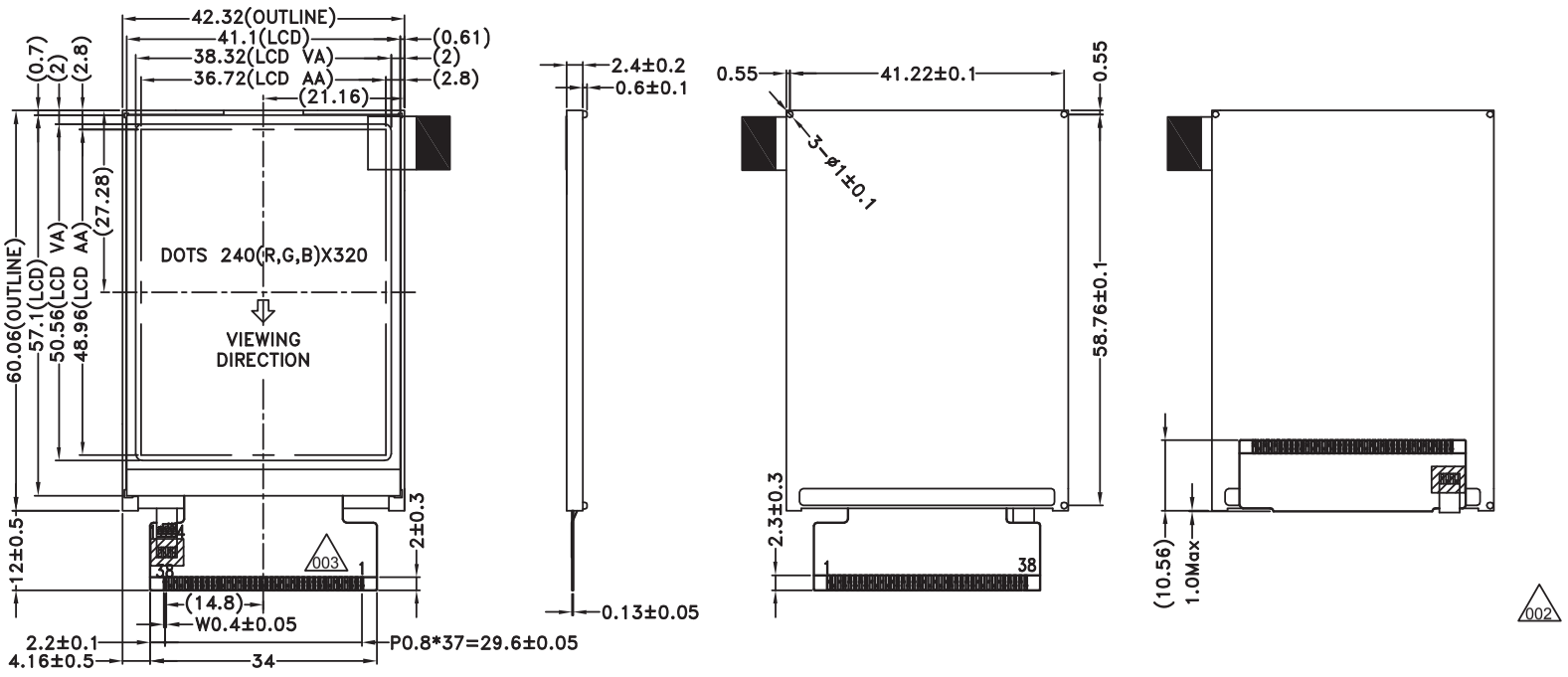
5.2.1 Avoid any strong mechanical shock which can break the glass.
5.2.2 Avoid static electricity which can damage the CMOS LSI When working with the module , be sure to ground your body and any electrical equipment you may be using.
5.2.3 Do not remove the panel or frame from the module.
5.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully, do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)
5.2.5 Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.
5.2.6 Do not touch the display area with bare hands , this will stain the display area.
5.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.
5.2.8 To control temperature and time of soldering is 320 ± 10°C and 3-5 sec.
5.2.9 To avoid liquid (include organic solvent) stained on LCM

5.3 STORAGE

5.3.1 Store the panel or module in a dark place where the temperature is 25°C ± 5°C and the humidity is below 65% RH.
5.3.2 Do not place the module near organics solvents or corrosive gases.
5.3.3 Do not crush , shake , or jolt the module.

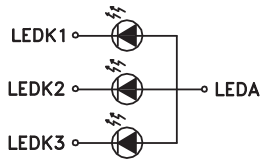
5.4 TERMS OF WARRANTY

5.4.1 Applicable warrant period
The period is within thirteen months since the date of shipping out under normal using and storage conditions.
5.4.2 Unaccepted responsibility
This product has been manufactured to your company's specification as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in nuclear power control equipment, aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required.



No:	PIN NAME
1	GND
2	RESET
3	D7
4	D6
5	D5
6	D4
7	D3
8	D2
9	D1
10	D0
11	/RD
12	/WR
13	RS
14	/CS
15	VDD_C1
16	VCOMH_C2
17	VCOML_C3
18	GVDD_C4
19	VCL_C5
20	AVDD_C6
21	VCI1_C7
22	C8N
23	C8P
24	C9N
25	C9P
26	VGL_C10_D1
27	VGH_C11
28	C12N
29	C12P
30	C13N
31	C13P
32	C14N
33	C14P
34	LEDA
35	LEDK1
36	LEDK2
37	LEDK3
38	VDD

NOTES:
1. THE TOLERANCE UNLESS CLASSFIED ±0.2mm
   THE R FOR NOT ASSIGNED 0.5±0.1mm
2. DRIVER IC: ST7781
3. VIEWING DIRECTION:12 O'CLOCK
4.THIS PRODUCT CONFORM ROHS



REV	REV BY	REVISER	DATE
007			
006			
005			
004			
003			
002	ADD PIN NO.	Shawn	2009/7/29
001	NEW DRAWING	Shawn	2009/7/21

PART NO: USMP-TT024Q-01B

DRAWING NAME : USMP-TT024Q-01B

TITLE: LCD MODULE DRAWING

US Micro Products
Electronic Products for the OEM

6207 Bee Caves Rd., Ste. 330; Austin, TX 78746 USA
Tel:(800) 741-7755, sales@usmicroproducts.com
www.usmicroproducts.com

Design	Shawn	(3)	Surface		
Check	Eddy	Unit	MM	Material	
Approve	Ryan	Scale	1:1	Thickness	
		Page	1/1	Quantity	

最小長度 (mm) \ 公差等級	精級
1 ~ 4	-
4 ~ 16	-
16 ~ 63	-
63 ~ 250	-
250 ~ 1000	-

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