US Micro Products
ENGINEERED DISPLAY SOLUTIONS

TFT SPECIFICATION

Part Number	USMP-T018-012016NAS-A0
Size	1.77"
Resolution	128 x 160
Brightness	290 cd/m²
Contrast	200:1
Viewing Angle	45/15/45/45
Operating Temp.	-20 ~ 70°C

FOR ADDITIONAL INFORMATION
PLEASE CONTACT:
engineering@usmicroproducts.com

Issue Date	Approved by (customer use)	Checked by	Prepared by

History of Version

Date	Ver.	Edi.	Description	Page	Design by
3/11/2011	01	001	New Drawing	-	Violin Huang
5/9/2011	01	002	New Sample	-	Violin Huang

Contents

1. SPECIFICATIONS

1.1 Features

Main LCD Panel

Item	Standard Value
Display Type	128 * (R、G、B) * 160 Dots
LCD Type	a-Si TFT , Normally White TN mode , Transmissive
Screen size(inch)	1.77 (Diagonal)
Viewing Direction	12 O'clock
Color configuration	R.G.B. vertical stripe
Backlight	White LED
Interface	8-bit interface for 80 system
Other(controller / driver IC)	ST7735R(Support 65K Colors)

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	34.0 (W) * 47.0 (L) * 2.4 (H)(MAX)	mm

TFT LCD Panel

Item	Standard Value	Unit
Viewing Area (LCD)	29.032 (W) * 36.04 (L)	mm
Active Area (LCD)	28.032 (W) * 35.04 (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	30.0	V
Input Voltage	VIN	-	-0.3	VDD+0.3	V
Operating Temperature	T_{OP}	-	-20	+70	°C
Storage Temperature	T_{ST}	-	-30	+80	°C
Storage Humidity	H_D	Ta ≦ 60 °C	20	90	%RH

1.4 DC Electrical Characteristics

Module GND = 0V, Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Interface operation voltage	VDD	I/O supply voltage	-	2.8	-	V
Input High Voltage	V_{IH}	-	0.7*VDD	-	VDD	V
Input Low Voltage	V_{IL}	-	GND	-	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	GND	-	0.2*VDD	V
Supply Current	IDD	VDD= 2.8V, Pattern= Black*1	-	1.0	1.5	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°	-	30	45	ms	Note2
Viewing angle	Top	θY+	CR ≥ 10	-	45	-	Deg.	Note4
	Bottom	θY-		-	15	-		
	Left	θX-		-	45	-		
	Right	θX+		-	45	-		
Contrast ratio		CR	Ta = 25°C θX , θY = 0°	150	200	-	-	Note3
Color of CIE Coordinate (With B/L)	White	X		0.23	0.28	0.33	-	Note1
		Y		0.26	0.31	0.36		
	Red	X		0.58	0.63	0.68		
		Y		0.29	0.34	0.39		
	Green	X		0.28	0.33	0.38		
		Y		0.56	0.61	0.66		
	Blue	X		0.07	0.14	0.19		
		Y		0.03	0.08	0.13		
Average Brightness Pattern=white display (With B/L)		IV	IF= 30mA	230	290	-	cd/m^2	Note1

Note1:

1：△B= B(min) / B(max) × 100%.

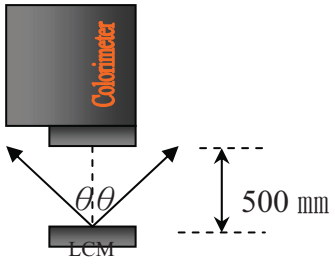
2：Measurement Condition for Optical Characteristics:

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%.

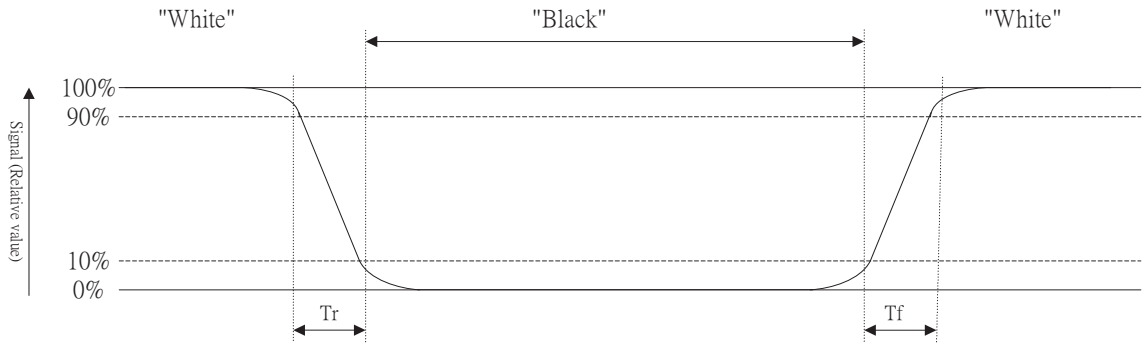


Colorimeter BM 7 fast

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:



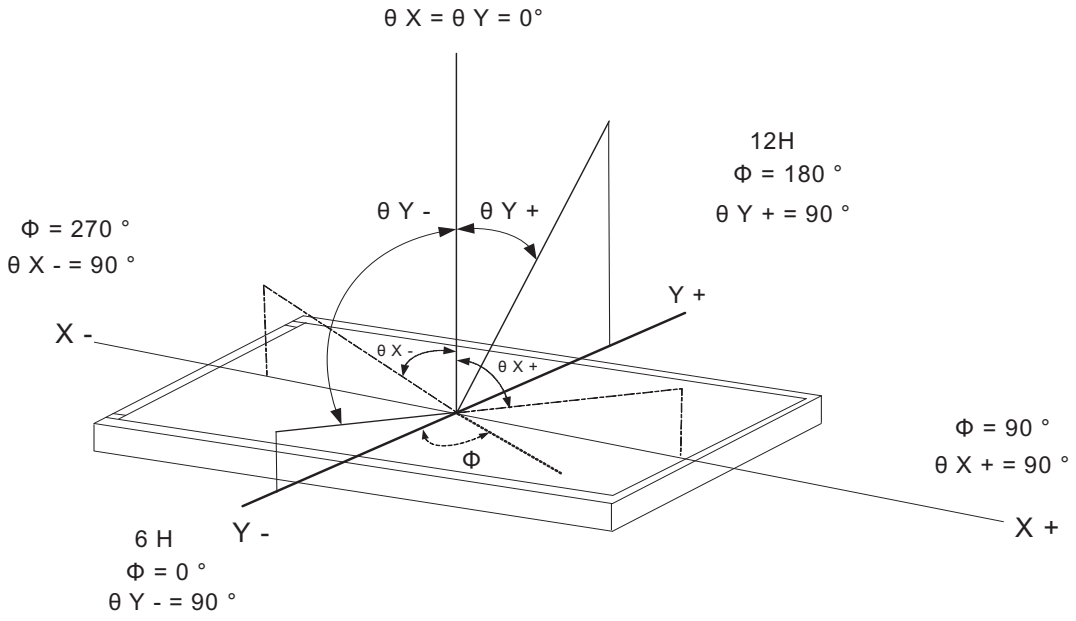
Note3: Definition of contrast ratio:

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

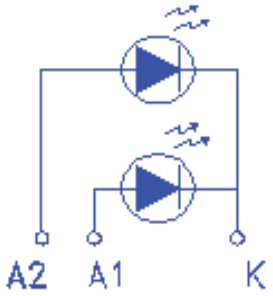
Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	IF	Ta =25℃	-	60	mA
Reverse Voltage	VR	Ta =25℃	-	5.0	V
Power Dissipation	PD	Ta =25℃	-	180	mW

Electrical / Optical Characteristics

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	VF	IF=30mA	-	3.3	3.5	V
Average Brightness (without LCD)	IV	IF=30mA	3200	3500	-	cd/m^2
Color of CIE Coordinate (without LCD)	X		0.25	0.28	0.31	-
	Y		0.25	0.28	0.31	
Color	White					

Circuit Dirgram:



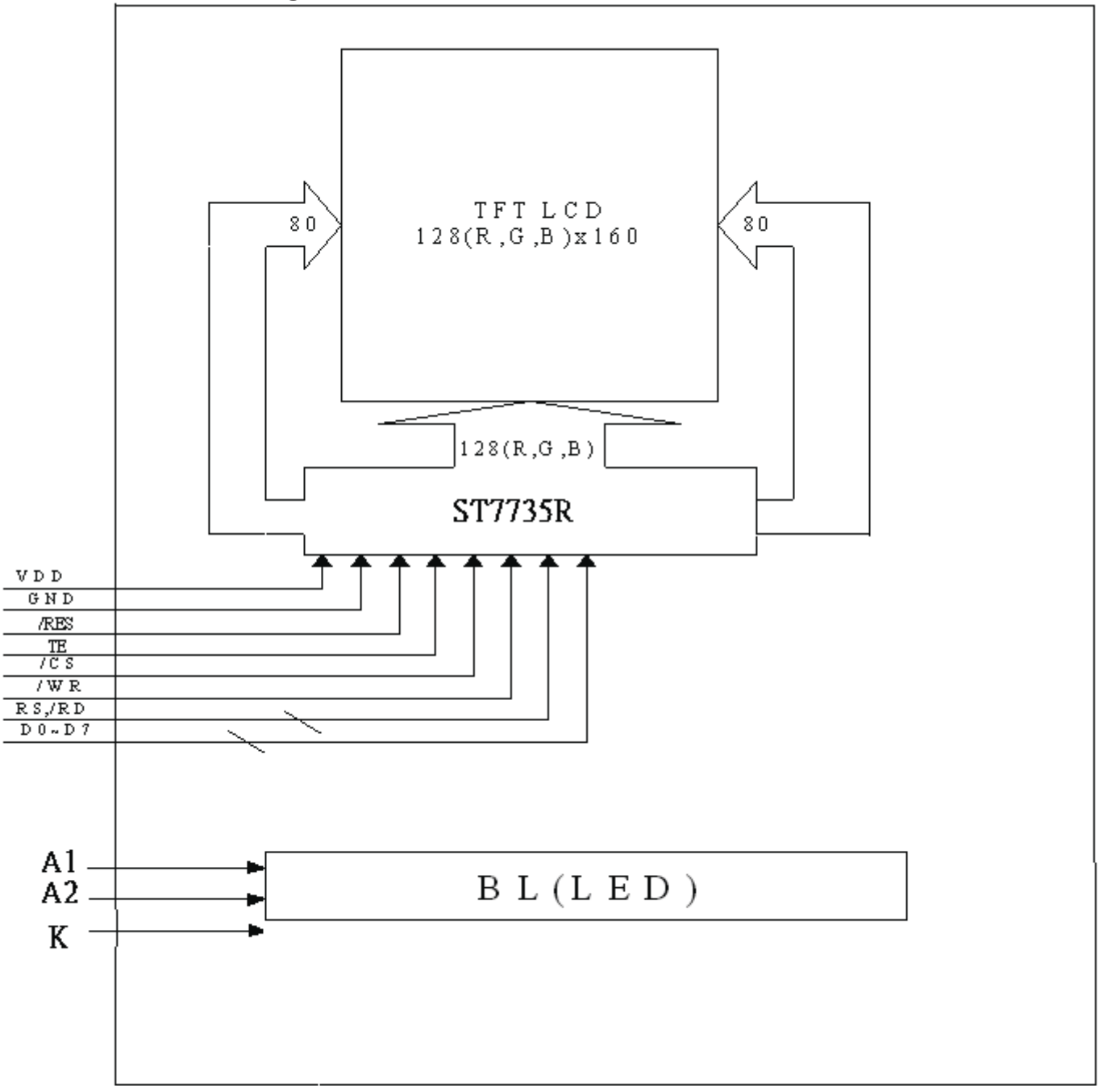
2. MODULE STRUCTURE

2.1 Counter Drawing

2.1.1 LCM Mechanical Diagram

* See Appendix

2.1.2 Block Diagram

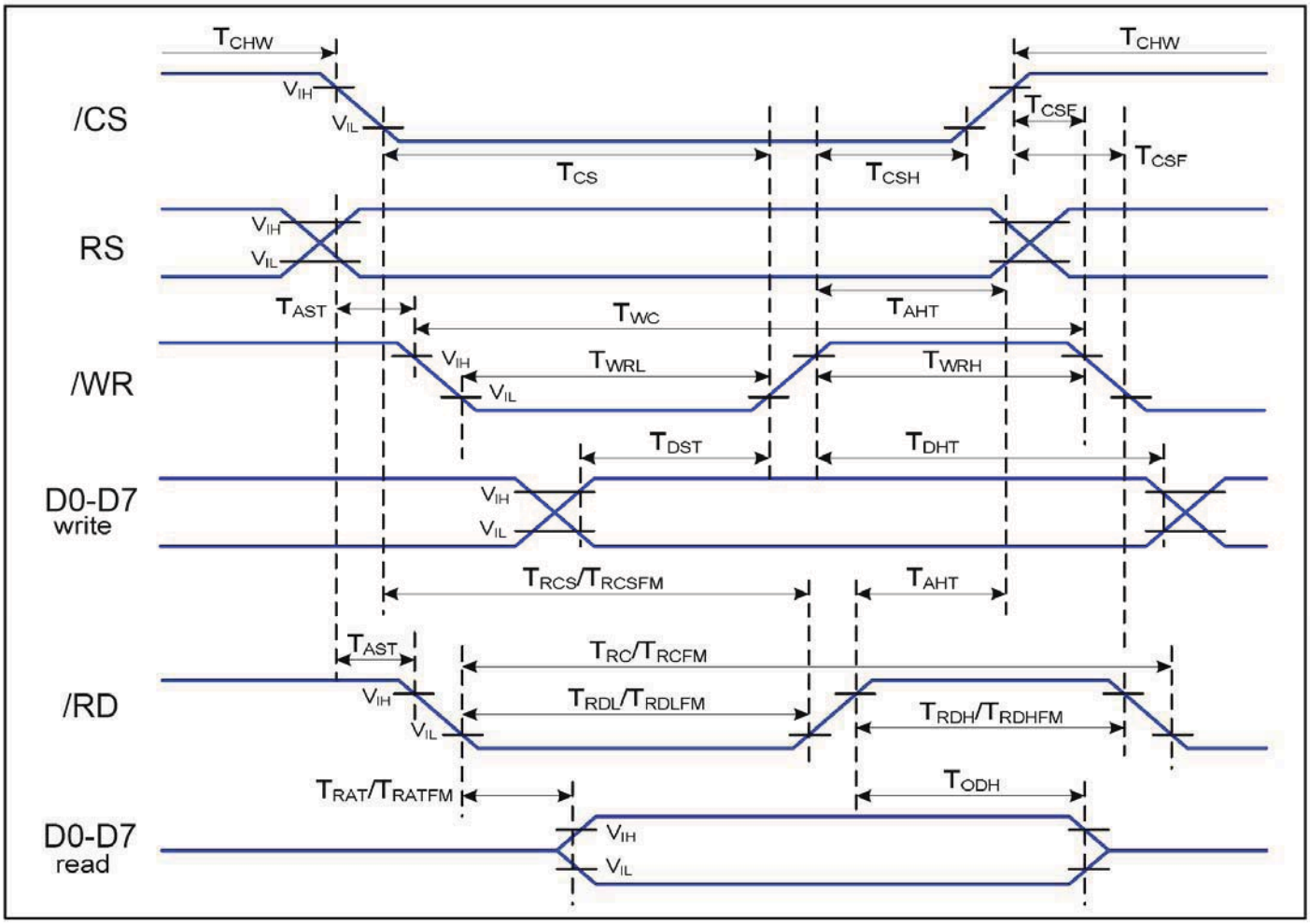


2.2 Interface Pin Description

Pin No.	Symbol	Function
1	K	Power Supply for LED Backlight Cathode input.
2	A2	Power Supply for LED Backlight Anode input.
3	A1	Power Supply for LED Backlight Anode input.
4	RD	Read signal input , Active “L”.
5	RS	The signal for command or parameter select under parallel mode Low: command.；High: parameter.
6	D1	Bi-directional data bus.
7	D3	Bi-directional data bus.
8	D5	Bi-directional data bus.
9	D7	Bi-directional data bus.
10	TE	Tearing effect output pin to synchronies MPU to frame rate,activated by S/W command
11	RESET	This signal will reset the device and it must be applied to properly initialize the chip, Active “L”.
12	CS	Chip selection pin, Active “L”.
13	D6	Bi-directional data bus.
14	D4	Bi-directional data bus.
15	D2	Bi-directional data bus.
16	D0	Bi-directional data bus.
17	WR	Write enable in MPU parallel interface, Active “L”.
18	GND	System ground
19	VDD	Power supply for analog, digital , I/O system and booster circuit Connect to Capacitor: VDD -------||-------- GND 6.3V 1.0 uF
20	AVDD	Power pin for analog circuits. Connect to Capacitor: AVDD -------||-------- GND 6.3V 1.0 uF
21	AVCL	A power supply pin for generating GVCL. Connect to Capacitor: AVCL -------||-------- GND 6.3V 1.0 uF
22	GND	System ground

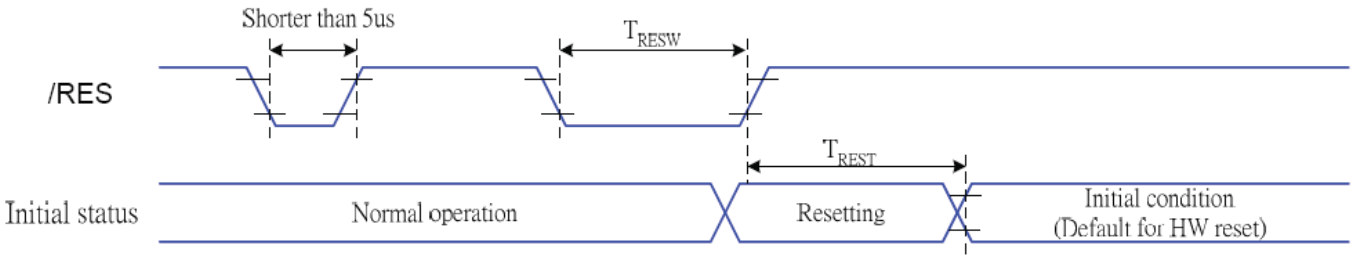
2.3 Timing Characteristics

80-System Bus Interface



Signal	Symbol	Parameter	Min	Max	Unit	Description
RS	TAST	Address setup time	10		ns	-
	TAHT	Address hold time (Write/Read)	10		ns	
/CS	TCHW	Chip select “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)	350		ns	
	TCSF	Chip select wait time (Write/Read)	10		ns	
	TCSH	Chip select hold time	10		ns	
/WR	TWC	Write cycle	100		ns	
	TWRH	Control pulse “H” duration	30		ns	
	TWRL	Control pulse “L” duration	30		ns	
/RD (ID)	TRC	Read cycle (ID)	160		ns	When read ID data
	TRDH	Control pulse “H” duration (ID)	90		ns	
	TRDL	Control pulse “L” duration (ID)	45		ns	
/RD (FM)	TRCFM	Read cycle (FM)	450		ns	When read from frame memory
	TRDHFM	Control pulse “H” duration (FM)	150		ns	
	TRDLFM	Control pulse “L” duration (FM)	150		ns	
D0-D7	TDST	Data setup time	10		ns	For CL=30pF
	TDHT	Data hold time	10		ns	
	TRAT	Read access time (ID)		40	ns	
	TRATFM	Read access time (FM)		40	ns	
	TODH	Output disable time		80	ns	

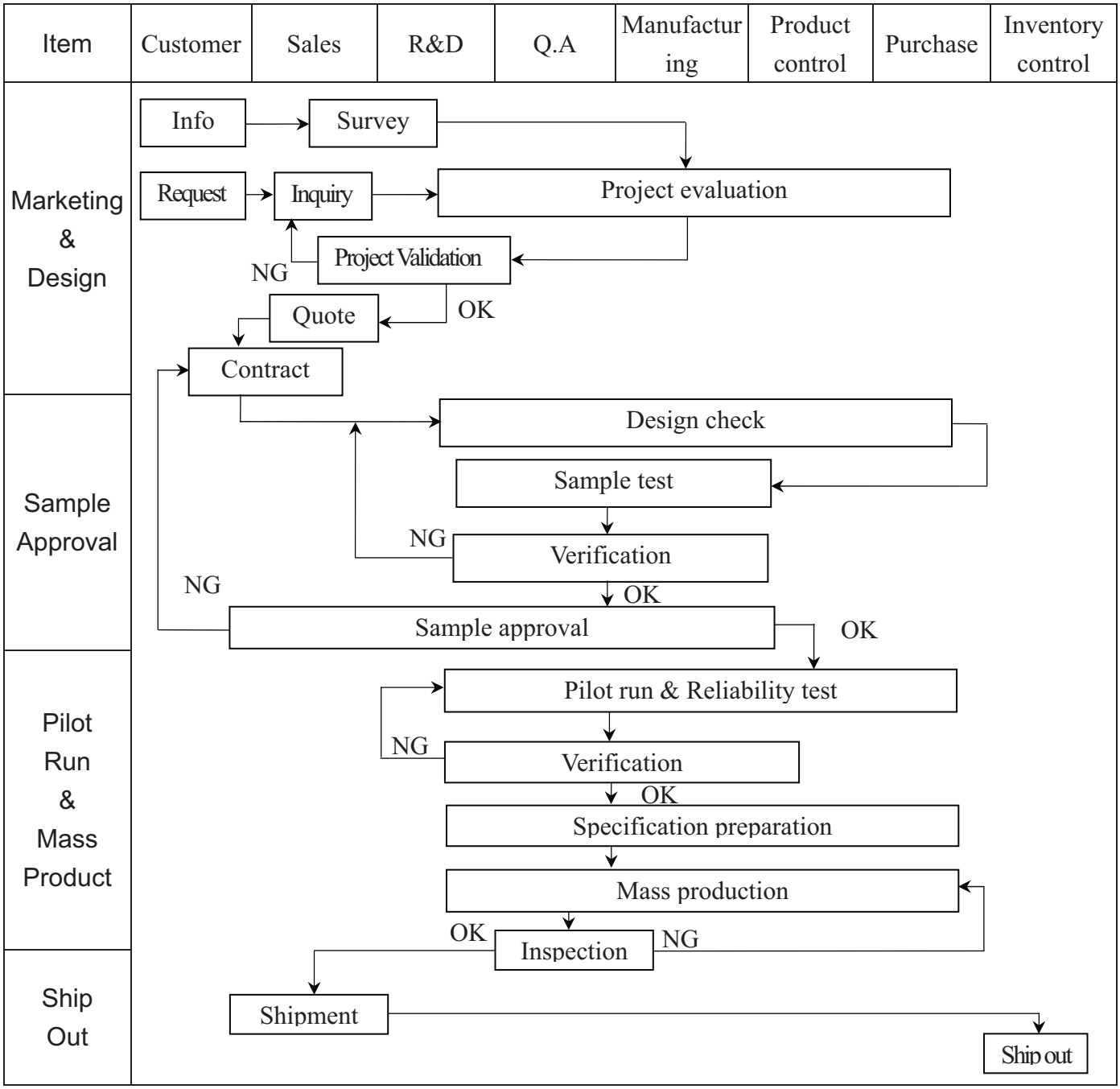
Reset Timing：

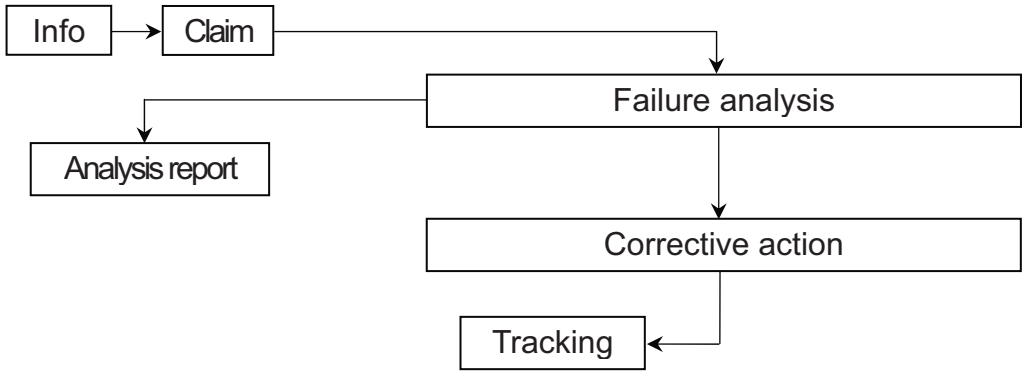


Related Pins	Symbol	Parameter	MIN	MAX	Unit
/RES	tRESW	Reset pulse duration	10	-	us
	tREST	Reset cancel	-	5	ms
				120	ms

3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart



Item	Customer	Sales	R&D	Q.A	Manufacturing	Product control	Purchase	Inventory control
Sales Service								
Q.A Activity	1. ISO 9001 Maintenance Activities 2. Process improvement proposal 3. Equipment calibration 4. Education And Training Activities 5. Standardization Management							

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

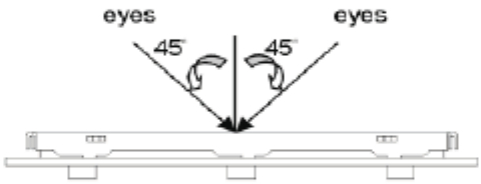
◆OUT Going Defect Level：Sampling.

◆Standard of the product appearance test：

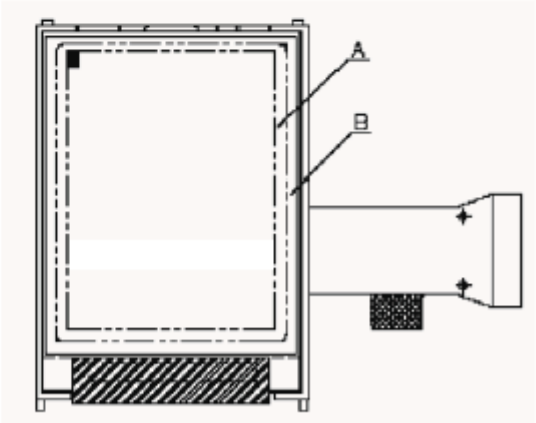
a. Manner of appearance test：

(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

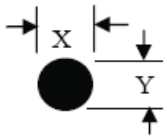
(4). Standard of inspection： (Unit：mm)

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

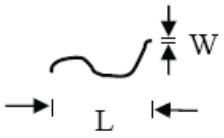
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td rowspan="3">01</td><td rowspan="3">Product condition</td><td>1.1 The part number is inconsistent with work order of production.</td><td>Major</td></tr>
<tr><td>1.2 Mixed product types.</td><td>Major</td></tr>
<tr><td>1.3 Assembled in inverse direction.</td><td>Major</td></tr>
<tr><td>02</td><td>Quantity</td><td>2.1 The quantity is inconsistent with work order of production.</td><td>Major</td></tr>
<tr><td>03</td><td>Outline dimension</td><td>3.1 Product dimension and structure must conform to structure diagram.</td><td>Major</td></tr>
<tr><td rowspan="5">04</td><td rowspan="5">Electrical Testing</td><td>4.1 Missing line character and icon.</td><td>Major</td></tr>
<tr><td>4.2 No function or no display.</td><td>Major</td></tr>
<tr><td>4.3 Display malfunction.</td><td>Major</td></tr>
<tr><td>4.4 LCD viewing angle defect.</td><td>Major</td></tr>
<tr><td>4.5 Current consumption exceeds product specifications.</td><td>Major</td></tr>
<tr><td>05</td><td>Dot defect
(Bright dot、Dark dot)
On -display</td><td>
<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.
</td><td>Minor</td></tr>
</table>

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

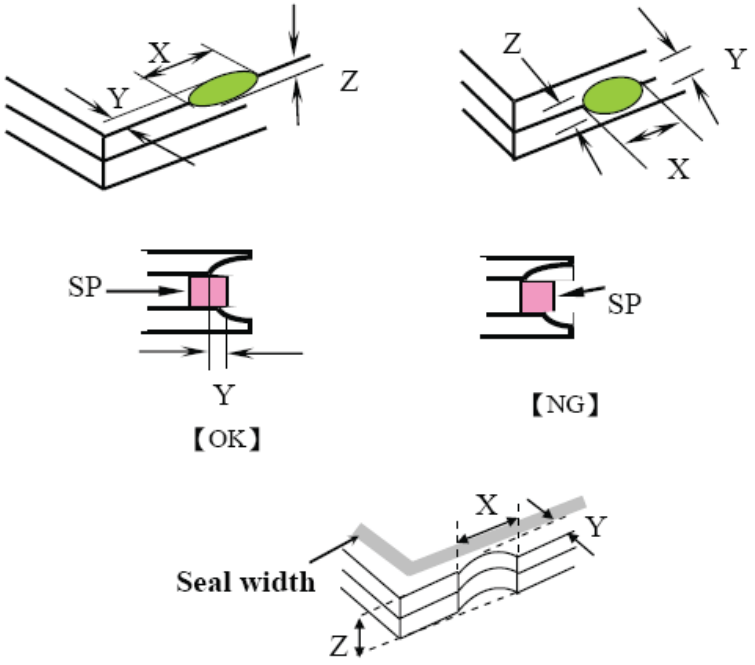
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td>06</td><td>Black or white dot、scratch、contamination

Round type
 

Φ=(x+y) / 2

Line type
 
</td><td>6.1 Round type (Non-display or display) :
<table><tr><th rowspan="2">Dimension
(diameter : Φ)</th><th colspan="2">Acceptance (Q'ty)</th></tr><tr><th>A area</th><th>B area</th></tr><tr><td>Φ ≦ 0.15</td><td>Ignore</td><td rowspan="5">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 colspan="2">Dimension</th><th colspan="2">Acceptance (Q'ty)</th></tr><tr><th>Length (L)</th><th>Width (W)</th><th>A area</th><th>B area</th></tr><tr><td>---</td><td>W ≦ 0.03</td><td>Ignore</td><td rowspan="4">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 rowspan="2">Dimension
(diameter : Φ)</th><th colspan="2">Acceptance (Q'ty)</th></tr><tr><th>A area</th><th>B area</th></tr><tr><td>Φ ≦ 0.20</td><td>Ignore</td><td rowspan="4">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.B01)

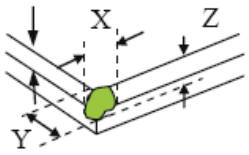
NO	Item	Criterion	Level
08	The crack of glass	Symbols : X : The length of crack Y : The width of crack. Z : The thickness of crack W : terminal length t : The thickness of glass a : LCD side length 8.1 General glass chip : 8.1.1 Chip on panel surface and crack between panels: 	Minor

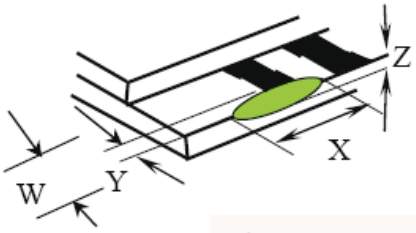
X	Y	Z
≦ a	Crack can't enter viewing area	≦1/2 t
≦ a	Crack can't exceed the half of SP width.	1/2 t < Z ≦2 t

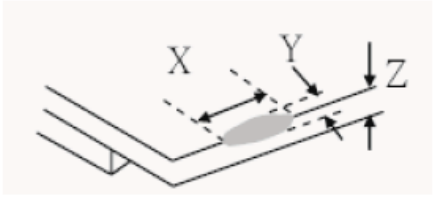
◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

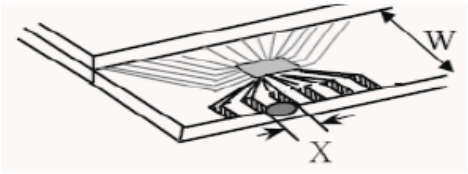
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td>08</td><td>The crack of glass</td><td>
Symbols :

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 :




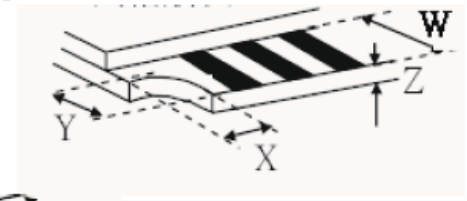


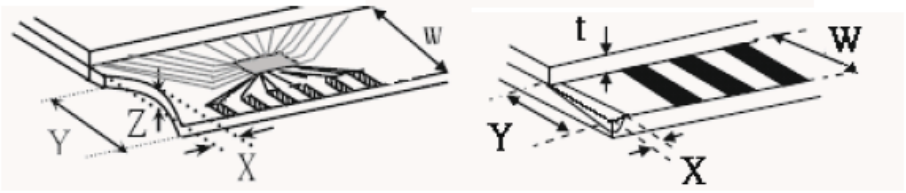
<table>
<tr><th></th><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>Front</td><td>≦ a</td><td>≦ 1/2 W</td><td>≦ t</td></tr>
<tr><td>Back</td><td>≦ a</td><td>≦ W</td><td>≦ 1/2 t</td></tr>
</table>
</td><td>Minor</td></tr>
</table>

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

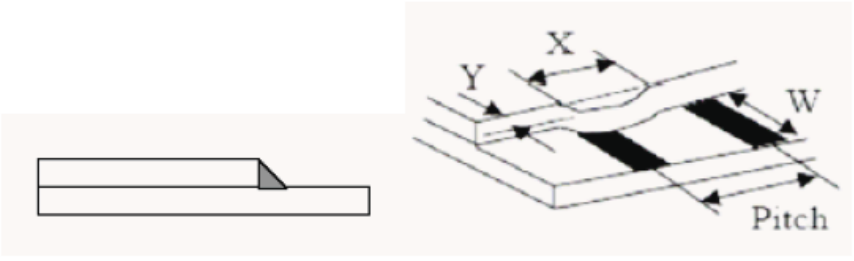
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>Level</th></tr>
<tr><td>08</td><td>The crack of glass</td><td>
Symbols :

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

8.2.2 Non-conductive portion :




<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≦ 1/3 a</td><td>≦W</td><td>≦t</td></tr>
</table>
⊙ 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 :


<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≦ a</td><td>≦ 1/3 W</td><td>≦t</td></tr>
</table>
</td><td>Minor</td></tr>
</table>

◆Specification For TFT-LCD Module Less Than 3.5″ : (Ver.B01)

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.B01)

<table>
<tr><th>NO.</th><th>TEST ITEM</th><th>TEST CONDITION</th></tr>
<tr><td>1</td><td>High Temperature Storage Test</td><td>Keep in +80℃ 96 hrs
Surrounding temperature, then storage at normal condition 4hrs.</td></tr>
<tr><td>2</td><td>Low Temperature Storage Test</td><td>Keep in -30℃ 96 hrs
Surrounding temperature, then storage at normal condition 4hrs.</td></tr>
<tr><td>3</td><td>High Temperature / High Humidity Storage Test</td><td>Keep in +60 / 90% R.H duration for 96 hrs
Surrounding temperature, then storage at normal condition 4hrs.
(Excluding the polarizer)</td></tr>
<tr><td>4</td><td>Temperature Cycling Storage Test</td><td>-30℃ → +25℃ → +80℃→ +25℃
(30mins) (5mins) (30mins) (5mins)
10 Cycle
Surrounding temperature, then storage at normal condition 4hrs.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">ESD Test</td><td>Air Discharge:
Apply 2 KV with 5 times
Discharge for each polarity +/-

Contact Discharge:
Apply 250 V with 5 times
discharge for each polarity +/-</td></tr>
<tr><td>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%)</td></tr>
<tr><td>6</td><td>Vibration Test (Packaged)</td><td>1. Sine wave 10～55 Hz frequency (1 min/sweep)
2. The amplitude of vibration :1.5 mm
3. Each direction (X、Y、Z) duration for 2 Hrs</td></tr>
<tr><td>7</td><td>Drop Test (Packaged)</td><td><table><tr><th>Packing Weight (Kg)</th><th>Drop Height (cm)</th></tr><tr><td>0 ~ 45.4</td><td>122</td></tr><tr><td>45.4 ~ 90.8</td><td>76</td></tr><tr><td>90.8 ~ 454</td><td>61</td></tr><tr><td>Over 454</td><td>46</td></tr></table>Drop Direction :※1 corner / 3 edges / 6 sides each 1time</td></tr>
</table>

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.

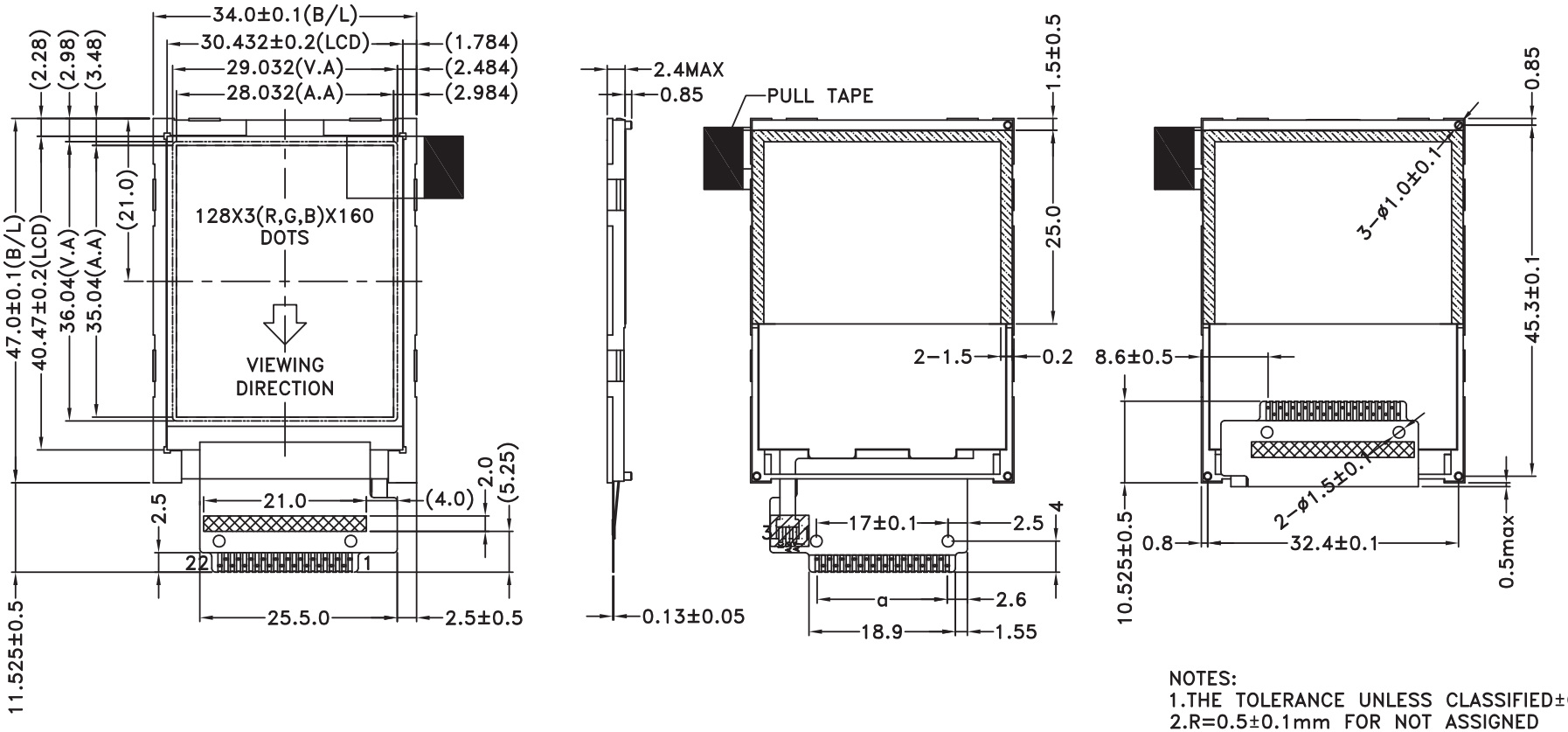
5.4 TERMS OF WARRANTY

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	K
2	A2
3	A1
4	RD
5	RS
6	D1
7	D3
8	D5
9	D7
10	TE
11	RESET
12	CS
13	D6
14	D4
15	D2
16	D0
17	WR
18	GND
19	VDD
20	AVDD
21	AVCL
22	GND

NOTES:
1.THE TOLERANCE UNLESS CLASSIFIED±0.2mm
2.R=0.5±0.1mm FOR NOT ASSIGNED
3.OPERATING TEMP:−20° C~70° C
4.STORAGE TEMP:−30° C~80° C
5.LCD DRIVER:ST7735R
6.VIEWING DIRECTION:12 O'CLOCK
7.BACKLIGHT:LUMINANCE
>=100cd/m^2,UNIFORMITY >=80%
8.⊠ DOUBLE TAPE(T=0.05mm)
9.a:P0.8x21=16.8±0.05(W=0.5±0.05)

REV	REV BY	REVISER	DATE
007			
006			
005			
004			
003			
002			
001	NEW DRAWING	Terry	2011/03/10

PART NO: USMP-T018-012016NAS-A0

DRAWING NAME :

TITLE: LCD MODULE DRAWING

US Micro Products
ENGINEERED DISPLAY SOLUTIONS

Design	Terry	⟨3⟩	Surface		
Check	Eddy	Unit	MM	Material	
Approve	Ryan	Scale	4:5	Thickness	
		Page	1/1	Quantity	

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