

**1.77 inch TFT LCD
without Touch Panel
SPECIFICATION**

MODEL NAME: [F 399N36P J 23

Date: 2012 / 09 / 19

Customer Signature		
Customer		
Approved Date	Approved By	Reviewed By

Revision History

Revision	Date	Originator	Detail	Remarks
1	2012-06-29		First Release	
2	2012-08-09		Define brightness Define NTSC Ratio(Gamut)	Page 6
3	2012-09-19		Final check : LEDs in parallel	Page 5
4	2013-01-16		LCD weight : 5.5g	Page 4
5	2013-08-27		Modify structure of frame	Page 21

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1. General Description

This display module is a transmissive type color active matrix TFT(Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This module is composed of a TFT LCD module, a driver circuit, and a back-light unit.

The resolution of a 1.77" contains 128 (RGB)X160dots and can display up to 65k colors.

2. Module Parameter

Features	Details	Unit
Display Size(Diagonal)	1.77"	-
LCD type	α -Si TFT	-
Display Mode	TN/ Normally white	-
Resolution	128 RGB x 160	-
View Direction	12 O'clock	Best image
Grayscale Inversion Direction	6 O'clock	-
Module Outline	34.7(H) ×46.7(V)×2.5 (T)	mm
TP Outline		mm
TP Viewing Area		
TP Active Area		
Active Area	28.03 (H)×35.04(V)	mm
Viewing Area	N/A	
Pixel Size	0.219(H) x0.219 (V)	mm
Pixel Arrangement	Stripe	-
Display Colors	NORMAL WHITE	-
Interface	MCU interface	-
Driver IC	ST7735S	-
Operating Temperature	-20~70	°C
Storage Temperature	-30~80	°C
Weight	5.5	g

3. Absolute Maximum Ratings

$V_{SS}=0V, T_a=25^{\circ}C$

Item	Symbol	Min.	Max.	Unit	
Supply Voltage	Power supply	VCC	-0.3	+4.8	V
	Analog	VCI	-0.3	+4.8	V
	IO	IOVCC	-0.3	+4.6	V
Input Voltage	V_i	-0.3	IOVCC+0.3	V	
Storage temperature	T_{stg}	-40	+125	°C	
Operating temperature	T_{op}	-30	+85	°C	
Storage humidity	H_{stg}	10	Note 1	%RH	
Operating humidity	H_{op}	10	Note 1	%RH	

Note 1: 90%RH max, If T_a is below 50°C; 60%RH max, If T_a is over 60°C.

4. DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	
Supply Voltage	Power supply	VCC	2.5	2.75	4.8	V
	Analog	VCI	2.5	2.75	4.8	V
	IO	IOVCC	1.65	1.8	3.7	V
Logic Low input voltage	V_{IL}	0.0	-	0.3*IOVCC	V	
Logic High input voltage	V_{IH}	0.7*IOVCC	-	IOVCC	V	
Logic Low output voltage	V_{OL}	0.0	-	0.2*IOVCC	V	
Logic High output voltage	V_{OH}	0.8*IOVCC	-	IOVCC	V	
Current Consumption	Normal display	Ivdd	-	-	-	mA
	Standby mode	Ivdd-	-	-	-	uA
Frame Frequency	f_{FR}	-	TBD	-	Hz	

5. Backlight Characteristics

5.1. Backlight Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	V_f	Ta=25 °C, I _F =30mA		3.2		V/LED
Forward Current	I_f	Ta=25 °C, V _F =3.2V	-	30	-	mA
Luminance	L_v	-	3200			cd / m ²
Uniformity	Avg	-	80	-	-	%
CIE	X	-	0.26	-	0.3	-
	Y	-	0.26	-	0.3	-
Power dissipation	P_d	-	-	-	-	mW
Backlight Driving Voltage	V _{AK}	-	-	3.2	-	V
Drive method	Constant current					
LED Configuration	2 White LEDs in parallel					

Note: Test condition I_f =30mA, Ta=25°C.

6. Optical Characteristics

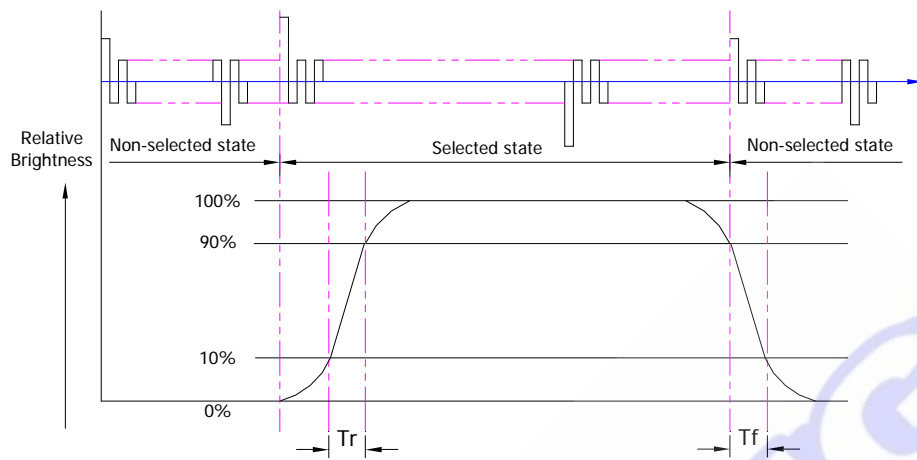
6.1. Optical Characteristics

Ta=25°C, VDD=2.8V, TN LC+ Polarizer

	Item	Symbol	Condition	Specification			Unit	
				Min.	Typ.	Max.		
Backlight On (Transmissive Mode)	LCM/ Display brightness	L_v	Normally viewing angle $\theta_x = \theta_y = 0^\circ$	240	260	-	cd/m^2	
	Luminance on TP surface ($I_f = 30mA$)	L_v		-	TBD	-	cd/m^2	
	Contrast ratio(See 6.3)	CR		400	500	-	-	
	Response time (See 6.2)	$TR+TF$		-	8	16	ms	
	Chromaticity Transmissive (See 6.5)	Red	X_R	-	0.606	0.626	0.646	
			Y_R		0.314	0.334	0.354	
		Green	X_G		0.257	0.277	0.297	
			Y_G		0.529	0.549	0.569	
		Blue	X_B		0.122	0.142	0.162	
			Y_B		0.102	0.122	0.142	
	White	X_W	0.283	0.303	0.323			
		Y_W	0.305	0.325	0.345			
	Viewing Angle (See 6.4)	Horizontal	θ_{x+}	Center ≥ 10	35	45	-	Deg.
θ_{x-}			35		45	-		
Vertical		θ_{y+}	35		45	-		
		θ_{y-}	10		20	-		
	NTSC Ratio(Gamut)	-	-	40	40	-	%	

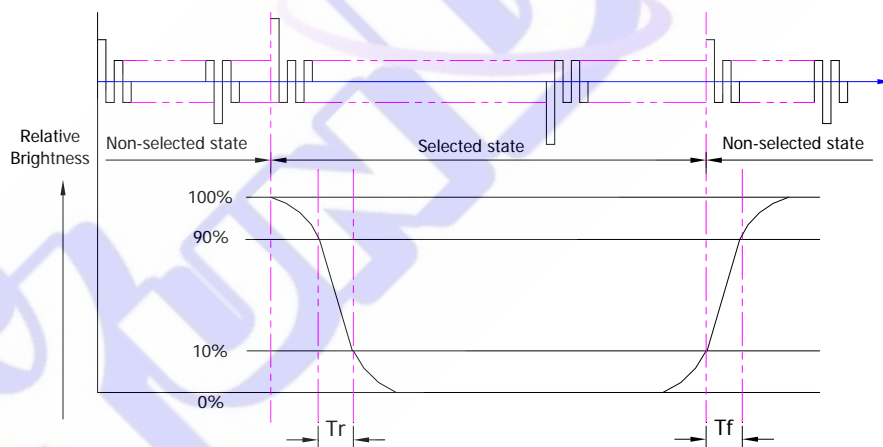
6.2. Definition of Response Time

6.2.1. Normally Black Type (Negative)



T_r is the time it takes to change from non-selected state with relative luminance 10% to selected state with relative luminance 90%;
 T_f is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

6.2.2. Normally White Type (Positive)



T_r is the time it takes to change from non-selected state with relative luminance 90% to selected state with relative luminance 10%;
 T_f is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

6.3. Definition of Contrast Ratio

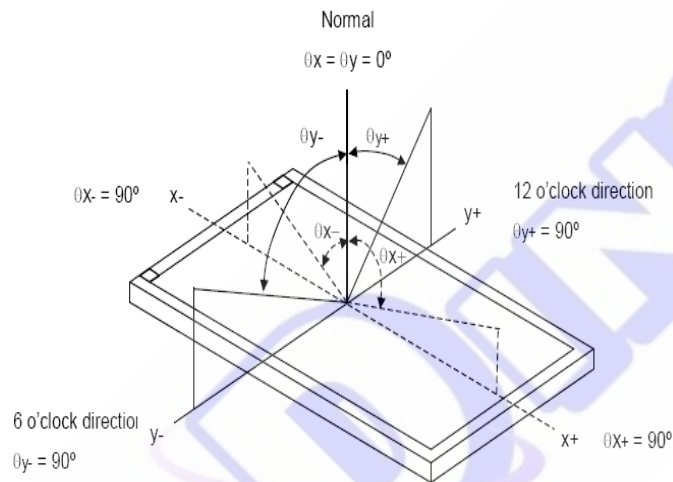
Contrast is measured perpendicular to display surface in reflective and transmissive mode.

The measurement condition is:

Measuring Equipment	BM-7 or EQUI
Measuring Point Diameter	3mm//1mm
Measuring Point Location	Active Area centre point
Test pattern	A: All Pixels white
	B: All Pixel black
Contrast setting	Maximum

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel

6.4. Definition of Viewing Angles



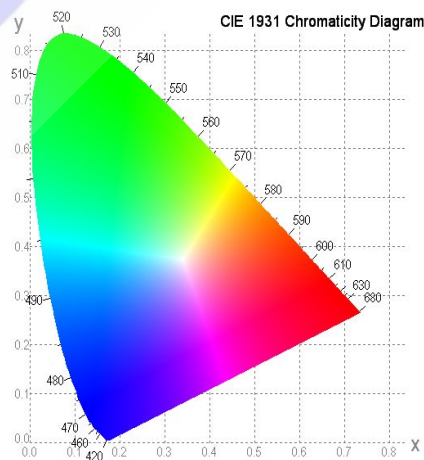
Measuring machine: LCD-5100 or EQUI

6.5. Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)



6.6. Definition of Surface Luminance, Uniformity and Transmittance

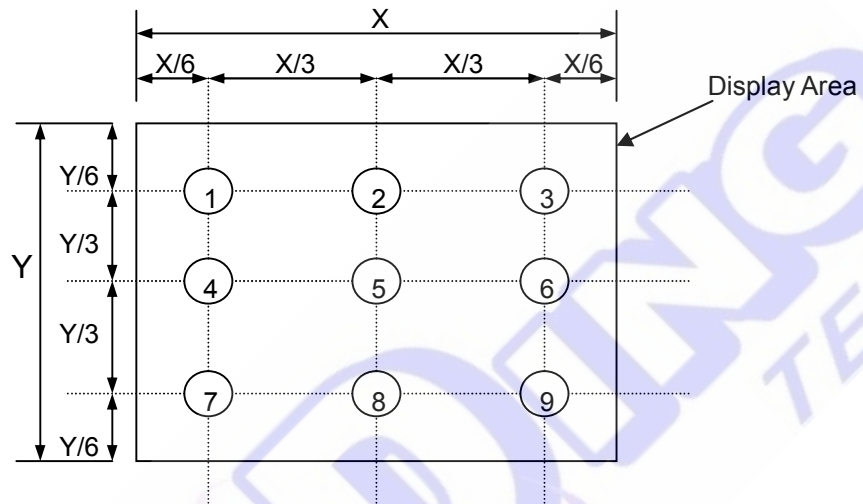
Using the transmissive mode measurement approach, measure the white screen luminance of the display panel and backlight.

6.6.1. Surface Luminance: $L_V = \text{average} (L_{P1}:L_{P9})$

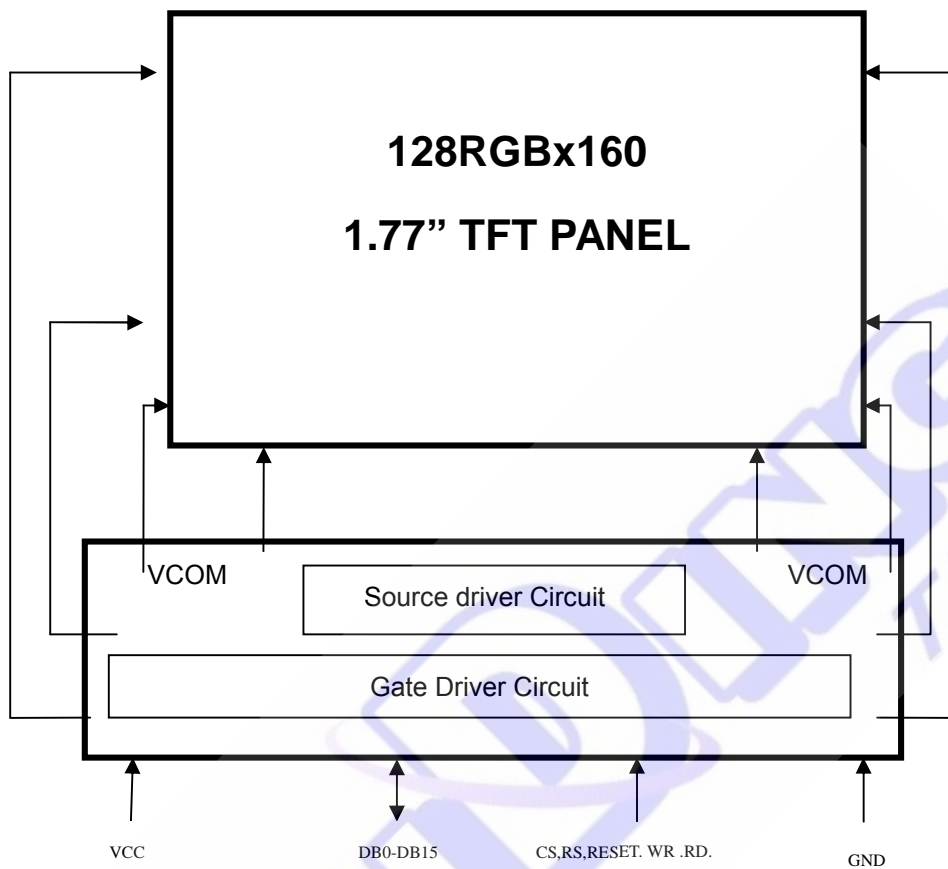
6.6.2. Uniformity = $\text{Minimal} (L_{P1}:L_{P9}) / \text{Maximal} (L_{P1}:L_{P9}) * 100\%$

6.6.3. Transmittance = $L_V \text{ on LCD} / L_V \text{ on Backlight} * 100\%$

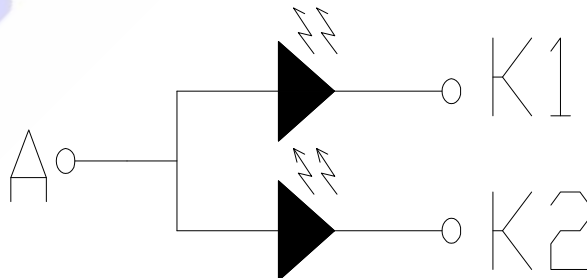
Note : Measuring machine: BM-7



7. Block Diagram and Power Supply



LED CIRCUIT DIAGRAM:



8. Interface Pins Definition

8.1. Module interface

No.	Symbol	I/O	DESCRIPTION
1	GND	p	Ground
2	LEDK1	P	Back light cathode
3	LEDA	P	Back light anode
4	LEDK2	P	Back light cathode
5	VCC	P	Analog Supply Voltage
6	ID		No Connect
7	IM0	I	System interface select. Low: 8-bit bus interface, High: 16-bit bus interface
8	CS	I	Chip selection
9~24	DB15~DB0	I	Data input
25	RD	I	Read signal
26	WR	I	Write signal
27	RS	I	Command/Data select signal
28	RESET	I	Reset signal
29	IOVCC	P	Logic Supply Voltage
30~32	NC		No Connect
33	GND	P	Ground

9. AC Characteristics

9.1. Reset timing

Please refer to IC datasheet.

9.2. interface timing

9.2.1. MCU interface timing requirement 1

Please refer to IC datasheet

10. Command Table

Please refer to IC datasheet.



11. Recommended Setting and Initialization Flow for Reference.

TBD.

12. Quality Assurance

12.1. Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer by Inteltronic display

12.2. Agreement Items

Inteltronic and customer shall negotiate if the following situation occurs:

12.4.1 Discrepancies between Inteltronic's QA standards and customer's QA standards.

12.4.2 Additional requirement to be added in product specification.

12.4.3 Any other special problem.

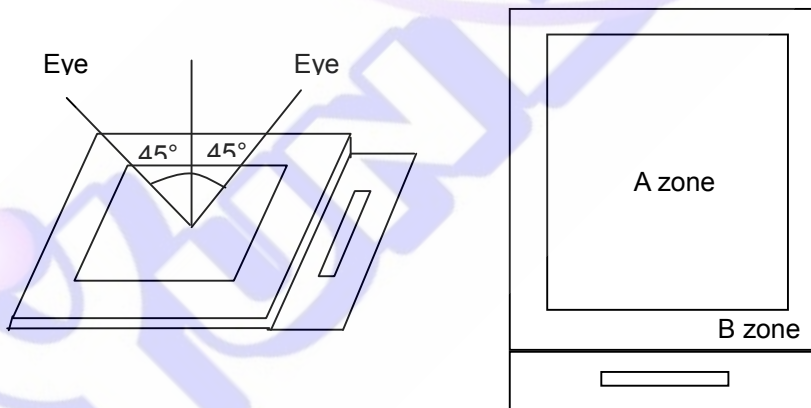
12.3. Standard of the Product Visual Inspection

12.3.1 Appearance inspection:

12.3.1.1 The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm \pm 2cm.

12.3.1.2 The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

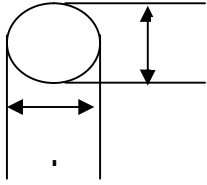
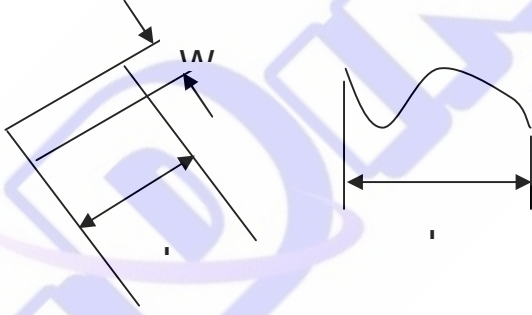
12.3.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area,

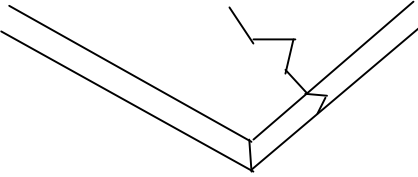


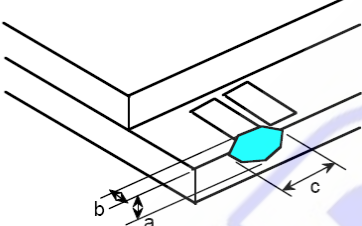
12.3.2 Basic principle:

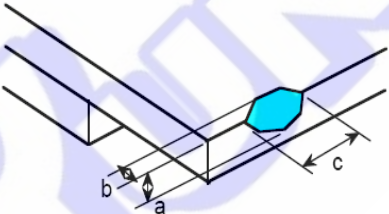
12.3.2.1 A set of sample to indicate the limit of acceptable quality level must be discussed by both Inteltronic and customer when there is any dispute happened.

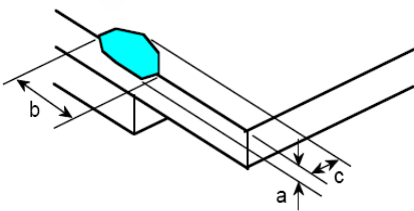
12.4. Inspection Specification

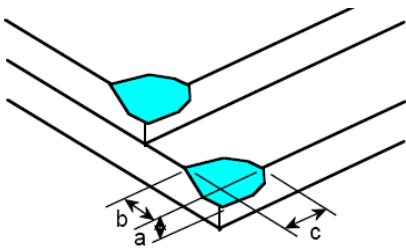
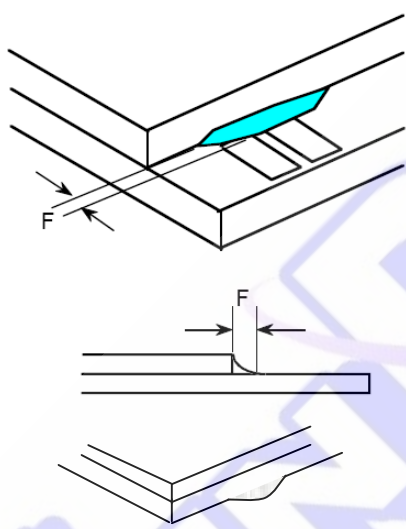
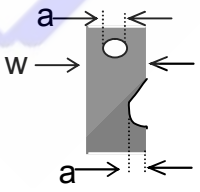
No.	Item	Criteria (Unit: mm)																		
01	Black / White spot Foreign material (Round type) Pinholes Stain Particles inside cell. (Minor defect)	 <table border="1" data-bbox="852 416 1353 757"> <thead> <tr> <th>Size</th> <th>Area</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td></td> <td>Ignore</td> </tr> <tr> <td>$0.10 < \phi \leq 0.20$</td> <td></td> <td>2</td> </tr> <tr> <td>$0.20 < \phi \leq 0.25$</td> <td></td> <td>1</td> </tr> <tr> <td>$0.25 < \phi$</td> <td></td> <td>0</td> </tr> <tr> <td>Total</td> <td></td> <td>2 no include $\phi \leq 0.10$</td> </tr> </tbody> </table> <p data-bbox="611 712 770 745">$\phi = (a + b) / 2$</p> <p data-bbox="611 835 1297 869">Distance between 2 defects should more than 3mm apart.</p>	Size	Area	Acc. Qty	$\phi \leq 0.10$		Ignore	$0.10 < \phi \leq 0.20$		2	$0.20 < \phi \leq 0.25$		1	$0.25 < \phi$		0	Total		2 no include $\phi \leq 0.10$
Size	Area	Acc. Qty																		
$\phi \leq 0.10$		Ignore																		
$0.10 < \phi \leq 0.20$		2																		
$0.20 < \phi \leq 0.25$		1																		
$0.25 < \phi$		0																		
Total		2 no include $\phi \leq 0.10$																		
02	Black and White line Scratch Foreign material (Line type) (Minor defect)	 <table border="1" data-bbox="671 1328 1297 1597"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>/</td> <td>$W \leq 0.03$</td> <td>Ignore</td> </tr> <tr> <td>$L \leq 2$</td> <td>$0.03 < W \leq 0.05$</td> <td>1</td> </tr> <tr> <td>/</td> <td>$0.05 < W$</td> <td>0</td> </tr> <tr> <td colspan="2">Total</td> <td>1</td> </tr> </tbody> </table> <p data-bbox="611 1641 1361 1753">Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.</p>	Length	Width	Acc. Qty	/	$W \leq 0.03$	Ignore	$L \leq 2$	$0.03 < W \leq 0.05$	1	/	$0.05 < W$	0	Total		1			
Length	Width	Acc. Qty																		
/	$W \leq 0.03$	Ignore																		
$L \leq 2$	$0.03 < W \leq 0.05$	1																		
/	$0.05 < W$	0																		
Total		1																		

03	Glass Crack (Minor defect)	 <p>LCD with extensible crack line is unacceptable(When press the cracked LCD area, the line will expand, we define it is extensible crack line)</p>
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04	Glass Chipping Pad Area: (Minor defect)	 <table border="1" data-bbox="869 880 1337 1010"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c < 5.0, b < 0.4$</td> <td>Ignore</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c < 5.0, b < 0.4$	Ignore	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty							
$c < 5.0, b < 0.4$	Ignore							
$a < \text{Glass Thickness}$								

05	Glass Chipping Rear of Pad Area: (Minor defect)	 <table border="1" data-bbox="869 1178 1337 1395"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>2</td> </tr> <tr> <td>$c < 3.0, b < 0.5$</td> <td>4</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	2	$c < 3.0, b < 0.5$	4	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	2											
$c < 3.0, b < 0.5$	4											
$a < \text{Glass Thickness}$												

06	Glass Chipping Except Pad Area: (Minor defect)	 <table border="1" data-bbox="869 1637 1337 1767"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c \leq 0.6, b < 5.0$</td> <td>Ignore</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c \leq 0.6, b < 5.0$	Ignore	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty							
$c \leq 0.6, b < 5.0$	Ignore							
$a < \text{Glass Thickness}$								

07	<p>Glass Corner Chipping: (Minor defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c < 2.0, b < 1.5$</td> <td>Ignore</td> </tr> <tr> <td>$c < 1.5, b < 2$</td> <td>Ignore</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c < 2.0, b < 1.5$	Ignore	$c < 1.5, b < 2$	Ignore	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty									
$c < 2.0, b < 1.5$	Ignore									
$c < 1.5, b < 2$	Ignore									
$a < \text{Glass Thickness}$										
08	<p>Glass Burr: (Minor defect)</p> 	<table border="1"> <thead> <tr> <th>Length</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$F < 0.5$</td> <td>Ignore</td> </tr> </tbody> </table> <p>Glass burr don't affect assemble and module dimension.</p>	Length	Acc. Qty	$F < 0.5$	Ignore				
Length	Acc. Qty									
$F < 0.5$	Ignore									
09	<p>FPC Defect: (Minor defect)</p> 	<p>9.1 Dent, pinhole width $a < w/3$. (w: circuitry width.)</p> <p>9.2 Open circuit is unacceptable.</p> <p>9.3 No oxidation, contamination and distortion.</p>								

10	Bubble on Polarizer (Minor defect)	<table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>2</td> </tr> <tr> <td>$0.30 < \varphi$</td> <td>None</td> </tr> </tbody> </table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	2	$0.30 < \varphi$	None
		Diameter	Acc. Qty							
		$\varphi \leq 0.20$	Ignore							
		$0.20 < \varphi \leq 0.30$	2							
$0.30 < \varphi$	None									
11	Dent on Polarizer (Minor defect)	<table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>2</td> </tr> <tr> <td>$0.30 < \varphi$</td> <td>None</td> </tr> </tbody> </table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	2	$0.30 < \varphi$	None
		Diameter	Acc. Qty							
		$\varphi \leq 0.20$	Ignore							
		$0.20 < \varphi \leq 0.30$	2							
$0.30 < \varphi$	None									
12	Bezel	12.1 No rust, distortion on the Bezel.								
		12.2 No visible fingerprints, stains or other contamination.								
13	Touch Panel	D: Diameter W: width L: length 13.1 Spot: $D \leq 0.20$ is acceptable $0.20 < D \leq 0.3$, acceptable QTY, 3 2dots are acceptable and the distance between defects should more than 10 mm. $D > 0.3$ is unacceptable 13.2 Dent: $D > 0.30$ is unacceptable 13.3 Scratch: $W \leq 0.03$, $L \leq 10$ is acceptable, $0.03 < W \leq 0.10$, $L \leq 10$, acceptable QTY, 3 Distance between 2 defects should more than 10 mm. $W > 0.10$ is unacceptable.								
		14.1 No distortion or contamination on PCB terminals. 14.2 All components on PCB must same as documented on the BOM/component layout. 14.3 Follow IPC-A-600F.								
14	PCB	14.1 No distortion or contamination on PCB terminals. 14.2 All components on PCB must same as documented on the BOM/component layout. 14.3 Follow IPC-A-600F.								
15	Soldering	Follow IPC-A-610C standard								
16	Electrical Defect (Major defect)	The below defects must be rejected.								
		16.1 Missing vertical / horizontal segment, 16.2 Abnormal Display. 16.3 No function or no display. 16.4 Current exceeds product specifications. 16.5 LCD viewing angle defect. 16.6 No Backlight.								

		<p>16.7 Dark Backlight.</p> <p>16.8 Touch Panel no function.</p> <p>16.9 Dark Dot –one Allowed.</p> <p>16.10 Bright Dot – one Allowed.</p> <p>Remark:</p> <p>1. A pixel defect is acceptable if one color is none functional and causes a bright dot. The display may have one case where one color is out and cause a dark dot.</p> <p>2. Bright dot caused by scratch and foreign object accords to item 1.</p>
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Remark: Visual and cosmetic defects are rejectable only if these fall within the LCD viewing area.

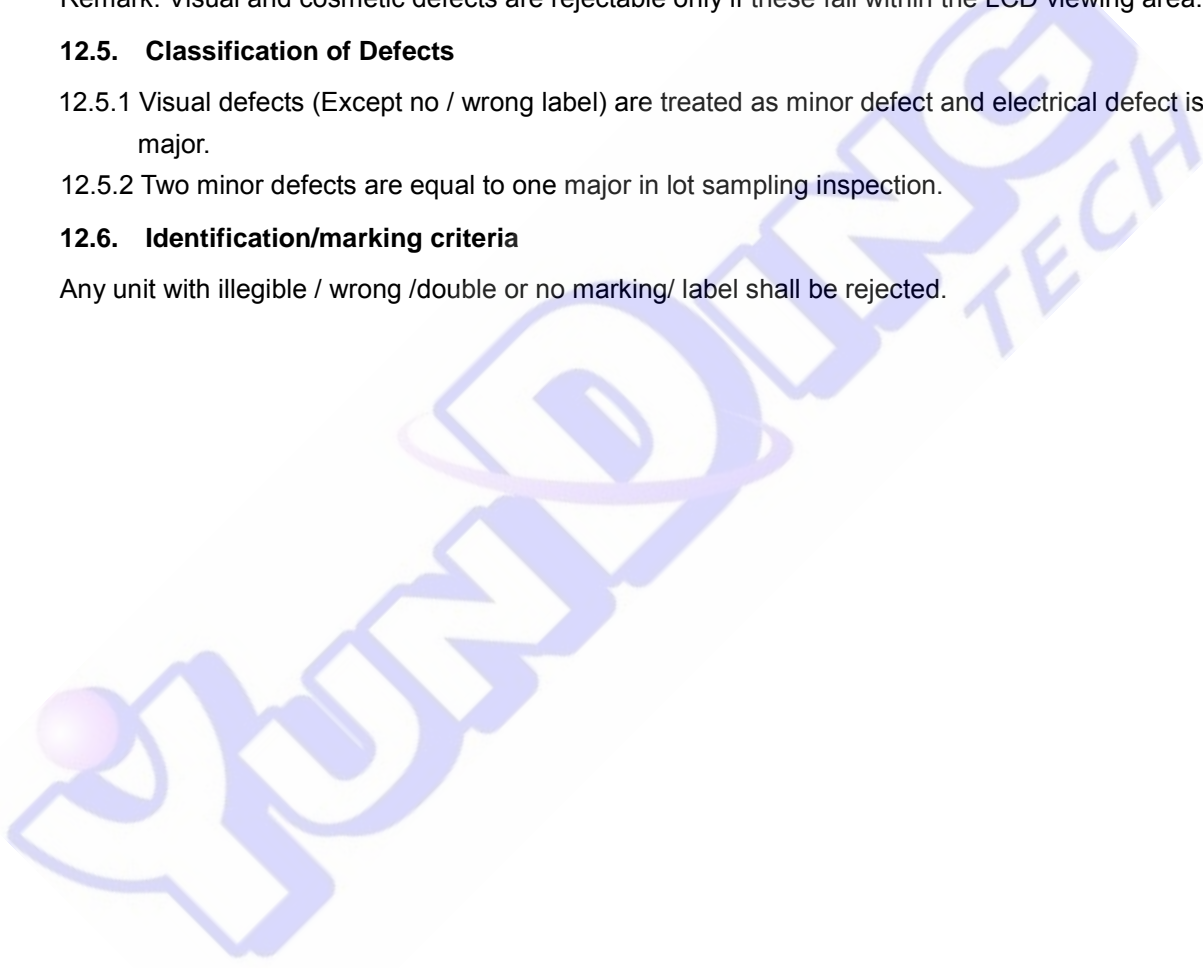
12.5. Classification of Defects

12.5.1 Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.

12.5.2 Two minor defects are equal to one major in lot sampling inspection.

12.6. Identification/marketing criteria

Any unit with illegible / wrong /double or no marking/ label shall be rejected.



13. Reliability Specification

Item	Condition	Cycle Time	Quantity	Remark
Constant Temp. and Constant Humidity Operation Test	+40 ± 3°C, 90 ± 3%RH	120hrs	--	*1
High Temp. Operation Test	+70 ± 3°C	120hrs	--	
Low Temp. Operation Test	-20 ± 3°C	120hrs	--	
Thermal Shock Test	-20 ± 3°C (30min) +70 ± 3°C (30min)	10cycles	--	
ESD Test(end product)	150pF, 330Ω, ±2KV, Contact	10times	--	*2, *3
	150pF, 330Ω, ±6KV, Air			
Vibration Test (for packaging)	Frequency: 10Hz to 55Hz to 10Hz, Swing:1.5mm,time: X,Y,Z each 2H.	6hrs	One inner carton	*4

Note 1. For humidity test, DI water should be used.

Inspection Standard: Inspect after 1-2hrs storage at room temperature, the sample shall be free from the following defects:

- Air bubble in the LCD
- Seal Leakage
- Non-display
- Missing Segment
- Glass Crack
- IDD is greater than twice initial value.
- Others as per QA Inspection Criteria

Note 2. No defect is allowed after testing

The End Product ESD value is only indicative and depends on customer ESD protection design for the whole system

Note 3. ESD should be applied to LCD glass panel, not other areas (such as on IC and so on) IDD should be within twice initial value.

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.

Note 4. Only upon request.

14. Precautions

14.1. Safety

14.1.1 The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

14.1.2 Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

14.2. Handling

14.2.1 Reverse and use within ratings in order to keep performance and prevent damage.

14.2.2 Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

14.3. Operation

14.3.1 Do not drive LCD with DC voltage

14.3.2 Response time will increase below lower temperature

14.3.3 Display may change color with different temperature

14.3.4 Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear "fractured".

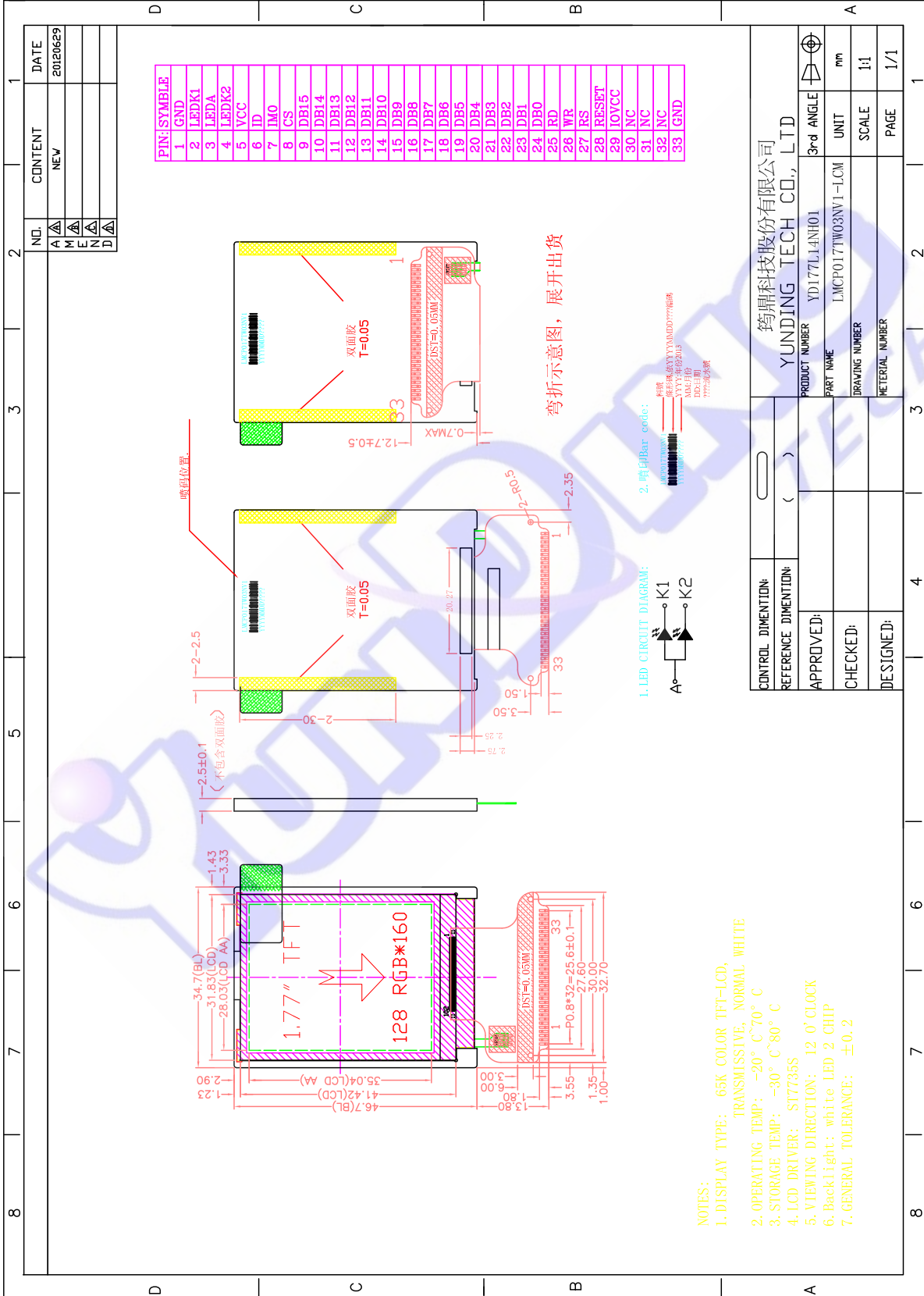
14.4. Static Electricity

14.4.1 CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.

14.4.2 The normal static prevention measures should be observed for work clothes and benches.

14.4.3 The module should be kept into anti-static bags or other containers resistant to static for storage.

15. Assembly Drawing



- NOTES:
1. DISPLAY TYPE: 65K COLOR TFT-LCD, TRANSMISSIVE, NORMAL WHITE
 2. OPERATING TEMP: -20° C~70° C
 3. STORAGE TEMP: -30° C~80° C
 4. LCD DRIVER: ST7735S
 5. VIEWING DIRECTION: 12 O'CLOCK
 6. Backlight: white LED 2 CHIP
 7. GENERAL TOLERANCE: ±0.2

Reference

Item	Description	Revision
ST7735S	IC Data sheet	V01
	LCM assembly drawing	R0

