

PRODUCT : **TFT LCD MODULE**

MODULE NO. : **WKS28186**

SUPPLIER: **WKS Technology Co., LTD**

DATE: **Aug 15, 2019**

SPECIFICATION

Revision: 0.0

WKS28186

This module uses ROHS material

This specification may change without prior notice in order to improve performance or quality. Please contact WKS R&D department for updated specification and product status before design for this product or release of this order.

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REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
0.0	2019-08-15	First release	Preliminary

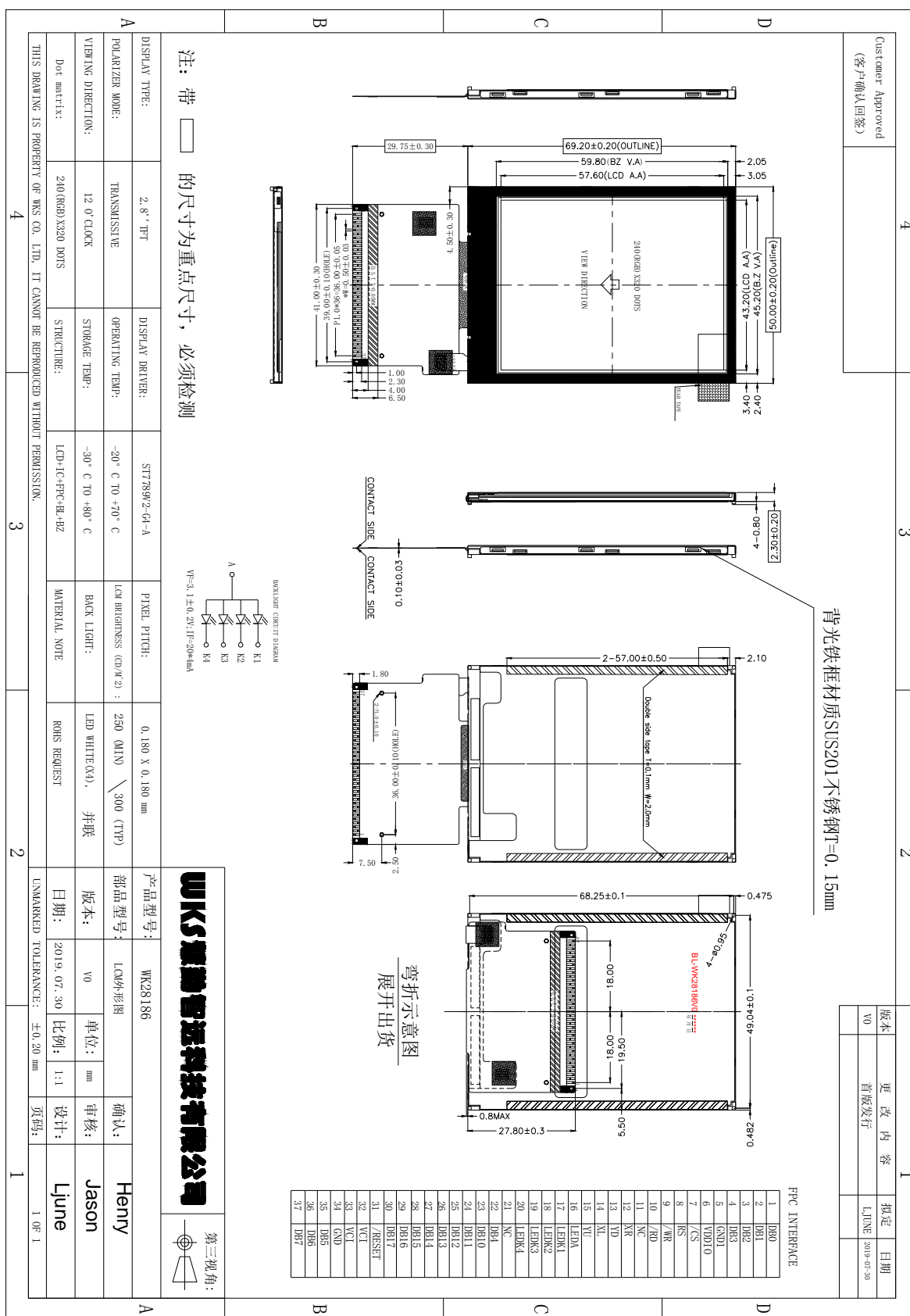
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1、GENERAL INFORMATION

<i>Item of general information</i>	<i>Contents</i>	<i>Unit</i>
<i>LCD Display Size (Diagonal)</i>	2.8	<i>inch</i>
<i>LCD Display Type</i>	TFT/TRANSMISSIVE	-
<i>LCD Display Mode</i>	Normally White	-
<i>Recommended Viewing Direction</i>	6	<i>o'clock</i>
<i>Gray inversion Direction</i>	12	<i>o'clock</i>
<i>LCM Module size (W×H×T)</i>	50.00×69.20×2.30	<i>mm</i>
<i>Active area (W×H)</i>	43.20×57.60	<i>mm</i>
<i>Number of pixels (Resolution)</i>	240RGB×320	<i>pixel</i>
<i>Pixel pitch (W×H)</i>	0.180×0.180	<i>mm</i>
<i>Color Pixel Arrangement</i>	RGB Stripe	-
<i>LCD Driver IC</i>	ST7789V	-
<i>Interface Type</i>	16bit MCU Interface	-
<i>Color Numbers</i>	65K	-
<i>Backlight Type</i>	White LED	-

2. EXTERNAL DIMENSIONS



3、ABSOLUTE MAXIMUM RATINGS

<i>Parameter of absolute maximum ratings</i>	<i>Symbol</i>	<i>Min</i>	<i>Max</i>	<i>Unit</i>
Analog Operating Voltage	VCI	-0.3	4.6	V
Logic Operating Voltage	VDDIO	-0.3	4.6	V
Operating temperature	Top	-20	70	℃
Storage temperature	Tst	-30	80	℃
Humidity	RH	-	90%(Max 60 ℃)	RH

Note: Absolute maximum ratings mean the product can withstand short-term, not more than 120 hours. If the product is a long time to withstand these conditions, the life time would be shorter.

4、ELECTRICAL CHARACTERISTICS(DC CHARACTERISTICS)

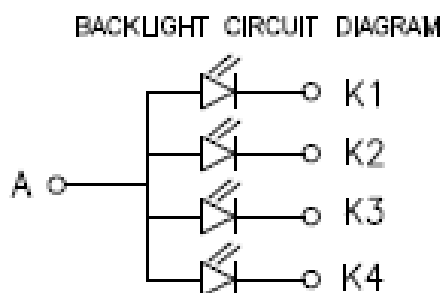
<i>Parameter of DC characteristics</i>	<i>Symbol</i>	<i>Min.</i>	<i>Typ.</i>	<i>Max.</i>	<i>Unit</i>
Analog Operating Voltage	VCI	2.5	2.8	3.3	V
Logic Operating Voltage	VDDIO	1.65	2.8	3.3	
Input voltage 'H' level	VIH	0.7*VDDIO	-	VDDIO	V
Input voltage 'L' level	VIL	VSS	-	0.3*VDDIO	V
Output voltage 'H' level	VOH	0.8*VDDIO	-	VDDIO	V
Output voltage 'L' level	VOL	VSS	-	0.2*VDDIO	V

5、BACKLIGHT CHARACTERISTICS

<i>Item of backlight characteristics</i>	<i>Symbol</i>	<i>Min.</i>	<i>Typ.</i>	<i>Max.</i>	<i>Unit</i>	<i>Remark</i>
<i>Forward Voltage</i>	<i>V_f</i>	3.0	3.2	3.4	<i>V</i>	<i>Note1</i>
<i>Forward Current</i>	<i>I_f</i>	-	80	-	<i>mA</i>	-
<i>Number of LED</i>	-	-	4	-	<i>Piece</i>	-
<i>LED Connection mode</i>	<i>P/S</i>	-	<i>Parallel</i>	-	-	-
<i>Lifetime of LED</i>	-	-	10000	-	<i>hour</i>	<i>Note2</i>

Note:

- *Note1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and I_f=80mA.*
- *Note2: The LED lifetime define as the estimated time to 50% degradation of initial luminous. The LED lifetime could be decreased if operating I_f is larger than 80mA.*
- *Backlight circuit:*



6、ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	Note
Response time		Tr+Tf	$\theta=0$ $\phi=0$ Ta=25 °C	-	25	-	ms	FIG 1.	4
Contrast Ratio		CR		-	300	-	-	FIG 2.	1
Luminance uniformity		$\delta WHITE$		-	80	-	%	FIG 2.	3
Surface Luminance		Lv		250	300	-	cd/m2	FIG 2.	2
CIE (x, y) chromaticity	White	White x	$\theta=0$ $\phi=0$ Ta=25 °C	-	0.308	-	-	FIG 2.	5
		White y		-	0.339	-			
	Red	Red x		-	0.652	-			
		Red y		-	0.331	-			
	Green	Green x		-	0.314	-			
		Green y		-	0.575	-			
	Blue	Blue x		-	0.138	-			
		Blue y		-	0.132	-			
Viewing angle range	$\phi=90(12\text{ o'clock})$		CR ≥ 10	-	60	-	deg	FIG 3.	6
	$\phi=270(6\text{ o'clock})$			-	55	-	deg		
	$\phi=0(3\text{ o'clock})$			-	50	-	deg		
	$\phi=180(9\text{ o'clock})$			-	50	-	deg		
NTSC ratio		-	-	-	61	-	%	-	-

Note 1. Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG 2.:

$$\text{Contrast Ratio(CR)} = \frac{\text{Average Surface Luminance with all white pixels(P1,P2,P3,P4,P5,P6,P7,P8,P9)}}{\text{Average Surface Luminance with all black pixels(P1,P2,P3,P4,P5,P6,P7,P8,P9)}}$$

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

L_v =Average Surface Luminance with all white pixels (P1,P2,P 3,P4, P5,P6,P7,P8,P9)

Note 3. The uniformity in surface luminance ($\delta WHITE$) is determined by measuring

luminance at each test position 1 through 9, and then dividing the maximum luminance of 9 points luminance by minimum luminance of 9 points luminance. For more information see FIG 2.

$$\delta_{\text{WHITE}} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5, P6, P7, P8, P9)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5, P6, P7, P8, P9)}}$$

Note 4. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 1.

Note 5. CIE (x, y) chromaticity ,The x,y value is determined by screen active area position 5. For more information see FIG 2.

Note 6. Viewing angle is the angle at which the contrast ratio is greater than a specific value. For TFT module, the specific value of contrast ratio is 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 3.

Note 7. For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface Luminance, Luminance uniformity and CIE, the testing data is base on BM-7 photo detector.

Note 8. For TN type TFT transmissive module, Gray scale reverse occurs in the direction of panel viewing angle.

FIG.1. The definition of Response Time

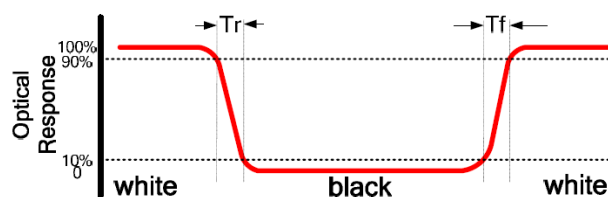


FIG.2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity,

CIE (x , y) chromaticity

$A : H/6 ;$

$B : V/6 ;$

$H, V : \text{Active Area(AA) size}$

Measurement instrument: BM-7; Light spot size=5mm, 350mm distance from the LCD surface to detector lens.

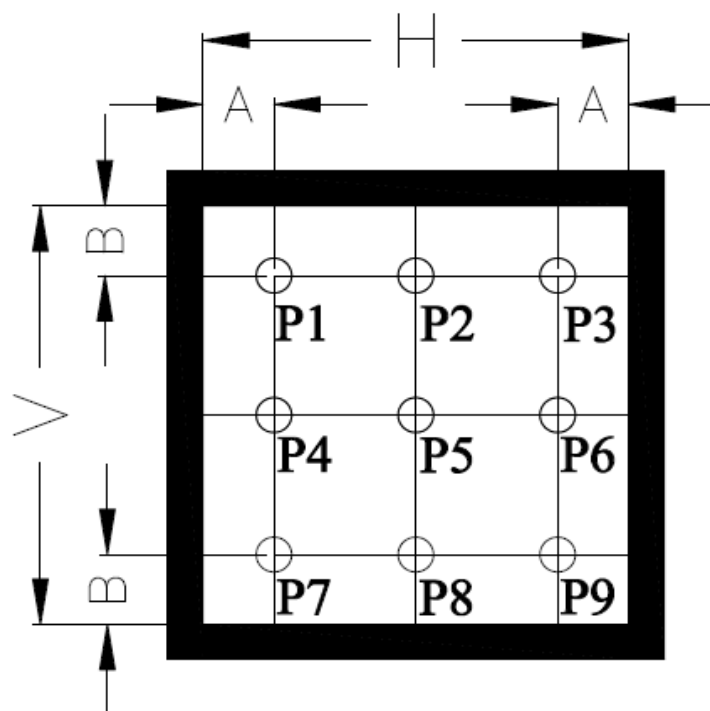
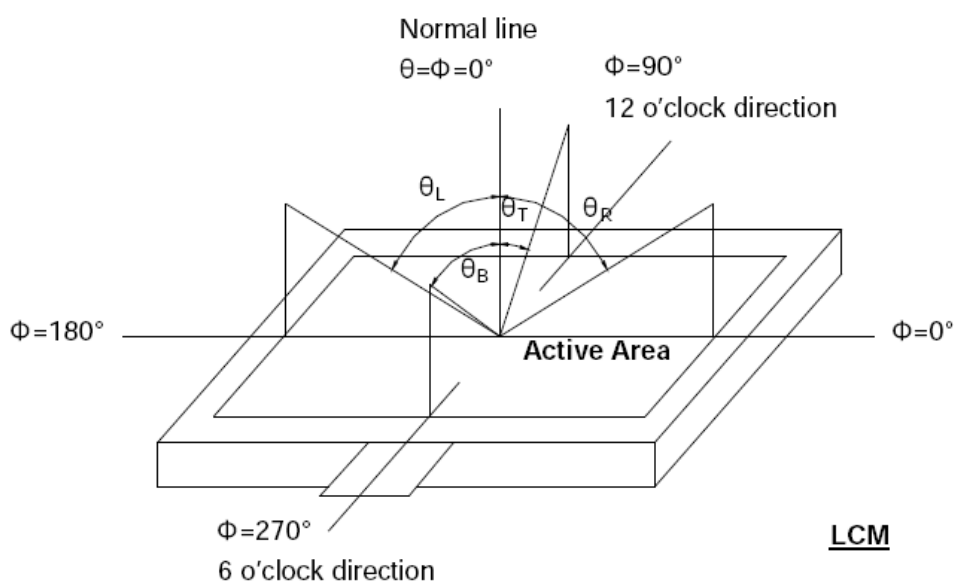


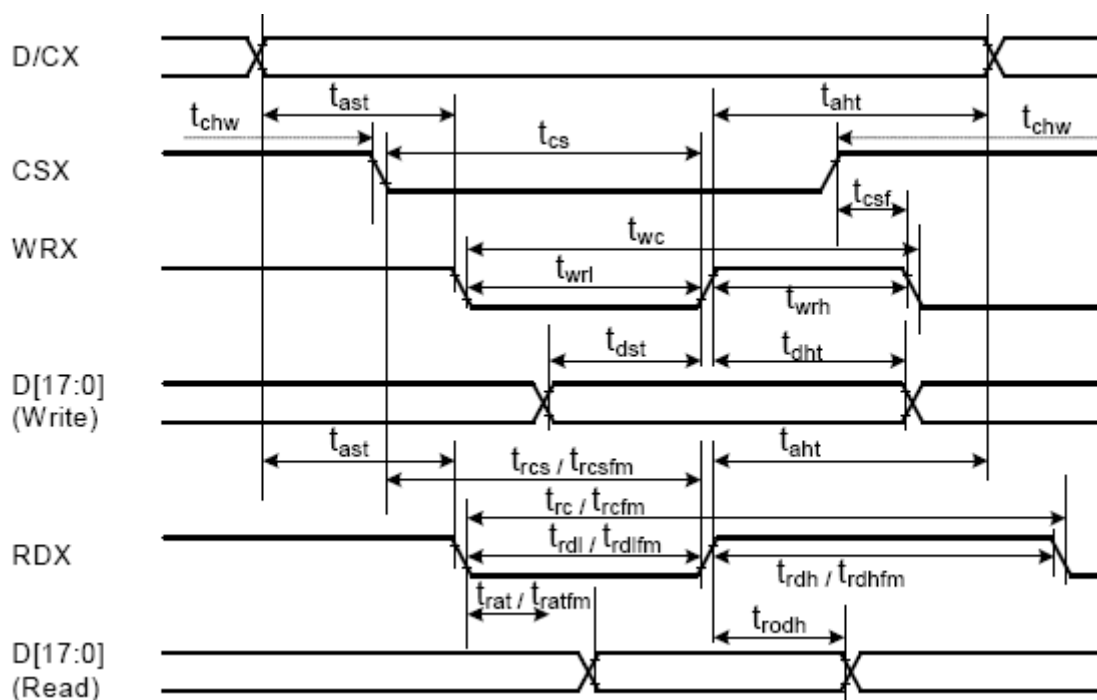
FIG.3. The definition of viewing angle



7、INTERFACE DESCRIPTION

NO.	Symbol	I/O	DESCRIPTION
1~4	DB0~DB3	I/O	Data bus
5	GND	Power supply	Power ground
6	VDDIO	Power supply	Power supply to the I/O. VDDI=1.65~3.3V
7	CS	I	Chip select
8	RS	I	Data/Command select
9	WR	I	Write strobe signal
10	RD	I	Read strobe signal
11	NC	-	No Connection
12	XR	I	RTP pin
13	YD	I	RTP pin
14	XL	I	RTP pin
15	YU	I	RTP pin
16	LEDA	Power supply	Backlight Anode
17~20	LEDK1~LEDK4	Power supply	Backlight Cathode
21	NC	-	No Connection
22	DB4	I/O	Data bus
23~30	DB8~DB15	I/O	Data bus
31	RESET	I	LCD RESET signal, Low is active
32~33	VCI	Power supply	Power supply to the liquid crystal power supply analog circuit.
34	GND	Power supply	Power ground
35~37	DB5~DB7	I/O	Data bus

8、INPUT TIMING



Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchwh	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: $T_a = -30$ to 70°C , $V_{DDI}=1.65\text{V}$ to 3.3V , $V_{CI}=2.5\text{V}$ to 3.3V , $V_{SS}=0\text{V}$

9、RELIABILITY TEST CONDITIONS

No.	Test Item	Test Condition
1	High Temperature Storage	80 °C/120 hours
2	Low Temperature Storage	-30 °C/120 hours
3	High Temperature Operating	70 °C/120 hours
4	Low Temperature Operating	-20 °C/120 hours
5	Temperature Cycle Storage	-20 °C(30min.)~25(5min.)~70 °C(30min.)×10cycles

A、Inspection after test:

Inspection after 2~4 hours storage at room temperature, the sample shall be free from defects:

- Air bubble in the LCD;
- Sealleak;
- Non-display;
- Missing segments;
- Glass crack;
- Current is twice higher than initial value.

B、Remark:

- The test samples should be applied to only one test item.
- Sample size for each test item is 5~10pcs.
- Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

10、INSPECTION CRITERION

This specification is made to be used as the standard of acceptance/rejection criteria for TFT-LCD/IPS TFT-LCD module product, and this specification is applicable only in the case that the size of module equal to or exceed than 4.3 inch.

10.1 Sample plan

Sampling plan according to GB/T2828.1-2003/ISO 2859-1: 1999 and ANSI/ASQC Z1.4-1993,normal level 2 and based on:

Major defect: AQL 0.65

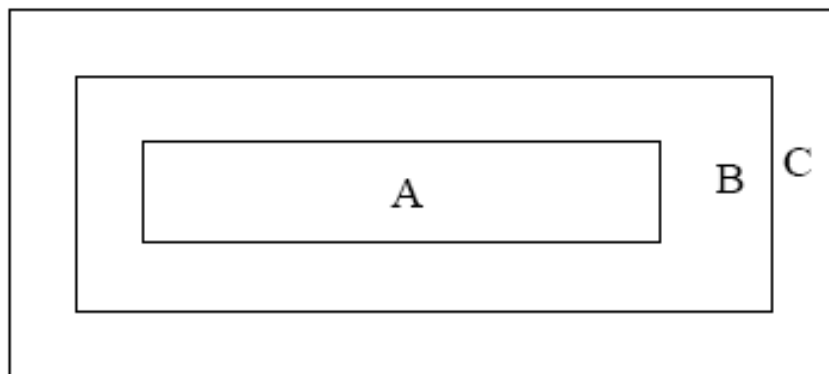
Minor defect: AQL 1.5

10.2 Inspection condition

Viewing distance for cosmetic inspection is about 30cm with bare eyes, and under an environment of 20~40W light intensity, all directions for inspecting the sample should be within 45 °against perpendicular line. (Normal temperature 20~25 °C and normal humidity 60 ±15%RH)

10.3 Definition of Inspection Item.

A、 Definition of inspection zone in LCD.



Zone A: character/Digit area

Zone B: viewing area except Zone A (Zone A + Zone B=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)

Fig.1 Inspection zones in an LCD

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

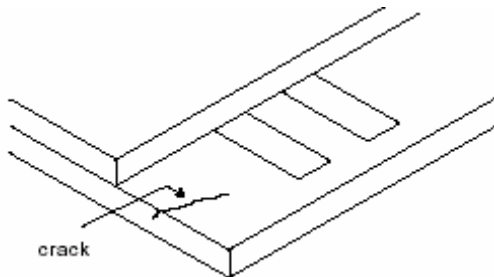
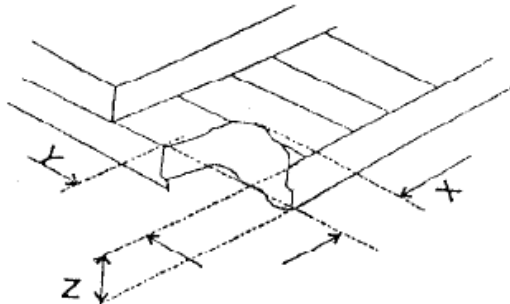
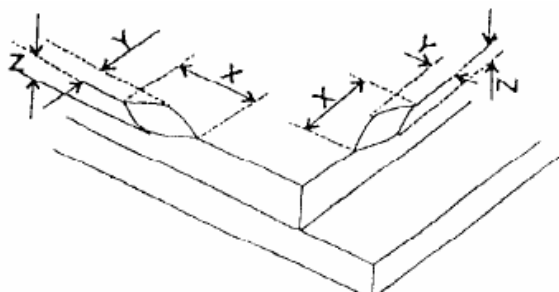
B、 Definition of some visual defect

<i>Bright dot</i>	<i>Because of losing all or part function, bad pixel dots appear bright and the size is more than 50% of one dot in which LCD panel is displaying under black pattern.</i>
<i>Dark dot</i>	<i>Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture, or pure whiter picture.</i>


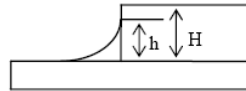
10.4 Major Defect

Item No.	Items to be inspected	Inspection standard	Classification of defects
1	Functional defects	1) No display 2) Display abnormally 3) Missing vertical, horizontal segment 4) Short circuit 5) Excess power consumption 6) Backlight no lighting, flickering and abnormal lighting	major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	

4	Polarizer defect	<p>5.4.1 Polarizer Position</p> <p>(i) Shifting in position should not exceed the glass outline dimension.</p> <p>(ii) Incomplete covering of the viewing area due to shifting is not allowed.</p> <p>5.4.2 Dirt on polarizer</p> <p>Dirt which can be wiped easily should be acceptable.</p> <p>5.4.3 Polarizer Dent & Air bubble</p> <table><tr><th colspan="2" rowspan="2">Zone Size(mm)</th><th colspan="3">Acceptable Qty</th><th rowspan="2">C</th></tr><tr><th colspan="3">A+B</th></tr><tr><th colspan="2"></th><th>4.3''~7''</th><th>7~10.1''</th><th>>10.1''</th><th></th></tr><tr><td colspan="2">$\Phi \leq 0.2$</td><td>Acceptable</td><td>Acceptable</td><td>Acceptable</td><td rowspan="3">Acceptable</td></tr><tr><td colspan="2">$0.2 < \Phi \leq 0.5$</td><td>4</td><td>5</td><td>6</td></tr><tr><td colspan="2">$\Phi > 0.5$</td><td>0</td><td>0</td><td>0</td></tr></table> <p>5.4.4 Polarizer scratch</p> <p>(i) If the polarizer scratch can be seen after cover assembling or in the operating condition, judge by the linear defect of 5.3.</p> <p>(ii) If the polarizer scratch can be seen only in non-operating condition or some special angle, judge by the following:</p> <table><tr><th colspan="2" rowspan="2">Zone Size (mm)</th><th colspan="3">Acceptable Qty</th><th rowspan="2">C</th></tr><tr><th colspan="3">A+B</th></tr><tr><th>Length</th><th>Width</th><th>4.3''~7''</th><th>7~10.1''</th><th>>10.1''</th><th></th></tr><tr><td>Ignore</td><td>$W \leq 0.05$</td><td>Acceptable</td><td>Acceptable</td><td>Acceptable</td><td rowspan="3">Acceptable</td></tr><tr><td>$1.0 < L \leq 5.0$</td><td>$0.05 < W \leq 0.20$</td><td>4</td><td>5</td><td>6</td></tr><tr><td>$L > 5.0$</td><td>$W > 0.2$</td><td>0</td><td>0</td><td>0</td></tr></table>	Zone Size(mm)		Acceptable Qty			C	A+B					4.3''~7''	7~10.1''	>10.1''		$\Phi \leq 0.2$		Acceptable	Acceptable	Acceptable	Acceptable	$0.2 < \Phi \leq 0.5$		4	5	6	$\Phi > 0.5$		0	0	0	Zone Size (mm)		Acceptable Qty			C	A+B			Length	Width	4.3''~7''	7~10.1''	>10.1''		Ignore	$W \leq 0.05$	Acceptable	Acceptable	Acceptable	Acceptable	$1.0 < L \leq 5.0$	$0.05 < W \leq 0.20$	4	5	6	$L > 5.0$	$W > 0.2$	0	0	0	Minor
Zone Size(mm)		Acceptable Qty			C																																																												
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$1.0 < L \leq 5.0$	$0.05 < W \leq 0.20$	4	5	6																																																													
$L > 5.0$	$W > 0.2$	0	0	0																																																													
5	MURA	Using 3% ND filter, it's NG if it can be seen in R,G,B picture.	Minor																																																														
	White/Black dot (MURA)	Visible under: ND3%; $D \leq 0.15\text{mm}$, Acceptable; $0.15\text{mm} < D \leq 0.5\text{mm}$, $N \leq 4$; $D > 0.5\text{mm}$, Not allowable.																																																															

6	Glass defect	<div><div>(i) Crack</div><div>Cracks are not allowed.</div><div></div></div>	Minor								
		<div><div>(ii) TFT chips on corner</div><div></div><table><tr><td>X</td><td>Y</td><td>Z</td><td>Acceptable</td></tr><tr><td>≤3.0</td><td>≤3.0</td><td>Not more than the thickness of glass</td><td>N≤3</td></tr></table><div>Chips on the corner of terminal shall not be allowed to extend into the ITO pad or expose perimeter seal.</div></div>	X	Y	Z	Acceptable	≤3.0	≤3.0	Not more than the thickness of glass	N≤3	Minor
		X	Y	Z	Acceptable						
≤3.0	≤3.0	Not more than the thickness of glass	N≤3								
<div><div>(iii) Usual surface crack</div><div></div><table><tr><td>X</td><td>Y</td><td>Z</td><td>Acceptable</td></tr><tr><td>≤1.5</td><td>≤1.5</td><td>Not more than the thickness of glass</td><td>N≤4</td></tr></table><div>It is only applicable to the upper glass of LCD.</div></div>	X	Y	Z	Acceptable	≤1.5	≤1.5	Not more than the thickness of glass	N≤4	Minor		
X	Y	Z	Acceptable								
≤1.5	≤1.5	Not more than the thickness of glass	N≤4								

10.6 Module Cosmetic Criteria

Item No.	Items to be inspected	Inspection Standard	Classification of defects
1	Difference in Spec.	Not allowable	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing	Major
		No soldering bridge	Major
		No cold soldering	Minor
4	Resist flaw on PCB	Visible copper foil ($\Phi 0.5$ mm or more) on substrate pattern is not allowed	Minor
5	FPC gold finger	No dirt, breaking, oxidation lead to black	Major
6	Backlight plastic frame	No deformation, crack, breaking, backlight positioning column breaking, obvious nick.	Minor
7	Marking printing effect	No dark marking, incomplete, deformation lead to unable to judge	Minor
8	Accretion of metallic Foreign matter	No accretion of metallic foreign matter (Not exceed $\Phi 0.2$ mm)	Minor
9	Stain	No stain to spoil cosmetic badly	Minor
10	Plate discoloring	No plate fading, rusting and discoloring	Minor
11	1. Lead parts	a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the lead form perfectly.	Minor
		b. Components side(In case of 'Through Hole PCB') Solder to reach the Components side of PCB.	Minor
	2. Flat packages	Either 'Toe'(A) or 'Seal'(B) of the lead to be covered by "Filet". Lead form to be assume over Solder. 	Minor
	3. Chips	$(3/2) H \geq h \geq (1/2) H$ 	Minor
	4. Solder ball/Solder splash	a. The spacing between solder ball and the conductor or solder pad $h \geq 0.13$ mm. The diameter of solder ball $d \leq 0.15$ mm.	Minor
		b. The quantity of solder balls or solder splashes isn't beyond 5 in 600 mm ² .	Minor
		c. Solder balls/Solder splashes do not violate minimum electrical clearance.	Major