

Shenzhen Leadtek Electronics Co.,Ltd

PRODUCT SPECIFICATION

TFT-LCD MODULE

Module No: LTK021MNHLM11-V0

☒ Preliminary Specification

☐ Approval Specification

Designed by	Checked by	Approved by
<i>jona</i>	<i>tom</i>	<i>lan</i>

Final Approval by Customer

Approved by	Comment

※The specification of "TBD" should refer to the measured value of sample . If there is difference between the design specification and measured value, we naturally shall negotiate and agree to solution with customer.



Record of Revisions

Rev.	Date	Sub-Model	Description of change
V0	2023.07.18		Preliminary Specification was first released



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1.0 GENERAL DESCRIPTION

1.1 Introduction

Leadtek Display model LTK021MNHLM11-V0 is a mono active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. It is a reflective type display operating in the total reflection. This TFT LCD has a 2.13 inch diagonally measured active display area with 122 horizontal by 250 vertical pixel resolution.

1.2 Features

- 2.13 inch configuration
- Mono by 2 Grey signal input
- RoHS Compliance & Halogen Free

1.3 Applications

- Industrial Control Application

1.4 General Information

Item	Specification	Unit
Outline Dimension	27.07 (H) x 56.20 (V) x 1.02 (T) (Typ.)	mm
Display Area	23.67 (H) x 48.50 (V)	mm
Number of Pixel	122 (H) x 250 (V)	pixels
Pixel Pitch	0.194 (H) x 0.194 (V)	mm
Display Mode	Normally White	

2.0 ABSOLUTE MAXIMUM RATINGS

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

Item	Symbol	Min.	Max.	Unit	Note
LC Operating Voltage	VOP	--	3.6	V	*1,*2
Operating Temperature	T _{OP}	-20	70	°C	
Storage Temperature	T _{ST}	-30	80	°C	
Operating Ambient Humidity	H _{OP}	10	*4	RH	*3
Storage Humidity	H _{ST}	10	*4	RH	*3

Note:

- *1. At 25±5°C
- *2. Due to the characteristics of LC Material, the Liquid Crystal driving voltage varies with environmental temperature.
- *3. Non-condensation.
- *4. Temp. ≤ 60°C, 90%RH Max.
Temp. > 60°C, Absolute humidity shall be less than 90%RH.

3.0 ELECTRICAL SPECIFICATIONS

Item	Symbol	Min.	Typ.	Max.	Unit	Note
TFT Gate ON Voltage	VGH	--	12	--	V	*1,*2
TFT Gate OFF Voltage	VGL	--	-5	--	V	
TFT Common Voltage	Vcom	-2	--	-1	V	DC com
Data (RGB signal) Voltage	Vsig	-3.6	--	3.6	V	

Note:

*1. VGH is TFT Gate operating Voltage.

*2. VGL is TFT Gate operating Voltage.

The storage structure of this model is C_{ST}(Storage on Common)

*3. Vcom must be adjusted to optimize display quality _Cross talk, Contrast Ratio and etc.

3.1 FPC Pin Assignment

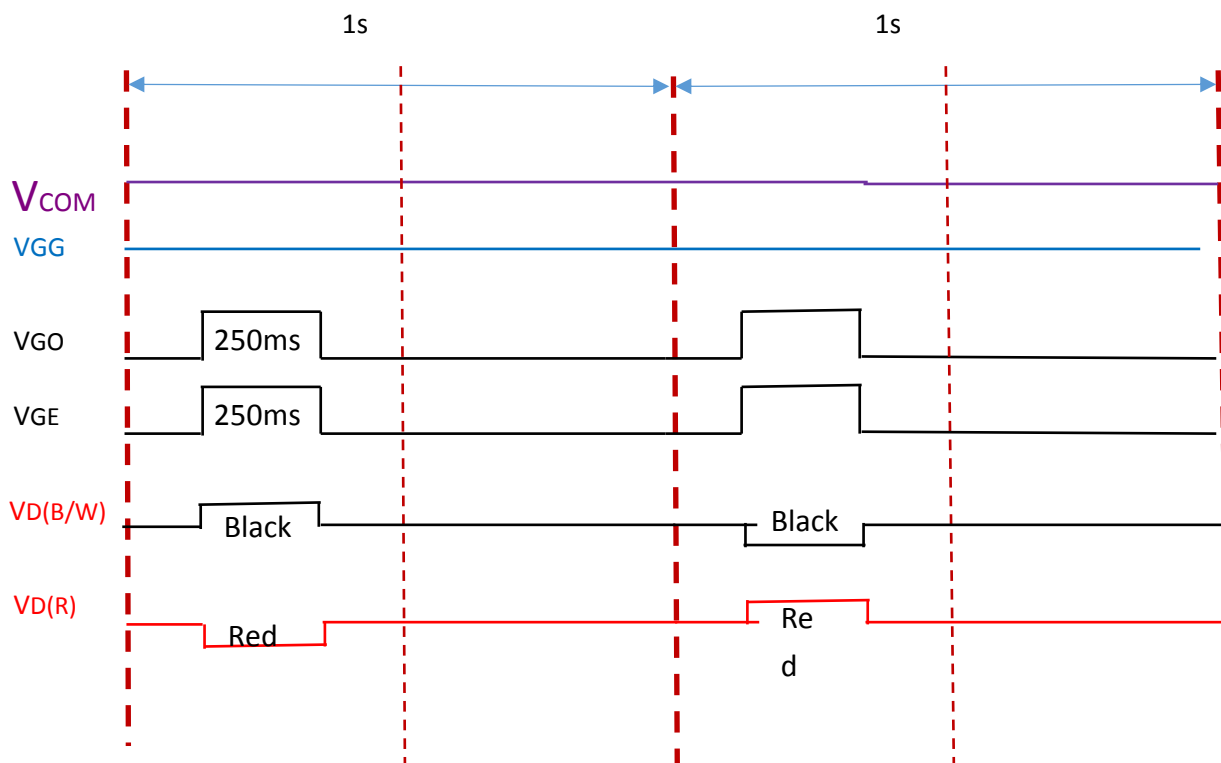
Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	DUMMY	31	CB2N	61	CSB	91	Vcom
2	DUMMY	32	CB2N	62	A0	92	Vcom
3	Vcom	33	CB1P	63	ERD	93	DUMMY
4	Vcom	34	CB1N	64	RWR	94	DUMMY
5	VCOM	35	CB1N	65	RSTB		
6	VGL	36	V1V	66	VDGND		
7	VCOM	37	CE1P	67	D0		
8	VCOM	38	CE1N	68	D1		
9	VDDA	39	NAVDD	69	D2		
10	VAGND	40	CE2N	70	D3		
11	CA1N	41	CE2P	71	D4		
12	CA1N	42	CC1N	72	D5		
13	CA1P	43	CC1P	73	D6		
14	CA1P	44	VGH	74	D7		
15	VPV	45	CD1P	75	VDDI		
16	VPV	46	CD1N	76	ModeSel		
17	CA2P	47	VGL	77	IF1		
18	CA2P	48	VCCO	78	IF0		
19	CA2N	49	VCCI	79	CLS		
20	CA2N	50	VDDA	80	CL		
21	VNV	51	VDDA	81	TE		
22	VNV	52	VDDR	82	EXTB		
23	CF1N	53	VDDI	83	VPP		
24	CF1N	54	VDDI	84	VPP		
25	CF1P	55	VDGND	85	VDGND		
26	CF1P	56	VDGND	86	VDDI		
27	AVDD	57	VAGND	87	VCOM		
28	AVDD	58	VAGND	88	VCOM		
29	CB2P	59	VRGND	89	VGL		
30	CB2P	60	VDDI	90	VCOM		

3.2 TFT Design Rules

Item		Specification	unit
COG Sitronix ST7306 Sitronix ST7305	Chip size	13000*650	μm
	Pad number	<u>Based on the IC Spec.</u>	
	Pin assignment	<u>Based on the IC Spec.</u>	

3.3 Cell Test Light On Waveform

No.	S/B Pattern (8 bit/6 bit/1bit)	D_黑/白		D_红		VGG	VGL	Vcom	VG(E/O)/IGD Signal	VG(E/O)/IGD Signal	频率
		Max.	Min.	Max.	Min.				High	Low	
1	White (L0/L0/L0)	0.00	0.00	0.00	0.00	30	-5	-0.29	15	-10	1Hz / 1s
2	Black (L255/L63/L1)	4.00	-4.00	4.00	-4.00	30	-5	-0.29	15	-10	1Hz / 1s



4.0 OPTICAL CHARACTERISTICS

4.1 Optical Specification

(Measuring with Nitto NZFUSN7TEGQHC polarizer , Reference Only)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
White Reflectance (with Polarizer)		Rw (%)	$\Theta=0$ Normal viewing angle —	—	40	—	%	(4) Measuring with Leadtek Display polarizer ,Reference Only Base on Vop=3.6V
Contrast Ratio		CR		—	15	—	—	(1)(2) Base on Vop=3.6V
Response Time		ms			5	7		
Color Chromaticity (CIE1931)	White	W_x		—	(0.30)	—	—	(1)(4)Measuring with Leadtek Display polarizer ,Reference Only
		W_y		—	(0.33)	—		
Viewing Angle	Hor.	Θ_L	CR>2	—	60	—	—	(1)(4)Measuring with Leadtek Display polarizer ,Reference Only
		Θ_R		—	60	—		
	Ver.	Θ_U		—	60	—		
		Θ_D		—	60	—		

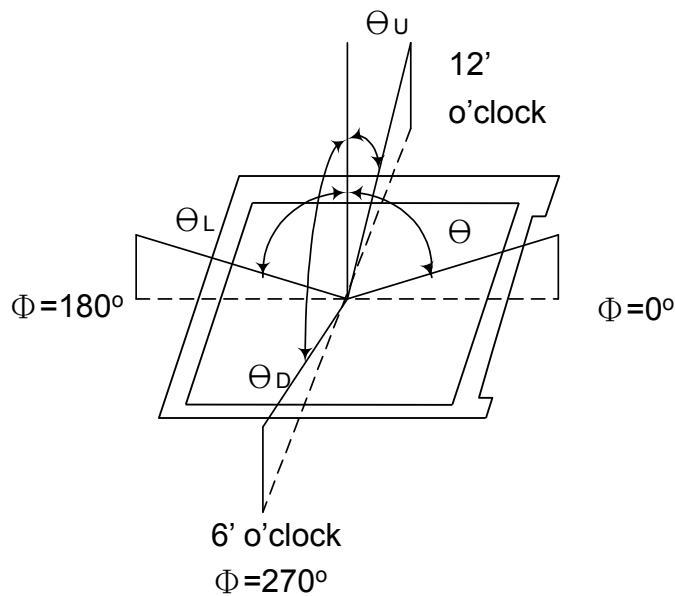
4.2 Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature : $25 \pm 2^\circ\text{C}$
- 15min. warm-up time.

4.3 Measuring Equipment

- DMS (DMS = Display Measurement System) of AUTRONIC-MELCHERS GmbH, motorized goniometer system for comprehensive display characterization

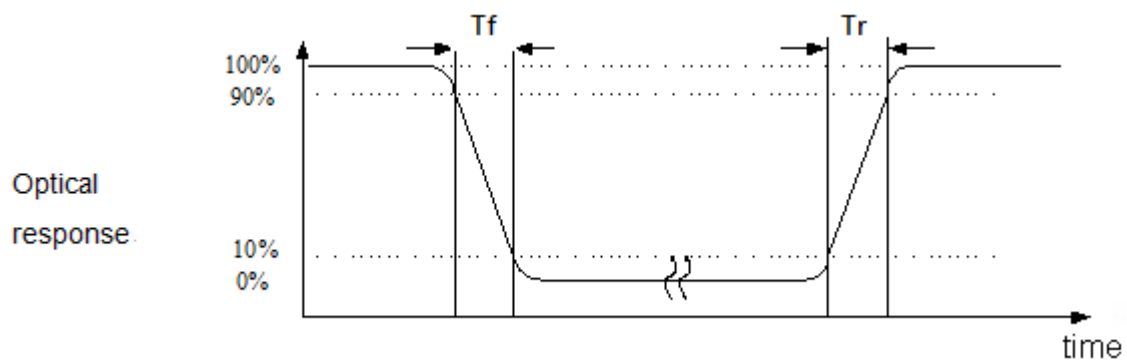
Note (1) Definition of Viewing Angle:



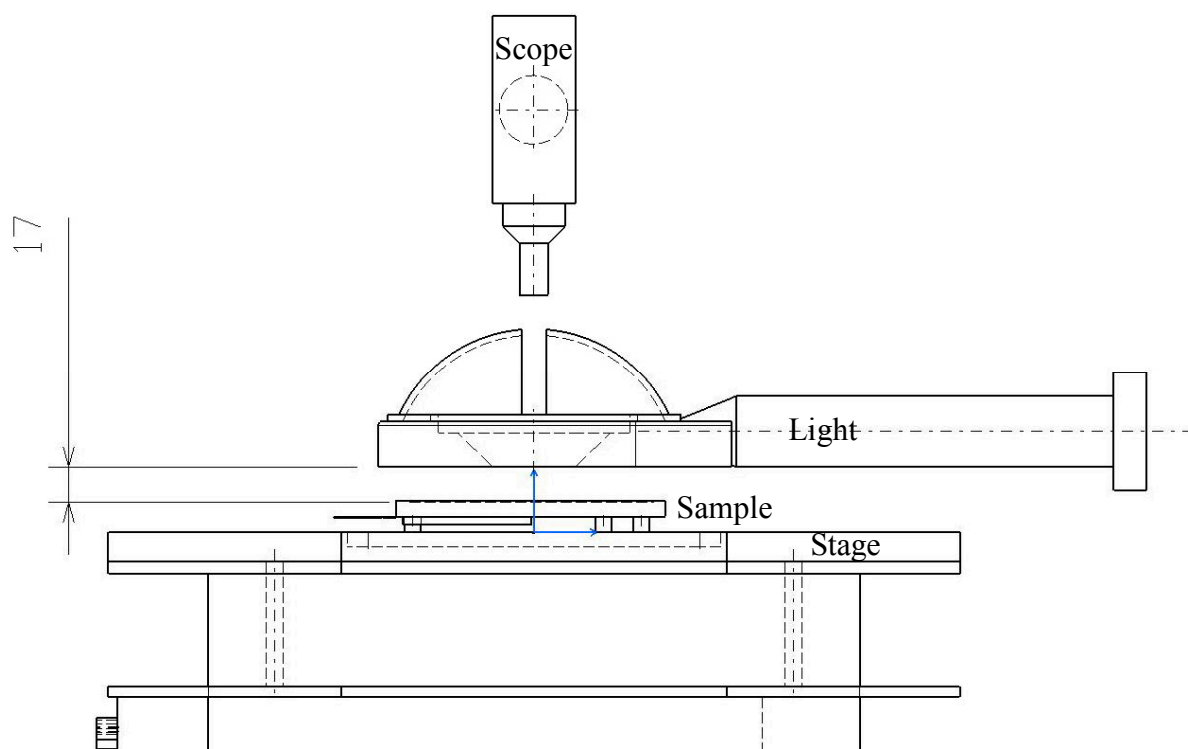
Note (2) Definition of Contrast Ratio (CR) :
measured at the center point of panel

$$\text{CR} = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3) Definition of Response Time : Sum of T_R and T_F



Note (4) Definition of optical measurement setup

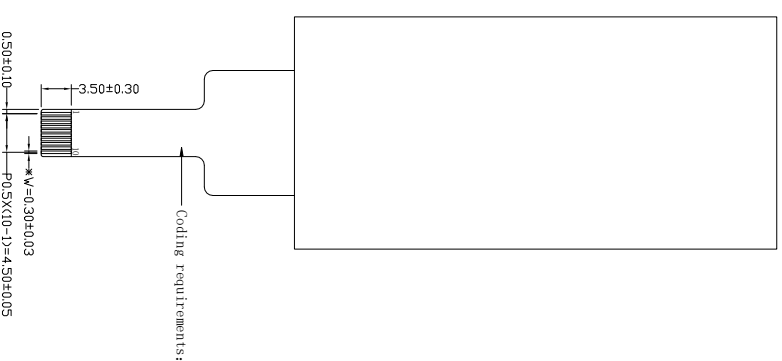
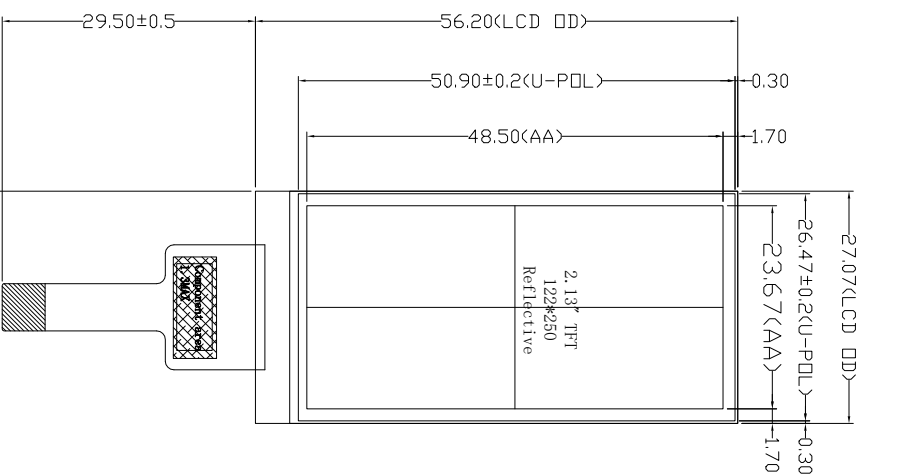


5.0 Mechanical Drawing

Front View

Side View

Back View



Pin	Symbol
1	GND
2	GND
3	VCC2.8
4	TE
5	NRESET
6	CS
7	WRX
8	DCX
9	SDA
10	GND

Notes:

1. Display : 2.13", TFT
2. Resolution: 122xRGBx250
3. LCD Viewing Direction: 60/60/60/60
4. Drive IC:ST7306
5. Display Mode: Normally White/Reflective
6. umark Tolerance:±0.2
7. OPERATING TEMP: -20° C~+70° C
8. STORAGE TEMP: -30° C~+80° C
9. Requirements on Environmental Protection: ROHS

3
2
1
0
REV

NEW
DESCRIPTION

	DATE	NAME
	2023. 07. 18	IAN

SCALE: 1/1	UNIT: mm	PAGE: 1/1	
Part No:	LTK021MHLMI1		
Customer No:			



LEADTEK COMPANY LIMITED

Approve	Check	Drawn
	JONA	IAN

6.0 Interface Signal

Pin No.	Symbol	Description
1	GND	Power Ground
2	GND	Power Ground
3	VCC	Power Supply(Analog). VCI=2.8V-3.3V
4	TE	Serves TE (Tearing Effect) pin on MPU interface.
5	RESET	Reset signal(low active)
6	CS	Chip select pin
7	SCL(WRX)	Servers as SCL (Serial Clock)
8	A0(DCX)	Data or command select pin
9	SDA	Serial data input pin
10	GND	Power Ground

7.0 RELIABILITY TEST ITEMS

No.	Item	Conditions	Remark
1	High Temperature Storage	Ta=+80°C, 240hrs	-
2	Low Temperature Storage	Ta=-30°C, 240hrs	-
3	High Temperature Operation	Ta=+70°C, 240hrs	-
4	Low Temperature Operation	Ta=-20°C, 240hrs	-
5	High Temperature and High Humidity (Operating)	Ta=+60°C, 90%RH, 240hrs	-

Note: (1) All tests above are practiced at module type.

(2) There is no display function NG issue occurred, all the cosmetic specification is judged before the reliability stress.



深圳市丽台电子有限公司

Shenzhen Leadtek Electronics Co.,Ltd

Quality inspection standards

品质允收标准

MODEL No. / 产品型号: Applies 0.95~5.0 TFT-LCD PanelUPDATED DATE / 生效日期: 2022-05-20VERSION / 版本: A0

Customer Signature/客户签字: _____

RECORD OF REVISION/修订履历:

Version 版本	Revision Record 修订内容	Compile 修订者	Date of Revision 修订日期
V0	首发/Starting	Green	2022.05.20

1.Scope 1适用范围

This document shall be applied to 0.95~5.0 TFT-LCD Panel.

本文件适用于0.95~5.0 TFT-LCD Panel.

2.Inspection and Environment onditions/检查条件与环境

2.1 Inspection Conditions 检查条件:

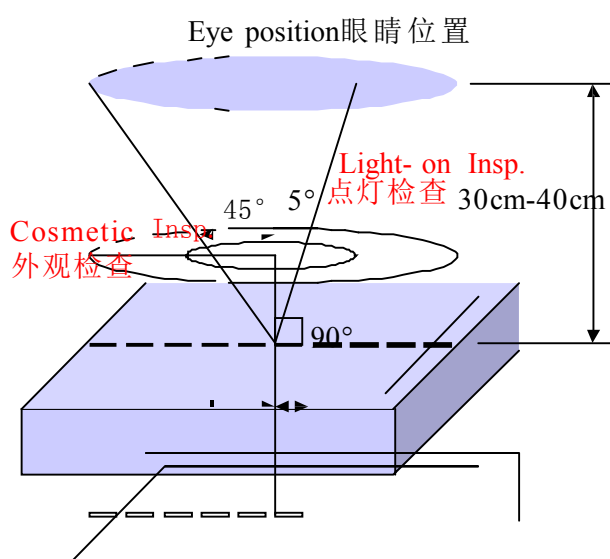
(1) Inspection Distance检测距离: 35 cm $\pm$ 5cm

(2) Each picture /每个画面: 2~3 secs/秒, Cosmetic Insp./外观10~12 secs/秒

(3) View Angle观看角度:

Light-on Inspection Angle点灯检验角度 : $\pm 45^\circ$

Cosmetic Inspection Angle外观检验角度 : $\pm 45^\circ$



(Perpendicular to LCD panel surface垂直于液晶显示表面)

2.2 Environment Conditions环境条件:

Ambient Temperature 温度		25 $^\circ$ C $\pm$ 5 $^\circ$ C
Ambient Humidity 湿度		55 $\pm$ 5%RH
Ambient Illumination 亮度	Cosmetic Inspection 外观检验	800-1000 Lux
	Functional Inspection 点灯检验	200~300Lux

2.3 Sampling Conditions 抽样条件:

(1) Lot Size : Quantity of shipment lot per model/.

批量: 单次运送单一机型数量

- (2) Sampling Method :
抽样方法:

Sampling Plan 抽样计划		GB2828/2003
		Normal Inspection, Single Sampling 正常检验、单次抽样
		General II Inspection 普通二级
AQL	Major Defect 主要缺点	0.25
	Minor Defect 次要缺点	0.65

- (3) The classification of Major(MA) and Minor(MI) defects is shown as 3. Inspection Criteria.
主缺(MA)及次缺(MI)定义于”3.检查标准”

3.Terms and Definitions/术语和定义

3.1 Classification of defects缺陷的分类:

Major defects: A major defect is a defect that is likely to result in failure, or to reduce materially the usability of the product for its intended purpose.

主要缺陷：会导致产品功能失效或减少产品可用性的缺陷。

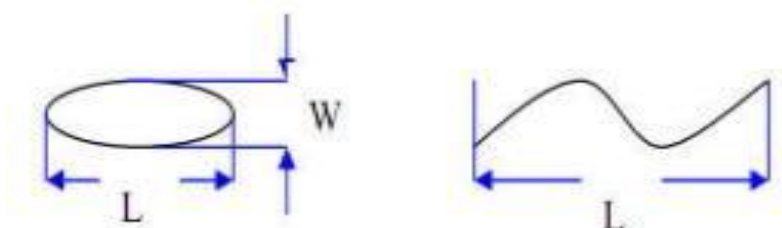
Minor defects: A minor defect either is a defect that is not likely to reduce materially the usability of the product for its intended purpose, or is a departure from an established having little bearing on the effective use or operation of the product.

次要缺陷：不会导致产品功能失效，不会减少产品的有效使用和操作。

- 3.2 Extraneous substances that can be wiped out ,like Finger point,Particles are not considered as a defect . 可以被擦拭干净的表面物质不视为缺陷 (如手指印，尘粒) 。

- 3.3 Defects on the Black Matraix(outside of Active Area) are not considered as a defect . BM 区域 (AA 区以外) 的缺陷不视为缺陷。

- 3.4 Size of circular defect,is defined by diameter”D” 。 The defect average diameter $D=1/2(W+L)$ 圆形缺陷的大小是由直径 D 定义的。缺陷的平均直径 $D=1/2(W+L)$



3.5 When defect size $L \geq 2W$, the defect count as liner type defect. Size of linear defect is defined by length(L) and the maximum width(W).

当缺陷尺寸 $L \geq 2W$ 时，被视为线状缺陷。线状缺陷是由长度 (L) 和最大宽度 (W) 定义的。3.6 Mura criteria :judged by ND filter6%,and can't be seen under at ND filter 6% .

3.6 MURA 判断标准：使用 ND6%判定，且透过 ND6%，遮住不可见。

3.7 Dot defect is defined as the defective area of the dot is larger than 50% of the dot area and is visible through 6% ND filter

DOT 定义为点缺陷面积大于 50% DOT 面积, 且透过 ND6%遮住是可见的。

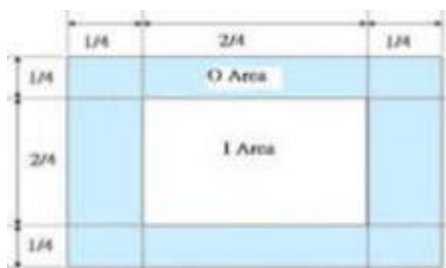
The drawing of 1/2 area sub-pixel definition: The 1/2 area sub-pixel can be defined as below one or more of specific shapes

1/2 面积的子像素定义绘图：1 / 2 面积的子像素可以定义为如下一个或多个特定形状图：



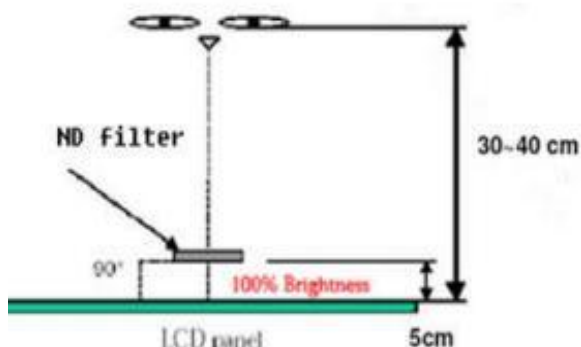
3.8 A dot defect that is smaller than the defined dot defect will be treated as small bright dot. 细碎亮点：小于“DOT 定义”的点缺陷视为细碎亮点。

I 区与 O 区比例：1： 2： 1



3.9 Inspection method of ND Filter - holding ND filter in front of the panel around 5cm and examine the panel from 35±5 cm in the front view for 2~3 second.

ND 卡的检查方法：在面板上方大约 5CM 处握住 ND 卡，眼睛距离面板 30-40CM，通过 2~3 秒观察。



4. Inspection Criteria 检验标准

4.1 Appearance Inspection specification 外观检查规格:

Judge area 区域	Judge item 项目	Specification inspection 检查规格	Judge criterion	
			Major	Minor
Silicone 硅胶	Silicone spread 硅胶涂布	The height can't over C/F , color filter , or gommu 高度不能过超 C/F		MI
	Silicone residue 硅胶残余	Can't cover polarizer, FPC ...etc. 不能覆盖 POL, FPC 等		MI
LCD 玻璃	Wire(on Array) 线路	No damage 不能损伤	MA	
	Edge 边缘	No extended crack 不可有延伸性裂纹	MA	
PCBA Connector FPC/FFC	Appearance 外观	Scratch or damage result in copper expose is not allowed 划伤或损伤不允许导致出现露铜		MI
	Component 零件	No damage 不能损伤	MA	
	Connection status 连接状况	Need correct connection 需要正确连接	MA	
	Broken 破裂	Not allowable 不允许	MA	
	Folding sign 对位记号折叠	Not allowable 不允许	MA	
POL 偏光片	Scract on the polarizer 偏光片划伤	1.W≤0.05mm; L≤5mm, Ignore (忽略)		MI
		2.0.05mm<W≤0.10mm ; L≤5mm ; N≤3 ; DS≥10mm		
		3.0.10mm<W; 5mm<L , Not allowable不允许		

Judge area 区域	Judge item 项目	Specification inspection 检查规格	Judge criterion	
			Major	Minor
POL 偏光片	Dent on the polarizer 偏光片凹痕	1.D<0.15mm, Ignore (忽略)		MI
		2.0.15mm<D≤0.30mm; N≤3; DS≥10mm		
		3.0.30mm<D, Not allowable不允许		
	POL Linear bubble 线状气泡	1.W≤0.05mm; L≤5mm, Ignore (忽略)		MI
		2.0.05mm<W≤0.10mm; L≤5mm; N≤3; DS≥10mm		
		3.0.10mm<W; 5mm<L, Not allowable不允许		
	POL dot bubble 点状气泡	1.D<0.15mm, Ignore (忽略)		MI
		2.0.15mm<D≤0.30mm; N≤3; DS≥10mm		
		3.0.30mm<D, Not allowable不允许		
	POL edge bubble 片边缘气泡	1. The display area is 1/2BM outside, Not allowable 显示区往外 1/2BM 区域内, 不允许		MI
		2. The display area is outside the outer 1/2BM area, Not allowable 显示区往外1/2BM区域以外, 不管控		

Judge area 区域	Judge item 项目	Specification inspection 检查规格	Judge criterion	
			Major	Minor
TP&CG	Foreign Material in spot shape 点状异物	1.D≤0.15mm; Ignored (忽略) 2.0.15mm<D≤0.30mm; N≤3; DS≥10mm 3.D>0.30mm; Not allowable不允许		MI
	Fisheye/bubbles 鱼眼/气泡	1.D≤0.15mm; Ignored (忽略) 2.0.15mm<D≤0.30mm; N≤3; DS≥10mm 3.D>0.30mm; Not allowable不允许		MI
	Scratches on the surface 表面划伤	1.W≤0.05mm; Ignored (忽略) 2.0.05mm<W≤0.10mm, L≤5mm; N≤3; DS≥10mm 3.W>0.10mm, L>5mm; Not allowable不允许		MI
	Collapse corner、Crash edge 崩角、崩边	Product front:/产品正面: collapse corners, collapsed edges are not allowed 崩角、崩边不允许; Product back/产品背面: X≤0.5, Y≤0.5, Z≤1/2T; N≤2; DS≥10mm	MA	
	Printed fonts/LOGO 丝印/LOGO	Printed fonts/LOGO clarity、complete、content right 字体/LOGO丝印清晰、完整、内容正确		MI
	Broken 破损	Not allowable不允许	MA	
	Dirty surfaces 表面脏污	Dirt cannot be wiped, Not allowable 不可擦拭的脏污, 不允许		MI
	IR hole IR孔	Black spots/黑点: W ≤0.15mm, N≤2, Not visible against a black background/黑色背景下不可见		MI
		IR hole Scratches: 1.W<0.03mm, Ignored (忽略) (Dense points Not allowable 不允许密集); 2.0.03mm<W≤0.08mm; L≤2mm; N≤2; 3.W>0.08mm, L>2mm, Not allowable 不允许		MI

4.2 Electrical Inspection specification 电性检查规格:

Item 项目	Judgment Criteria 判定标准	Judge criterion	
		Major	Minor
LCD Bright /Dark dot 玻璃亮点/暗点	1.D $\leq$ 0.15mm, Ignored (忽略), Not dense (不可密集) 2.0.15mm<D $\leq$ 0.30mm; N $\leq$ 3; DS $\geq$ 10mm 3.D>0.30mm, Not allowed/不允许		MI
Mura	Invisible through 6% ND filter, 200~300Lux 透过ND6% 遮住, 目测不可见即为OK, 200~300Lux		MI
Small bright dot 细碎亮点	Not allowed if it can be observed through ND Filter6% 透过ND6%目测看得见, 不允许		MI
ZBD Rate 玻璃亮点比率	90:10		MI
Light Leakage 漏光	Invisible through 6% ND filter, OK 透过ND6%遮住目测不可见即为OK If necessary,set up set up Limit Sample. 如果有必要,可制订限度样品		MI
Bubble in Cell (LC Bubble/Actice Area) CELL气泡 (AA区LCD气泡)	Eyes should not find it . 目视观察不可见, 视为 OK	MA	

Item 项目	Judgment Criteria 判定标准	Judge criterion	
		Major	Minor
Foreign Material in spot shape 点状异物	1. $D \leq 0.15\text{mm}$, Ignored (忽略) 2. $0.15\text{mm} < D \leq 0.30\text{mm}$; $N \leq 3$; $DS \geq 10\text{mm}$ 3. $D > 0.30\text{mm}$, Not allowable/不允许		MI
Foreign Material in line or spiral shape 线状异物	1. $W \leq 0.05\text{mm}$, Ignored (忽略) 2. $L \leq 5\text{mm}$; $0.05\text{mm} < W \leq 0.10\text{mm}$; $N \leq 3$ 3. $W > 0.10\text{mm}$; $L > 5\text{mm}$, Not allowable/不允许		MI
White dot in back-light 白点	1. $D \leq 0.15\text{mm}$, Ignored (忽略) 2. $0.15\text{mm} < D \leq 0.30\text{mm}$; $N \leq 3$; $DS \geq 10\text{mm}$ 3. $D > 0.30\text{mm}$, Not allowed/不允许		MI
TP no touch 无触摸	Not allowable 不允许	MA	
Abnormal Disply 显示异常	Not Allowed 不允许	MA	
NO display 无显示	Not Allowed 不允许	MA	
Line Defect 缺线	Not Allowed 不允许	MA	
Angle of view error 视角错误	Not Allowed 不允许	MA	
Tect crostalk 不消失的残影	Not Allowed 不允许	MA	