



PRODUCT SPECIFICATION

TFT MODULE

MODEL: LT-043480272-C01N

Rev A

CUSTOMER APPROVAL	
SIGNATURE	DATE

PREPARED	CHECKED	APPROVED

RECORDS OF REVISION

Date	Rev.	Description	Note	Page
2017-12-26	A	Preliminary		

Contents

1. SPECIFICATIONS

- 1.1 Features**
- 1.2 Mechanical Specifications**
- 1.3 Absolute Maximum Ratings**
- 1.4 DC Electrical Characteristics**
- 1.5 Optical Characteristics**
- 1.6 Backlight Characteristics**

2. MODULE STRUCTURE

- 2.1 Counter Drawing**
- 2.2 Interface Pin Description**
- 2.3 POER ON/OFF SEQUENCE**
- 2.4 RGB Interface DC characteristic**
- 2.5 DATA INPUT FORMAT**

3. QUALITY ASSURANCE SYSTEM

- 3.1 Quality Assurance Flow Chart**
- 3.2 Inspection Specification**

4. RELIABILITY TEST

- 4.1 Reliability Test Condition**

5. PRECAUTION RELATING PRODUCT HANDLING

- 5.1 Safety**
- 5.2 Hand**
- 5.3 Storage**
- 5.4 Terms of Warranty**

1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	TFT, Transmissive
Number of dots	480RGB*272
Recommended Viewing Direction	12 O'CLOCK
Backlight	White LED
Mode	Normal White
Interface	RGB 24 bits
Driver IC	ST7282

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	105.5(L) * 67.2(W) * 3.0(H)	mm
Active Area	95.04 (L) * 53.86(W)	mm

Note : For detailed information please refer to LCM drawing

1.3 Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Max.	Unit
Power Supply Voltage	V _{DD}	-	-0.5	4.6	V
Input Voltage	V _{IN}	-	V _{SS} -0.3	V _{DD} +0.3	V
Operating Temperature	T _{OP}	-	-20	70	°C
Storage Temperature	T _{ST}	-	-30	80	°C
Storage Humidity	H _D	Ta < 60 °C	10	90	%RH

1.4 DC Electrical Characteristics

 $V_{DD} = 3.3\text{ V} \pm 10\%$, $V_{SS} = 0\text{ V}$, $T_a = 25^\circ\text{C}$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage	V_{DD}	-	3.0	3.3	3.6	V
Input Current	I_{DD}	-		25	33	mA
“H” Input Voltage	V_{IH}	-	$0.7 V_{DD}$	-	V_{DD}	V
“L” Input Voltage	V_{IL}	-	V_{SS}	-	$0.3 V_{DD}$	V
“H” Output Voltage	V_{OH}	-	$V_{DD}-0.4$	-	-	V
“L” Output Voltage	V_{OL}	-	-	-	$GND+0.4$	V

1.5 Optical Characteristics

 $T_a = 25^\circ\text{C}$

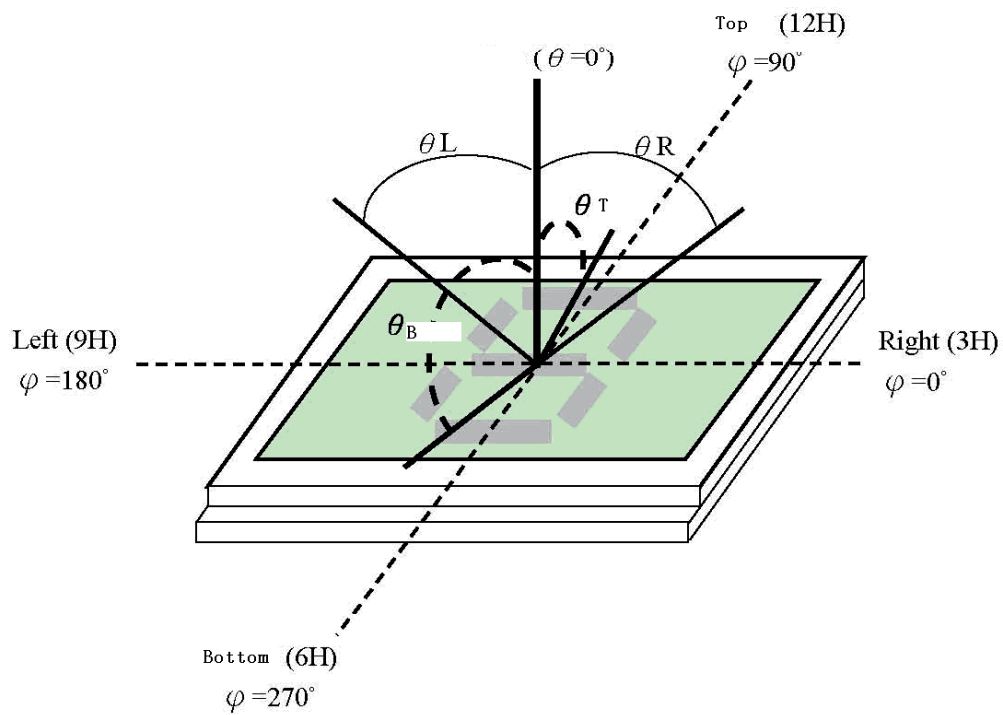
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating voltage	VDD	$T_a=25^\circ\text{C}$	3.0	3.3	3.6	V
LCM Luminance	L_v	White($V_{DD}=3.3$, $I_{BL}=40\text{mA}$)	400	550	--	cd/m ²
LCM Clour coordinate	λP	White	X=0.255	X=0.3	X=0.335	
			Y=0.278	Y=0.313	Y=0.348	

Item		Symbol	Conditions	Min.	Typ.	Max.	Reference
View Angle	TOP	Θ_{y+}	$CR \geq 10$	-	70%	-	Notes 1
	BOTTOM	Θ_{y-}		-	55%	-	
	LEFT	Θ_{x+}		-	70%	-	
	RIGHT	Θ_{x-}		-	70%	-	
CIE *1	WHITE	X	$TA=25^{\circ}$ $\Theta_x, \Theta_Y=0^{\circ}$	0.255	0.3	0.335	
		Y		0.278	0.313	0.348	
	RED	X		0.564	0.599	0.634	
		Y		0.329	0.364	0.399	
	GREEN	X		0.295	0.346	0.365	
		Y		0.513	0.548	0.583	
	BLUE	X		0.106	0.141	0.176	
		Y		0.035	0.07	0.105	
Contrast Ratio		CR	$\theta = 0^{\circ}$	300	500	-	Note 3
Response Time(rise+fall)		Tg		--	25 ms	30ms	Notes 2

Note 1.

Optical characteristics-2

Viewing angle

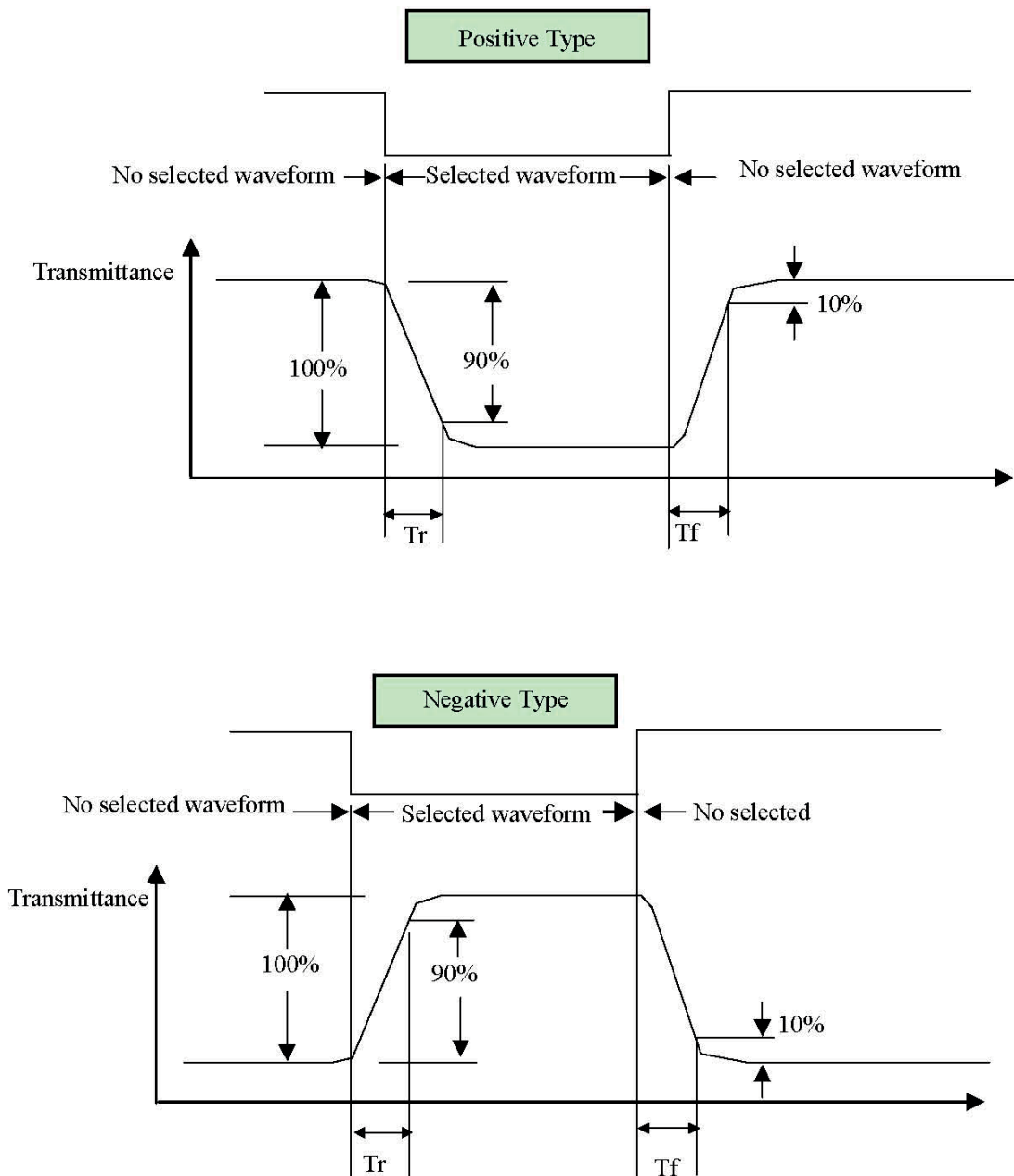


Viewing angle

Note 2.

Optical characteristics-3

Fig.2 Definition of response time



Electrical characteristics-2

※2 Drive waveform

Vop: Drive voltage

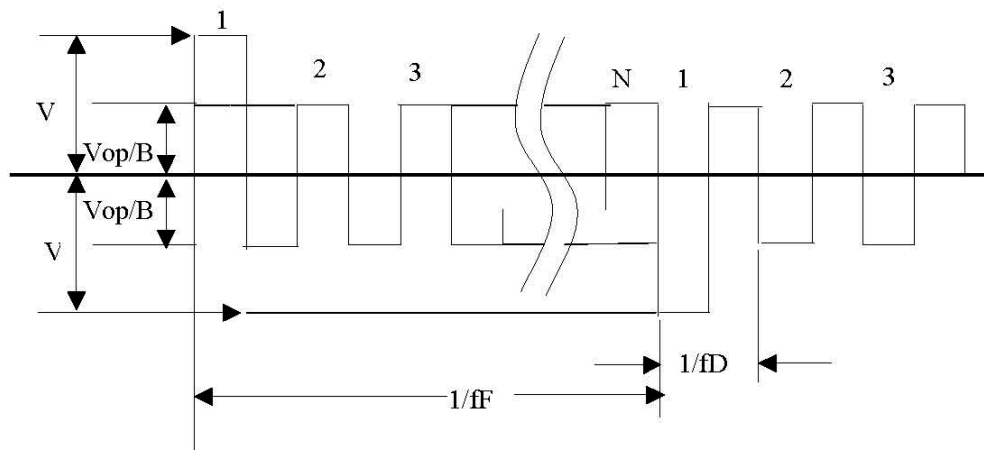
fF: Frame frequency

1/B: Bias

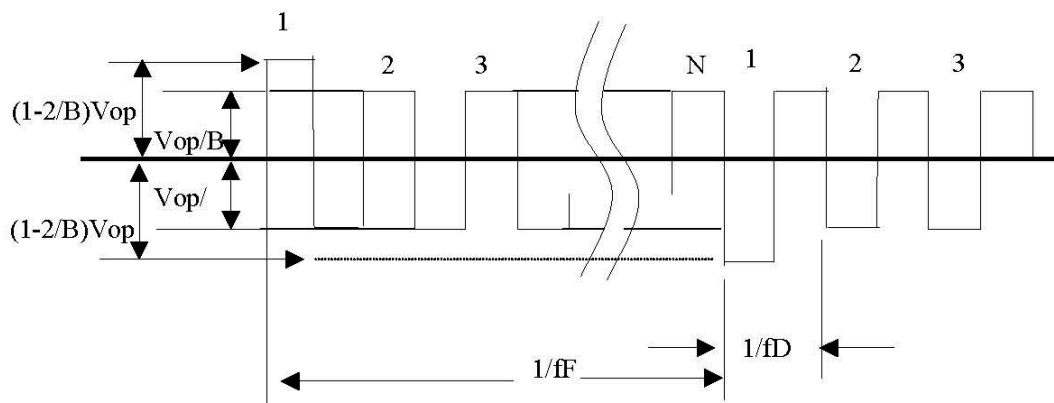
fD: Drive frequency

N: Duty

(1) Selected waveform



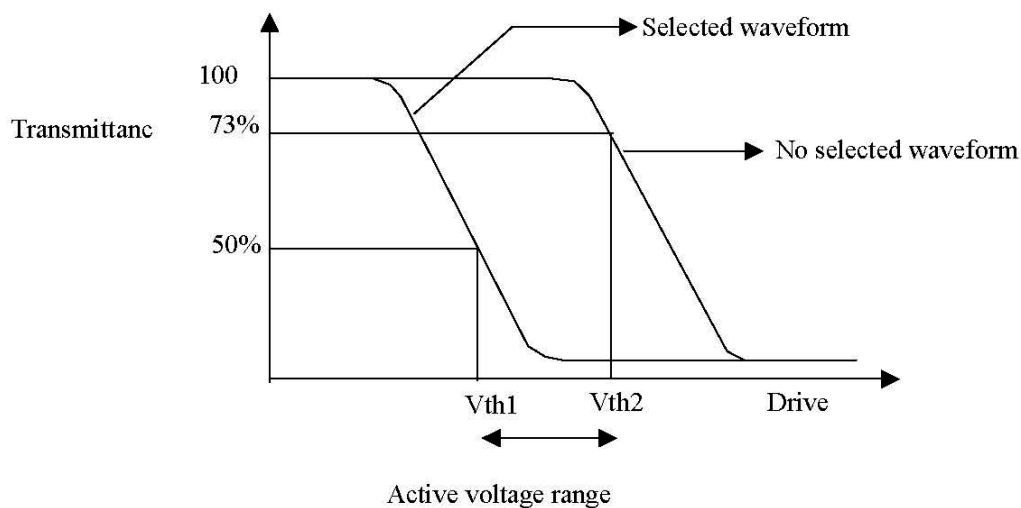
(2) Non- Selected wave form



Note:

Frame frequency is defined as follows: Common side supply voltage peak - to - peak / 2 = 1 period

Note 3. : Definition of Vth

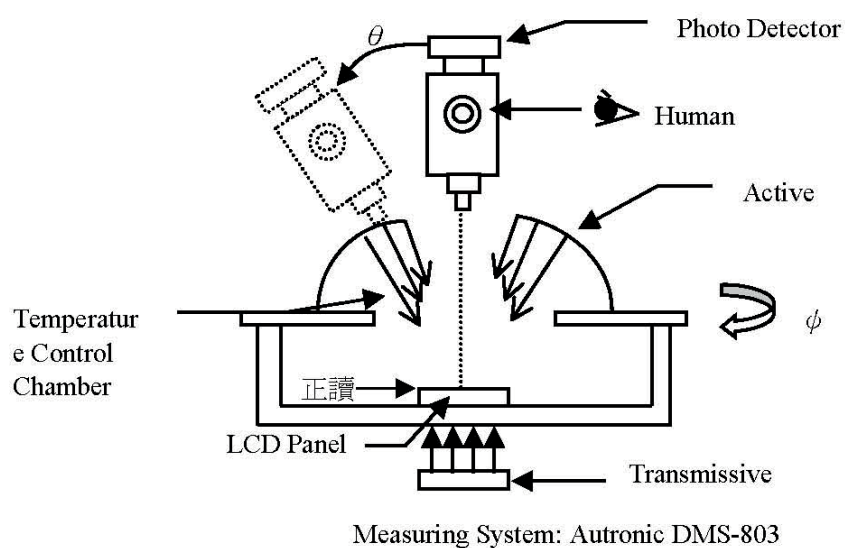


	Vth1	Vth2
View direction	10°	40°
Drive waveform	(Selected waveform)	(No selected waveform)
Transmittance	50%	73%

※1 Contrast ratio

= (Brightness in OFF state) / (Brightness in ON state)

Outline of Electro-Optical Characteristics Measuring System



1.6 Backlight Characteristics

LCD Module with LED Backlight

Ta =25°C

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage LED	V _F	I _F =40 mA	14	15	17	V
Forward Current	I _F		-	40	-	mA
Luminance Uniformity	L _V		75			%
Average Brightness (without LCD)	I _V	I _F =40 mA	8500	9500	--	cd/m ²
CIE Color Coordinate (Without LCD)	X	I _F =40 mA	0.25	0.29	0.33	-
	Y		0.25	0.29	0.33	
Life time	L _F	I _F =40 mA	30000			Hours
Color	White					

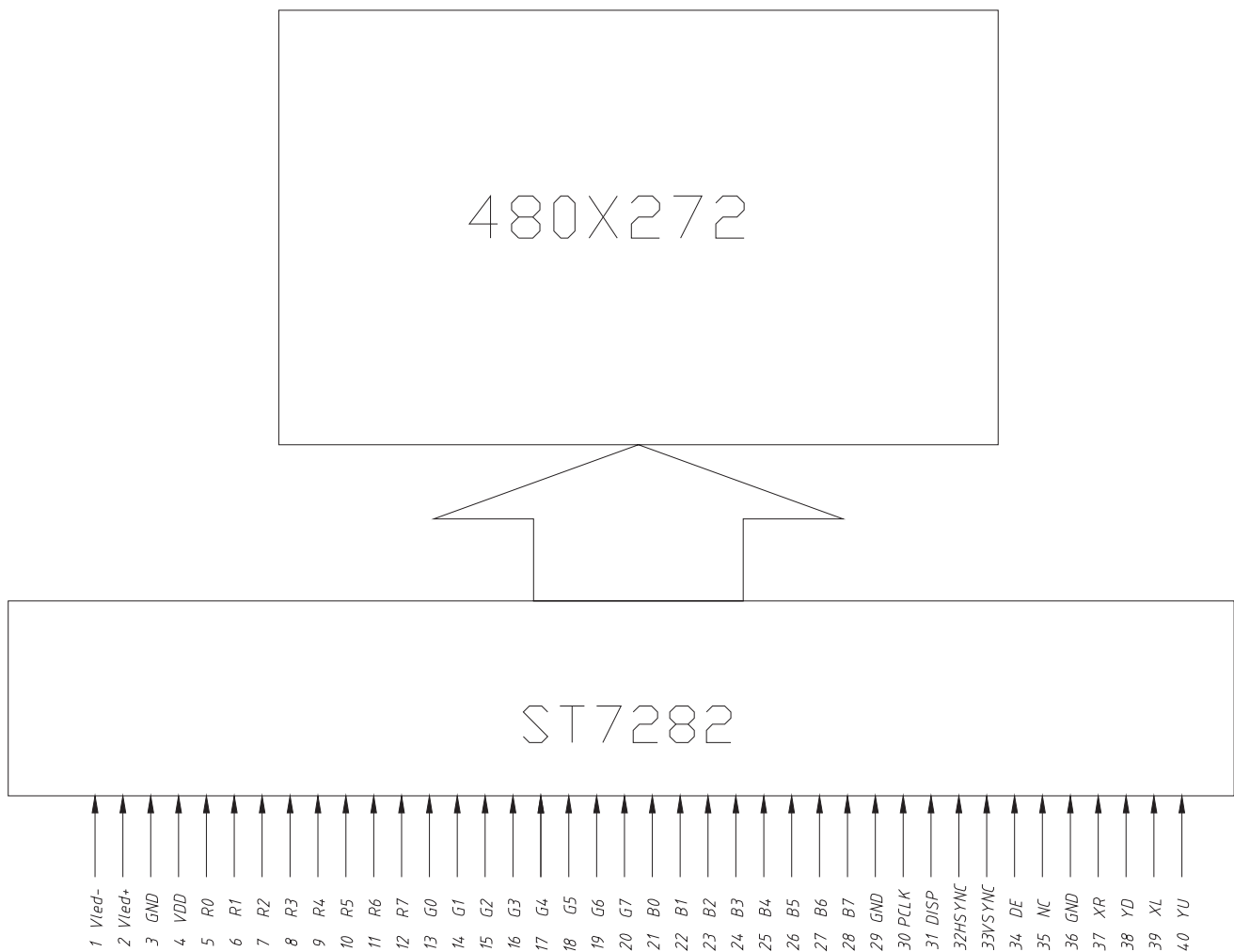
2. MODULE STRUCTURE

2.1 Counter Drawing

2.1.1 LCM Mechanical Diagram

* See Appendix

2.1.2 Block Diagram



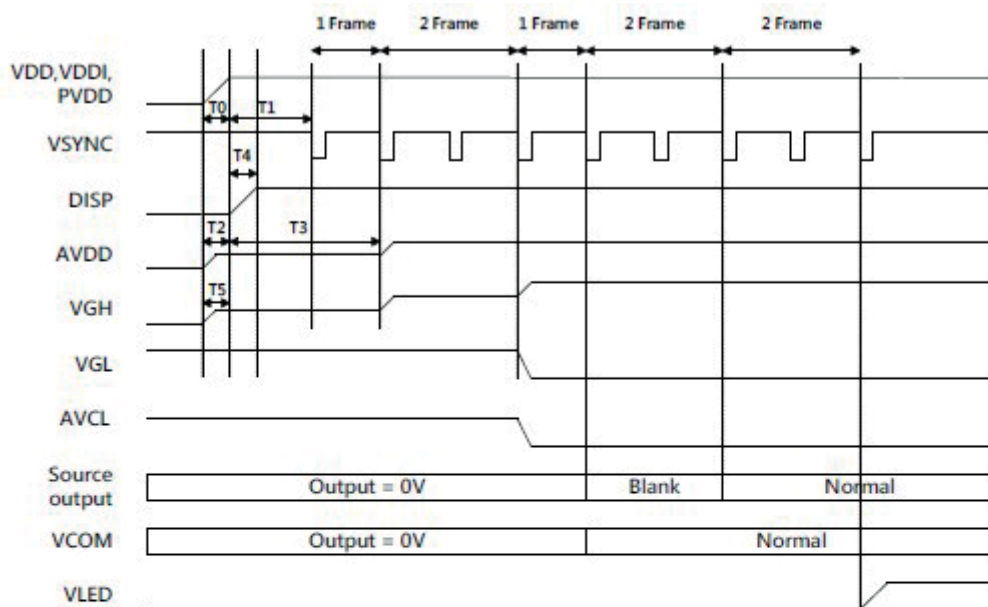
2.2 Interface Pin Description

LCM Interface

Pin No.	Symbol	Function
1	VLED-	LED back light(Cathode)
2	VLED+	LED back light(Anode)
3	GND	Ground.
4	VDD	Power supply
5~28	R0~R7	Red data bus
	G0~G7	Green data bus
	B0~B7	Blue data bus
29	GND	Ground.
30	PCLK	Data clock
31	DISP	Normal display and Standby mode select pin
32	HSYNC	Line sync signal
33	VSYNC	Framesync signal
34	DE	Data enable pin
35	NC	NC
36	GND	Ground.
37	XR	Touch Panel Control pin
38	YD	
39	XL	
40	YU	

2.3 POER ON/OFF SEQUENCE

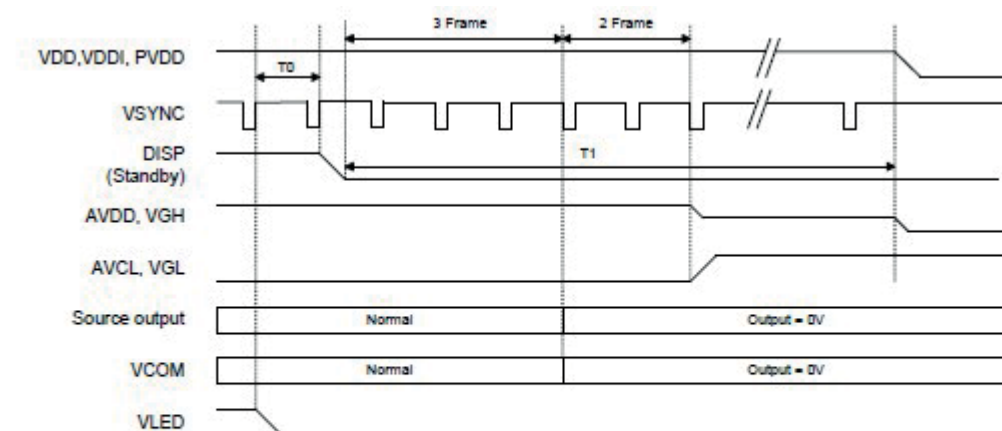
Power on Timer



Item	Description	Min. Time
T0	Determined by the external power	
T1	Time from stable VDD, VDDI, PVDD set-up to the first VSYNC	T1=0
T2	Time from AVDD=0V to AVDD=3.3V	T2=T0
T3	Time from AVDD=3.3V to AVDD=6.0V	T3=T1+ (1*Frame)
T4	Time from stable VDD, VDDI, PVDD set-up to DISP asserted	T4=0
T5	Time from VGH=0V to VGH=3.3V	T5=T0

Note: Recommend the LCM power on rise time T0= 0~ 1ms.

Power off Timer



Item	Description	Min. Time
T0	Time from backlight power off to DISP="L"	1*Frame
T1	Time from DISP="L" to LCM Power off	5*Frame

2.4 RGB Interface DC characteristic

2.4.1 DC CHARACTERISTIC

DC Characteristics

DC Electrical Characteristics (PVDD=VDD=VDDI= 3.3V, AGND= 0V, TA=25°C).

Recommended Operating Range

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
Supply Voltage	VDD	3.0	3.3	3.6	V	
IO Supply Voltage	VDDI	1.65	-	VDD	V	
Charge Pump Supply Voltage	PVDD	3.0	3.3	3.6	V	
NVM Supply Voltage	VPP	7.4	7.5	7.6	V	

DC Characteristics for Digital Circuit

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
Logic-High Input Voltage	Vih	0.7VDDI	-	VDDI	V	
Logic-Low Input Voltage	Vil	DGND	-	0.3VDDI	V	
Logic-High Output Voltage	Voh	VDDI-0.4	-	VDDI	V	
Logic-Low Output Voltage	Vol	DGND	-	DGND+0.4	V	

DC Characteristics for Analog Circuit

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
Positive High-voltage power	VGH	13	15	17.5	V	
Negative High-voltage power	VGL	-11.5	-10	-7	V	
Output Voltage Deviation	Vod		±35	±45	mV	
Standby Current	Isc			50	uA	
Operation Current	Ioc		20		mA	No Load@ FR=60Hz

2.4.2 AC CHARACTERISTIC

AC Characteristics

AC Electrical Characteristics (PVDD=VDD=VDDI= 3.3V, AGND= 0V, TA=25°C).

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
System operation timing						
VDD power source slew time	TPOR	-	-	20	ms	From 0V to 99% VDD
GRB pulse width	tRSTW	10	50	-	us	R=10Kohm, C=1uF
Input/ Output timing						
CLK pulse duty	Tcw	40	50	60	%	
Hsync width	Thw	2	-	-	DCLK	
Hsync period	Th	55	60	65	us	
Vsync setup time	Tvst	12	-	-	ns	
Vsync hold time	Tvhd	12	-	-	ns	
Hsync setup time	Thst	12	-	-	ns	
Hsync hold time	Thhd	12	-	-	ns	
Data setup time	Tdsu	12	-	-	ns	
Data hold time	Tdhd	12	-	-	ns	
DE setup time	Tdest	10	-	-	ns	
DE setup time	Tdehd	10	-	-	ns	
SD output stable time	Tst	-	-	12	us	Output settled within +20mV Loading = 6.8k+28.2pF.
GD output rise and fall time	Tgst	-	-	6	us	Output settled (5%~95%), Loading = 4.7k+29.8pF
3-wire serial communication						
Delay between CSB and VSYNC	Tcv	1			us	
CS input setup time	Ts0	50			ns	
Serial data input setup time	Ts1	50			ns	
CS input hold time	Th0	50			ns	
Serial data input hold time	Th1	50			ns	
SCL pulse high width	Twh1	50			ns	
SCL pulse low width	Twl1	50			ns	
CS pulse high width	Tw2	400			ns	

2.5 DATA INPUT FORMAT

RGB Input Timing Table

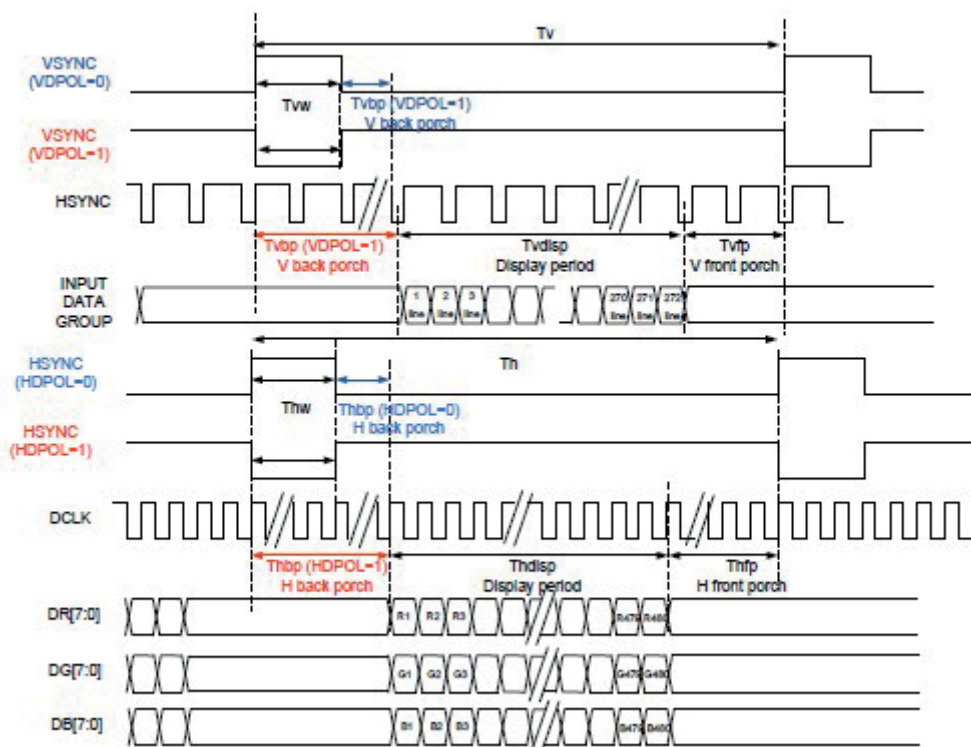
RGB input timing table (PVDD=VDD=VDDI= 3.3V, AGND= 0V, TA=25°C).

Parallel 24-bit RGB Timing Table

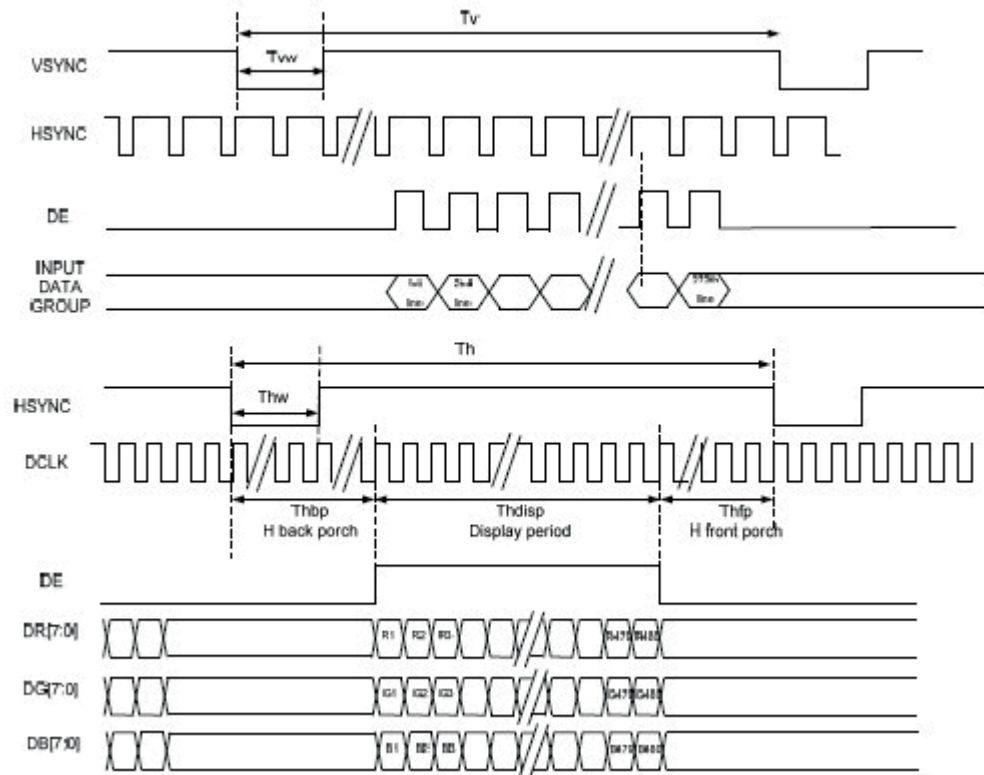
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK Frequency	Fclk	8	9	12	MHz	
DCLK Period	Tclk	83	111	125	ns	
HSYNC	Period Time	Th	485	531	598	DCLK
	Display Period	Thdisp		480		DCLK
	Back Porch	Thbp	3	43	43	DCLK
	Front Porch	Thfp	2	8	75	DCLK
	Pulse Width	Thw	2	4	75	DCLK
VSYNC	Period Time	Tv	276	292	321	H
	Display Period	Tvdisp		272		H
	Back Porch	Tvbp	2	12	12	H
	Front Porch	Tvfp	2	8	37	H
	Pulse Width	Tvw	2	4	37	H

Note: It is necessary to keep Tvbp =12 and Thbp =43 in sync mode. DE mode is unnecessary to keep it.

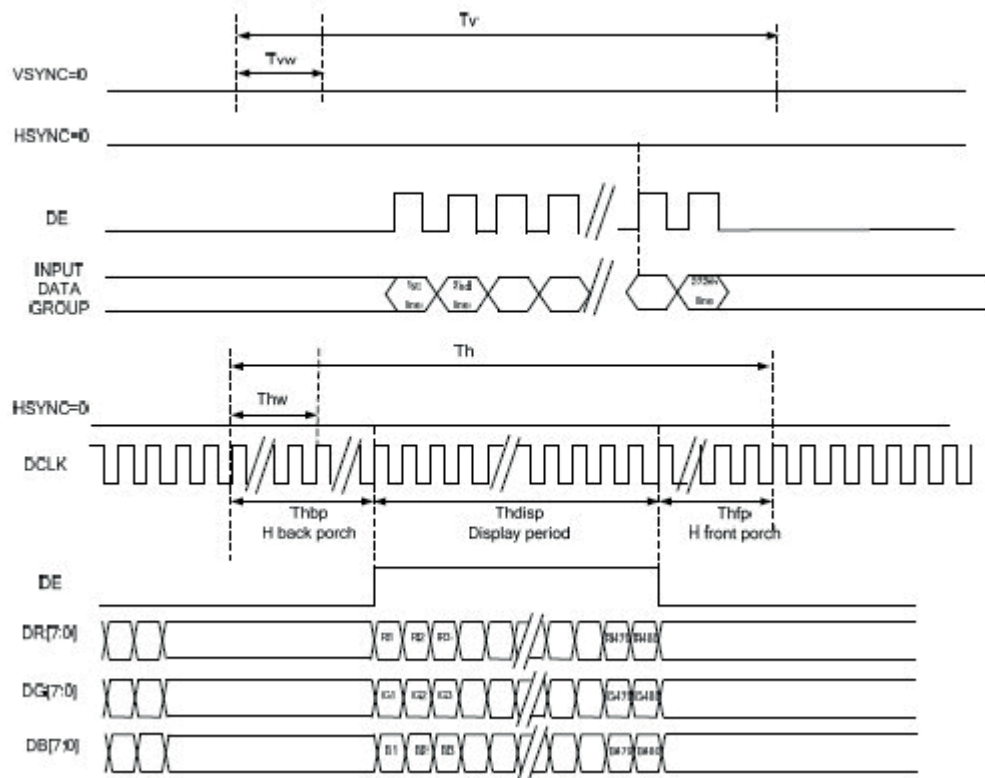
SYNC Mode Timing Diagram



SYNC-DE Mode Timing Diagram

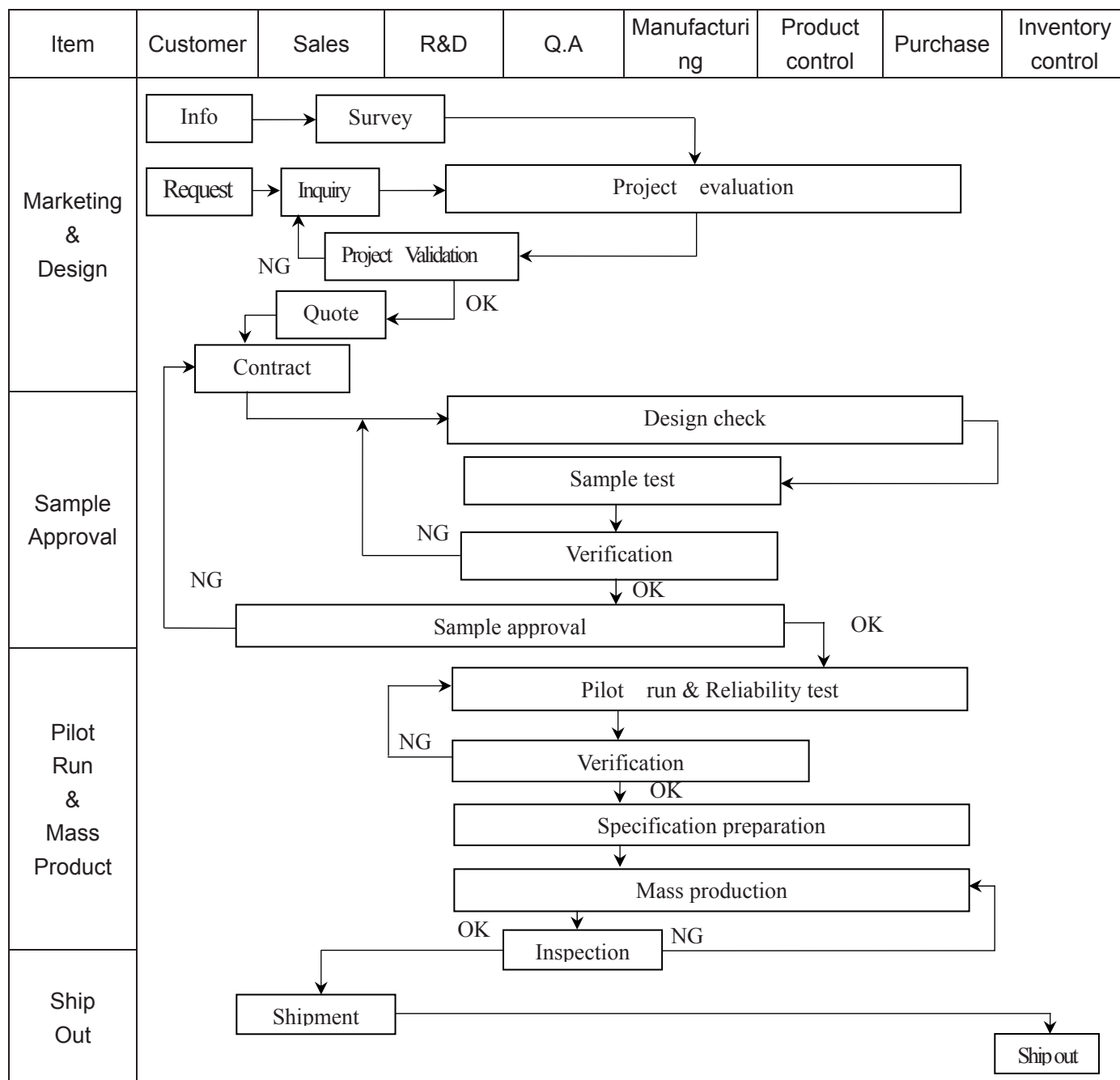


DE Mode Timing Diagram



3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart



3.2 Inspection Specification

1. Description

These inspection standards shall be applied to LCD cell supplied by INNOLUX Corporation.

2. Liability

2.1 Input Deadline

Due to the product is Cell LCD shipping, to prevent quality problem caused by external environment, the product shall be use in 3 days after open the box.

3. The environmental condition of inspection

The environmental condition and visual inspection shall be conducted as below.

- (1) Ambient temperature : 25 ± 5 °C
- (2) Humidity : 25~75 % RH
- (3) Panel visual inspection on the operation condition for cosmetic shall be conducted at the distance 30~40cm or more between the LCD module and eyes of inspector.
Ambient Illumination : 800~1200Lux for external appearance inspection
Ambient Illumination : 200~500 Lux for light on inspection
- (4) The viewing angle :
 - a) ± 15 degree to the front surface of display panel in vertical direction.
 - b) ± 15 degree to the front surface of display panel in horizontal direction.
- (5) Display panel shall be conducted at the distance 30~40cm between the LCD module and eyes of inspector (Fig. 1)

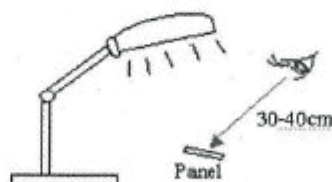


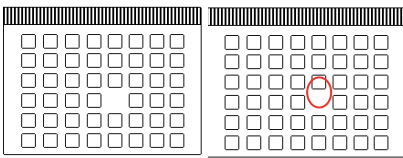
Fig. 1

4. Inspection Criteria

- (1) Definition of dot defect induced from the panel inside
 - a) Bright dot : Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
 - b) Dark dot : Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

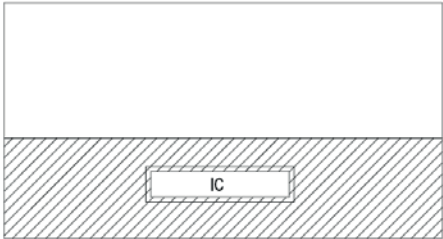
(2) Display Inspection

Items		Acceptable count
Bright dot	Random	$N \leq 1$
Dark dot	Random	$N \leq 2$
Total bright and dark dot		$N \leq 3$
Distance	Minimum Distance Between dark dots Minimum Distance Between dark and bright dot.	5mm
Tiny bright dot (Visible through 6% ND filter)		$D \leq 0.1\text{mm}$, Ignore $0.1\text{mm} < D \leq 0.3\text{mm}$, $N \leq 2$ Distance $\geq 5\text{mm}$
Display failure (V-line/H-line/Cross line etc.)		Not allowable

No.	Defects缺陷项目	Description缺陷描述	Criteria执行标准
1	Non-display无显示（黑屏） Maj 主要	Non-display无显示（黑屏）	Reject 拒收
2	incomplete display 缺划 Maj 主要	 OK NG	Reject 拒收
3	wrong view angle视角错 Maj 主要	view angle is different from spec. 视角方向与产品资料不符	Reject 拒收
4	Not light 背光不亮 Maj 主要	1.背光不亮。 2.个别 LED 灯不亮。 1.backlight not work, 2. some LED not light,	Reject 拒收
5	Luminance uniformity 背光亮度的均匀度 Min 次要	According to the product specification or limited samples 亮度与发光均匀度不符合规格要求（参照样板）	Reject 拒收

6	Backlight Color 背光颜色差异 Min 次要	According to the product specification or limited samples 背光颜色与样品不符、不符合规格书规定	Reject 拒收
---	-------------------------------------	---	-----------

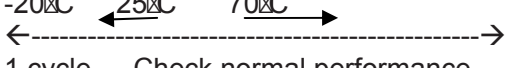
No.	Defects缺陷项目	Description 缺陷描述	Criteria 执行标准
1	LC leakage漏液晶 Maj 主要	LC leakage 液晶漏出	Reject 拒收
2	Polarizer defects 光片不良 Min 次要	polarizer offset光片贴歪	as per the drawing spec依图纸规格
		bubble under the polarizer 光片气泡	Dim尺寸
			Q'ty allow允许个数
			$\varnothing < 0.3\text{mm}$
			$0.3\text{mm} \leq \varnothing \leq 0.5\text{mm}$
			$0.5\text{mm} < \varnothing$
3	FPC	polarizer damaged 光片损伤	polarizer perforation rejected, other damaged judged as the linear/dot defect. Ignore if in the Zone B. 光片穿孔不允许,未穿孔按点状/线状标准判定(非VA区范围忽略不计)
		FPC金手指氧化 FPC connector oxidation. (min)	不允许Reject
		损伤, 蚀刻, 针孔 (次要) etching/damage/pinhole (Min)	不超过1/3线宽, Not exceed 1/3 width of wire.
		FPC金手指脏污(次要) FPC connector dirty (min)	允许 $\Phi \leq 1/2$ 金手指宽度 dirty $\Phi \leq 1/2$ width of pin, allow. (min)
		金手指划伤(次要)	深度不超过1/2金层厚度

		Connector scratch(min)	The scratch depth not exceed 1/2 thickness of gold .
		铜箔、保护胶片/基板胶片有剥离 copper/protective film/base board film separate(maj)	不允许Reject
4	COG 点胶 (次要) COG silicon	胶未盖住ITO走线 (mark 点不计) IC周边缺胶, (次要) Silicon not covering ITO line (Mark lines ignore lack silicon around IC, not allow. (min)  (Note: the shadow part mean silicon)	但如果IC周边有胶, 只是IC顶部少胶, 如下图: 可接受 If there are enough silicon around IC, only not enough silicon on top part of the IC, accept.
		点胶高度超过偏光片表面 (次要) glue higher than polarizer surface (次要)	不允许Reject
		硅胶气泡/针孔 bubble or Pinhole	允许气泡/针孔 $\Phi \leq 2 \text{ mm}$, glue bubble/ pinhole $\Phi \leq 2 \text{ mm}$, accept.
		金手指划伤 (次要) Connector scratch(min)	深度不超过1/2金层厚度 The scratch depth not exceed 1/2 thickness of gold.
5	焊接 Soldering	虚焊、连锡 (主要) false soldering, short soldering (Min)	不允许Reject
		技术要求	参考 IPC-A-610D 中 SMT 及焊接的相关检查标准 the detail technology refer to the SMT and melding related inspection standard of IPC-A-610D.

		其他点线(次要) for other dot or line (次要)	1. 点 $\varnothing \leq 0.15 \text{ mm}$ 不计; $0.15 < \varnothing \leq 0.3 \text{ mm}$, 允许2个。 1. Dot $\varnothing \leq 0.15 \text{ mm}$ ignore; $0.15 < \varnothing \leq 0.3 \text{ mm}$, 2 dots Accept. 2. 线 $W \leq 0.05 \text{ mm}$, 不计; $0.05 \text{ mm} < W \leq 0.1 \text{ mm}$, $L \leq 3 \text{ mm}$, 允许1条。 2. line $W \leq 0.05 \text{ mm}$, ignore; $0.05 \text{ mm} < W \leq 0.1 \text{ mm}$, $L \leq 3 \text{ mm}$, 1 accepted.
--	--	--	--

4. RELIABILITY TEST

4.1 Reliability Test Condition

NO	Test Item		Description	Test Condition	Remark
1	Environmental Test	High Temperature Storage	Applying the high storage temperature Under normal humidity for a long time Check normal performance.	80°C 120H	
2		Low Temperature Storage	Applying the low storage temperature Under normal humidity for a long time Check normal performance.	-30°C 120H	
3		High Temperature Operation	Apply the electric stress (Voltage & current) under high temperature for a Long time.	70°C 120H	#1
4		Low Temperature Operation	Apply the electric stress under low Temperature for a long time	-20°C 120H	#1 #2
5		High Temperature/High Humidity Operation	Apply high temperature and high Humidity storage for a long time	90%RH 40°C 120H	#2
6		Temperature Cycle	Apply the low and high temperature cycle 30 min 5 min 30 min -20°C 25°C 70°C  1 cycle Check normal performance	-20°C/70°C 10 cycle	
7		ESD Test (operation)	150pF, 330 Ω	Contact ±2KV with 5 times Air : ±4KV with 5 times	#3

Remark:

#1: Normal operations condition

- Power supply for LCD driver voltage
- Power supply voltage for LCD system: Getting optimum contrast at 25°C

#2: Pay attention to keep dewdrops from the module during this test.

#3: Measure Point: LCD glass and metal bezel

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 $280 \pm 10^{\circ}\text{C}$ 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 $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ 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.

