

**Display Elektronik GmbH**

**DATA SHEET**

**TFT MODULE**

**DEM 480272G1 TMH-PW-N  
(C1-TOUCH)**

**4,3“ TFT**

**+**

**Projective Capacitive TP**

**Product Specification**

**Ver.: 1**

**09.10.2018**

**REVISION RECORD**

<b>Rev No.</b>	<b>Rev date</b>	<b>Contents</b>	<b>Remarks</b>
0	22.09.2018	First Release	Preliminary
1	09.10.2018	Update INSPECTION CRITERION	Page 15

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1. GENERAL INFORMATION

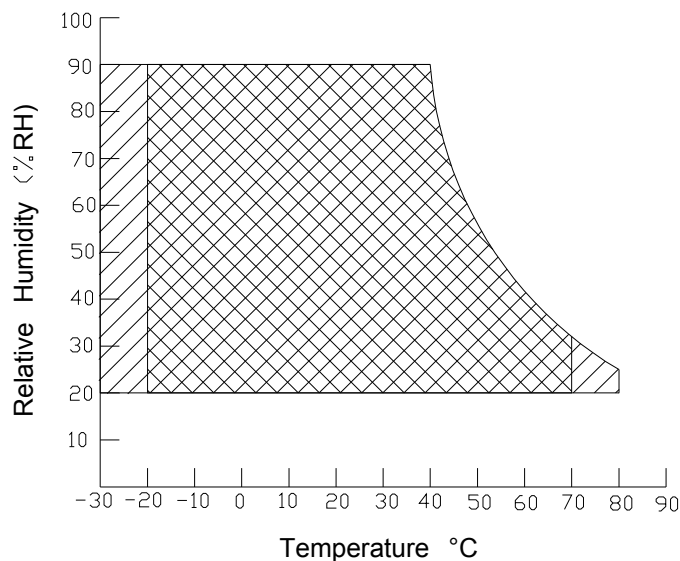
No.	Item	Contents	Unit
1	LCD Size	4.3 Inch (Diagonal)	/
2	Display Mode	a-si TFT&CTP Normally White / Transmissive	/
3	Viewing Direction (Eye)	12 O'clock	/
4	Gray Scale Inversion Direction	6 O'clock	/
5	Resolution	480 x 272 Pixels (TFT) / 480 x 272 Dots (CTP)	/
6	Module Size	105.50 x 67.20 x 4.85	mm
7	Active Area	95.04 x 53.856	mm
8	Pixel Pitch	0.198 x 0.198	mm
9	Interface Type	RGB 24-Bit Interface(TFT)/I2C(CTP)	/
10	Color Depth	16.7 Million	/
11	Module Power Consumption	t.b.d.	W
12	Backlight Type	LED, Lightguide, White	/
13	Driver IC	ILI6480BQ or compatible (TFT) ATMXT336T-MAUR030 (CTP)	/
14	Weight	t.b.d.	g

2. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Input Voltage for TFT	VDD	-0.3	5.0	V	
Power Supply Input Voltage for CTP	VCC	-0.3	3.6	V	
Backlight Current (Normal Temp.)	ILED	-	50	mA	
Operation Temperature	Top	-20	+70	°C	Note1
Storage Temperature	Tst	-30	+80	°C	Note1
Humidity	RH	20%	90%	/	Note1

Note1:

- 1).The relative humidity and temperature range are as below sketch, 90%RH Max.
- 2).The maximum wet bulb temperature  $\cong 40^{\circ}\text{C}$  and without dewing.



Operating Range Storage Range +

### 3. ELECTRICAL CHARACTERISTICS

#### TFT DC CHARACTERISTICS (at Ta=+25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Input Voltage	VDD	3.0	3.3	3.6	V	
I/O Logic Voltage	VDDIO	-	-	-	V	=VDD
Input Voltage 'H' Level	VIH	0.7VDDIO	-	VDDIO	V	
Input Voltage 'L' Level	VIL	VSS	-	0.3VDDIO	V	
Power Supply Current	IVDD	-	17	-	mA	
TFT Gate on Voltage	VGH	-	-	-	V	
TFT Gate off Voltage	VGL	-	-	-	V	
Analog Power Supply Voltage	AVDD	-	-	-	V	
Differential Input Common Mode Voltage	Vcom	-	-	-	V	Note1

Note1: The value is just the reference value. The customer can optimize the setting value by the different D-IC  
Vcom must be adjusted to optimize display quality, as Crosstalk and Contrast Ratio etc..

#### CTP DC CHARACTERISTICS (at Ta=+25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Input Voltage	VCC	2.6	3.3	3.6	V	Note2
Input Power Ripple	Vpp	-	-	50	mV	
I/O Signal Voltage	VCCIO	1.7	1.8	1.9	V	Note2
Input Voltage 'H' Level	VIH	0.7VCCIO	-	VCCIO	V	
Input Voltage 'L' Level	VIL	VSS	-	0.3VCCIO	V	
Operating Current (Normal Mode)	IVCC	-	-	-	mA	
Operating Current (Sleep Mode)	IVCC	-	-	-	mA	

Note2: If you need more information of CTP, please contact us.

**4. BACKLIGHT CHARACTERISTICS**

(at Ta=+25°C,RH=60%)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Voltage	VF	14.0	15.0	16.0	V	IF=20*2mA
LED Forward Current	IF	-	40	-	mA	
LED Power Consumption	PLED	-	0.60	-	W	Note1
Number of LED	-		10		PCS	
Connection Mode	-	5 in series 2 in parallel			/	
LED Lifetime	-	50000	-	-	Hrs	Note2

Note1: Calculator value for reference:  $IF \cdot VF = PLED$ 

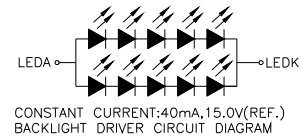
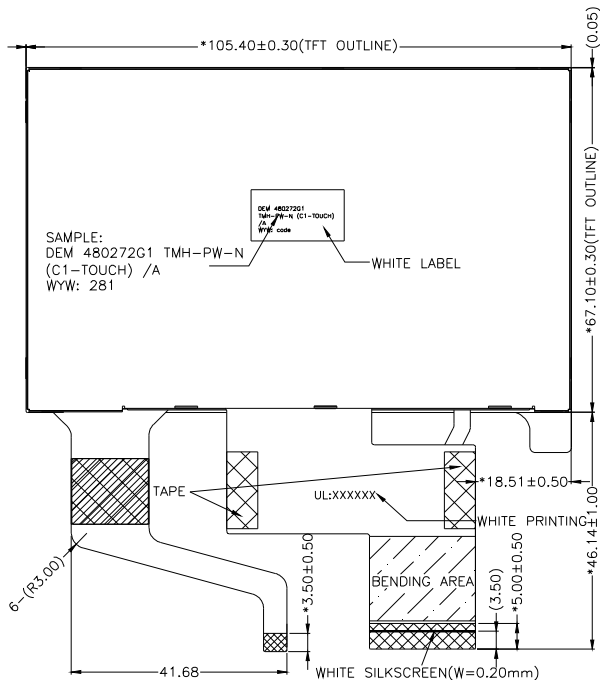
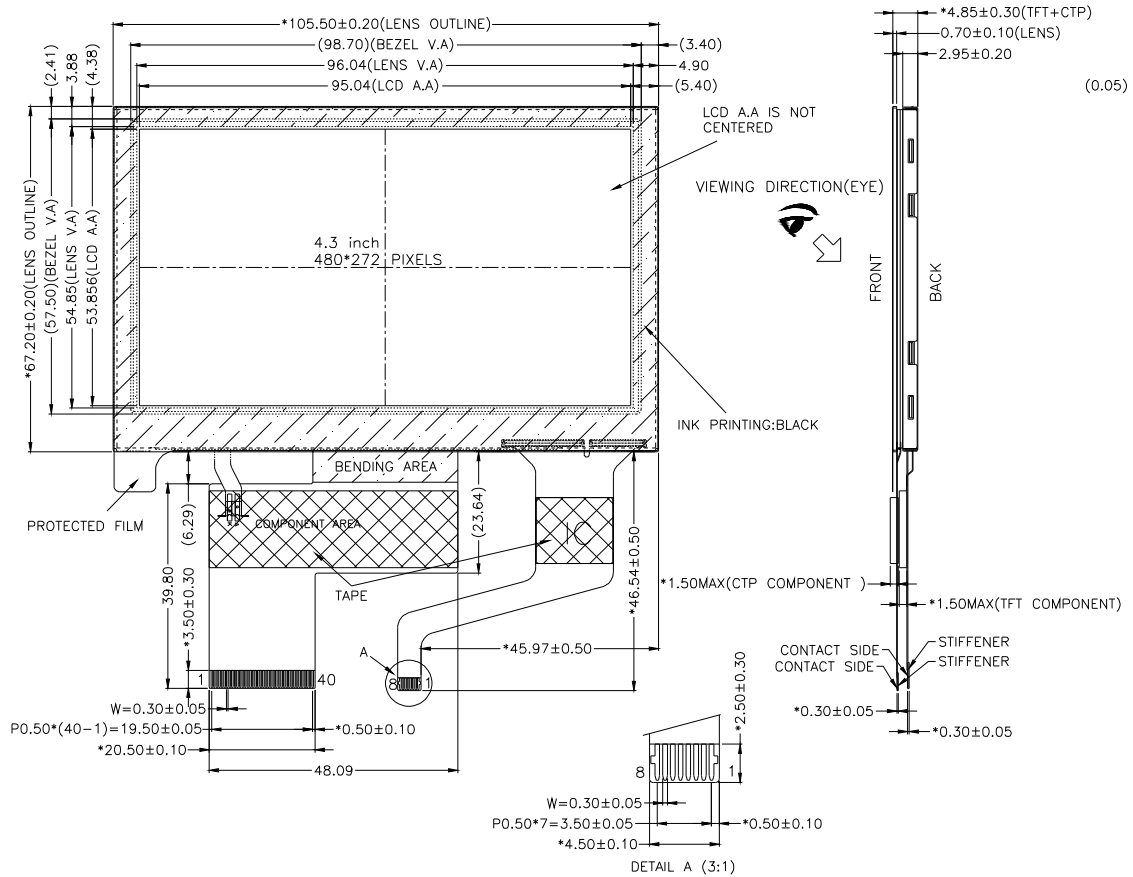
Note2: The LED Lifetime define as the estimated time to 50% degradation of initial brightness at Ta=25°C and IF =40mA. The LED lifetime could be decreased if operating IF is larger than 40mA.

**5. TOUCH PANEL CHARACTERISTICS**

(at Ta=+25°C)

Item	Description	Remark
Product Structure	G+G	-
Surface Hardness	6H	Pencil, Loading 500g, 45 deg
Ball-Falling Test	60cm	Steel Ball Weight 64g
Touch Count Max	5 Points	-
I2C Slave Address*	0x4A	-
Origin of Coordinate*	Top Left Corner	-

6. EXTERNAL DIMENSIONS



## 7. ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	Note
Response Time	Tr+ Tf	-	-	15	24	ms	FIG.1	Note 1
Contrast Ratio	Cr		300	500	-	-	FIG.2	Note 2
Surface Luminance	Lv	$\theta=0^\circ$	550	600	-	cd/m <sup>2</sup>	FIG.2	Note 3
Luminance Uniformity	Yu	$\theta=0^\circ$	75	80	-	%	FIG.2	Note 4
NTSC	-	$\theta=0^\circ$	-	50	-	%	FIG.2	Note 5
Viewing Angle	$\theta$	$\varnothing=90^\circ$	-	50	-	deg	FIG.3	Note 6
		$\varnothing=270^\circ$	-	70	-	deg	FIG.3	
		$\varnothing=0^\circ$	-	70	-	deg	FIG.3	
		$\varnothing=180^\circ$	-	70	-	deg	FIG.3	
CIE (x,y) Chromaticity	Red x	$\theta=0^\circ$ $\varnothing=0^\circ$ Ta=25°C	Typ -0.04	0.562	Typ +0.04	-	FIG.2 CIE1931	Note 5
	Red y			0.336		-		
	Green x			0.342		-		
	Green y			0.598		-		
	Blue x			0.150		-		
	Blue y			0.085		-		
	White x			0.308		-		
	White y			0.339		-		

**Note1. Definition of Response Time**

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time ( $T_{ON}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{OFF}$ ) is the time between photo detector output intensity changed from 10% to 90%. For additional information see FIG.1.

**Note2. Definition of Contrast Ratio**

Contrast ratio(Cr) is defined mathematically by the following formula.  
For more information see FIG.2.

$$\text{Contrast ratio} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Measured at the center area of the LCD

**Note3. Definition of Surface Luminance**

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

$$L_v = \text{Average Surface Luminance with all white pixels}(P_1, P_2, P_3, \dots, P_n)$$

**Note4. Definition of Luminance Uniformity**

The luminance uniformity in surface luminance is determined by measuring luminance at each test position 1 through n, and then dividing the maximum luminance of n points luminance by minimum luminance of n points luminance. For more information see FIG.2.

$$Y_u = \frac{\text{Minimum surface luminance with all white pixels } (P_1, P_2, P_3, \dots, P_n)}{\text{Maximum surface luminance with all white pixels } (P_1, P_2, P_3, \dots, P_n)}$$

**Note5. Definition of Color Chromaticity (CIE1931)**

CIE (x,y) chromaticity, The x,y value is determined by screen active area center position P5. For more information see FIG.2.

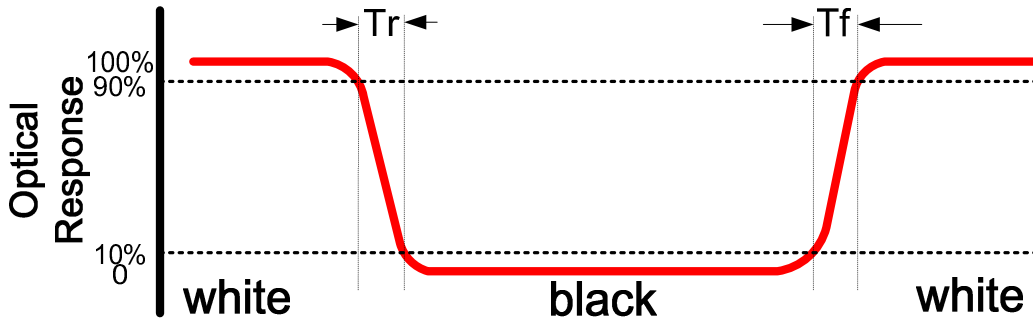


**Note6. Definition of Viewing Angle**

Viewing angle is the angle at which the contrast ratio is greater than 10. 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.

For viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope or DMS series Instruments or compatible. For contrast ratio, Surface Luminance, Luminance uniformity and CIE,the testing data is base on TOPCON's BM-5or BM-7 photo detector or compatible.

**FIG.1. The Definition of Response Time**



**FIG.2. Measuring Method for Contrast Ratio, Surface Luminance, Luminance Uniformity, CIE (x,y) Chromaticity**

H,V : Active area

Light spot size  $\varnothing=1.5\text{mm}$  (BM-7)50cm distance or compatible distance from the LCM surface to detector lens.

Test spot position : see Figure a.

measurement instrument : TOPCON's luminance meter BM-7 or compatible ,see Figure b.

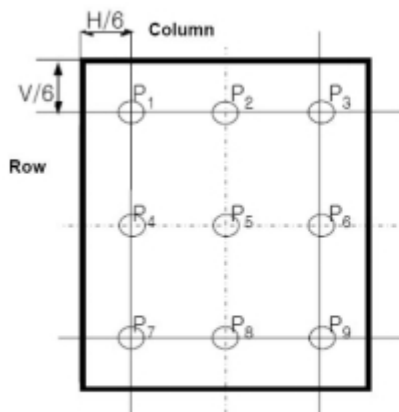


Figure a

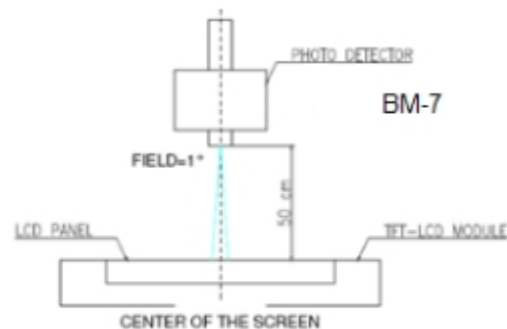
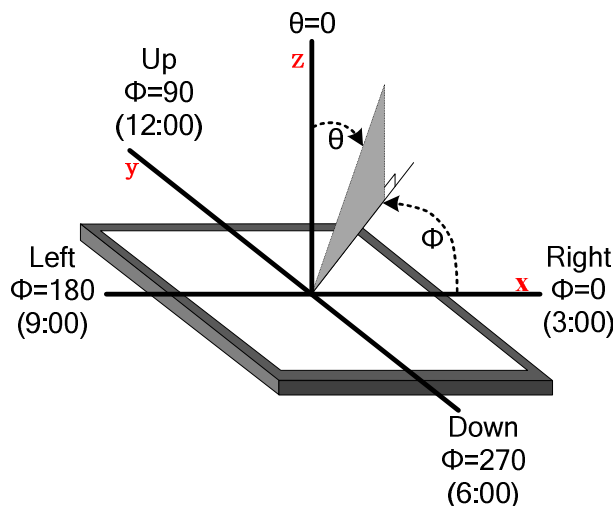


Figure b

**FIG.3. The Definition of Viewing Angle**



## 8. INTERFACE DESCRIPTION

### TFT Module Interface Description

Interface No.	Name	I/O or connect to	Description
1	LEDK	P	Power for LED backlight(Cathode)
2	LEDA	P	Power for LED backlight(Anode)
3	GND	P	Ground
4	VDD	P	Power for LCD
5-12	Red(0-7)	I	Red data
13-20	Green(0-7)	I	Green data
21-28	Blue(0-7)	I	Blue data
29	GND	I	Ground
30	DCLK	I	Dot clock
31	DISP	I	Display on/off
32	HSYNC	I	Horizontal sync input.
33	VSYNC	I	Vertical sync input
34	DE	I	Data enable
35	NC	/	/
36	GND	P	Power ground
37	XR/NC	/	/
38	YD/NC	/	/
39	XL/NC	/	/
40	YU/NC	/	/

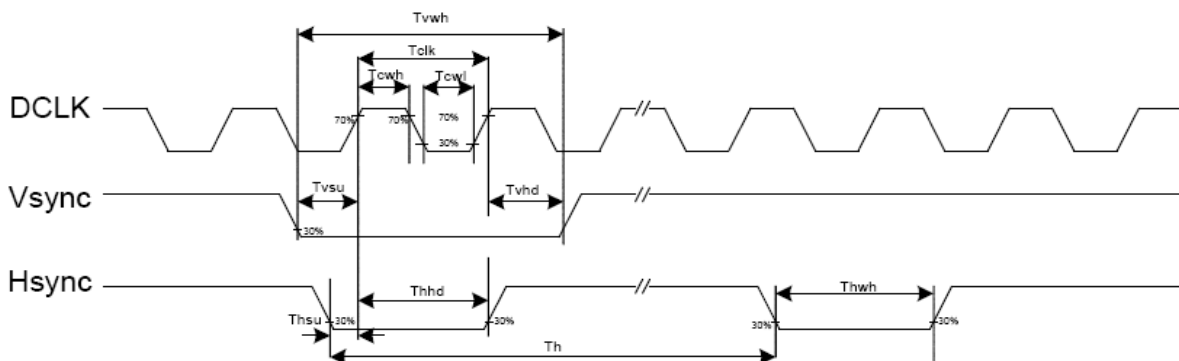
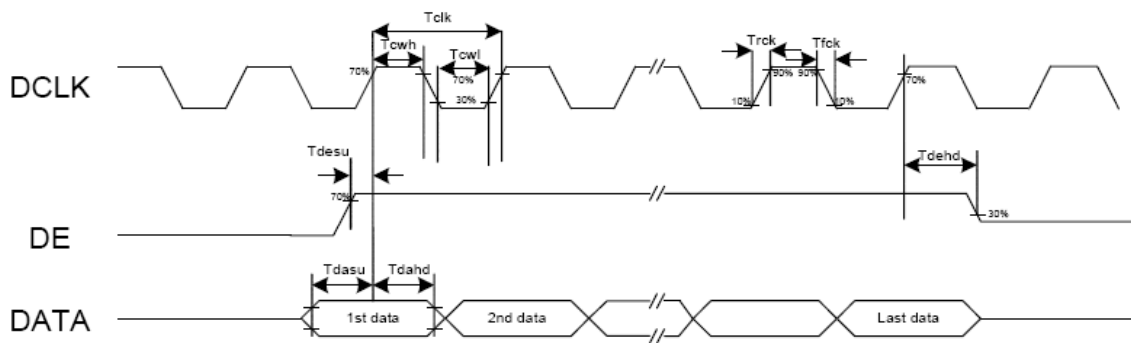
### CTP Interface Description

Interface No.	Name	I/O or connect to	Description
1	GND	P	Ground
2	SCL	I	Serial interface clock
3	SDA	I/O	Serial interface date
4	INT	O	State change interrupt
5	RESET	I	Reset low
6	VCC	P	Power Supply of CTP
7	AVDD	P	Power Supply of CTP
8	NC	/	/

### 9. AC CHARACTERISTICS

#### TFT Module AC CHARACTERISTICS

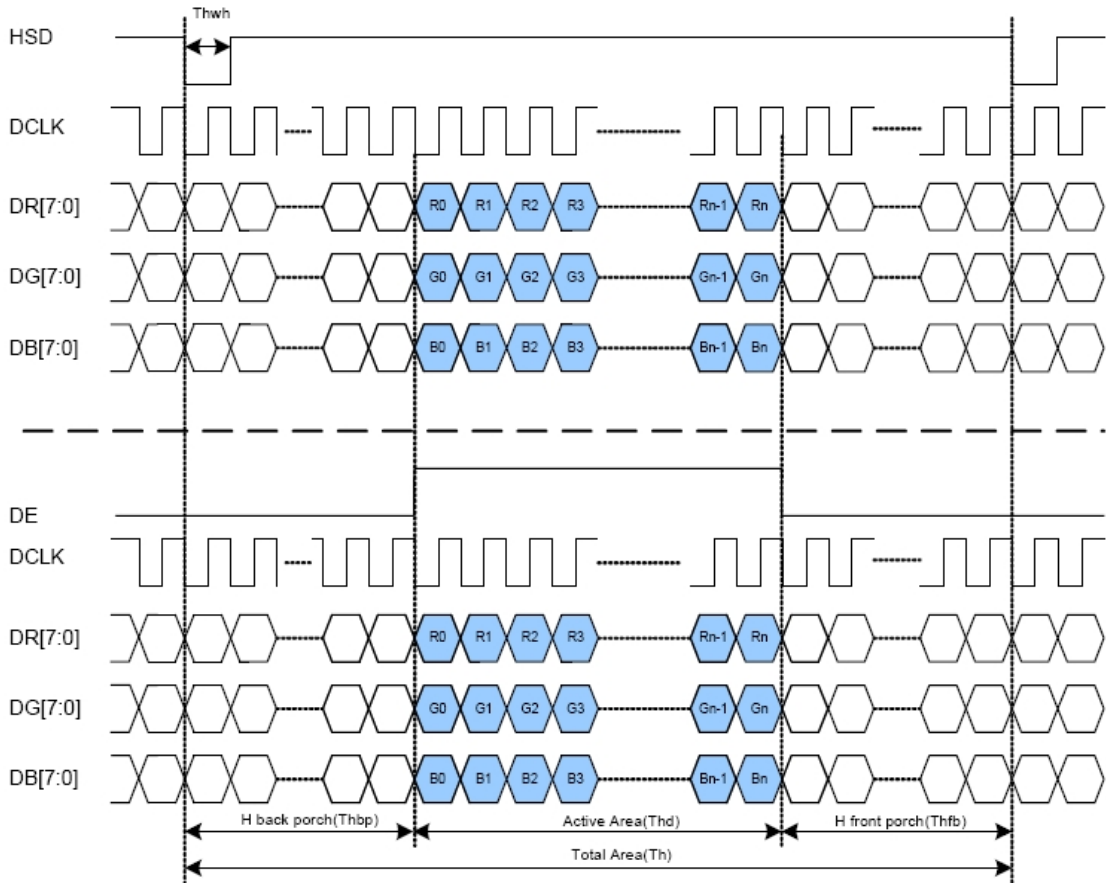
Input Output timing						
DCLK clock time	Tclk	33.3	-	-	ns	DCLK=30MHz
DCLK clock low period	Tcwl	40	-	60	%	
DCLK clock high period	Tcwh	40	-	60	%	
Clock rising time	Trck	9	-	-	ns	
Clock falling time	Tfck	9	-	-	ns	
HSD width	Thwh	1	-	-	DCLK	
HSD period time	Th	55	60	65	us	
HSD setup time	Thsu	12	-	-	ns	
HSD hold time	Thhd	12	-	-	ns	
VSD width	Tvwh	1	-	-	Th	
VSD setup time	Tvsu	12	-	-	ns	
VSD hold time	Tvhd	12	-	-	ns	
Data setup time	Tdasu	12	-	-	ns	
Data hold time	Tdahd	12	-	-	ns	
DE setup time	Tdesu	12	-	-	ns	
DE hold time	Tdehd	12	-	-	ns	
Source output setting time	Tsst	-	-	TBD	us	10% to 90% CL=60pF, RL=2Kohm
Gate output setting time	Tgst	-	-	TBD	ns	10% to 90%, CL=60pF
VCOM output setting time	Tcst	-	-	TBD	us	10% to 90%, CL=40nF, RL=50ohm
Time from VSD to 1st line data input	Tvs	3	8	31	Th	HV mode By HDL[4:0] setting



Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
DCLK frequency	fclk	5	9	12	MHz
VSD period time	Tv	277	288	400	H
VSD display area	Tvd	272			H
VSD back porch	Tvb	3	8	31	H
VSD front porch	Tvfp	2	8	97	H
HSD period time	Th	520	525	800	DCLK
HSD display area	Thd	480			DCLK
HSD back porch	Thbp	36	40	255	DCLK
HSD front porch	Thfp	4	5	65	DCLK

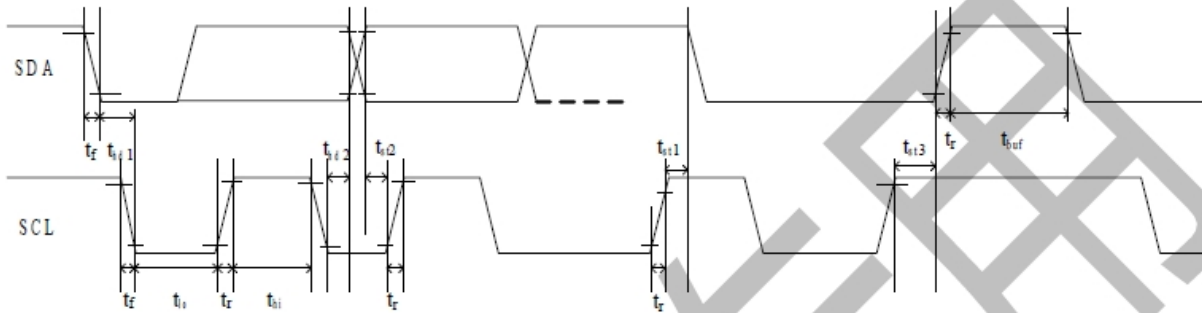
(HV Mode)

(DE Mode)



**CTP AC CHARACTERISTICS**

Communication speed is 400Kbps or less.



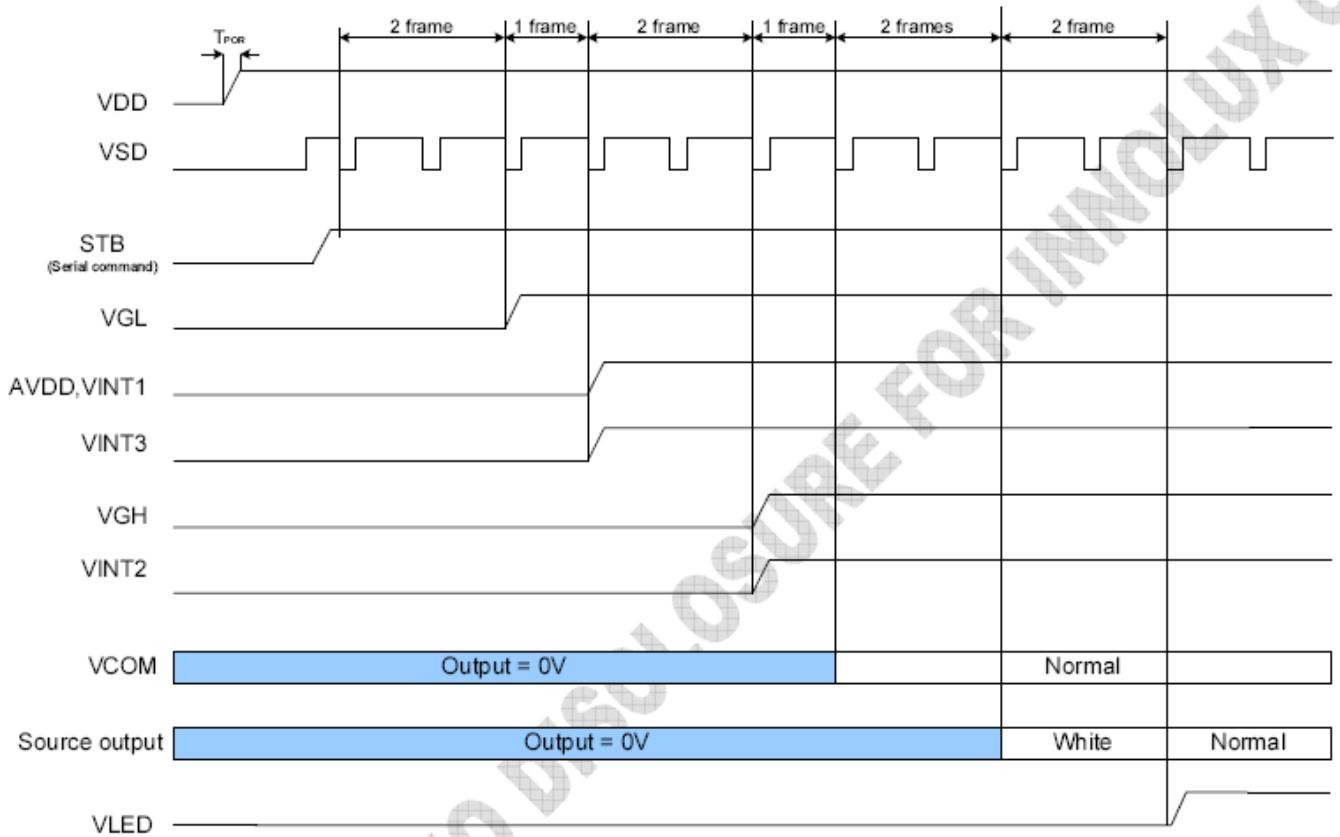
Parameter	Symbol	MIN.	Max.	Unit
SCL low period	$t_{Lo}$	0.9	0.9	us
SCL high period	$t_{Hi}$	0.8	0.8	us
SCL setup time for START condition	$t_{St1}$	0.4	0.4	us
SCL setup time for STOP condition	$t_{St3}$	0.4	0.4	us
SCL hold time for START condition	$t_{Hd1}$	0.3	0.3	us
SDA setup time	$t_{St2}$	0.4	0.4	us
SDA hold time	$t_{Hd2}$	0.4	0.4	us

### 10. POWER SEQUENCE

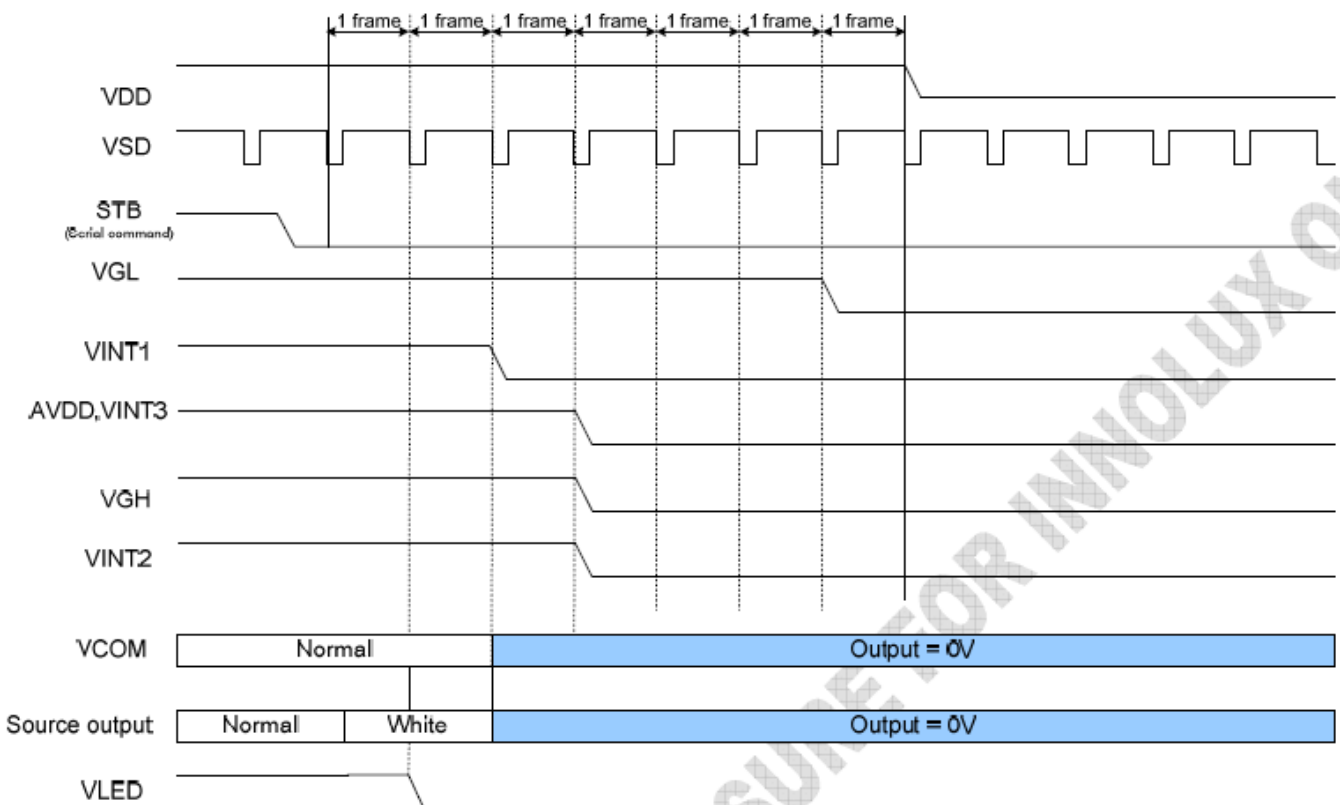
#### TFT Module POWER SEQUENCE

In order to power on /off ILI6480BQ correctly, please follow the following recommended power on /off sequence.

##### Power On Sequence:

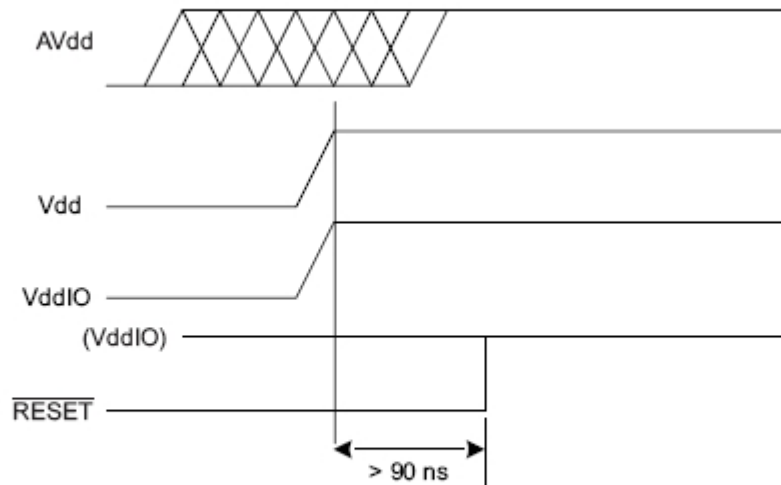


##### Power Off Sequence:



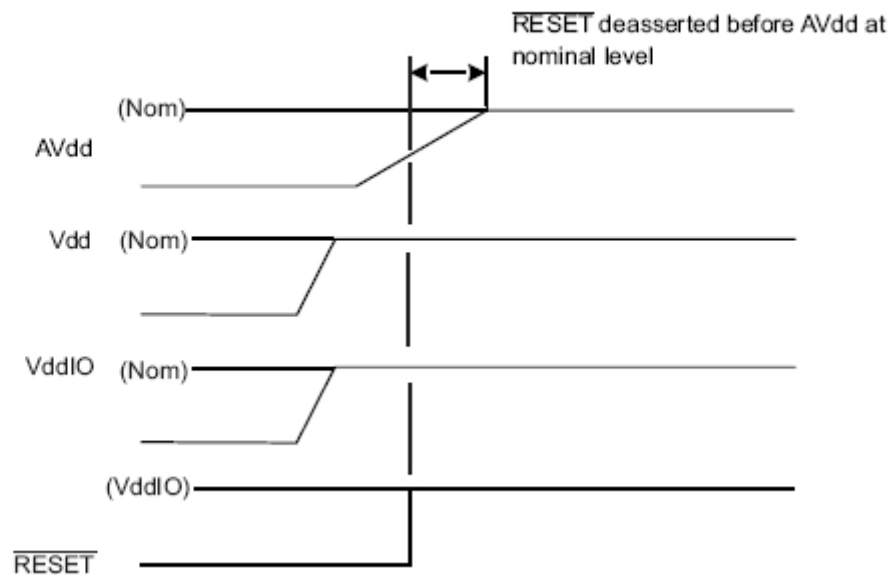
CTP POWER SEQUENCE

FIGURE 5-1: POWER SEQUENCING ON THE MXT336U



Note: When using external  $\overline{\text{RESET}}$  at power-up, VddIO must not be enabled after Vdd

FIGURE 5-2: POWER SEQUENCING ON THE MXT336U – LATE RISE ON AVDD



**WARNING** The device should be reset only by using the  $\overline{\text{RESET}}$  line. If an attempt is made to reset by removing the power from the device without also sending the signal lines low, power will be drawn from the interface lines and the device will not reset correctly.

## 11. RELIABILITY TEST CONDITIONS

No.	Test item	Test condition	Inspection after test	
11.1	High temperature storage test	+80°C/240 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects : 1.Current changing value before test and after test is 50% larger; 2. Function defect : Non-display,abnormal-display,missing lines, Short lines,I/O corrosion; 3.Visual defect : Air bubble in the LCD,Seal leak,Glass crack.	
11.2	Low temperature storage test	-30°C/240 hours		
11.3	High temperature operating test	+70°C/120 hours		
11.4	Low temperature operating test	-20°C/120 hours		
11.5	Temperature cycle storage test	-30°C ~ 25°C ~ +80°C/10cycles (30min.) (10min.) (30min.)		
11.6	High temperature high humidity test	+50°C*90% RH/120 hours		
11.7	Vibration test	Frequency : 250 r/min Amplitude : 1 inch Time: 45min		
11.8	Drop test	Drop direction: 1 corner/3 edges/6 sides 10 time		
		Packing weight(kg)		Drop height(cm)
		<11		80±1.6
		11 ≤G<21		60±1.2
		21 ≤G<31	50±1.0	
		31 ≤G<40	40±0.8	
11.9	ESD test	Air discharge: ±8KV, 10time Contact discharge: ±4KV, 10time		
<p>Remark :</p> <p>1.The test samples should be applied to only one test item.</p> <p>2.Sample size for each test item is 3~5pcs.</p> <p>3.For High temperature high humidity test, Pure water(Resistance&gt;10MΩ) should be used.</p> <p>4.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.</p> <p>5.B/L evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence B/L has.</p> <p>6.Failure judgment criterion: Basic specification, Electrical characteristic, Mechanical characteristic, Optical characteristic.</p>				



## 12. INSPECTION CRITERION

### 12.1 Objective

The CTP test criterion are set to formalize CTP quality standards for DISPLAY with reference to those of the customer for inspection, release and acceptance of finished CTP products in order to guarantee the quality of CTP products required by the customer.

### 12.2 Scope

This specification is applicable to capacitive touch panel manufactured by DISPLAY.

### 12.3 Equipment for Inspection

lamp-box、ionizing fan、10X microscopes、film card、alcohol/oil ether/acetone、finger cots、vernier caliper、anti-static wrist straps、microcalliper、feeler、pencil hardness tester、spectrophotometer、drop ball test,etc.

### 12.4 Sampling Plan and Reference Standards

#### 12.4.1.1 Sampling plan:

Refer to National Standard GB/T 2828.1---2012/ISO2859-1:1999, level II of normal levels:

**Major defect: AQL 0.4**

**Minor defect: AQL 1.0**

### 12.5 Inspection Conditions and Inspection Reference

12.5.1 Inspection environment: temperature: 23°C±3°C; humidity: 45%~75%RH; cleanness: 10000 grade;

12.5.2 Inspection distance: 30cm±5cm;

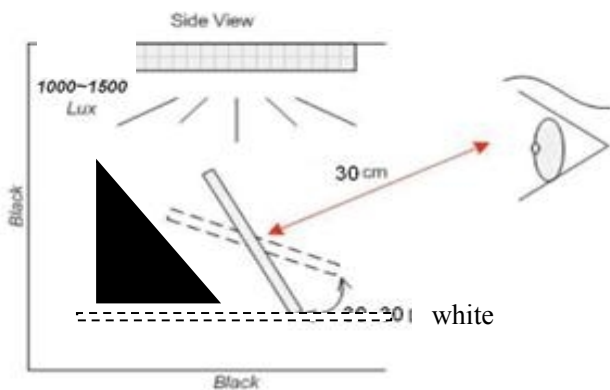
12.5.3 Inspection angle: vertical rotate angle: ±30°, up->down; horizontal rotate angle:±30°,left->right

12.5.4 Inspection luminance : fluorescent (finished product) inspection luminance is 800~1200Lux;

12.5.5 Background color: black/white;

12.5.6 Inspection time : 10~15s/ pcs

#### Black Booth or Black Background



12.5.7.1 A area: front side visible area - BM(Black Mask), the area encircled by blue lines.

12.5.7.2 B area: four broadside(inspect from broadside) area & FPC area, encircled by green lines.



12.5.8 Defect type:

12.5.8.1 A area defect type:

Line defect (scratch、soft flocks、fibre)、dot defect (white dot、black dot、same color dot、different color dot、dust、bubble)、surface stain、pin-hole、light leak、scratch.

12.5.8.2 B area defect type:

Broken、crack/chipping、FPC defect

12.5.9 Undefined items or other special items, refer to mutual agreement and limited sample.If criterion does not match product specifications/ technical requirement, both should be subject to special inspection criterion agreed by customer.

## 12.6 Defects and Acceptance Standards

12.6.1 Electrical properties test

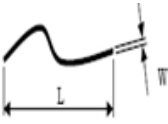
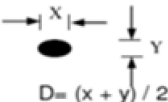
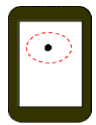
Check in factory tester. The program will release result automatically. There are “OK”、“PASS”、“NG”and the final judgment must be “OK” “PASS”, and we need to pass the draw line test.

Refer to 《\*\*serise IC test program》

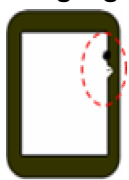
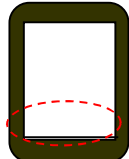
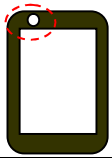
No.	Defects	Descriptions	Accepted standard	MAJ.	MIN.
12.6.1.1	Short	Measured data has much difference compared with normal; line is not stable	Reject	√	
12.6.1.2	Open	Measured data has no change. Line is open	Reject	√	
12.6.1.3	No reaction	No reaction and there is no line in screen	Reject	√	
12.6.1.4	Mis-display/ abnormal display	Screen has display but line is open or bent	Reject	√	
12.6.1.5	Button no reaction	Press the button but no reaction	Reject	√	
12.6.1.6	Button not correct	Press the button .Reaction is not stable	Reject	√	

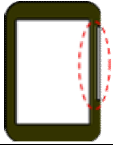



12.6.2 Appearance Inspection

12.6.2.1 Dot/Line Defect

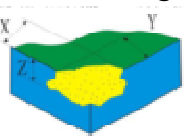

Defect	≤5"	5~10"	10~15"	>15"	Accepted standard	MAJ.	MIN.
<b>S/C , line defect</b>  <b>W:width</b> <b>L:length</b>  	Tactile S/C->NG	Tactile S/C->NG	Tactile S/C->NG	Tactile S/C->NG	Reject		√
	W≤0.03mm, ->OK; Density is high ->NG	W≤0.05mm, ->OK; Density is high ->NG	W≤0.05mm, ->OK; Density is high ->NG	W≤0.05mm, ->OK; Density is high ->NG	Accept		√
	0.03mm<W≤0.10mm, L≤5mm quantity≤4 distance>10mm	0.05mm<W≤0.1mm, L≤8mm quantity≤6 distance>10mm	0.05mm<W≤0.1mm, L≤10mm quantity≤6 distance>10mm	0.05mm<W≤0.1mm, L≤20mm quantity≤8 distance>10mm	Accept		√
	W>0.10mm L>5mm	W>0.1mm L>8mm	W>0.1mm L>10mm	W>0.1mm L>20mm	Reject		√
<b>Dot defect</b> <b>D:Diameter</b>   	W≤0.10mm, ->OK;	W≤0.15mm, ->OK;	W≤0.15mm, ->OK;	W≤0.15mm, ->OK;	Accept		√
	0.10mm<D≤0.25mm quantity≤4 distance>10mm	0.15mm<D≤0.30mm quantity≤6 distance>10mm	0.15mm<D≤0.40mm quantity≤6 distance>10mm	0.20mm<D≤0.50mm quantity≤5 distance>10mm	Accept		√
	D>0.25mm	D>0.30mm	D>0.40mm	D>0.50mm	Reject		√

12.6.2.2 LENS defect


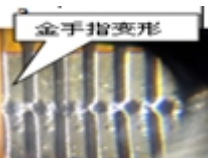

Defect	Description	Accepted standard	MAJ.	MIN.
<b>Printing zigzag</b>  	zigzag width which is almost the same with VA area W≤0.15mm	Accept		√
	zigzag width which is almost the same with VA area W>0.15mm	Reject		√
<b>Wire mark</b>  	≤0.15mm	Accept		√
	>0.15mm	Reject		√
<b>Ink pinhole</b>  	Invisible with reflector light	Accept		√

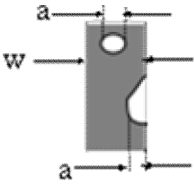
<p><b>Ink film defect</b></p>	<p>Ink film:s/c、 soft flocks、 fibre Ink film stain/color shift:refer to limited sample Ink film foreign material/scratch: refer to 6.2.1 visible area judgment</p>	<p>Accept</p>		<p>√</p>
<p><b>Ink light leak</b></p> 	<p>Broadside light leak width≤0.15mm Each side light leak quantity≤1</p>	<p>Accept</p>		<p>√</p>
<p><b>Ink color shift</b></p>	<p>Refer to limited sample</p>			<p>√</p>
<p><b>font、glass silver line (ink area) width≥0.2mm</b></p>	<p>D≤0.20mm; N≤2 ↑</p>	<p>Accept</p>		<p>√</p>
<p></p>	<p>D&gt;0.20mm</p>	<p>Reject</p>		<p>√</p>
	<p>Refer to limited sample, if it's out of spec</p>	<p>Reject</p>		<p>√</p>
<p><b>word/color error</b></p>	<p>Word or color or position is different from drawing and sample.</p>	<p>Reject</p>	<p>√</p>	
<p><b>word missing width≤0.2mm</b></p> 	<p>height, a≤1/4h, width≤1/2w</p>	<p>Accept</p>		<p>√</p>
<p><b>Font thickness different and color nonuniform</b></p> 	<p>Refer to limited sample, if it's out of spec</p>	<p>Reject</p>		<p>√</p>
<p><b>IR/video/Receive hole /Button hole</b></p>	<p>Irregular hole , offside, refer to drawing</p>	<p>Accept</p>		<p>√</p>
<p></p>	<p>Foreign material/scratch exist in hole,refer to 6.2.1</p>	<p>Reject</p>		<p>√</p>
<p><b>LENS broadside foreign material</b></p>	<p>Width≤ 0.15mm</p>	<p>Accept</p>		<p>√</p>
<p><b>Ink spill</b></p>	<p>LENS broadside or receive hole or button hole have ink spill defect, refer to limited sample.</p>	<p>Accept</p>		<p>√</p>

12.6.2.3 Breakage

Defect	≤5"	5~10"	10~15"	>15"	Accepted standard	MAJ.	MIN.
<b>LENS breakage</b> 	X≤0.3mm, Y≤0.3mm, one side ≤1	X≤0.3mm, Y≤0.4mm, one side≤1	X≤0.4mm, Y≤0.4mm, one side≤1	X≤0.5mm, Y≤0.5mm, one side≤1	Accept		√
	X>0.3mm, Y>0.3mm	X>0.3mm, Y>0.4mm	X>0.4mm, Y>0.4mm	X>0.5mm, Y>0.5mm	Reject		√
<b>Sensor breakage</b>	Not affect ITO line, not lengthen,function test is OK And be non-visual after attaching Lens				Accept		√
	affect ITO line and be visual				Reject		√
<b>Glass crack</b> 	Crack lengthen to outside				Accept		√
	Crack lengthen to inside				Reject		√

12.6.2.4 FPC defect


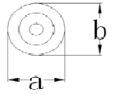
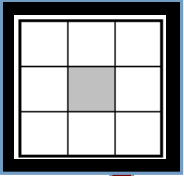
Defect	Description	Accepted standard	MAJ.	MIN.
<b>FPC folding</b> 	FPC is folding and can not restore-> Reject FPC is folding and can restore->compare with limited sample	Reject		√
<b>FPC cover layer defect</b>	FPC cover layer peeling off	Reject		√
<b>FPC color shift and bubble</b>	PI layer have color shift or bubbled due to high welding temperature or long welding time.	Reject		√
<b>Golden finger defect</b> 	peeling off、bonding deformed、glue remained、oxidized, stained	Reject		√
<b>Joggle defect</b> 	bent, broken, peeling off	Reject		√
<b>FPC defect</b>	(golden finger) dented, pin hole a≤w/3	Accept		√

	open/scratch/cracked	Reject		√
	oxidized, stained	Reject		√
<b>FPC loophole</b>	Soft loophole≤2.0mm, hard (PCB、PC、steel cover layer) loophole≤1.0mm	Accept		√

## 12.6.2.5 Attaching defect (protective film/adhesive tape/foam/PC...)


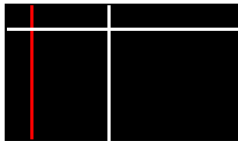



Defect	Description	Accepted standard	MAJ.	MIN.
<b>High temperature glue paper</b>	1.Glue paper attached in FPC doesn't cover component or FPC cove layer. 2.Glue paper attached in golden finger doesn't cover golden finger or peel off	Reject		√
<b>Protective film</b>	Clean、 attaching flat、 no shifting or bubble	Accept		√
	Protective film attaching bubble in VA: D≤2.0mm N≤5 distance≤20mm	Accept		√
	Protective film attaching bubble in VA: D>2.0mm N>5 distance>20mm	Reject		√
<b>Tape</b>	Attach position refer to the drawing	Accept		√
<b>Foam</b>	Gap spec:0.5+/-0.5mm, foam must be smaller than sensor edge side and can not enter into VA.	Accept		√
<b>PC board/ adhesive tape</b>	Tape must be smaller than LENS edge side and can not be folding ,dent or shifting.	Accept		√
<b>Anti-explosion fim/Anti-glare film/blue film</b>	Impression print refer to the limited sample	Accept		√
	Attach position refer to the drawing	Accept		√

12.6.2.6 Others

Defect	Description	Accepted standard	MAJ.	MIN.
<b>Glue flow</b> 	Insulation oil flow in VA area	Reject		√
	ACF/insulation oil flow in VA area	Reject		√
	Sensor edge side glue flow	Accept		√
<b>IC/FPC gap glue</b>	FPC gap glue:cover FPC connect point totally IC glue: cover IC line connect totally	Accept		√
	Glue height : follow the technology spec	Accept		√
<b>Newton circles (rainbow)</b> 	Circles quantity > 2	Reject		√
<b>Layering</b>	LENS/Sensor layering	Reject	√	
<b>Surface</b>	Stain defect which can be removed by cleaning solvent and cloth Defect quantity ≤ 10% Lot total quantity -> Accept Remark: defect product which is sorted out by AQL is not included in the 10% part. Unmovable stain refer to 6.2.1 specification.	Reject		√
<b>Isolation point</b>  VA diagram	Gray area In 8X8mm area, all isolation points are missing	Reject		√
	White area In 15X15mm area, all isolation points are missing	Reject		√
	5mm within VA (black area) , isolation points missing -> Ignored	Accept		√
	Isolation points are overlaid	Accept		√

12.6.3 TFT defects and Inspection Criterion

12.6.3.1 Function items (Defect category MA)

Defects	Inspection Criterion	Pictures	Inspection method/tools	Defect category
No display /reaction	shows no picture/display in normal connected situation. ->Rejected		Naked eyes/ testers	MA
Missing segment	Shows missing lines in normal display		Naked eyes/ testers	MA
Image retention (sticking)	The previous picture stays in the next picture. Disappear time <10s, OK; time>10s, NG		Naked eyes/ testers	MA
Flicker	Not accepted		Naked eyes/ testers	MA
Display abnormal	Not accepted		Naked eyes/ testers	MA
Display dim/bright	Refer to limited sample	/	Naked eyes/ limited sample	MA
Contrast	Refer to limited sample	/	Naked eyes/ limited sample	MA
White dot	Refer to dot criterion	/	Naked eyes	MI
White speckle	Refer to limited sample	/	Naked eyes/ limited sample	MI
Yellow speckle	Refer to limited sample	/	Naked eyes/ limited sample	MI

12.6.3.2 LCD pixel dot defect(defect category: MI)

Item	Inspection criterion			
	S <5"	5≤S<10"	10≤S<15"	>15"
Color pixel dot defect(RGB dot)	1	2	2	3
2 connected bright dot	0	0	1	1
3 connected bright dot or more	0	0	0	0
Bright dot quantity	1	2	3	4
Random dark dot quantity	2	3	4	5
2 connected dark dot	1	1	2	2
3 connected dark dot or more	0	0	0	0
Dark dot quantity	3	4	5	6
Multi-bright dot	ND 5% hidden, OK			



Item	Inspection criterion
Remark: 2 bright dots distance DS≥15mm 2 dark dots distance DS≥5mm	
1) Bright dot: Power on TFT and RGB dot in black display	
2) Dark dot: Power on TFT and gray or black dot in RGB display	
3) Multi-bright dot: Power on TFT and fluorescent tiny dot in black display(only visible in black display)	


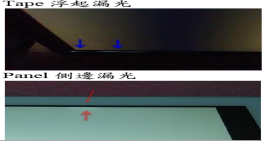
## 12.6.3.3 Backlight components

No.	Item	Description	Accepted criterion	MAJ.	MIN.
12.6.3.3.1	No backlight wrong Color	/	Rejected	√	
12.6.3.3.2	Color deviation	When powered on, the LCD color differs from its sample and found that the color not conforming to the drawing after testing.	Refer to sample and drawing.		√
12.6.3.3.3	Brightness deviation	When powered on, the LCD brightness differs from its sample and is found after testing not conforming to the drawing; or if it conforms to the drawing but the brightness over ±40% than its typical value.	Refer to sample and drawing.		√
12.6.3.3.4	Uneven brightness	Uneven on the same LCD and out of the specification of the drawing. The no specification evenness= (the max value-the min value)/ mean value< 70%.	Refer to sample and drawing.		√
12.6.3.3.5	Spot/line /scratch	When power on, it has dirty spot, scratches and so on spot and line defects.	Refer to 6.2.1		√

## 12.6.3.4 Metal frame (Metal Bezel)

No.	Item	Description	Accepted criterion	MAJ.	MIN.
12.6.3.4.1	Material & surface treatment	Metal frame/surface treatment do not conform to the specifications.	Rejected	√	
12.6.3.4.2	Tab twist Unconformity/ Tab not twisted	Wrong twist method or direction and twist tabs are not twisted as required.	Rejected	√	
12.6.3.4.3	Bezel paint loss	Scratch/paint loss/Bezel surface concave-convex dot/dent	1.Front surface: Paint peel off and scratch to the bottom Dot:D≤0.5mm, exceeds 3; Line:L≤3.0mm,W≤0.05mm exceeds 2; 2.Front dent, air bubble and side with paint peeling off scratch to the bottom Dot: D≤1.0mm, exceeds 3; Line:L≤3.0mm,W≤0.05mm, exceeds 2;	√	
12.6.3.4.4	Bezel scratch			√	
12.6.3.4.5	Painting peel off, discoloration,dent, and scratch			√	
12.6.3.4.6	Burr	Burr(s) on metal bezel is so long as to get into viewing area.	Rejected	√	

12.6.3.5 Others

No.	Item	Description	Accepted criterion	MAJ.	MIN.
12.6.3.5.1	Assembly foreign material	Dot/linear stain after assembly backlight and diffuse film TP assembly foggy stain	Invisible when power on->OK Refer to 6.2.1 dot/line spec		√
12.6.3.5.2	Product mark	Missing, unclear, incorrect, or misplaced part	Rejected		√
12.6.3.5.3	Newton's rings	Area<1/6 screen area quantity≤1	Accepted		√
12.6.3.5.4	Mura	1.In black display ND 5% invisible ->OK; visible->NG 2.Naked eyes inspection RGB display invisible Black display, area<1/4 screen area	Refer to limited sample 		√
12.6.3.5.5	Light leak	1.LCD edge (near backlight) shadow by LCD lamps irregular illuminate 2.Judge in black/white/gray display (slight leaky is yellowish,greenish, blueish ->NG) ; 	Refer to limited sample		√
12.6.3.5.6	Polarizer	1.Polarizer slant.Cover VA and not over LCD edge 2.No unmovable stain or finger print in polarizer VA 3.Bubble/warped but not enter VA	Accepted		√

12.6.4 General Appearance

12.6.4.1 Common function inspection equipment :micro calliper、vernier caliper、pencil hardness tester、spectrophotometer 、drop ball test.

No.	Items	Spec
1	Dimension	According to drawing
2	Curl	≤0.3% -> OK, "S" curl ->NG
3	Surface hardness	According to drawing
4	VA TT (550nm)	According to drawing
5	IR TT-- (550nm & 850nm)	According to drawing
6	Intensity (drop ball test)	According to drawing

Remark: the criterion is common for all product and if some components are not included,just ignore it.

12.7. Others

Items not specified in this document or released on compromise should be inspected with reference to mutual agreement and limit samples.

**13. HANDLING PRECAUTIONS****13.1 Mounting method**

The LCD module consists of two thin glass plates with polarizers which easily be damaged. And since the module is so constructed as to be fixed by utilizing fitting holes in the printed circuit board.

Extreme care should be needed when handling the LCD modules.

**13.2 Caution of LCD handling and cleaning**

When cleaning the display surface, Use soft cloth with solvent [recommended below] and wipe lightly :

- Isopropyl alcohol
- Ethyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent :

- Water
- Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

Do not use the following solvent on the pad or prevent it from being contaminated :

- Soldering flux
- Chlorine (Cl) , Sulfur (S)

If goods were sent without being silicon coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happens by miss-handling or using some materials such as Chlorine (Cl), Sulfur (S) from customer, Responsibility is on customer.

**13.3 Caution against static charge**

The LCD module uses C-MOS LSI drivers, so we recommend that you :

Connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

**13.4 Packing**

Module employs LCD elements and must be treated as such.

- Avoid intense shock and falls from a height.
- To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

**13.5 Caution for operation**

- It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life.
- An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.
- Usage under the maximum operating temperature, 50%Rh or less is required.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.

**13.6 Storage**

In the case of storing for a long period of time for instance, for years for the purpose of replacement use, the following ways are recommended.

- Storing in an ambient temperature 10°C to 30°C, and in a relative humidity of 45% to 75%. Don't expose to sunlight or fluorescent light.
- Storing in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.
- Storing with no touch on polarizer surface by anything else.

It is recommended to store them as they have been contained in the inner container at the time of delivery from us.

**13.7 Safety**

- It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.

- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

#### **14. PRECAUTION FOR USE**

**14.1** A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

**14.2** On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

- When a question is arisen in this specification.
- When a new problem is arisen which is not specified in this specifications.
- When an inspection specifications change or operating condition change in customer is reported to DISPLAY, and some problem is arisen in this specification due to the change.
- When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.