FORMIKE® GROUP
LCD·SOLUTION·TOUCHSCREEN

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH043ST43-C01 Version: 1.0

【 】 Preliminary Specification
【 ◆ 】 Finally Specification

CUSTOMER'S APPROVAL	
SIGNATURE:	DATE:

●It signifies that you fully understand and accept all the contents of this specification if you sign and send back the first page of this specifications.

Designed by	R&D Checked by	Quality Department by	Approved by
LEO			

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● This specification is subject to change without notice. Please contact FORMIKE or it's representative before designing your product based on this specification.

Revision record

VER NO.	VER DATE	CONTENTS	Note
1.0	**2019-02-18**	**NEW ISSUE**	

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1. General Description

1.1 Description

KWH043ST43-C01 is a Transmissive type color active matrix liquid crystal display (LCD), which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, driver IC, FPC ,backlight and CTP unit .
The following table described the features of FORMIKE KWH043ST43-C01.

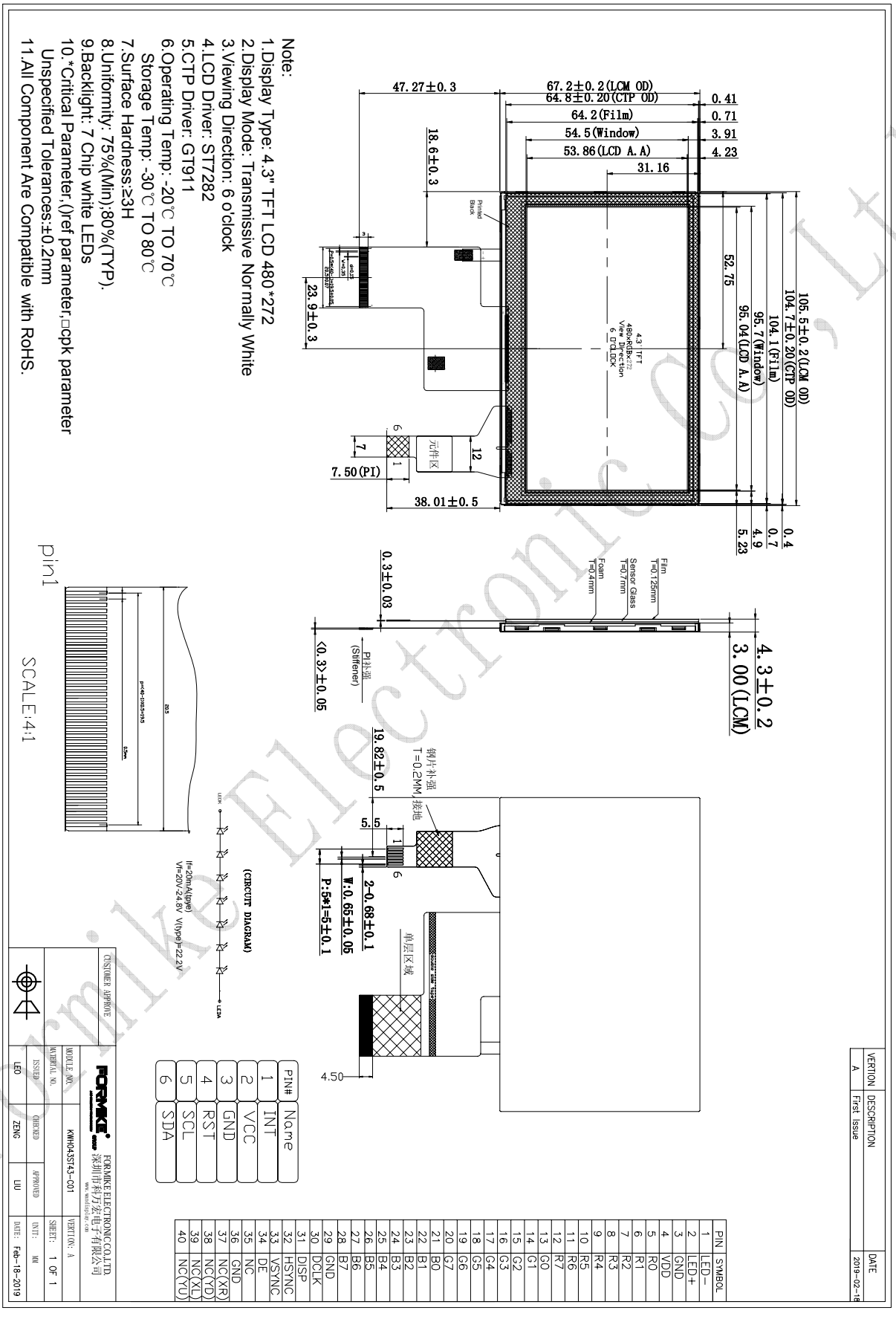
1.2 Application

PAD,PMP,MP4,DVB-S,GPS, Multimedia products,Portable Navigation and other electronic Products
Etc.

1.3 Features:

Features	Description	UNITS
LCD type	4.3'TFT	--
Dot arrangement	480（RGB）×272	dots
Driver IC	ST7282	--
Color Depth	16M	
Interface	RGB 24bit Interface	
View Direction	6 O'clock	
Module size	105.50(W) ×67.20 (H)×4.30(T)	mm
Active area	95.04(W) ×53.86 (H)	mm
Dot pitch	0.198 (W) ×0.198 (H)	mm
Back Light	7 White LED In Serial	--
With/Without TSP	With CTP	
Weight(g)	TBD	

2. External Dimensions



3. Interface Description

FPC Connector is used for the module electronics interface. The recommended model is FH19SC-40S-0.5SH manufactured by HIROSE.

Pin No.	Symbol	Functional	Remark
1	VLED-	Power for LED backlight cathode.	
2	VLED+	Power for LED backlight anode.	
3	GND	Power ground.	
4	VDD	Power voltage.	
5	R0	Red data(LSB).	
6	R1	Red data.	
7	R2	Red data.	
8	R3	Red data.	
9	R4	Red data.	
10	R5	Red data.	
11	R6	Red data.	
12	R7	Red data(MSB).	
13	G0	Green data(LSB).	
14	G1	Green data.	
15	G2	Green data.	
16	G3	Green data.	
17	G4	Green data.	
18	G5	Green data.	
19	G6	Green data.	
20	G7	Green data(MSB).	
21	B0	Blue data(LSB).	
22	B1	Blue data.	
23	B2	Blue data.	
24	B3	Blue data.	
25	B4	Blue data.	
26	B5	Blue data.	
27	B6	Blue data.	
28	B7	Blue data(MSB).	
29	GND	Power Ground.	
30	CLK	Pixel clock.	
31	DISP	Display on/off.	NOTE1
32	HSYNC	No Connector.	
33	VSYNC	No Connector.	
34	DE	Data Enable.	NOTE2
35	NC	No Connector.	
36	GND	Power Ground.	
37	NC(XR)	NC(Touch panel pin for XR).	
38	NC(YD)	NC(Touch panel pin for YD).	
39	NC(XL)	NC(Touch panel pin for XL).	
40	NC(YU)	NC(Touch panel pin for YU).	

Note1: During set to DISP=" H ", input data are valid. During set to DISP=" L ", input data are invalid and white display data is written to data register automatically.
Note2: DE=" H ": data can be access, DE=" L ": data cannot be access

FPC Connector is used for the cap. Touch panel electronics interface. The recommended model is FH12-6S-1.0SH manufactured by HIROSE.

Pin No.	Symbol	Functional	Remark
1	INT	Interrupt pin.	
2	VCC	2.8~3.3V Power supply.	
3	GND	Ground .	
4	RST	Reset pin for system.	
5	SCL	Serial clock PIN for IIC interface	
6	SDA	Serial data PIN for IIC interface	

4. Absolute Maximum Ratings

Item	Symbol	Values		Unit	Condition
		Min.	Max.		
Power Voltage	VDD	0.3	5.0	V	
Logic Input Signal	VIN	-0.3	VDD+0.3	V	
Logic Output Signal	VOUT	-0.3	VDD+0.3	V	

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

5. Electrical Characteristics

5.1 Operating conditions:

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power Supply	VDD	3.0	3.3	3.6	V	
Operating Current	IDD	-	15	-	mA	Black pattern
Frame frequency	Frame	-	60	90	Hz	
Dot Data Clock	DCLK	-	9.0	15	MHz	
Power Consumption	PLCD	-	49.5	-	mW	Black pattern

5.2 DC CHARATERISTICS

arameter	Symbol	Rating			Unit	Condition
		Min.	Typ.	Max.		
Low level input voltage	V_{IL}	0	-	0.3*VDD	V	
Hight level input voltage	V_{IH}	0.7*VDD	-	VDD	V	

6.Timing Characteristics.

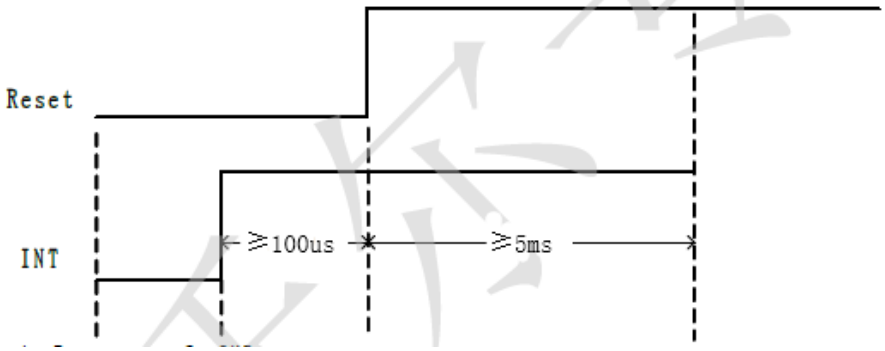
6.1 Touch panel IIC timing.

VCC=3.3V,pull up resistance 2K.

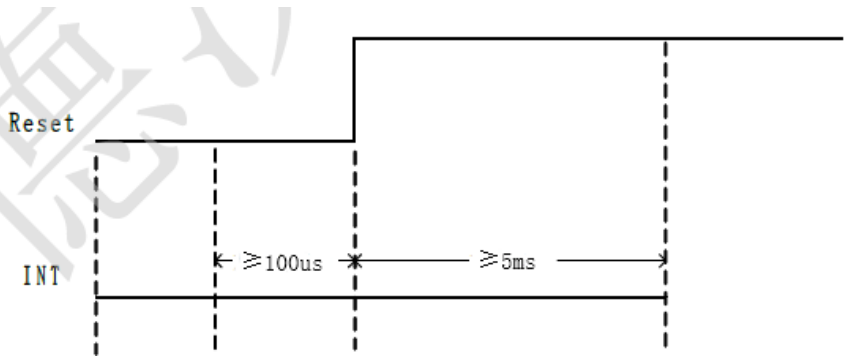
Parameter	Unit	Min	Max
SCL frequency	KHz	0	400
Bus free time between a STOP and START condition	us	4.7	\
Hold time (repeated) START condition	us	4.0	\
Data setup time	ns	250	\
Setup time for a repeated START condition	us	4.7	\
Setup Time for STOP condition	us	4.0	\

Parameter	Symbol	Min.	Max.	Unit
SCL low period	t_{lo}	1.3	-	us
SCL high period	t_{hi}	0.6	-	us
SCL setup time for START condition	t_{st1}	0.6	-	us
SCL setup time for STOP condition	t_{st3}	0.6	-	us
SCL hold time for START condition	t_{hd1}	0.6	-	us
SDA setup time	t_{st2}	0.1	-	us
SDA hold time	t_{hd2}	0	-	Us

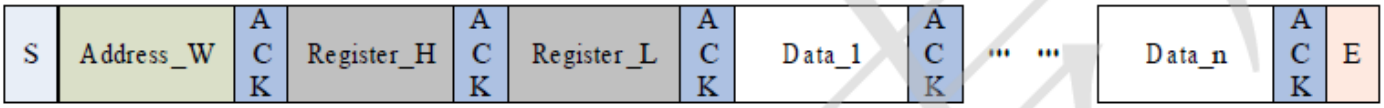
I2C Address 0x28/0x29 setting



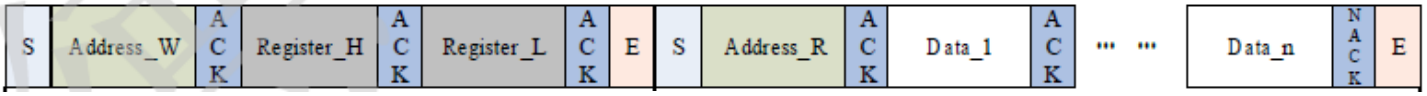
I2C Address 0xAB/0xBB setting



I2C Serial Data Transfer Format



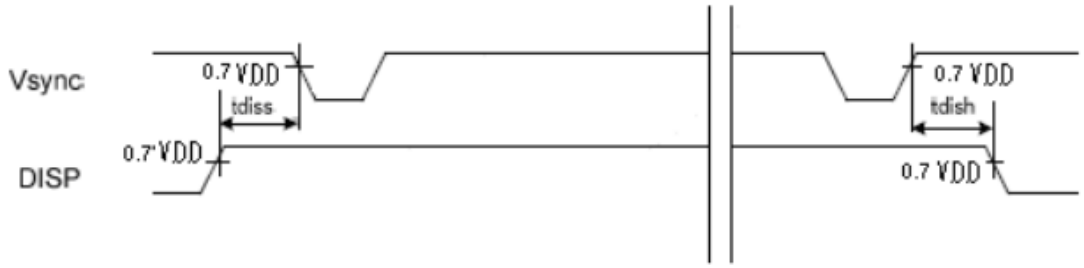
I2C master write, slave read

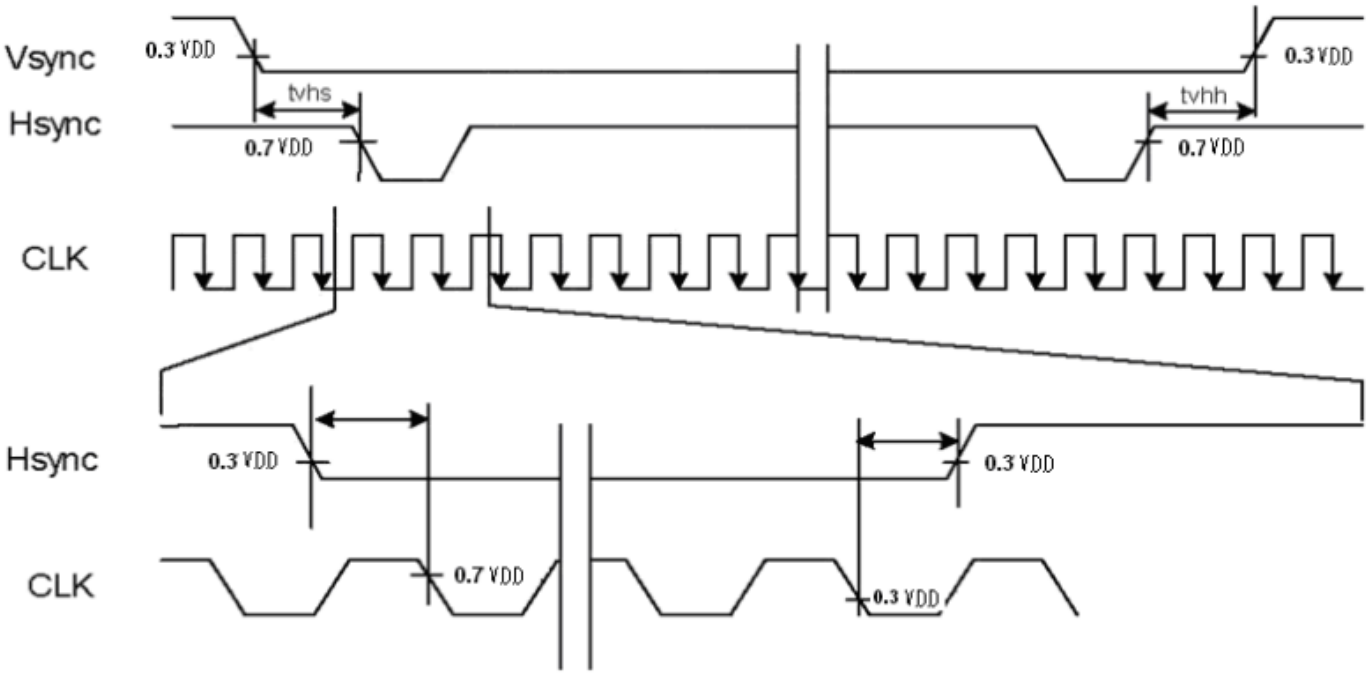


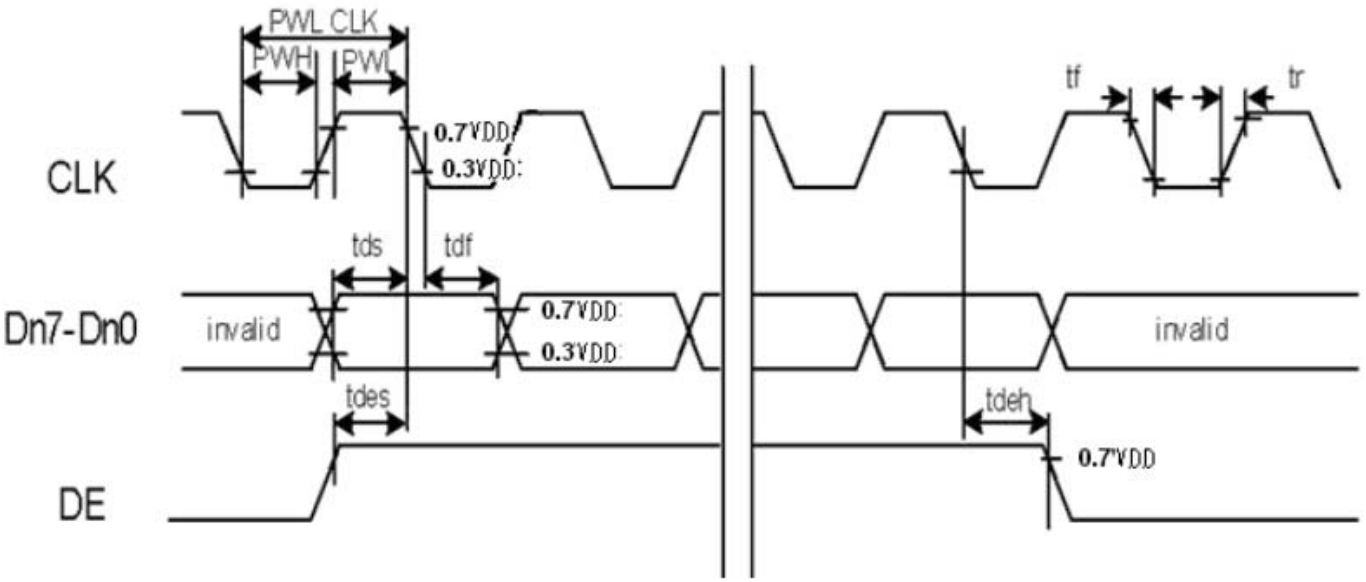
I2C master read, slave write

6.2. RGB Interface AC Timing Characteristics.

Parameter	Symbol	Spec.			Unit
		Min	Typ	Max	
DISP setup time	t_{diss}	10			ns
DISP hold time	t_{dish}	10			ns
Clock period	PW_{CLK} (2)	66.7	-	-	ns
Clock pulse high period	PWH (2)	26.7	-	-	ns
Clock pulse low period	PWL (2)	26.7	-	-	ns
Hsync setup time	t_{hs}	10	-	-	n
Hsync hold time	t_{hh}	10	-	-	
Data setup time	t_{ds}	10	-		ns
Data hold time	t_{dh}	10	-		ns
DE setup time	t_{des}	10	-		ns
DE hold time	t_{deh}	10			ns
Vsync setup time	t_{vhs}	10		-	ns
Vsync hold time	t_{vhh}	10		-	ns

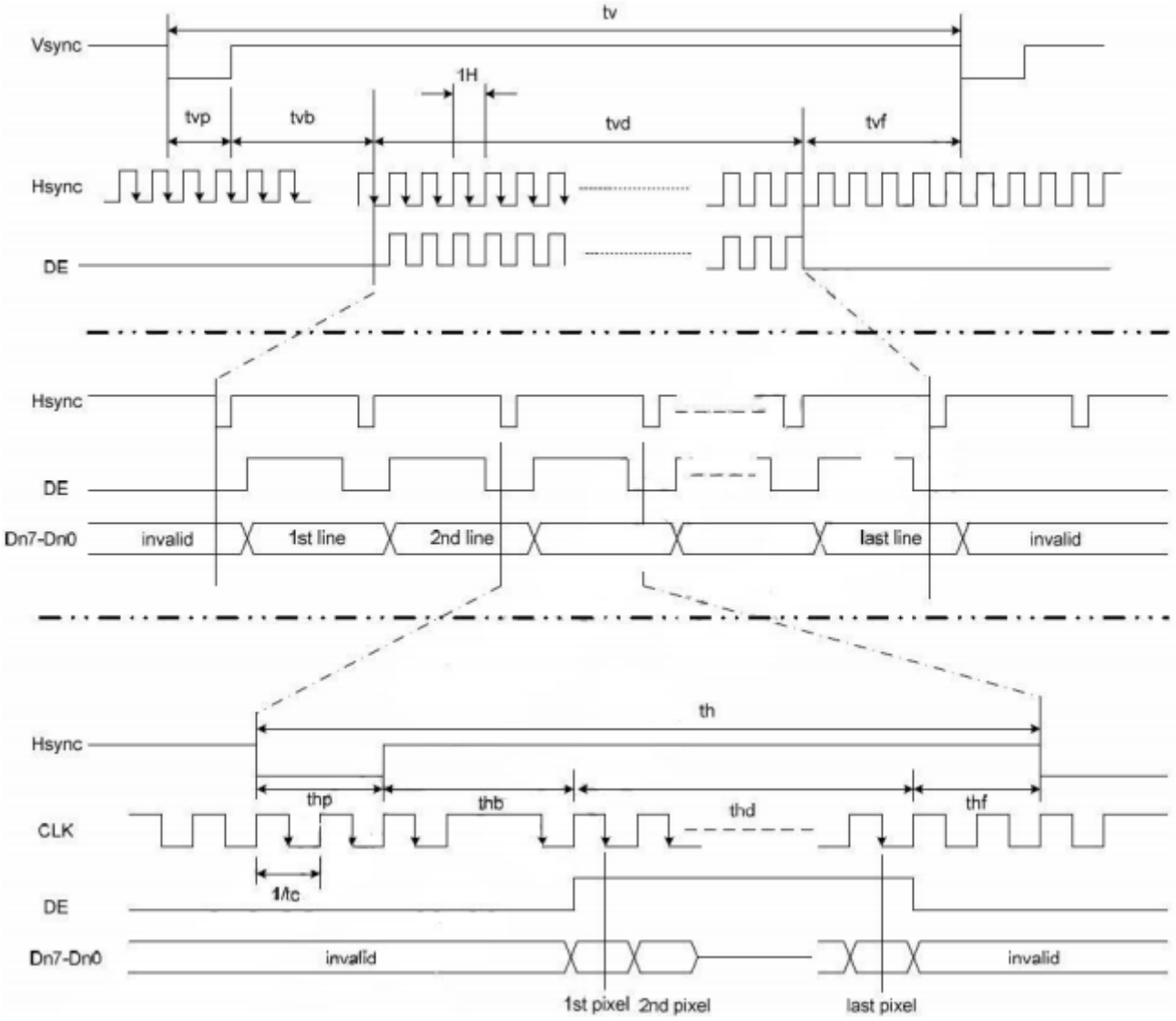

Vsync
DISP
0.7 VDD
tdiss
0.7 VDD
0.7 VDD
tdish
0.7 VDD


Vsync
Hsync
CLK
0.3 VDD
tvhs
0.7 VDD
0.3 VDD
tvhh
0.7 VDD
Hsync
CLK
0.3 VDD
0.3 VDD
0.7 VDD
0.3 VDD

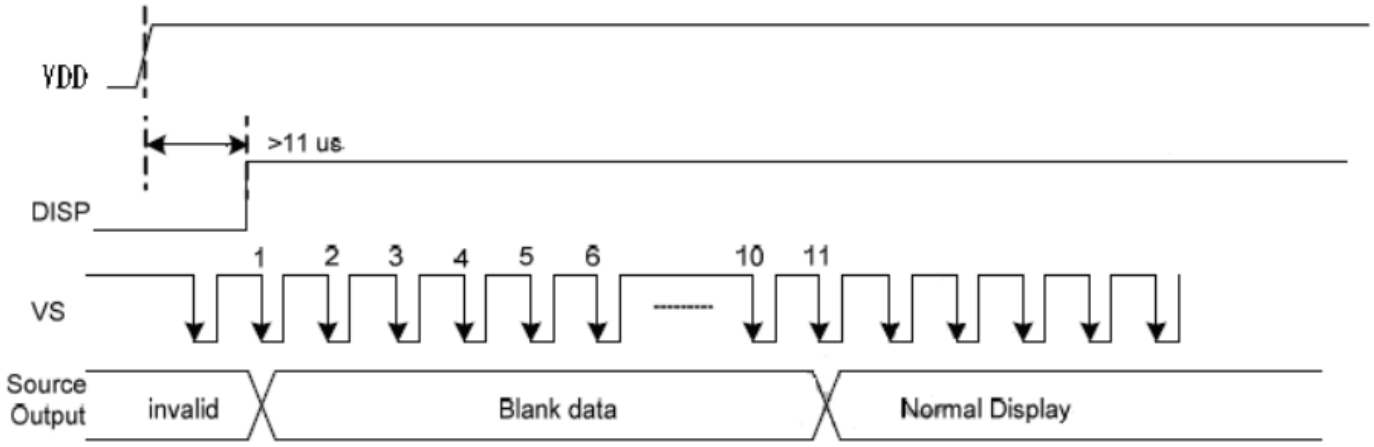

PWL CLK
PWH
PWL
CLK
0.7VDD
0.3VDD
tf
tr
tds
tdf
Dn7-Dn0
invalid
0.7VDD
0.3VDD
invalid
tdes
tdeh
DE
0.7VDD

6.3. RGB Interface DC Timing Characteristics.

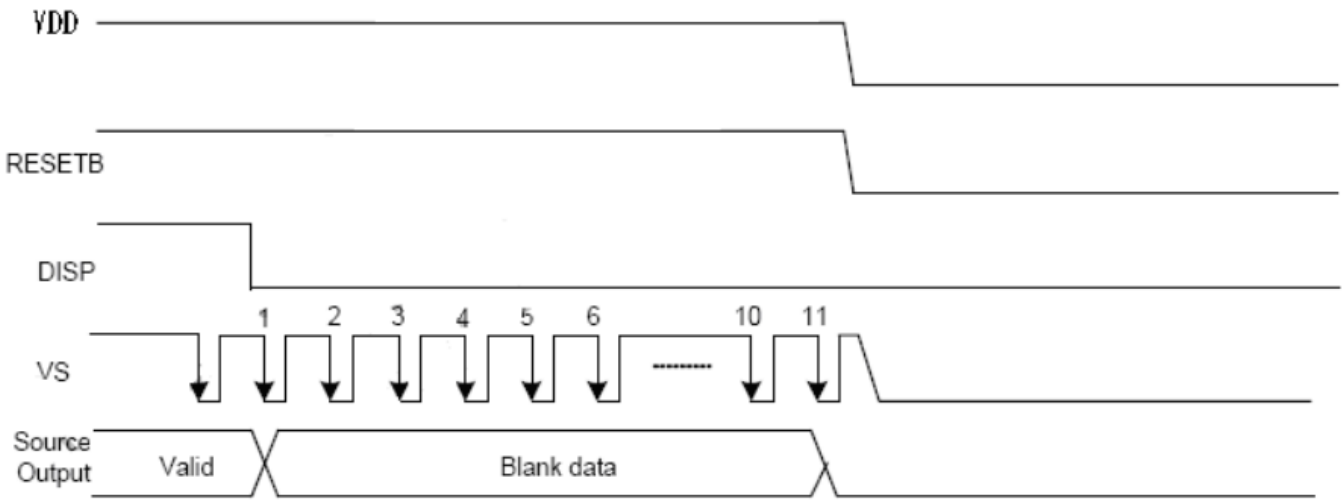
Item		Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK Frequency		Fclk	8	9	12	MHz	
DCLK Period		Tclk	83	111	125	ns	
HSYNC	Period Time	Th	485	531	598	DCLK	
	Display Period	Thdisp		480		DCLK	
	Back Porch	Thbp	3	43	43	DCLK	By H_Blanking setting
	Front Porch	Thfp	2	8	75	DCLK	
	Pulse Width	Thw	2	4	75	DCLK	
VSYNC	Period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



6.4 Power sequence

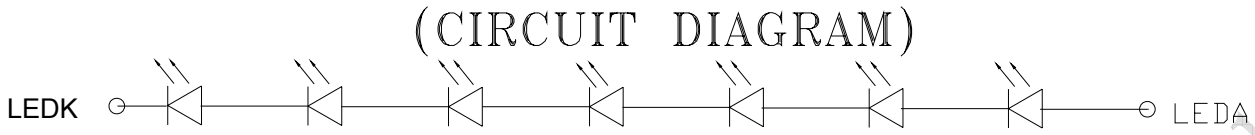


Power On Sequence



Power Off Sequence

7. Backlight Characteristics.

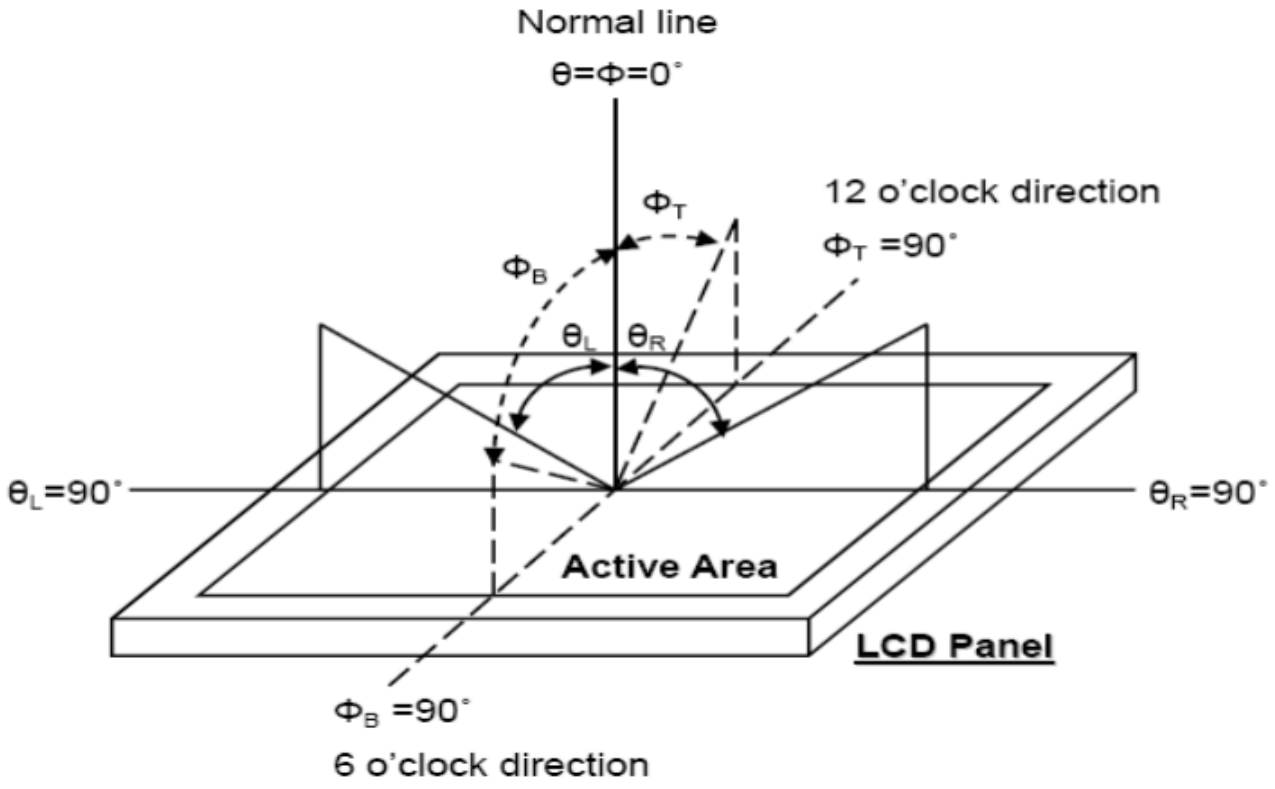


Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	**Vf**	**20.0**	**22.4**	**24.0**	**V**	**If=20 mA**	**-**
Supply Current	**If**	**-**	**20**	**-**	**mA**	**-**	**-**
Reverse Voltage	**Vr**	**-**	**-**	**5**	**V**	**10uA**	
Power dissipation	**Pd**	**-**	**448**	**-**	**mW**	**-**	
Luminous Intensity for LCM		**220**	**250**	**-**	**Cd/m2**	**If=20 mA**	
Uniformity for LCM	**-**	**80**	**-**	**-**	**%**	**If=20 mA**	
Life Time	**-**	**50000**	**-**	**-**	**Hr**	**If=20 mA**	**-**
Backlight Color	**White**						

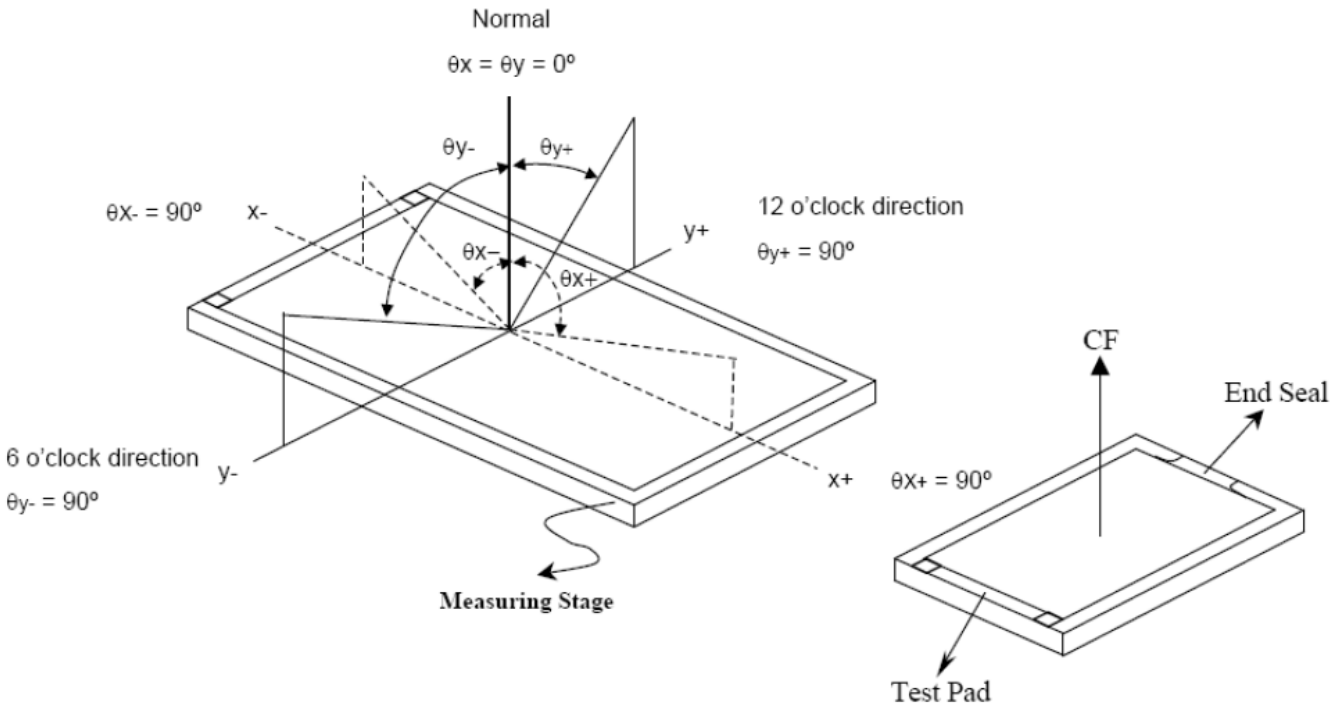
8.Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Note
Response time		TR	Θ=0	-	15	-	ms	(3)(5)
		TF		-	15	-	ms	
Contrast ratio		CR	At optimized viewing angle	450	550	-	-	(4)
Color Chromaticity	White	Wx	Θ=0	0.26	0.31	0.36	-	(2)(6)
		Wy		0.28	0.33	0.38		
Viewing Angle	Hor.	ΘR	CR≧10	60	70	-	-	(1)
		ΘL		60	70	-		
	Ver.	φH		45	55	-		
		φL		60	70	-		
Uniformity				75	80		%	(8)

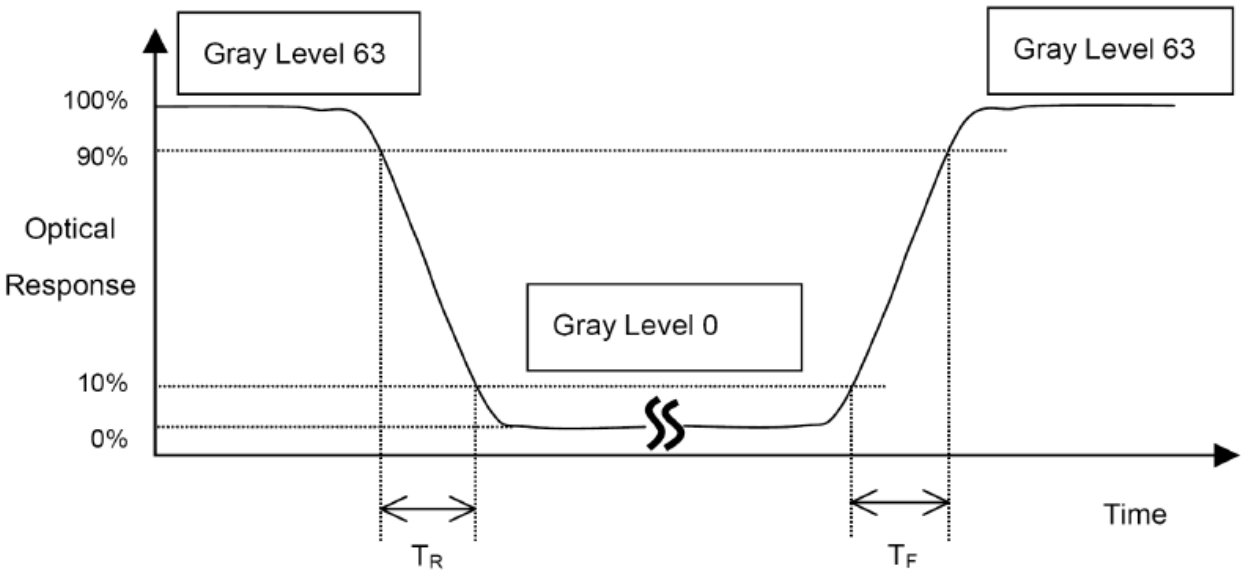
Note 1: Definition of viewing angle range



Note 2: Test equipment setup:
After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 luminance meter 1.0° field of view at a distance of 50cm and normal direction.



Note 3: Definition of Response time:
The response time is defined as the LCD optical switching time interval between "White" state and"Black" state. Rise time, Tr, is the time between photo detector output intensity changed from 90% to 10% . And fall time, Tf, is the time between photo detector output intensity changed from10% to 90% .



Note 4: Definition of contrast ratio:
The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the “White” state}}{\text{Luminance measured when LCD on the “Black” state}}$$

Note 5: White Vi = V_{i50} ± 1.5V
Black Vi = V_{i50} ± 2.0V
“±” means that the analog input signal swings in phase with VCOM signal.
“±” means that the analog input signal swings out of phase with VCOM signal.
The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.
Note 6: Definition of color chromaticity (CIE 1931)
Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

$$\text{Note 8 : Uniformity (U)} = \frac{\text{Brightness (min)}}{\text{Brightness (max)}} \times 100\%$$

9. RELIABILITY

No.	Test Item	Test Condition	Remark
1	High Temperature Storage	+80℃± 2℃，96 hrs	Note
2	Low Temperature Storage	-30℃± 2℃，96 hrs	Note
3	High Temperature Operation	+70℃± 2℃，96 hrs	Note
4	Low Temperature Operation	+20℃± 2℃，96 hrs	Note
5	High Temperature & High Humidity Storage Test	+50℃± 5℃, 90％R.H, 96 hours	Note
6	Temperature Cycle (non operation)	-30℃ ← +25℃ → +80℃ (30mins ← 5mins →30mins) 10 Cycles	Note
7	Electronic Static Discharge	Air Discharge: 2KV to with 5 times Ambiance: 15℃~35℃,30%~60%R.H Resistance(Rd): 330Ω ±10% Capacitance(Cs + Cd): 150pF±10%	Discharge for each polarity Mode of Operation: Single Discharge, successive discharge at least 1 sec
8	Vibration (Packaged)	Frequency range: 10Hz ~ 55 Hz Amplitude: 1.5mm Direction of X.Y. Z for 3 Hrs in total	
9	Drop Test (Packaged)	Height: 80cm, Time: 1 1 corner, 3 edged, 6 surfaces	

Note : Recovery Time should be 2~4 hours at room temperature (20±8℃) and humidity (below 60% R.H). No abnormalities in functions and appearance

10.INSPECTION CRITERION

10.1 Scope

Display Quality Evaluation
Mechanics Specification

10.2 Sampling Plan

MIL-STD-105E
Unless there is other agreement, the sampling plan for incoming inspection shall follow MIL-STD-105E
Lot size: Quantity per shipment as one lot (different model as different lot).
Sampling type: Normal inspection, single sampling
Sampling level: Level II.

10.3 Acceptable Quality Level

Item	Major	Minor
Appearance	1.0%	1.5%
Electrical	0.65	1.0%

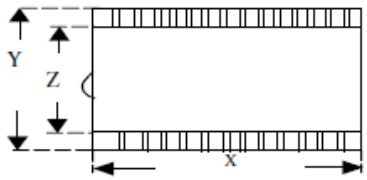
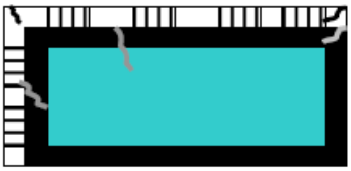
10.3.1 Classification of defects：
10.3.1.1Major defect
Any defect may result in functional failure, or reduce the usability of product for its purpose. For Example：Electrical failure, deformation and etc.
10.3.1.2 Minor defect
The criteria on major or minor judgment will be according with the classification of defects.

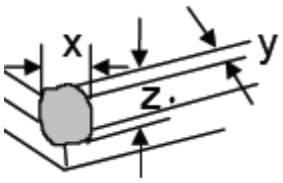
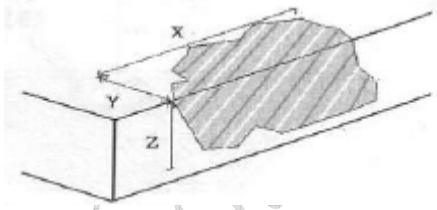
10.4 Panel Inspection Condition

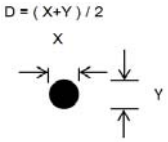
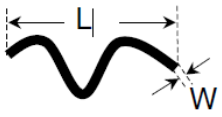
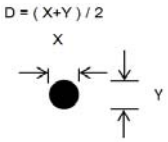
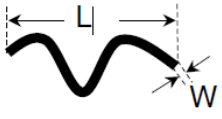
10.4.1 Environment:
10.4.2 Room Temperature: 25±5° C.
10.4.3 Humidity: 50±20% RH.
Illumination: 300 ~ 700 Lux.
10.4.4 Inspection Distance: 35±5 cm

10.5 TFT Inspection Criteria

10.5.1 Visual inspection criterion in cosmetic / appearance

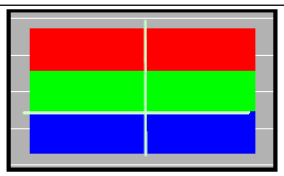
Glass defect			
No	Item	Criteria	Remark
1	Dimension (Minor)	By engineering diagram	
2	Crack (Major)	Extensive crack	

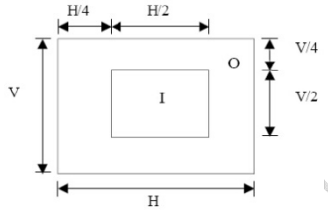
3	Corner (Minor)	X ≤3 mm Y ≤3 mm Z≤ T Ignore	 T: Glass thickness Z: Thickness X: Length Y: Width
4	Side (Minor)	X ≤5mm Y ≤3 mm Z≤ T Ignore	 T: Glass thickness Z: Thickness X: Length Y: Width

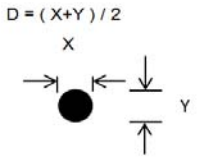
TFT defect in appearance			
No	Item	Criteria	Remark
1	Foreign Spot (Minor) Including: Black spot, White spot Pin hole Foreign particle	D≤0.15mm，Ignore 0.15mm<D≤0.3mm，N≤3 0.3mm<D，N=0 Distance≥5mm Ignore if out of Area AA	D =(X+Y)/2, X: Length, Y: Width 
2	Foreign Line(Minor) Including: Black line White line Bright line	W≤0.03mm，Ignore 0.03mm<W≤0.05mm, L≤4mm, N≤3 0.05mm<W≤0.08mm, L≤4mm, N≤1 W>0.08mm, N=0 Ignore if out of Area AA	L: Length, W: Width 
3	Polarizer Dent/Air Bubble (Minor)	D≤0.2mm，Ignore 0.2mm<D≤0.3mm，N≤3 0.3mm<D≤0.5mm，N≤1 D>0.50mm, N=0 Distance≥5mm	D =(X+Y)/2, X: Length, Y: Width 
4	Polarizer Scratches (Minor)	W≤0.03mm，Ignore 0.03mm<W≤0.05mm, L≤4mm, N≤3 0.05mm<W≤0.08mm, L≤4mm, N≤1 W>0.08mm, N=0 Ignore if out of Area AA	L: Length, W: Width 

Other defects			
No	Item	Criteria	Remark
1	FPC (Minor)	Any crack or breakage which effect the function are not allowed Disregard if the dirty removed	
2	Backlight (Minor)	Power up is allowed. Breaking off is not allowed. The scratch which may causes a problem in practical use is not allowed	
3	Bezel (Minor)	Erasable dirt is ignore	

10.5.2 Visual inspection criterion in electrical display

Glass defect			
No	Item	Criteria	Remark
1	No display (Major) Abnormally Short circuit	Not allowed	
2	Missing line (Major)	Not allowed	
3	Darker or lighter line (Major)	Not allowed	
4	Weak line (Minor)	By limit sample	

<table>
<tr><td colspan="4">Display Inspection</td></tr>
<tr><td>No</td><td>Item</td><td>Criteria</td><td>Remark</td></tr>
<tr><td>1</td><td>Bright / Dark dot</td><td>
<table>
<tr><td>Items</td><td>Area I</td><td>Area O</td><td>Tota l</td></tr>
<tr><td>Bright</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Dark</td><td>1</td><td>3</td><td>3</td></tr>
<tr><td>Bright & Dark</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>2 adjacent dots</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="4">Minimum Distance ≥ 5mm</td></tr>
</table>
</td><td> 

1.1sub-pixel: 1R or 1G or 1B
2.Point defect area≥ 1/2 sub pixel</td></tr>
<tr><td>2</td><td>Tiny bright dot</td><td>Visible through 6% ND filter
D≤0.15mm，Ignore
0.15mm<D≤0.3mm，N≤3
0.3mm<D≤0.35mm，N≤1
D>0.35mm, N=0
Distance≥5mm
Ignore if out of Area AA</td><td>D =(X+Y)/2,
X: Length, Y: Width
 
</td></tr>
<tr><td>4</td><td>Mura/Waving/ Hot spot</td><td>Not visible through 6% ND filter in 50% gray or judge by limit sample if necessary</td><td></td></tr>
</table>

* Note:
1. Defect which is on the Black Matrix (outside of active area) are not considered as a defect.
2. If any specific defect is not included in the above defect table, this defect should be judged by Formike.
3. W：Width, L：Length D：Average Diameter N: Count.

11. PRECAUTION RELATING & PRODUCT HANDLING

Display is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification.

11.1 SAFETY

11.1.1 If the LCD panel breaks, be careful not to get the liquid crystal to touch your skin.

11.1.2 If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

11.2 HANDLING

11.2.1 Avoid any strong mechanical shock which can break the glass.

11.2.2 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. The followings should be noted:

11.2.2.1 CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.

11.2.2.2 Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.

11.2.2.3 Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.

11.2.2.4 The modules should be kept in anti-static bags or other containers resistant to static for storage.

11.2.2.5 Only properly grounded soldering irons should be used.

11.2.2.6 If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.

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

11.2.3.8 Since dry air is inductive to static, a relative humidity of 50-60% is recommended

11.2.3 Do not remove the panel or frame from the module.

11.2.4 The polarizing plate of the display is very fragile. 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.)

11.2.5 Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.

11.2.6 Do not touch the display area with bare hands, this will stain the display area.

11.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

11.2.8 To control temperature and time of soldering is 300± 10℃and 3-4 sec.

To avoid liquid (include organic solvent) stained on LCD Module.

11.3 STORAGE

11.3.1 Store the panel or module in a dark place where the temperature is 25℃±5℃and the humidity is below 60% RH.

11.3.2 Avoid exposure to direct sunlight or to the light of fluorescent lamps.

11.3.3 Do not place the module near organic solvents or corrosive gases.

Do not crush, shake, or jolt the module.

11.4 LIMITED WARRANTY

11.4.1 FORMIKE modules are not consumer products, but may be incorporated by FORMIKE's customers into consumer products or components thereof, FORMIKE does not warrant that its modules and components are fit for any such particular purpose.

11.4.2 The liability of FORMIKE is limited to repair or replacement on the terms set forth below. FORMIKE will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between FORMIKE and the customer, FORMIKE will only replace or repair any of its Modules which is found defective electrically or visually when inspected in accordance with FORMIKE INSPECTION CRITERIA

11.4.3 No warranty can be granted if any of the precautions state in handling liquid crystal display has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.

11.4.4 In returning the modules, they must be properly packaged; there should be detailed description of the failures or defect.

12. OTHERS

12.1 If there is any not specified quality standard in this specification as well as RMA , please refer to < INSPECTION CRITERIA>. Contact FORMIKE to get the complete <INSPECTION CRITERIA> by the contact window or feedback@wandisplay.com.

12.2 Special agreement of <INSPECTION CRITERIA> is recognized only in writhing between FORMIKE and the customer also indicated it before ordering.