ORIENT DISPLAY

MAKE THINGS POSSIBLE

Specification for TFT

AFV720720A0R-4.0INTM-I

Revision A

A	Orient Display
FY	TFT Type
720720	Resolution 720 x 720
A0R	Serial A0 Round
4.0	4.0”, Module Dimension 105.60*109.87*2.18mm
I	IPS Display
N	Top: -20~+70°C; Tstr: -30~+80°C
T	Transmissive
M	Medium Brightness, 350 cd/m2
I	MIPI Interface
/	ST7703I OR COMPATIBLE
/	No Touch Panel

REVISION RECORD

Rev No.	Contents	Prepared	Rev date
O	First release	TXM	2023-08-22
A	Update the Surface luminance Update the TBD date	JFY	2023-08-23

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CONTENTS

1. GENERAL INFORMATION

No.	Item	Contents	Unit
1	LCD size	4.0 inch (Diagonal)	/
2	Display mode	IPS/NORMALLY BLACK/TRANSMISSIVE	/
3	Viewing direction(eye)	FREE	/
4	Gray scale inversion direction	-	/
5	Resolution(H*V)	720*720 Pixels	/
6	Module size (L*W*H)	105.60*109.87*2.18	mm
7	Active area (L*W)	101.52*101.52	mm
8	Pixel pitch (L*W)	0.141*0.141	mm
9	Interface type	MIPI interface	/
10	Color Depth	16.7M	/
11	Module power consumption	0.57(Appr)	W
12	Back light type	EDGE&WHITE LED	/
13	Driver IC	ST7703I OR COMPATIBLE	/
14	Weight	43(Appr)	G

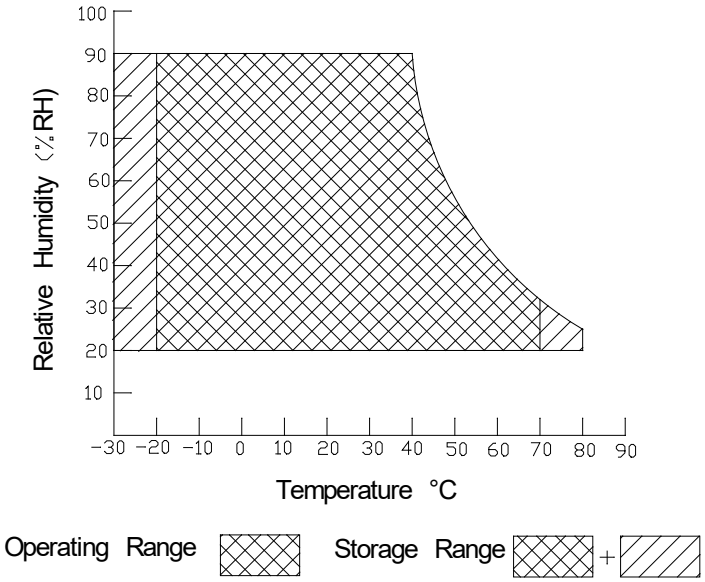
2. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Power supply input voltage for TFT	VDD	-0.3	5.5	V	
Backlight current (normal temp.)	ILED	-	50	mA	
Operation temperature	Top	-20	+70	℃	Note1
Storage temperature	Tst	-30	+80	℃	Note1
Humidity	RH	20%	90%	RH	Note1

Note1 :

1).The relative humidity and temperature range are as below sketch,90%RH Max.

2).The maximum wet bulb temperature ≤40℃ and without dewing.



3. ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS(at Ta=25℃)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power supply input voltage	VDD	3.1	3.3	3.5	V	
I/O logic voltage	IOVCC	1.6	1.8	3.5	V	
Input voltage 'H' level	VIH	0.7IOVCC	-	IOVCC	V	
Input voltage 'L' level	VIL	VSS	-	0.3IOVCC	V	
Power supply current	IVDD	-	25	-	mA	
TFT gate on voltage	VGH	-	-	-	V	
TFT gate off voltage	VGL	-	-	-	V	
Analog power supply voltage	AVDD	-	-	-	V	
TFT common electrode voltage	VCOM	-	-	-	V	Note1

Note1 : The value is just the reference value. VCOM must be adjusted to optimize display quality, as Crosstalk and Contrast Ratio etc..

4. BACKLIGHT CHARACTERISTICS

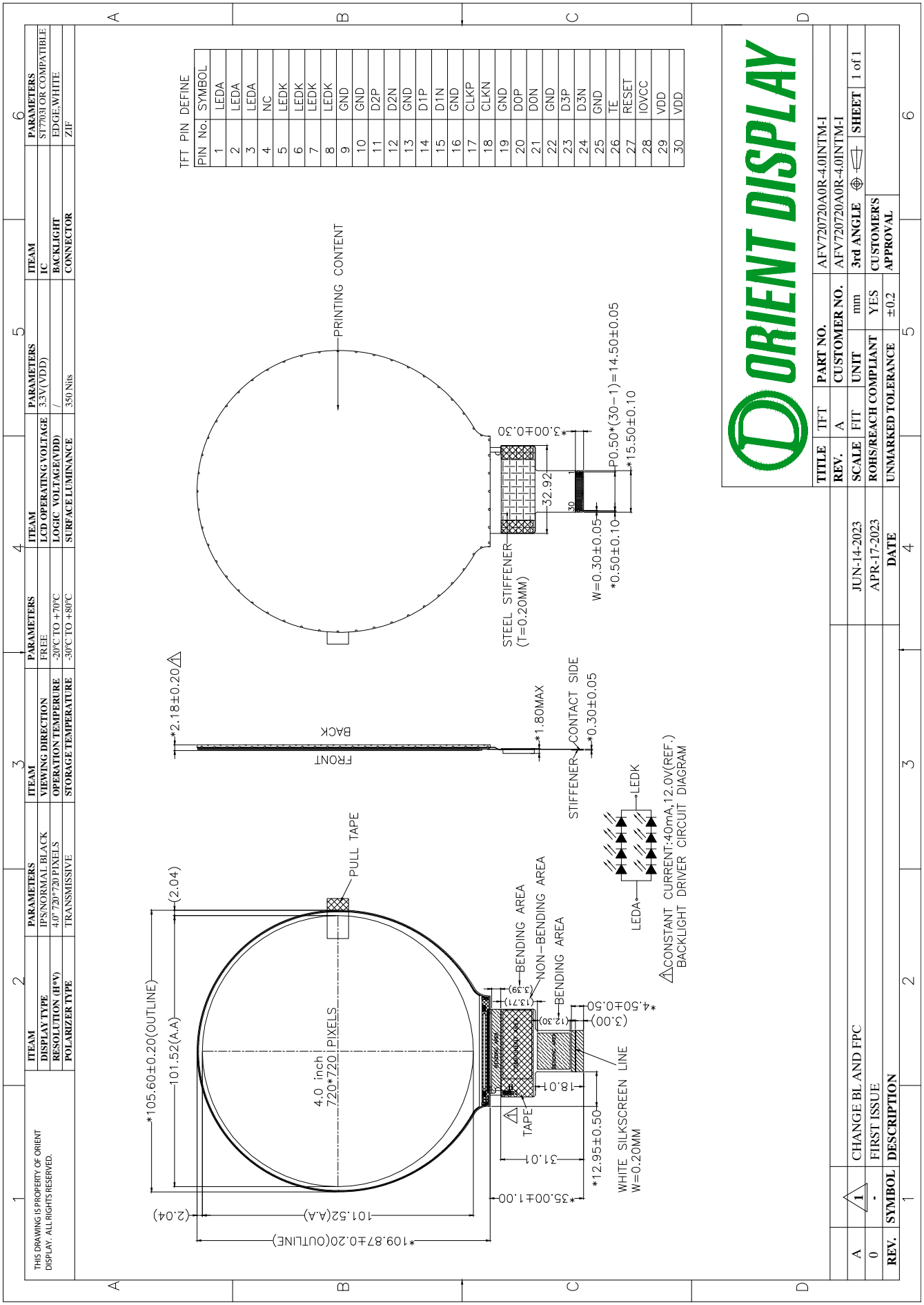
(at Ta=25℃,RH=60%)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED forward voltage	VF	11.2	12.0	13.2	V	
LED forward current	IF	-	40	-	mA	IF=20*2mA
LED power consumption	PLED	-	0.48	-	W	Note1
Number of LED	-		8		PCS	
Connection mode	-	4 in series 2 in parallel			/	
LED life-time	-	30000	-	-	Hrs	Note2

Note1 : Calculator value for reference : IF*VF = PLED

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

5. EXTERNAL DIMENSIONS



6. ELECTRO - OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	Note
Response time	Tr+ Tf	-	-	30	35	ms	FIG.1	Note 1
Contrast ratio	Cr		800	960	-	-	FIG.2	Note 2
Surface luminance	Lv	θ=0°	300	350	-	cd/m^2	FIG.2	Note 3
Luminance uniformity	Yu	θ=0°	75	80	-	%	FIG.2	Note 4
NTSC	-	θ=0°	-	50	-	%	FIG.2	Note 5
Viewing angle	θ	∅=90°	80	85	-	deg	FIG.3	Note 6
		∅=270°	80	85	-	deg	FIG.3	
		∅=0°	80	85	-	deg	FIG.3	
		∅=180°	80	85	-	deg	FIG.3	
CIE (x,y) chromaticity	Red x	θ=0° ∅=0° Ta=25℃	Typ -0.04	0.63	Typ +0.04	-	FIG.2 CIE1931	Note 5
	Red y			0.34		-		
	Green x			0.32		-		
	Green y			0.60		-		
	Blue x			0.15		-		
	Blue y			0.07		-		
	White x			0.28		-		
	White y			0.32		-		

The TFT module should be stabilized at a given temperature for 10 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 10 minutes in a windless room.

Note1. Definition of response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black”state.

Normally white: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%.

Normally black:Rise time (T_{ON}) is the time between photo detector output intensity changed from 10% to 90%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 90% to 10%.

For additional information see FIG1.

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.

Lv = Average Surface Luminance with all white pixels(P1,P2,P3, ...,Pn)

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.

$$Yu = \frac{\text{Minimum surface luminance with all white pixels (P1,P2,P3,.....,Pn)}}{\text{Maximum surface luminance with all white pixels (P1,P2,P3,.....,Pn)}}$$

Note5. Definition of color chromaticity (CIE1931)

CIE (x,y) chromaticity,The x,y value is determined by screen active area center position.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 display 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 CS-2000/BM-7 photo detector or compatible.

FIG.1. The definition of response Time

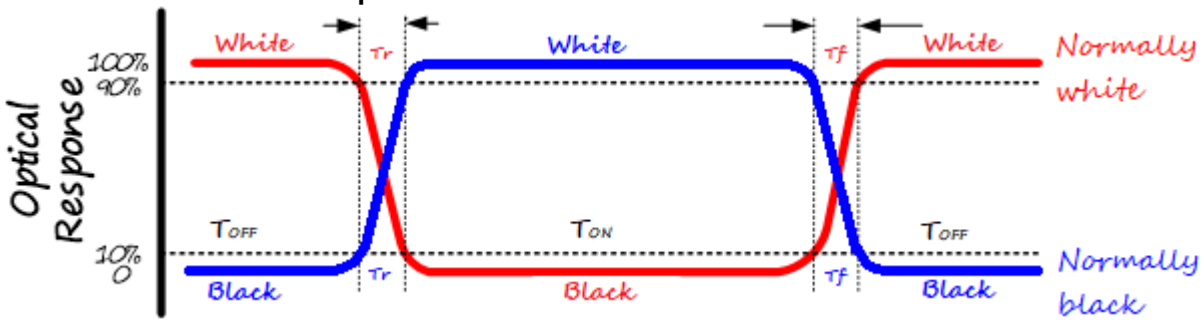


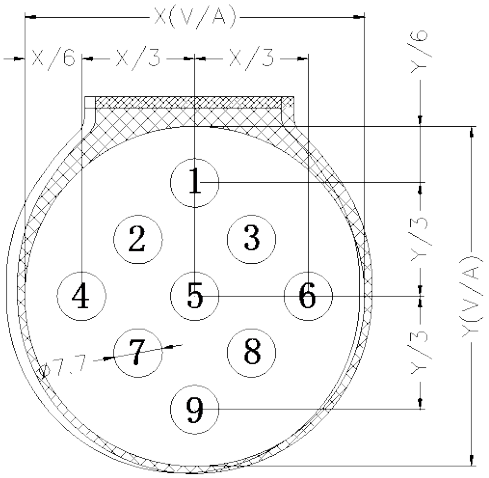
FIG.2. Measuring method for contrast ratio, surface luminance, luminance uniformity, CIE (x,y) chromaticity

H,V : Active area

Light spot size ∅=1.5mm or ∅=7.7mm (CS-2000/BM-7)50cm distance or compatible distance from the LCM surface to detector lens.

Test spot position : see Figure a.

measurement instrument : Luminance meter CS-2000/BM-7 or compatible ,see Figure b.



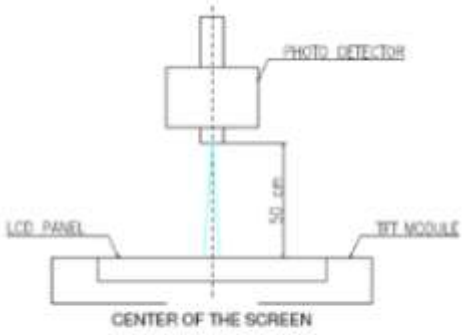
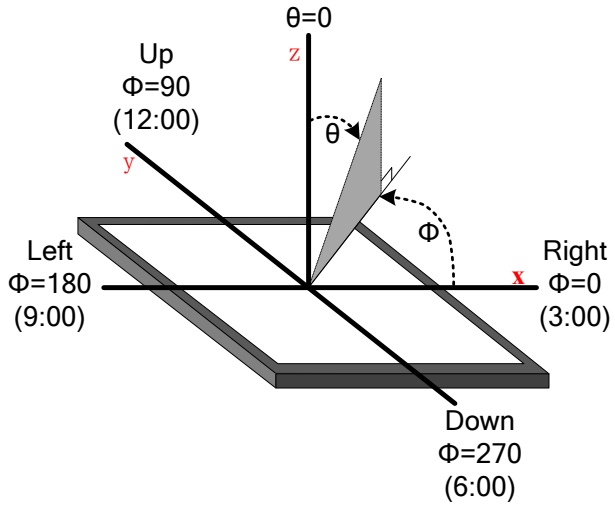


Figure b

FIG.3. The definition of viewing angle



7. INTERFACE DESCRIPTION

Module Interface description

Interface No.	Name	I/O or connect to	Description
1-3	LEDA	P	Power for LED backlight(Anode)
4	NC	/	/
5-8	LEDK	P	Power for LED backlight(Cathode)
9-10	GND	P	Ground
11	D2P	I	High speed interface data differential signal input pins
12	D2N	I	High speed interface data differential signal input pins
13	GND	P	Ground
14	D1P	I	High speed interface data differential signal input pins
15	D1N	I	High speed interface data differential signal input pins
16	GND	P	Ground
17	CLKP	I	High speed interface clock differential signal input pins
18	CLKN	I	High speed interface clock differential signal input pins
19	GND	P	Ground
20	D0P	I/O	High speed interface data differential signal input/output pins.
21	D0N	I/O	High speed interface data differential signal input/output pins.
22	GND	P	Ground
23	D3P	I	High speed interface data differential signal input pins
24	D3N	I	High speed interface data differential signal input pins
25	GND	P	Ground
26	TE	O	Tearing effect output pin
27	RESET	I	Reset Pin.
28	IOVCC	P	Power supply for display driver IC interface and logic system
29-30	VDD	P	Power for LCD

I: input, O: output, P: Power,NC or / : No connection

8.AC CHARACTERISTICS

High Speed Mode

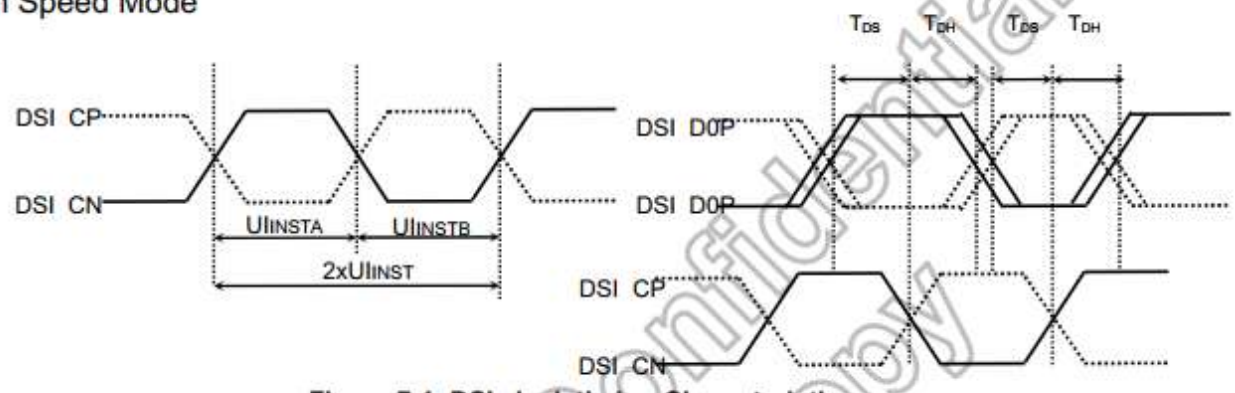


Figure 7.4: DSI clock timing Characteristics

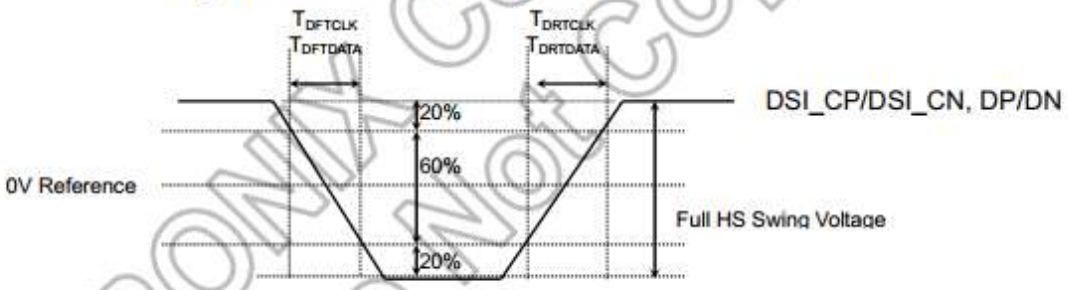


Figure 7.5: Rising and falling time on clock and data channel

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, T_A = -30 to 70°C)

Signal	Item	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
DSI_CP/ DSI_CN	Double UI instantaneous	2xUINST	4 Lane:3.30 3 Lane:2.85	-	25	ns
	UI instantaneous	UINSTA UINSTB	4 Lane:1.67 3 Lane:1.43	-	12.5	ns
DP/DN	Data to clock setup time	TDS	0.15xUI	-	-	ps
	Data to clock hold time	TDH	0.15xUI	-	-	ps
DSI_CP/ DSI_CN	Differential rise time for clock	TDRTCLK	150	-	0.3UI	ps
	Differential fall time for clock	TDFTCLK	150	-	0.3UI	ps
DP/DN	Differential rise time for data	TDRTDATA	150	-	0.3UI	ps
	Differential fall time for data	TDFTDATA	150	-	0.3UI	ps

Table 7.3: DSI High Speed Mode Characteristics

Low Power Mode

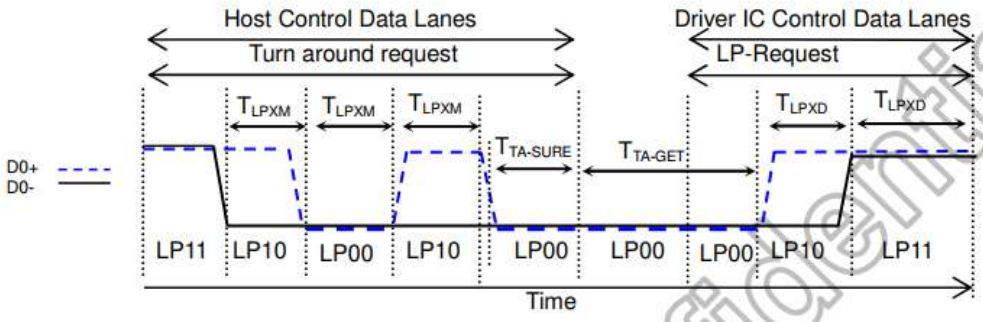


Figure 7.6: BTA from HOST to Display Module Timing

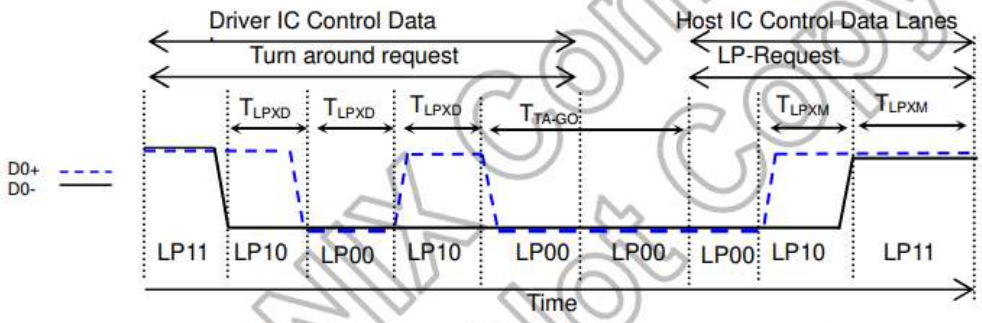


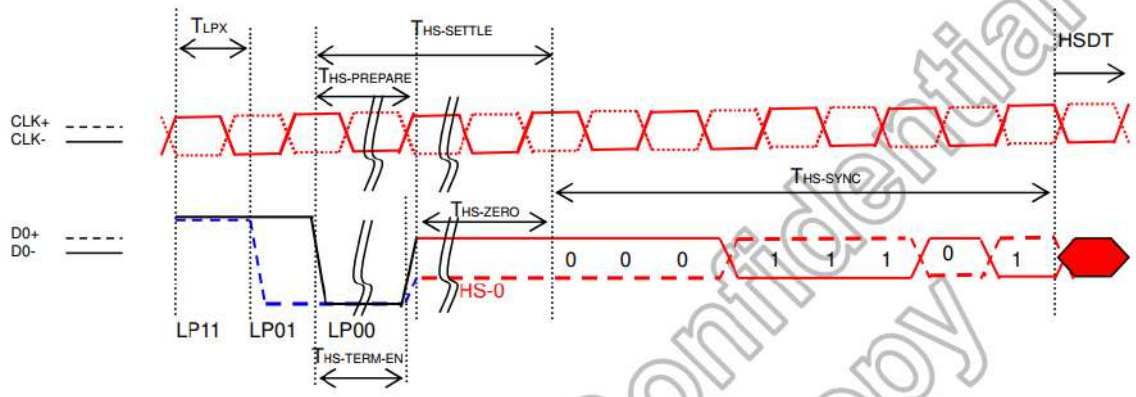
Figure 7.7: BTA from Display Module Timing to HOST

(VSSA=0V,IOVCC=1.65V to 2.0V,VCI=2.5V to 3.3V,T_A=-30 to 70℃)

Signal	Item	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
DSI_D0P/ DSI_D0P	Length of LP-00/LP01/LP10/LP11 Host→ Display module	T_{LPXM}	50	-	-	ns
	Length of LP-00/LP01/LP10/LP11 Display module →Host	T_{LPXD}	50	-	-	ns
	Time-out before the MPU start driver	$T_{TA-SURE}$	T_{LPXD}	-	2xT_{LPXD}	ns
	Time to drive LP-00 by display module	T_{TA-GET}	5xT_{LPXD}	-	-	ns
	Time to drive LP-00 after turnaround request Host	T_{TAGO}	4xT_{LPXD}	-	-	ns

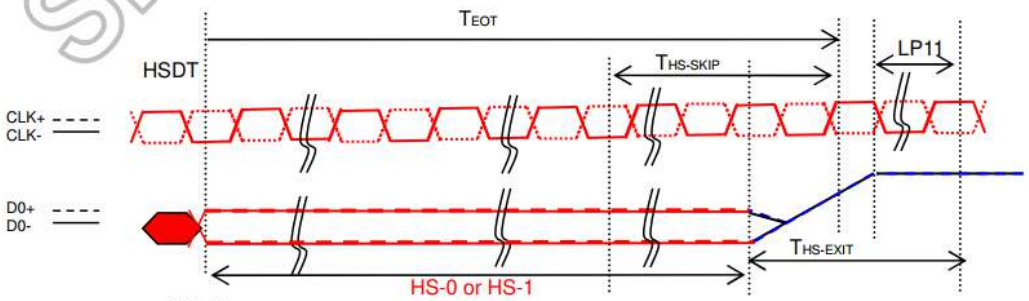
Table 7.4: DSI Low Power Mode Characteristics

DSI BURSTS



Signal	Item	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
DSI_D0P/ DSI_D0P	Length of LP-00/LP01/LP10/LP11	T_{LPX}	50	-	-	ns
	Time to Driver LP-00 to prepare for HS transmission	$T_{HS-PREPARE}$	40+4UI	-	85+6UI	ns
	Time to enable data receiver line termination	$T_{HS-TERM-EN}$	-	-	35+4xUI	ns
	Time to drive LP-00 by display module	T_{TA-GET}	5xT_{LPXD}	-	-	ns
	Time to drive LP-00 after turnaround request Host	T_{TAGO}	4xT_{LPXD}	-	-	ns

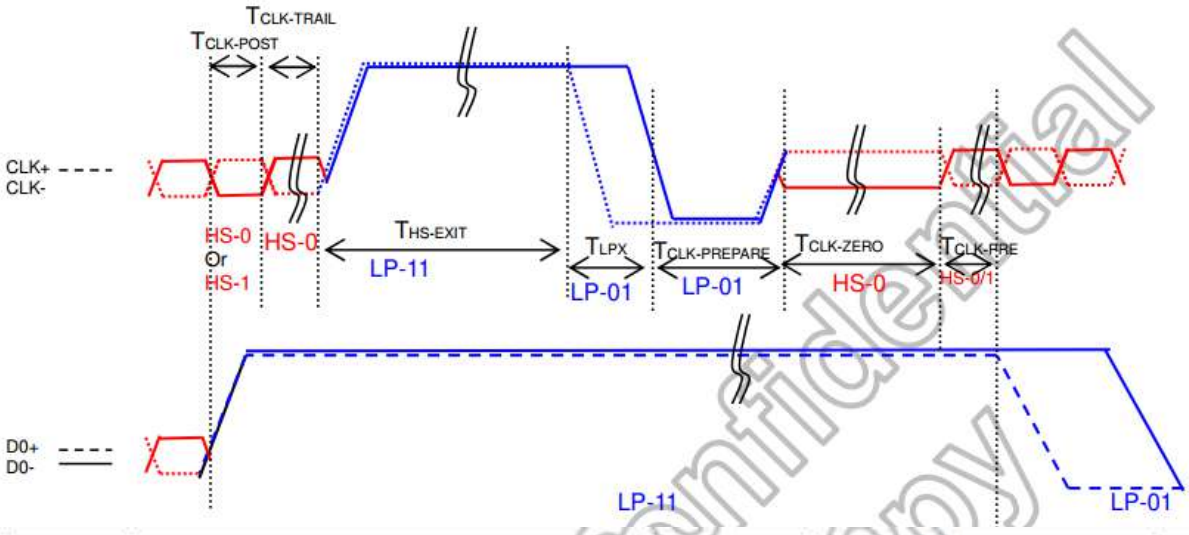
Table 7.5: DSI Low Power Mode to High Speed Mode Timing



NOTE:
If the last bit is HS-0, the transmitter changes from HS-0 to HS-1
If the last bit is HS-0, the transmitter changes from HS-1 to HS-0

Signal	Item	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
DSI_D0P/ DSI_D0P	Time-Out at Display Module to Ignore Transition Period of EoT	$T_{HS-SKIP}$	40	-	55+4xUI	ns
	Time to Driver LP-11 after HS Burst	$T_{HS-EXIT}$	100	-	-	ns

Table 7.6: DSI Low Power Mode to High Speed Mode Timing



Signal	Item	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
DSI_CP/ DSI_CN	Time that the MCU shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode	$T_{CLK-POST}$	60+52xUI	-	-	ns
	Time to drive HS differential state after last payload clock bit of a HS transmission burst	$T_{CLK-TRAIL}$	60	-	-	ns
	Time to drive LP-11 after HS burst	$T_{HS-EXIT}$	100	-	-	ns
	Time to drive LP-00 to prepare for HS transmission	$T_{CLK-PREPARE}$	38	-	95	ns
	Time-out at Clock Lane Display Module to enable HS Termination	$T_{CLK-TERM-EN}$	-	-	38	ns
	Minimum lead HS-0 drive period before starting Clock	$T_{CLK-PREPARE}$ + $T_{CLK-ZERO}$	300	-	-	ns
	Time that the HS clock shall be driven prior to any associated data Lane beginning the transition from LP to HS mode	$T_{CLK-PRE}$	8xUI			

Table 7.7: Clock Lanes High Speed Mode to/from Low Power Mode Timing

9. POWER SEQUENCE

To prevent the device damage from latch up and Improve subjective display effect,the power ON/OFF sequence shown below must be followed.

POWER ON SEQUENCE

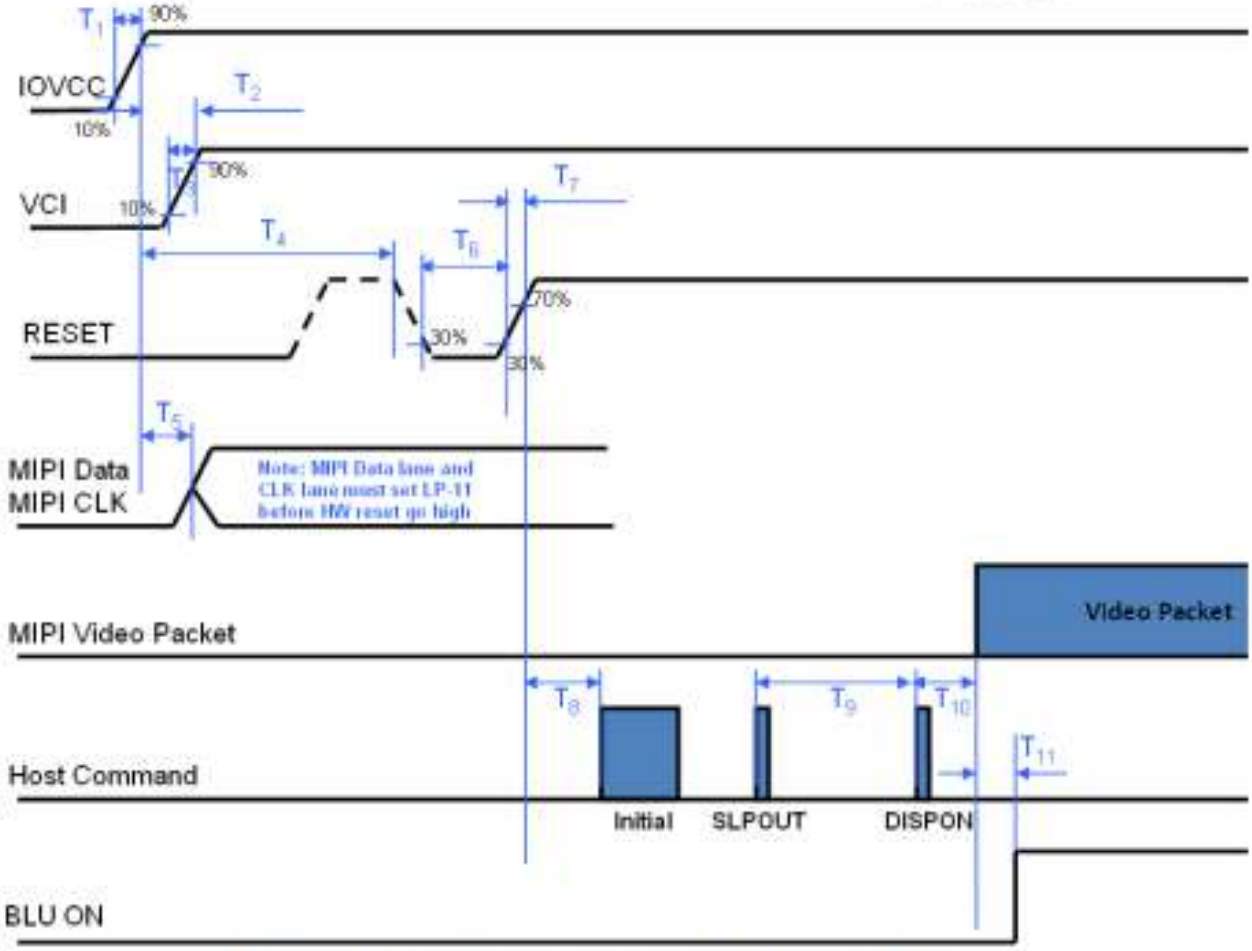


Figure 8-6: DSI Power On Sequence of Power IC Mode

	Min.	Typ.	Max.	Unit
T1	0.01	-	10	ms
T2		No Limit		ms
T3	0.01	-	10	ms
T4	1	-	-	ms
T5	1	-	-	ms
T6	10	-	-	us
T7		No Limit		ns
T8	15	-	-	ms
T9	120	-	-	ms
T10		No Limit		ms
T11	100	150	-	ms

Table 8-1: DSI Power On Timing of Power IC Mode

POWER OFF SEQUENCE

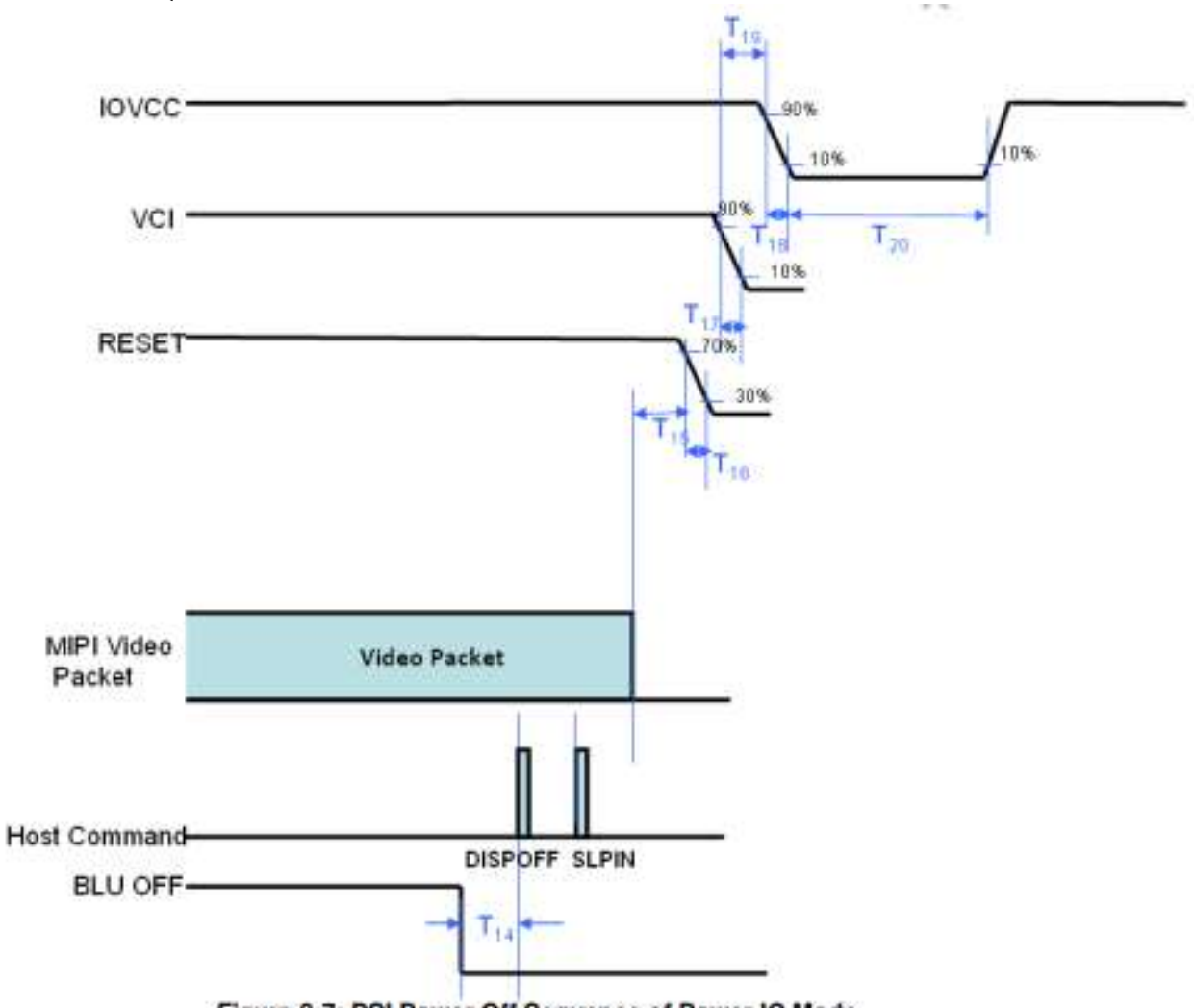


Figure 8-7: DSI Power Off Sequence of Power IC Mode

	Min.	Typ.	Max.	Unit
T14	40	100	-	ms
T15	10	-	-	ms
T16	No Limit			ms
T17	No Limit			ms
T18	No Limit			ms
T19	No Limit			ms
T20	100			ms

Table 8-2: DSI Power Off Timing of Power IC Mode

10. RELIABILITY TEST CONDITIONS

<table>
<tr><th>No.</th><th>Test item</th><th colspan="2">Test condition</th><th>Inspection after test</th></tr>
<tr><td>10.1</td><td>High temperature storage test</td><td colspan="2">+80℃/120 hours</td><td rowspan="11">Inspection after 2~4hours storage at room temperature, the sample should not have following defects :
1.Current changing value before test and after test is 50% larger;
2. Function defect : Non-display,abnormal-display,missing lines, Short lines,ITO corrosion;
3.Visual defect : Air bubble in the LCD,Seal leak,Glass crack.</td></tr>
<tr><td>10.2</td><td>Low temperature storage test</td><td colspan="2">-30℃/120 hours</td></tr>
<tr><td>10.3</td><td>High temperature operating test</td><td colspan="2">+70℃/120 hours</td></tr>
<tr><td>10.4</td><td>Low temperature operating test</td><td colspan="2">-20℃/120 hours</td></tr>
<tr><td>10.5</td><td>Thermal Shock
(non-operation)</td><td colspan="2">-30℃ ←→ +80℃/10cycles
(30min.)(<30sec.) (30min.)</td></tr>
<tr><td>10.6</td><td>High temperature high humidity test</td><td colspan="2">+60℃*90% RH/120 hours</td></tr>
<tr><td>10.7</td><td>Vibration test for Packaging</td><td colspan="2">Frequency : 250 r/min
Amplitude : 1 inch
Time: 45min</td></tr>
<tr><td rowspan="5">10.8</td><td rowspan="5">Drop test for Packaging</td><td colspan="2">Drop direction:
1 corner/3 edges/6 sides 10 times</td></tr>
<tr><td>Packing weight(kg)</td><td>Drop height(cm)</td></tr>
<tr><td>〈11</td><td>80±1.6</td></tr>
<tr><td>11≦G〈21</td><td>60±1.2</td></tr>
<tr><td>21≦G〈31</td><td>50±1.0</td></tr>
<tr><td>10.9</td><td>ESD test</td><td colspan="2">Air discharge: ±8KV, 10times
Contact discharge: ±4KV, 10times</td></tr>
</table>

Remark :
1.The test samples should be applied to only one test item.
2.Sample size for each test item is 3~5pcs.
3.For High temperature high humidity test, Pure water(Resistance>10MΩ) should be used.
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.
5.Failure judgment criterion: Basic specification, Electrical characteristic, Mechanical characteristic, Optical characteristic.
6.After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

11.INSPECTION CRITERION

Refer to 《Inspection Criterion for TFT Products-To customer》

12. HANDLING PRECAUTIONS

12.1 Mounting method

The TFT module consists of two thin glass plates with polarizes which easily be damaged. And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board.
Extreme care should be needed when handling the TFT modules.

12.2 Caution of TFT module 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 happen by miss-handling or using some materials such as Chlorine (Cl), Sulfur (S) from customer, Responsibility is on customer.

12.3 Caution against static charge

The TFT module use C-MOS LSI drivers, so we recommended 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.

12.4 Packing

Module employ TFT 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.

12.5 Caution for operation

●.It is an indispensable condition to drive TFT module within the specified voltage limit since the higher voltage then the limit cause the shorter TFT module life.
●.An electrochemical reaction due to direct current causes TFT module undesirable deterioration, so that the use of direct current drive should be avoided.
●.Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature TFT module how dark color in them. However those phenomena do not mean malfunction or out of order with TFT module, 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.

12.6 Storage

In the case of storing for a long period of time for instance, for years for the purpose or replacement use, the following ways are recommended.
●.Storing in an ambient temperature 10℃ to 30℃, 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 the anything else.
It is recommended to store them as they have been contained in the inner container at the time of delivery from

us.

12.7 Safety

●.It is recommendable to crash damaged or unnecessary TFT module 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.

13. PRECAUTION FOR USE

13.1 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.

13.2 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 ODNA, 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.

14. PACKING SPECIFICATION

Please consult our technical department for detail information.

15. INITIALIZATION CODE

Please consult our technical department for detail information.

16. HSF COMPLIANCE

●.This products complies with ROHS 2011/65/EU and 2015/863/EU、REACH 1907/2006/EC requirements, and the packaging complies with 94-62-EC.