



SPECIFICATIONS FOR TFT-LCD MODULE

Model Name:DBT040BCSA01

Version:	0
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- ☒ Approved For Specifications
- ☐ Approved For Specifications & Sample

APTUS ELECTRONICS CO., LIMITED:

Disea Model No.:	DBT040BCSA01
Prepared by:	Bob
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CUSTOMER:

Customer Model No.:	
Approved by:	
Date:	
Note:	

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1. Scope

This specification defines general provisions as well as inspection standards for TFT module supplied by APTUS electronics Co.,LTD.

If the event of unforeseen problem or unspecified items may occur, naturally shall negotiate and agree to solution.

2. General Specifications

2.1 LCD Parameter

Item	Contents	Unit	Note
LCD Type	TFT	-	
Display color	16.7M		
Viewing Direction	ALL	O'Clock	
Grayscale inversion direction	-	O'Clock	
Operating temperature	-20~+70	°C	
Storage temperature	-30~+80	°C	
Module size	4.0	inch	
Active Area(W×H)	101.52x101.52	mm	
Number of Dots	720x720	dots	
Controller	SC7707	-	
Power Supply Voltage	2.8	V	
Outline Dimensions	105.61x106.55x2.09	mm	
Backlight	4x2-LEDs (white)	pcs	
Weight	---	g	
Interface	4 LANE MIPI	-	



4.Interface Description

4.1 LCD interface

Pin No.	Symbol	I/O	Function
1	LEDA	P	LED back light(Anode).
2-3	LEDK	P	LED back light(Cathode).
4	VCI_3.3V	P	Power Supply +3.3V.
5	IOVCC_1.8V	P	Power Supply +1.8V.
6	RESET	I	Global reset signal input pin.
7	TE	I	Tearing effect output.
8	PWM	I	The PWM frequency output for LCD driver control.
9	GND	P	Ground.
10	D0P	I	DSI-D0+ data signal.
11	D0N	I	DSI-D0- data signal.
12	GND	P	Ground.
13	D1P	I	DSI-D1+ data signal.
14	D1N	I	DSI-D1- data signal.
15	GND	P	Ground.
16	CLKP	I	DSI-Clock+.
17	CLKN	I	DSI-Clock-.
18	GND	P	Ground.
19	D2P	I	DSI-D2+ data signal.
20	D2N	I	DSI-D2- data signal.
21	GND	P	Ground.
22	D3P	I	DSI-D3+ data signal.
23	D3N	I	DSI-D3- data signal.
24	GND	P	Ground.
25	TP_INT	I	Touch Interrupt. Please NC
26	TP_SDA	I	Touch IIC Data signal. Please NC
27	TP_SCL	I	Touch IIC Clock signal. Please NC
28	TP_RESET	I	Touch Reset Signal.Please NC
29	TP_VCI	P	Touch Power supply.Please NC
30	TP_VCI	P	Touch Power supply.Please NC

5. Absolute Maximum Ratings($T_a=25^{\circ}\text{C}$)

5.1 Electrical Absolute Maximum Ratings.($V_{ss}=0\text{V}$, $T_a=25^{\circ}\text{C}$)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCI	-0.3	5.5	V	1, 2
	IOVCC	-0.3	5.5		
	VGH-VGL	-0.3	+35		

Notes:

1. If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.
2. $V_{DD} > V_{SS}$ must be maintained.

5.2 Environmental Absolute Maximum Ratings.

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-30°C	80°C	-20°C	70°C	1,2
Humidity	-	-	-	-	3

1. The response time will become lower when operated at low temperature.
2. Background color changes slightly depending on ambient temperature.
The phenomenon is reversible.
3. $T_a \leq 40^{\circ}\text{C}$:85%RH MAX.
 $T_a > 40^{\circ}\text{C}$:Absolute humidity must be lower than the humidity of 85%RH at 40°C .

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics(V_{ss}=0V ,T_a=25°C)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Power supply		VCC	T _a =25°C	2.5	2.8	3.3	V	-
		IOVCC		1.65	1.8	3.3		
Input voltage	'H'	V _{IH}	VDD=3.3V	0.7 _{IOVCC}	-	IOVCC		-
	'L'	V _{IL}		GND	-	0.3IOVCC		-
Output voltage	'H'	V _{OH}	-	0.8 _{IOVCC}	-	IOVCC		-
	'L'	V _{OL}	-	0	-	0.2IOVCC		-
Current Consumption		I _{CC1}	Normal mode	-	27	-	mA	2
		I _{IOVCC}		-	14	-		

Note:

1:When an optimum contrast is obtained in transmissive mode.

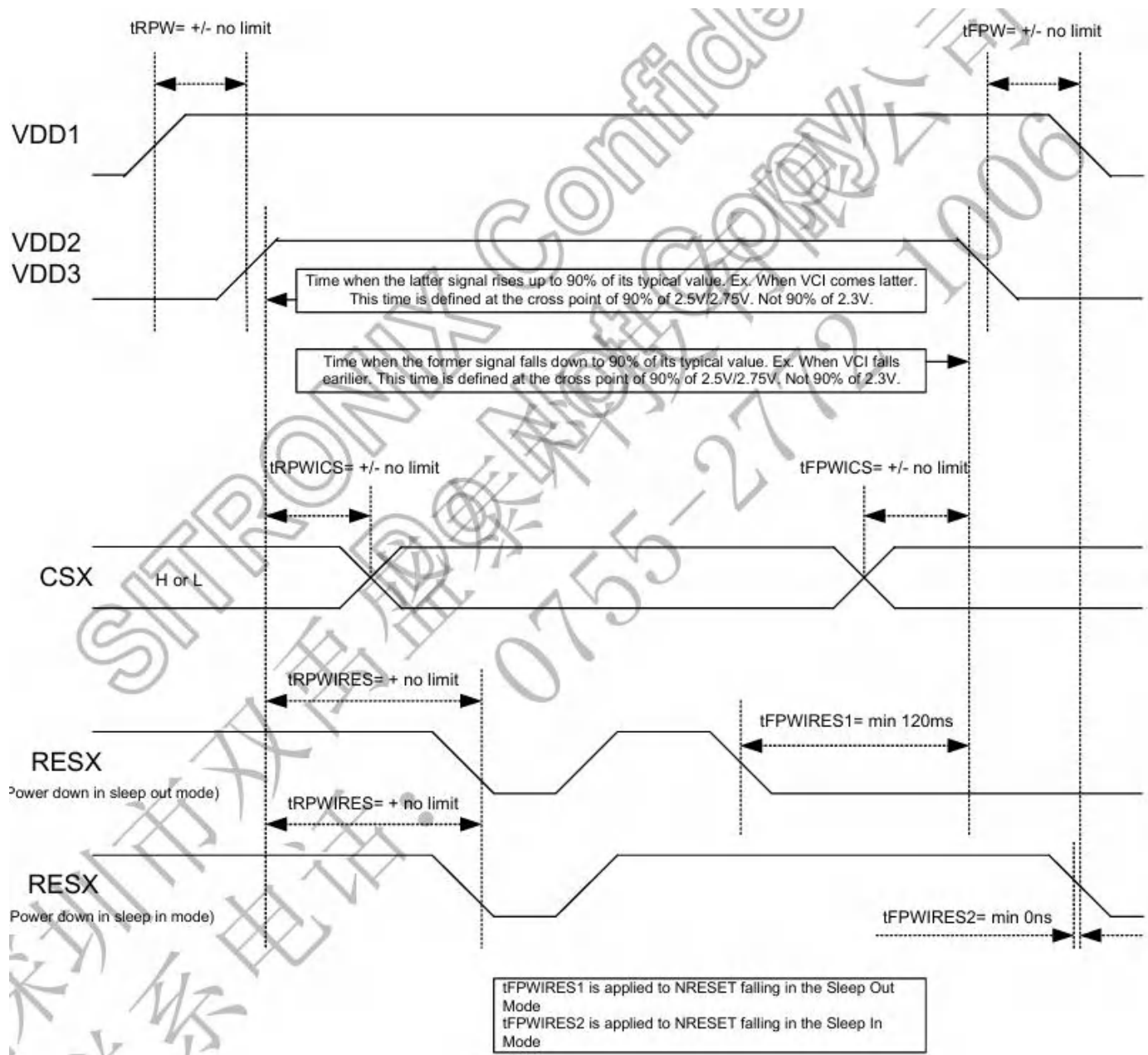
2: Tested in 1×1 chessboard pattern.



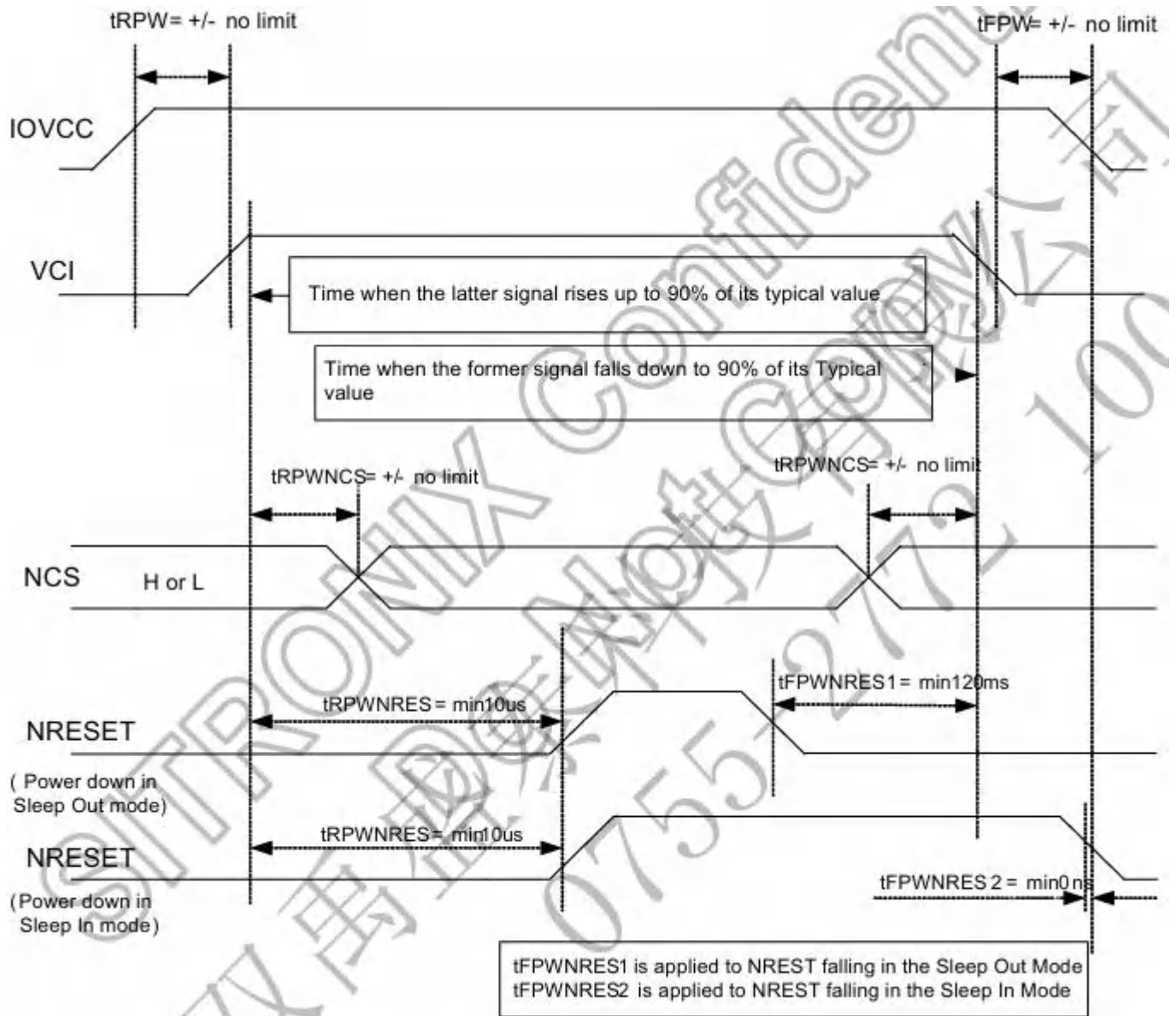
7.Timing Characteristics

7.1 Power on/off Sequence

Case 1: RESX line is held high or unstable by host at power on



Case 2: RESX line is held low by host at power on



Note: Unless otherwise specified timings herein show cross point at 50% of signal/power level

7.2 MIPI Interface characteristic

7.2.1 High Speed Mode

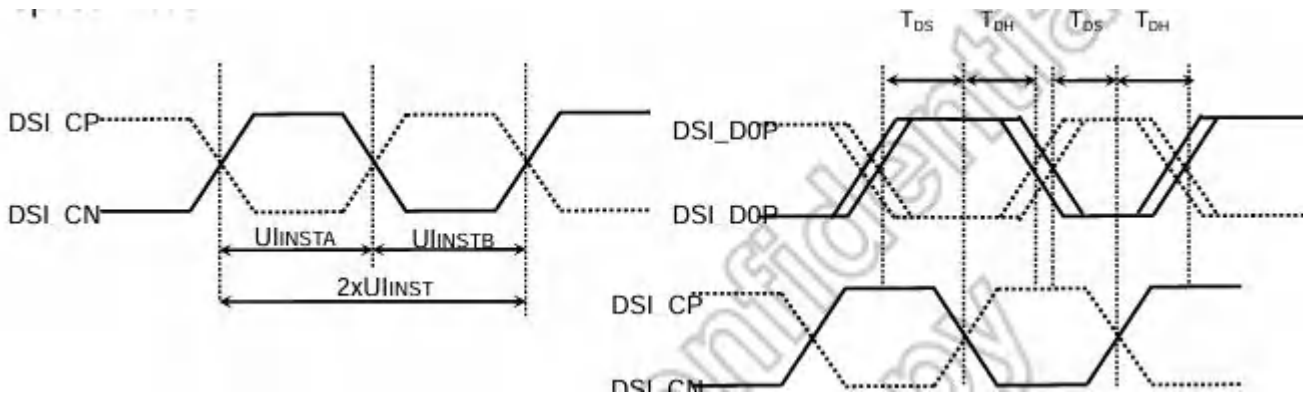


Figure : DSI clock channel timing

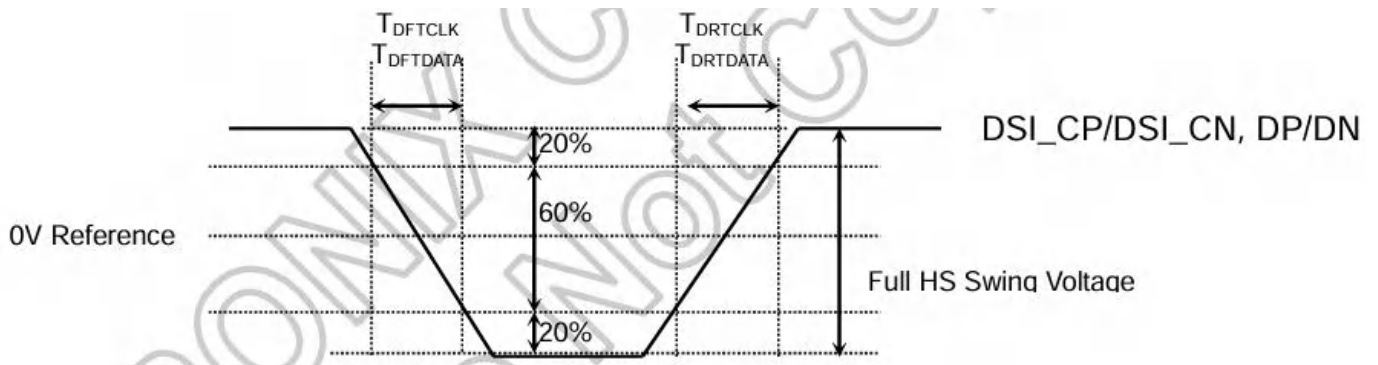


Figure : Rising and falling time on clock and data channel

(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	$2xU_{INST}$	TBD	-	25	ns
	UI instantaneous	U_{INSTA} U_{INSTB}	TBD	-	12.5	ns
DP/DN	Data to clock setup time	T_{DS}	$0.15xUI$	-	-	ps
	Data to clock hold time	T_{DH}	$0.15xUI$	-	-	ps
DSI_CP/ DSI_CN	Differential rise time for clock	T_{DRTCLK}	150	-	$0.3UI$	ps
	Differential fall time for clock	T_{DFTCLK}	150	-	$0.3UI$	ps
DP/DN	Differential rise time for data	$T_{DRTDATA}$	150	-	$0.3UI$	ps
	Differential fall time for data	$T_{DFTDATA}$	150	-	$0.3UI$	ps

Table : Mipi Interface- High Speed Mode Timing Characteristics

7.2.2 Low Power Mode

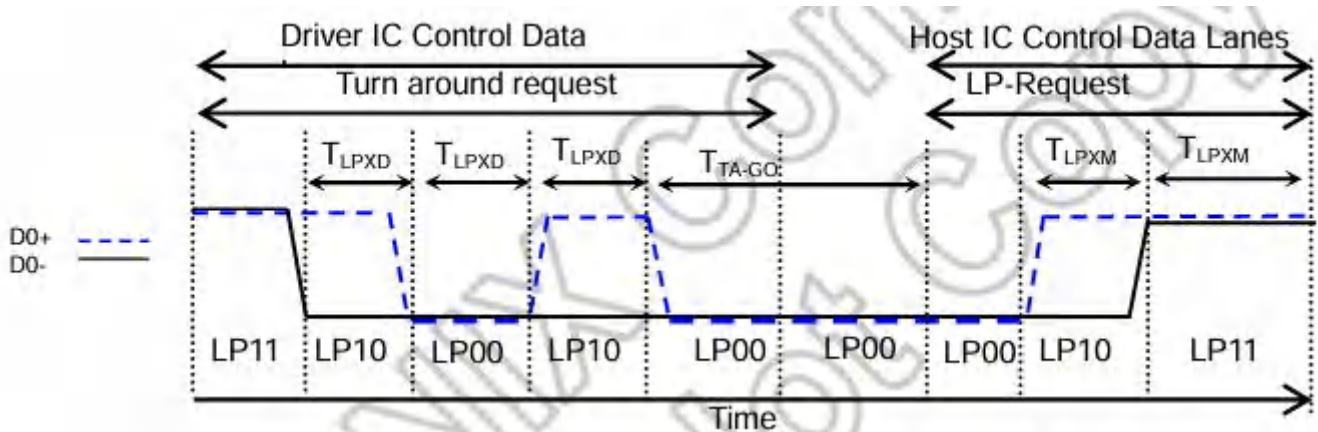


Figure : Bus Turnaround (BTA) from display module to MPU Timing

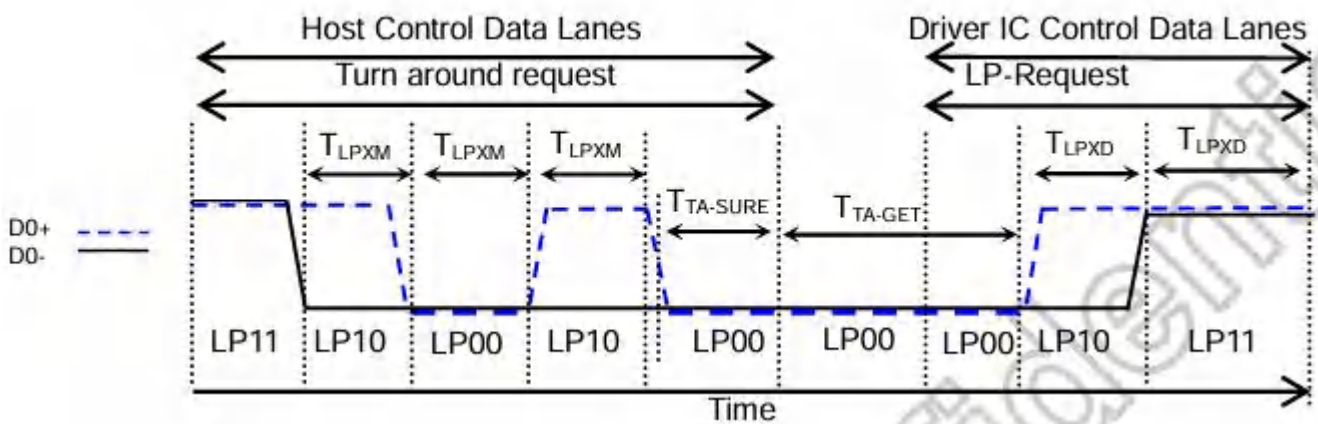


Figure : Bus Turnaround (BTA) from MPU to display module Timing

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.3V to 3.3V, TA = -30 to 70°C)

Signal	Item	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
DSI_D0P/ DSI_D0P	Length of LP-00/LP01/LP10/LP11 Host → Display module	TLPXM	50	-	-	ns
	Length of LP-00/LP01/LP10/LP11 Display module → Host	TLPXD	50	-	-	ns
	Time-out before the MPU start driver	T _{TA-SURE}	TLPXD	-	2xTLPXD	ns
	Time to drive LP-00 by display module	T _{TA-GET}	5xTLPXD	-	-	ns
	Time to drive LP-00 after turnaround request Host	T _{TA-GO}	4xTLPXD	-	-	ns

7.2.3 DSI Bursts Mode

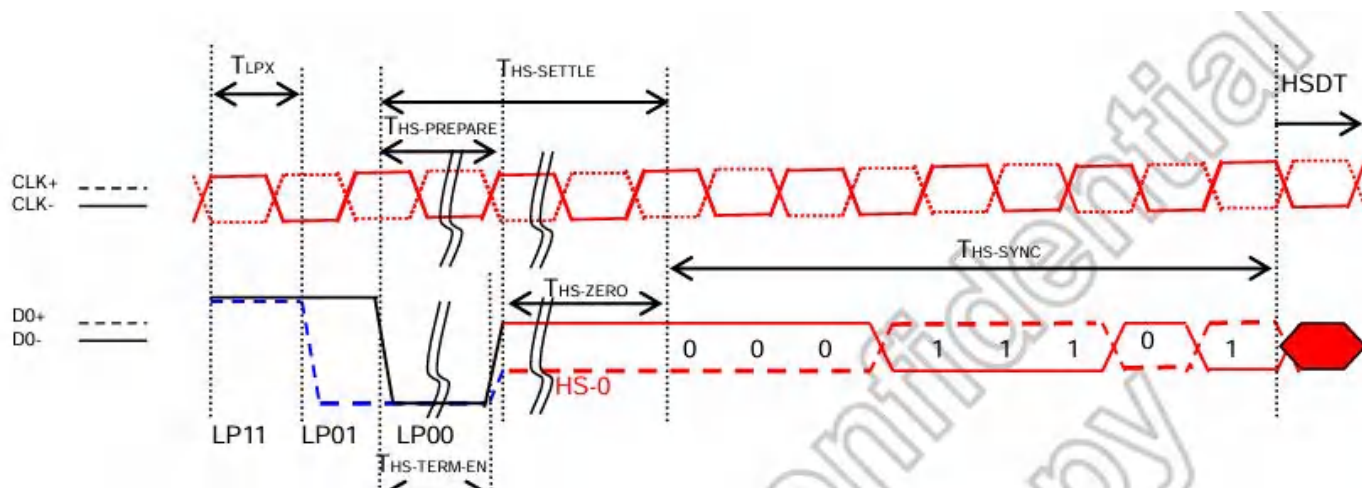
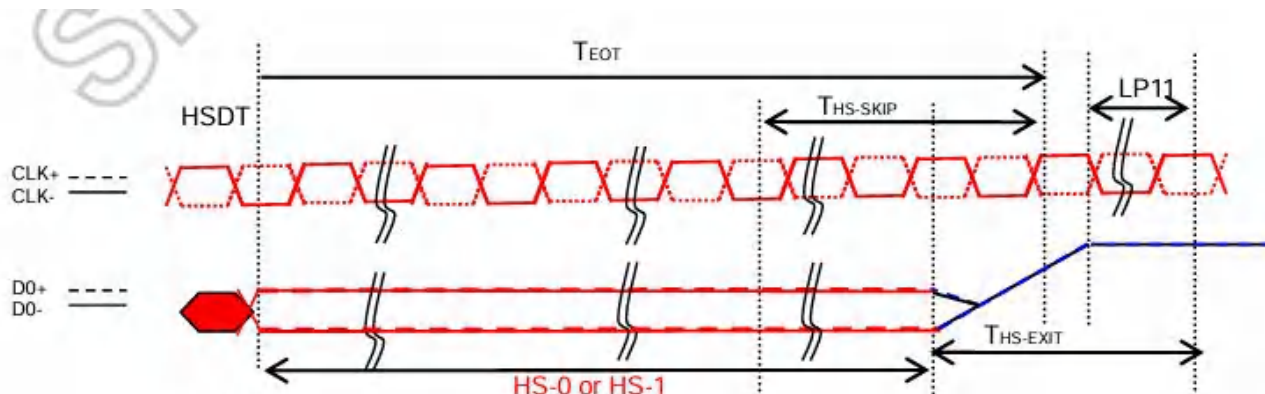


Figure : Data lanes-Low Power Mode to/from High Speed Mode Timing

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

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

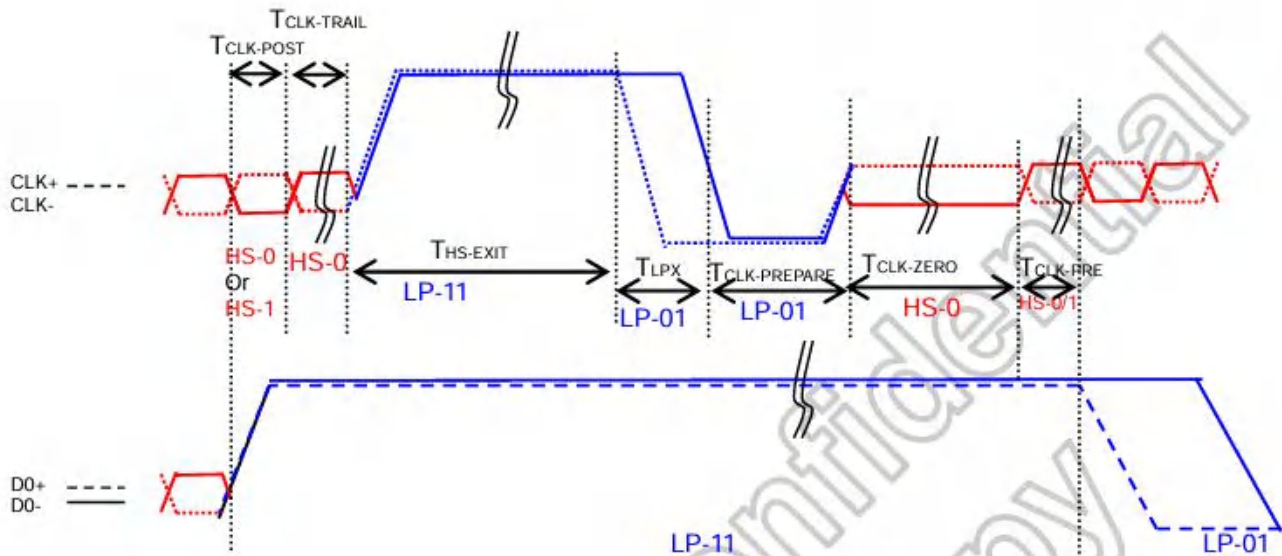


Figure : Clock lanes- High Speed Mode to/from Low Power Mode Timing

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	TCLK-POST	60+52xUI	-	-	ns
	Time to drive HS differential state after last payload clock bit of a HS transmission burst	TCLK-TRAIL	60	-	-	ns
	Time to drive LP-11 after HS burst	THS-EXIT	100	-	-	ns
	Time to drive LP-00 to prepare for HS transmission	TCLK-PREPARE	38	-	95	ns
	Time-out at Clock Lane Display Module to enable HS Termination	TCLK-TERM-EN	-	-	38	ns
	Minimum lead HS-0 drive period before starting Clock	TCLK-PREPARE + TCLK-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	TCLK-PRE	8xUI			

7.3 Reset Timing

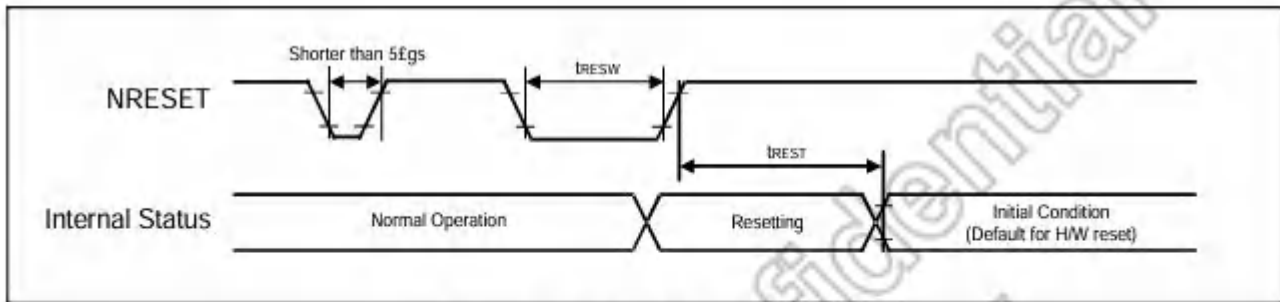


Figure 7.8: Reset input timing

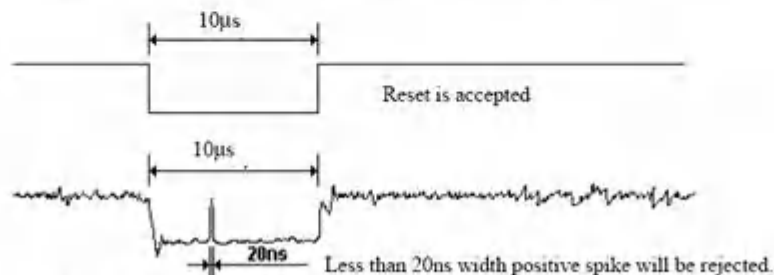
Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width ⁽¹⁾	NRESET	10	-	-	-	µs
tREST	Reset complete time ⁽²⁾	-	15	-	-	When reset applied during SLPIN mode	ms
		-	120	-	-	When reset applied during SLPOUT mode	ms

Table 7.8: Reset Input Timing

Note: (1) Spike due to an electrostatic discharge on NRESET line does not cause irregular system reset according to the following table.

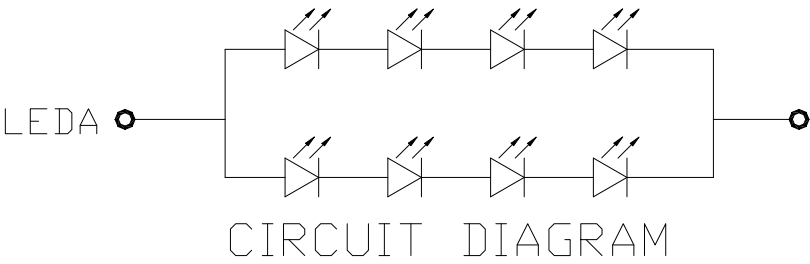
NRESET Pulse	Action
Shorter than 5 µs	Reset Rejected
Longer than 10 µs	Reset
Between 5 µs and 10 µs	Reset Start

- (2) During the resetting period, the display will be blanked (The display is entering blanking sequence, which Maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then return to Default condition for H/W reset.
- (3) During Reset Complete Time, ID and VCOM value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 15ms after a rising edge of NRESET.
- (4) Spike Rejection also applies during a valid reset pulse as shown as below:



- (5) It is necessary to wait 15msec after releasing NRESET before sending commands. Also Sleep Out command cannot be sent for 120msec.

8.0 Backlight Characteristic

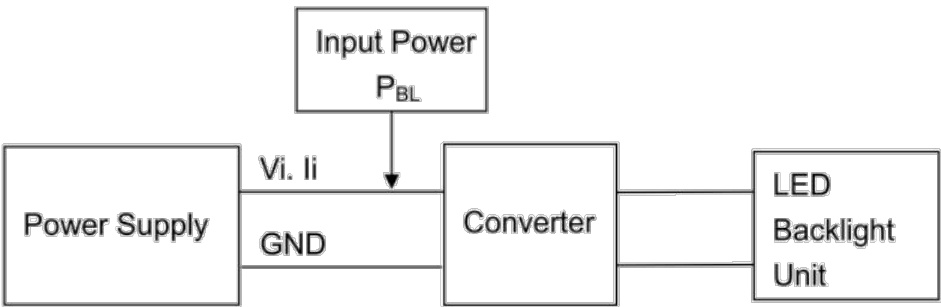


BL driving conditions:
 $I_F = 40\text{ mA}$, $V_f = 24\text{V} \pm 2.4\text{V}$ (TYP)
Twin-core lamp

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Voltage	V_f	21.6	24	26.4	V	Note 1
Supply Current	I_f	-	40	-	mA	Note 2
Power dissipation	P_{BL}	-	0.96	-	W	
Life Time	-	30000	-	-	Hr	Note 3,4
Backlight Color	White					

Note 1: The LED Supply Voltage is defined by the number of LED at $T_a=25^\circ\text{C}$ and $I_f=40\text{mA}$.

Note 2: LED current is measured by utilizing a high frequency current meter as shown below:



Note 3: The “LED life time” is defined as the module brightness decrease to 50% original brightness at $T_a=25^\circ\text{C}$ and $I_f=40\text{mA}$. The LED lifetime could be decreased if operating I_f is larger than 40mA.

Note 4: LED light bar circuit:

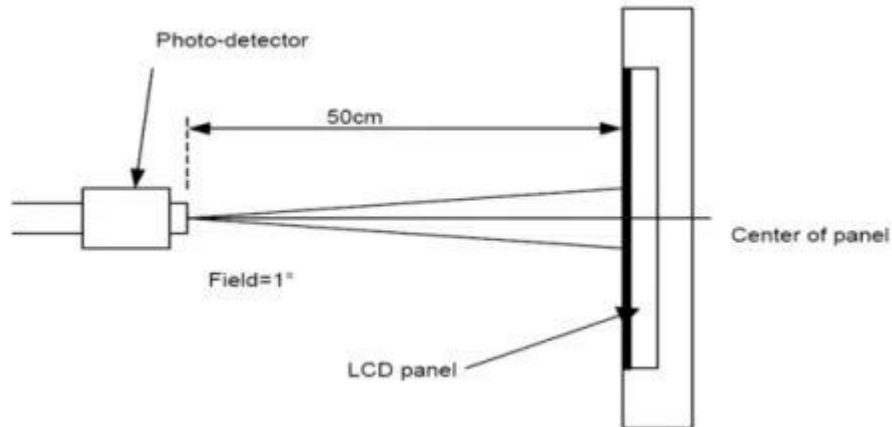
9. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		If=40mA	350	400	-	Cd/m²	1
Uniformity	△Bp			75	80	-	%	1,2
Viewing Angle	3:00		Cr≥10	-	85	-	Deg	1,2
	6:00			-	85	-		
	9:00			-	85	-		
	12:00			-	85	-		
Contrast Ratio	Cr		θ=0° Φ=0°	1000	1200	-	-	3,4
Response Time	Tr+Tf			-	30	35	ms	4,5
Color of CIE Coordinate	W	x	θ=0° Φ=0°	0.2548	0.3048	0.3548	-	1,6
		y		0.2944	0.3444	0.3944	-	
	R	x		0.5763	0.6263	0.6763	-	
		y		0.2983	0.3483	0.3983	-	
	G	x		0.2851	0.3351	0.3851	-	
		y		0.5432	0.5932	0.6432	-	
	B	x		0.0931	0.1431	0.1931	-	
		y		0.0477	0.0977	0.1477	-	
NTSC Ratio	S		-	50	-	%		

*The parameter is slightly changed by temperature, driving voltage and materiel

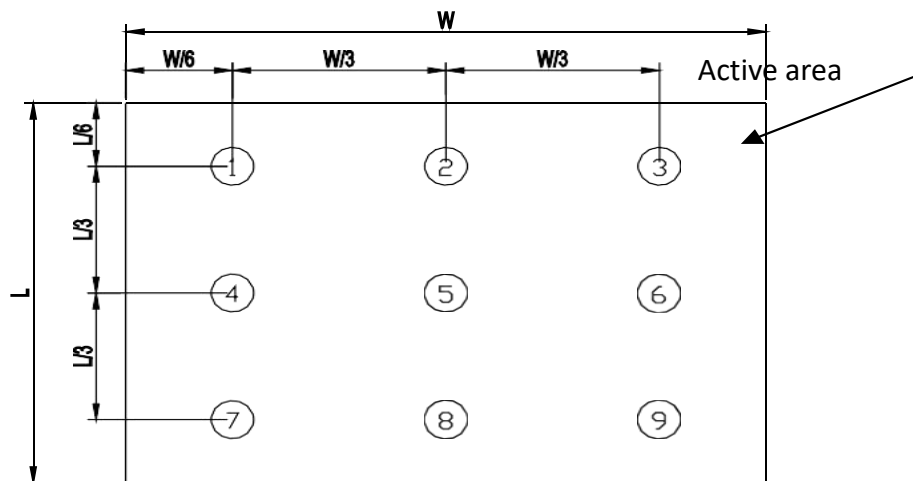
Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment CA310 Measuring condition:-Measuring surroundings: Dark room.-Measuring temperature: Ta=25°C.-Adjust operating voltage to get optimum contrast at the center of the display.

The measured value is more than 5 minutes at the center point of the LCD panel, and the backlight is turned on at the same time.

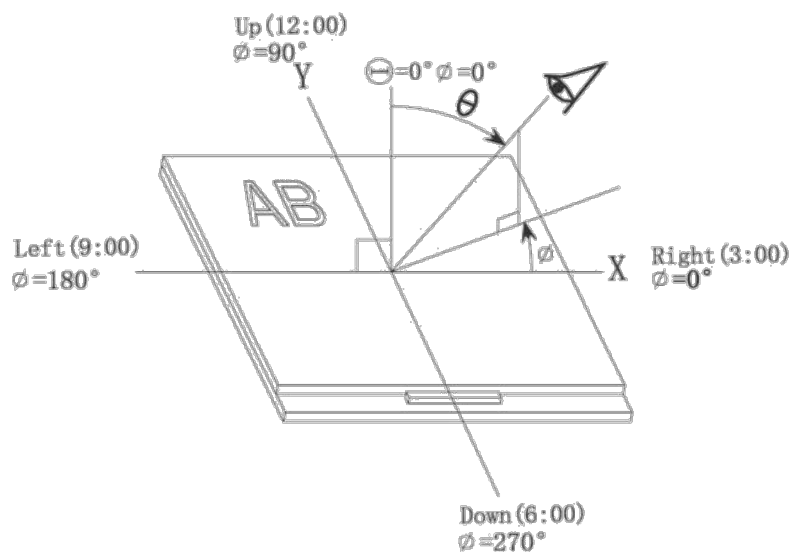


Note 2: The luminance uniformity is calculated by using following formula.

$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100 (\%)$; $B_p (\text{Max.})$ = Maximum brightness in 9 measured spots B_p
 (Min.) = Minimum brightness in 9 measured spots.



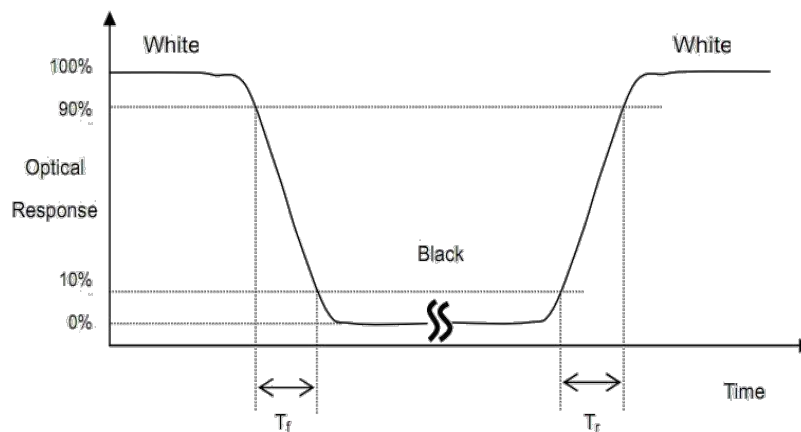
Note 3: The definition of viewing angle: Refer to the graph below marked by θ and ϕ



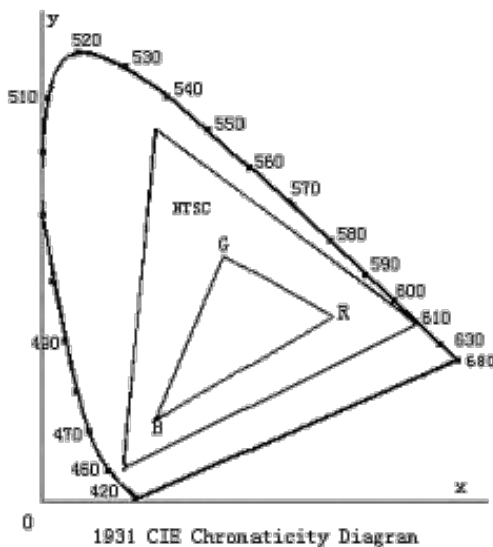
Note 4: Definition of contrast ratio Contrast measurements shall be made at viewing angle of $\theta = 0$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

Note 5: Definition of Response time The output signals of photo detector are measured when the input signals are changed from “white” to “black”(Tf) and from “black” to “white”(Tr), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.



Color gamut:

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

10. Reliability Test Conditions and Methods

No.	Test Items	Test Condition	Inspection After Test
①	High Temperature Storage	80°C±2°C×240Hours	Inspection after 2~4hours storage at room temperature, the samples should be free from defects: 1, Air bubble in the LCD. 2, Seal leak. 3, Non-display. 4, Missing segments. 5, Glass crack. 6, Current IDD is twice higher than initial value. 7, The surface shall be free from damage. 8, The electric characteristic requirements shall be satisfied. 9. Brightness reduction more than 50%.
②	Low Temperature Storage	-30°C±2°C×240Hours	
③	High Temperature Operating	70°C±2°C×240Hours	
④	Low Temperature Operating	-20°C±2°C×240Hours	
⑤	Temperature Cycle(Storage)	-30°C ← (30min) (5min) → 80°C (30min) 1cycle Total 10cycle.	
⑥	Damp Proof Test (Storage)	60°C±5°C×90%RH×240Hours	
⑦	Vibration Test	Frequency:10Hz~55Hz~10Hz Amplitude:1.5mm X,Y,Z direction for total 3hours (packing condition test will be tested by a carton).	
⑧	Drooping Test	Drop to the ground from 1M height one time every side of carton. (packing condition test will be tested by a carton).	
⑨	ESD Test	Voltage:±8KV,R:330Ω,C:150PF, Air Mode,5times.	

REMARK:

- 1, The Test samples should be applied to only one test item.
- 2, Sample side for each test item is 5~10pcs.
- 3, For Damp Proof 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 judge as a good part.
- 5, EL evaluation should be accepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- 6, Failure Judgment Criterion: Basic Specification Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

11. Inspection Standard



11.1 Scope

Specifications contain

11.1.1 Display Quality Evaluation

11.1.2 Mechanics Specification

11.2 Sampling Plan

Unless there is other agreement, the sampling plan for incoming inspection shall follow MIL-STD-105E.

11.2.1 Lot size: Quantity per shipment as one lot (different model as different lot).

11.2.2 Sampling type: Normal inspection, single sampling.

11.2.3 Sampling level: Level II.

11.2.4 AQL: Acceptable Quality Level

Major defect: AQL=0.65

Minor defect: AQL=1.5

11.3 Panel Inspection Condition

11.3.1 Environment:

Room Temperature: $25 \pm 5^{\circ}\text{C}$.

Humidity: $65 \pm 5\%$ RH.

Illumination: 300 ~ 700 Lux.

11.3.2 Inspection Distance:

35 ± 5 cm

11.3.3 Inspection Angle:

The vision of inspector should be perpendicular to the surface of the Module.

11.3.4 Inspection time:

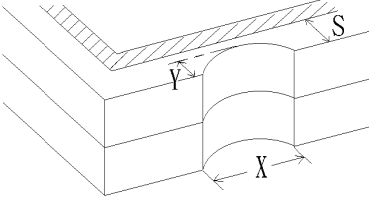
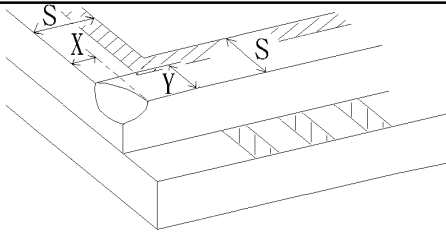
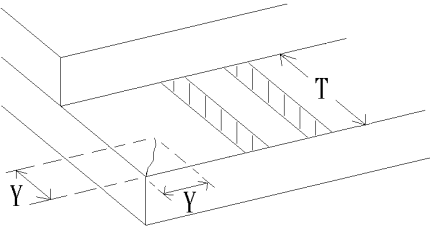
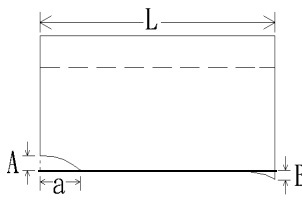
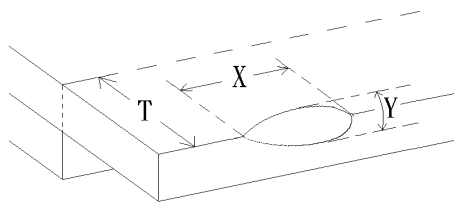
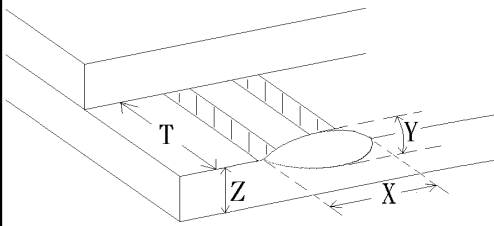
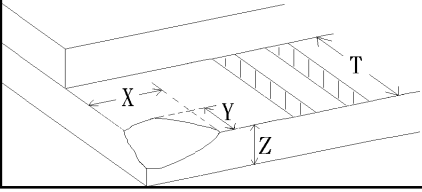
Perceptibility Test Time: 20 seconds max.

11.4 Inspection Plan

Class	Item	Judgment	Class
Packing & Indicate	1. Outside and inside package.	"MODEL NO.", "LOT NO." and "QUANTITY" should indicate on the package.	Minor
	2. Model mixed and quantity.	Other model mixed Quantity short or over	Major
	3. Product indication.	"MODEL NO." should indicate on the product.	Major
Assembly	4. Dimension, LCD glass scratch and scribe defect.	According to specification or drawing.	Major
Appearance	5. Viewing area.	Polarizer edge or LCD's sealing line is visible in the viewing area.....Rejected.	Minor
	6. Blemish, black spot, white spot in the LCD and LCD glass cracks.	According to standard of visual inspection.(inside viewing area)	Minor
	7. Blemish, black spot, white spot and scratch on the polarizer.	According to standard of visual inspection.(inside viewing area)	Minor
	8. Bubble in polarizer.	According to standard of visual inspection.(inside viewing area)	Minor
	9. LCD's rainbow color.	Strong deviation color (or newton ring) of LCD.....Rejected. Or according to limited sample.(if needed, and inside viewing area)	Minor
Electrical	10. Electrical and optical characteristics.(contrast Vop chromaticity....etc)	According to specification or drawing.(inside viewing area)	Major
	11. Missing line.	Missing dot line character	Major
	12.Short circuit. Wrong pattern display.	No display, wrong pattern display, current consumption. Out of specification	Major
	13. Dot defect.(for color and TFT)	According to standard of visual Inspection.	Minor

11.5 Standard Of Visual Inspection

NO.	CLASS	ITEM	JUDGMENT																				
11.5.1	Minor	Black and white spot. Foreign materiel. Dust. Blemish. Scratch.	(A) Round type:Unit: mm<table><tr><th>Diameter (mm.)</th><th>Acceptable Q'ty</th></tr><tr><td>$\Phi \leq 0.1$</td><td>Disregard</td></tr><tr><td>$0.1 < \Phi \leq 0.25$</td><td>2(Distance>10mm)</td></tr><tr><td>$0.25 < \Phi$</td><td>0</td></tr></table>Note: $\Phi = (\text{length}+\text{width})/2$ (B) Linear type:Unit: mm<table><tr><th>Length</th><th>Width (mm.)</th><th>Acceptable Q'ty</th></tr><tr><td>--</td><td>$W \leq 0.03$</td><td>Disregard</td></tr><tr><td>$L \leq 3.0$</td><td>$0.03 < W \leq 0.05$</td><td>1(Distance>10mm)</td></tr><tr><td>--</td><td>$0.05 < W$</td><td>Not allow</td></tr></table>	Diameter (mm.)	Acceptable Q'ty	$\Phi \leq 0.1$	Disregard	$0.1 < \Phi \leq 0.25$	2(Distance>10mm)	$0.25 < \Phi$	0	Length	Width (mm.)	Acceptable Q'ty	--	$W \leq 0.03$	Disregard	$L \leq 3.0$	$0.03 < W \leq 0.05$	1(Distance>10mm)	--	$0.05 < W$	Not allow
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--	$0.05 < W$	Not allow																					
11.5.2	Minor	Dent on polarizer.	Unit: mm. <table><tr><th>Diameter</th><th>Acceptable Q'ty</th></tr><tr><td>$\Phi \leq 0.1$</td><td>Disregard</td></tr><tr><td>$0.1 < \Phi \leq 0.25$</td><td>2(Distance>10mm)</td></tr><tr><td>$0.25 < \Phi$</td><td>0</td></tr></table>	Diameter	Acceptable Q'ty	$\Phi \leq 0.1$	Disregard	$0.1 < \Phi \leq 0.25$	2(Distance>10mm)	$0.25 < \Phi$	0												
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$0.25 < \Phi$	0																						
11.5.3	Minor	Bubble in polarizer.	Unit: mm. <table><tr><th>Diameter</th><th>Acceptable Q'ty</th></tr><tr><td>$\Phi \leq 0.1$</td><td>Disregard</td></tr><tr><td>$0.1 < \Phi \leq 0.25$</td><td>2(Distance>10mm)</td></tr><tr><td>$0.25 < \Phi$</td><td>0</td></tr></table>	Diameter	Acceptable Q'ty	$\Phi \leq 0.1$	Disregard	$0.1 < \Phi \leq 0.25$	2(Distance>10mm)	$0.25 < \Phi$	0												
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$\Phi \leq 0.1$	Disregard																						
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$0.25 < \Phi$	0																						
11.5.4	Minor	Dot defect	<table><tr><th>Items</th><th>Acceptable Q'ty</th></tr><tr><td>Bright dot</td><td>$N \leq 3$</td></tr><tr><td>Dark dot</td><td>$N \leq 3$</td></tr><tr><td>Total dot</td><td>$N \leq 6$</td></tr></table> Pixel define : Pixel R G B Dot Dot Dot Note1: The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot. Note 2: Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern. Note 3: The bright dot defect must be visible through 2% ND filter Note 4: Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue	Items	Acceptable Q'ty	Bright dot	$N \leq 3$	Dark dot	$N \leq 3$	Total dot	$N \leq 6$												
Items	Acceptable Q'ty																						
Bright dot	$N \leq 3$																						
Dark dot	$N \leq 3$																						
Total dot	$N \leq 6$																						

11.5.5	Minor	LCD glass chipping.	 Reject $Y > S$
11.5.6	Minor	LCD glass chipping.	 X or Y > S Reject
11.5.7	Major	LCD glass crack.	 $Y > (1/2) T$ Reject
11.5.8	Major	LCD glass scribe defect.	 1. $a > L/3$, $A > 1.5\text{mm}$ Reject 2. B : According to dimension
11.5.9	Minor	LCD glass chipping. (on the terminal area)	 $\Phi = (x+y)/2 > 2.5\text{mm}$ Reject
11.5.10	Minor	LCD glass chipping. (on the terminal surface)	 $Y > (1/3) T$ Reject
11.5.11	Minor	LCD glass chipping.	 $Y > T$ Reject



12. Handling Precautions

12.1 Mounting method

The LCD panel of **APTUS** TFT 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.

12.2 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.

12.3 Caution against static charge

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

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

12.4 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.

12.5 Caution for operation

- It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.
- An electro chemical 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 then the operating temperature range and on the other hand at higher temperature LCD's how 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.
- 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.

12.6 storing

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.

- Storage 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 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.



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 **APTUS** TFT , 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.