DMT097XGNLCMU-2B
PRODUCT SPECIFICATION

Version 0.2
Sep 14, 2023

Customer's Approval	
Signature	*Date*

Prepared by *Yvette Hsieh*
Approved by *Kenny Lin*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Jun 16, 2023	Preliminary	Kenny Lin
0.2	Sep 14, 2023	Modify p.2 Legal notice, p.5 No. of colour and interface, p.8 Mechanical drawing and p.22 Title	Yvette Hsieh

Legal Notice

Table of Contents

1. General Description

1.1 Introduction

This is a 9.7” size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode, transmissive, and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 1024 x 768 and can display up to 262K colours. The display module supports 6-bit LVDS interface and optical bonding touch panel.

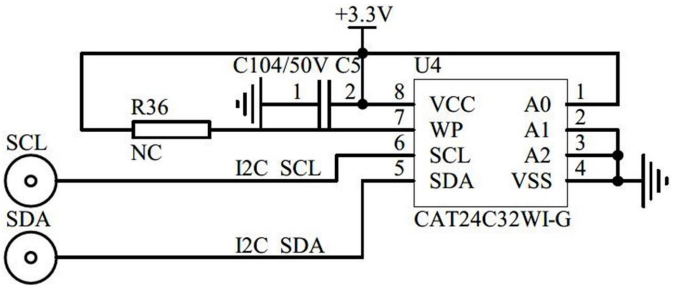
1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	9.7” Diagonal
Display Format	1024 x RGB x 768 Dots
No. of Colour	262K
Overall Dimensions	228.05 (W) x 187.9 (H) x 24.13 (D) mm
Active Area	196.61 (W) x 147.46 (H) mm
Mode	Normally Black / Transmissive / IPS
Surface Treatment	Glare (6H)
Viewing Direction	All round
Interface	6-bit LVDS
Driver IC	HX8282-A01 & HX8695-B01
Operating Temperature	0°C ~ 50°C
Storage Temperature	-20°C ~ 60°C
ROHS	Compliant to RoHS 2.0
EEPROM IC	CAT24C32WI-G

Note: EEPROM Slave Address

1	0	1	0	A_2O	A_1O	$A_0$1	R/W

Note: EEPROM Circuit



CTP Features

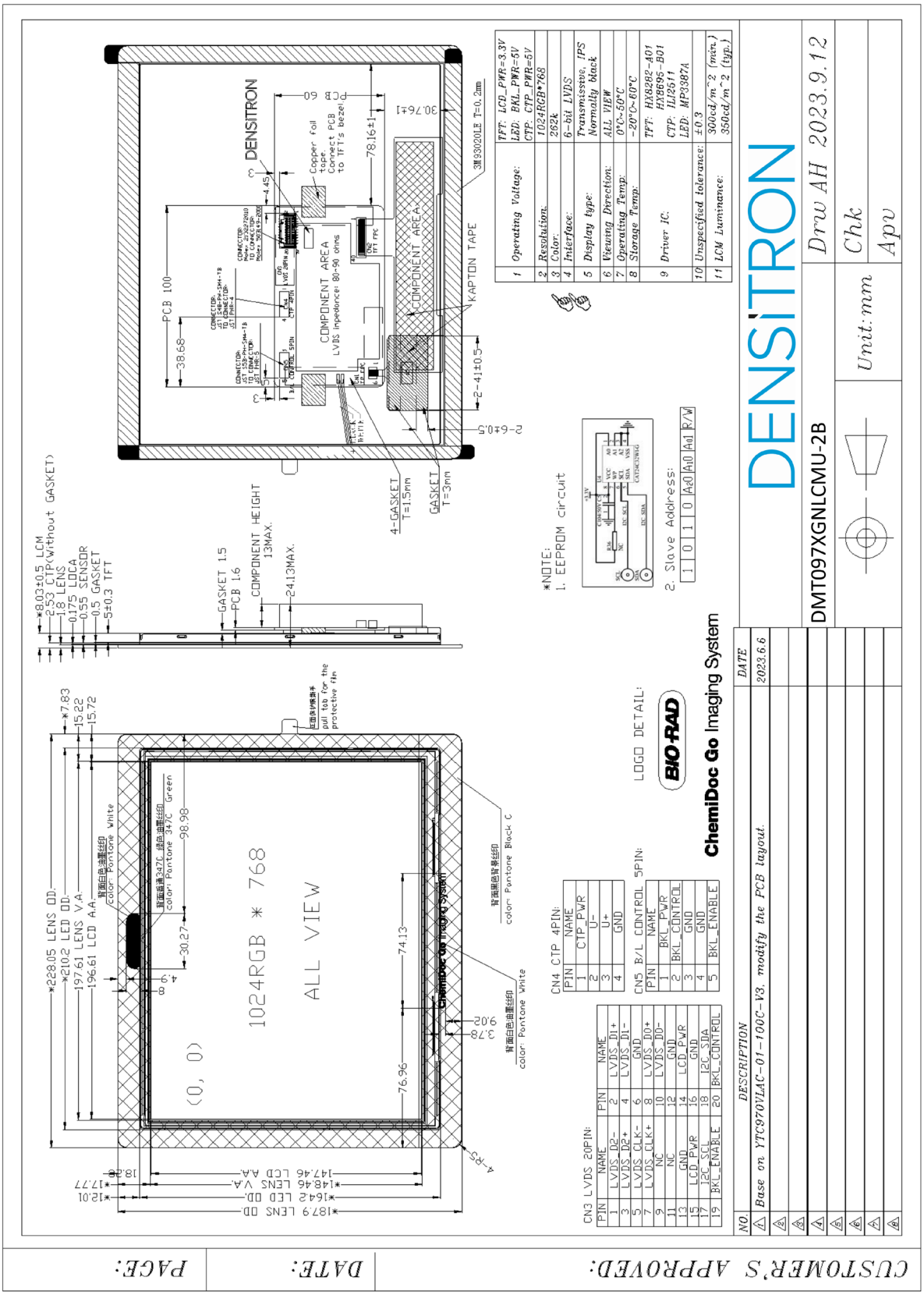
Item	Contents
Touch Panel	PCT (Mutual Capacitor)
Touch Interface	USB
Touch Driver IC	ILI2511
Bonding Type	TBD
Touch Mode	Finger
Touch Mode	5 Points
Optical Transmittance	87%

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	1024 x RGB x 768	Dots
Overall Dimensions	228.05 (W) x 187.9 (H) x 24.13 (D)	mm
Active Area	196.61 (W) x 147.46 (H)	mm
Dot Pitch	0.192 x 0.192	mm
Weight	TBD	g

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

3.1.1 Absolute Ratings of Environment

AGND = GND = 0V,Ta = 25℃

Item	Symbol	Min	Max	Unit	Note
Power Voltage	DC_IN	-0.5	3.96	V	-
Backlight Power	BKL_PWR	-0.3	6.5	V	-
	BKL_CONTROL	-0.3	6.5	V	-
	BKL_ENABLEs				-
Operating Temperature	T_{OPR}	0	50	℃	-
Storage Temperature	T_{STG}	-20	60	℃	-

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

3.2 DC Electrical Characteristics

3.2.1 Recommended Operating Condition

AGND = GND = 0V, Ta = 25℃

Item	Symbol	Min	Typ.	Max	Unit	Note
Power Voltage	LCD_PWR	2.7	3.3	3.6	V	-
Input Logic High Voltage	VIH	0.7LCD_PWR	-	LCD_PWR	V	-
Input Logic Low Voltage	VIL	0	-	0.3LCD_PWR	V	-

3.2.2 Power-on/off Sequence

Power on Sequence

T_{VDD-ON} ≈ 2ms, $T_{VDD-AVDD}$ ≈22ms, $T_{VGH-AVDD}$ ≈22ms, $T_{VGL-AVDD}$ ≈13ms.

Power off Sequence

$T_{AVDD-OFF} \approx T_{VGH-OFF} \approx T_{VGL-OFF} \approx 4ms$,

$V_{VDD-OFF} = 2.3V$

$T_{VDD-AVDD} \approx 18ms$.

3.3 Interface Pin Assignment

3.3.1 CN3 LVDS 20 PIN

No.	Symbol	Function	Note
1	LVDS_D2-	-LVDS differential data input	I
2	LVDS_D1+	+LVDS differential data input	I
3	LVDS_D2+	+LVDS differential data input	I
4	LVDS_D1-	-LVDS differential data input	I
5	LVDS_CLK-	-LVDS differential data input	I
6	GND	Ground.	P
7	LVDS_CLK+	+LVDS differential clock input	I
8	LVDS_D0+	-LVDS differential data input	I
9	NC	No connection	-
10	LVDS_D0-	-LVDS differential data input	I
11	NC	No connection	-
12	GND	Ground.	P
13	GND	Ground.	P
14	LCD_PWR	LCD power	P
15	LCD_PWR	LCD power	P
16	GND	Ground.	P
17	I2C_SCL	EEPROM IC serial Clock input pin accepts the clock signal generated by the Master.	I
18	I2C_SDA	EEPROM IC serial Data I/O pin accepts input data and delivers output data. In transmit mode, this pin is open drain. Data is acquired on the positive edge and is delivered on the negative edge of SCL.	I
19	BKL_ENABLE	Backlight Enable control input. EN is weakly pulled low internally.	I
20	BKL_CONTROL	PWM signal input. Apply a PWM signal on BKL_CONTROL for brightness control. A 100Hz to20kHz dimming signal is recommended. BKL_CONTROL is weakly pulled low internally.	I

3.3.2 CN5 B/L Control 5 PIN

No.	Symbol	Function	I/O
1	BKL_PWR	Backlight Power	P
2	BKL_CONTROL	PWM signal input. Apply a PWM signal on BKL_CONTRL for brightness control. A 100Hz to20kHz dimming signal is recommended. BKL_CONTROL is weakly pulled low internally.	I
3	GND	Ground	P
4	GND	Ground	P
5	BKL_ENABLE	Backlight Enable control input. EN is weakly pulled low internally.	I

3.3.3 CN4 CTP 4PIN

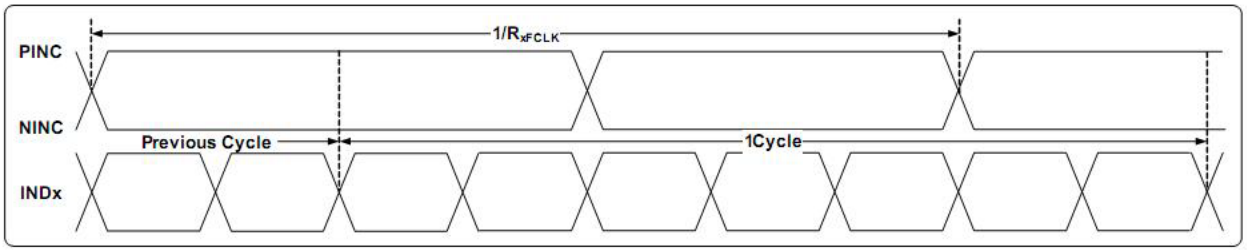
No.	CTP_PWR
1	CTP_PWR
2	U-
3	U+
4	GND

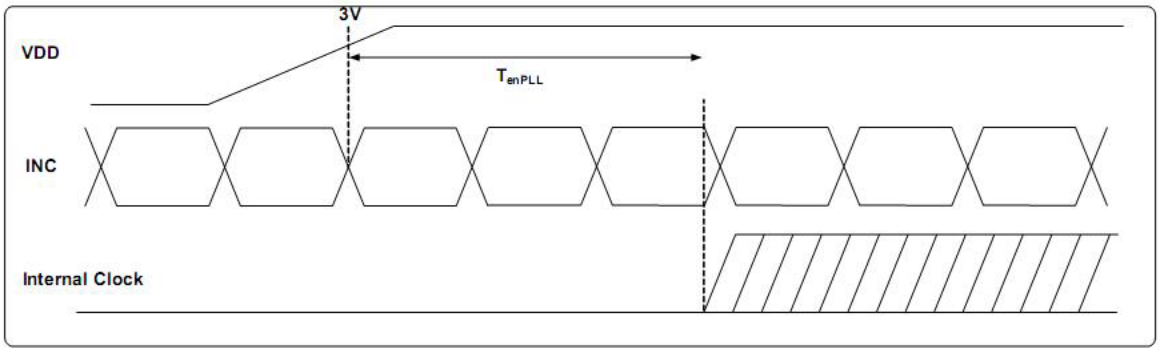
3.4 Timing Characteristics

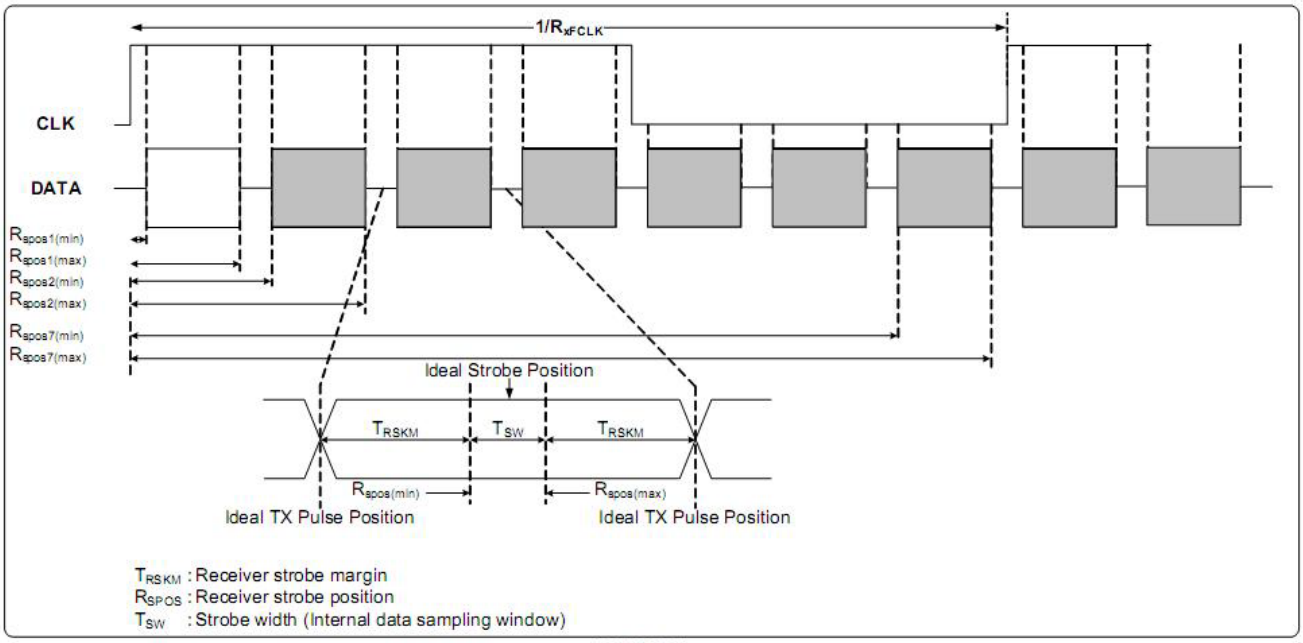
3.4.1 AC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Condition
Clock Frequency	R_{XFCLK}	20	-	71	MHz	-
Input Data Skew Margin	T_{RSKM}	500	-	-	pS	$\|VID\|$=400mV RXVCM=1.2V RXFCLK=71MHz
Clock High Time	T_{LVCH}	-	4/(7* R_{XFCLK})	-	ns	-
Clock Low Time	T_{LVCL}	-	3/(7* R_{XFCLK})	-	ns	-
PLL Wake-up Time	T_{emPLL}	-	-	150	us	-

LVDS Mode AC Electrical Characteristics







LVDS figure

Item	Symbol	Min	Typ.	Max	Unit	Condition
Modulation Frequency	SSC_{MF}	23	-	93	KHz	-
Modulation Rate	SSC_{MR}	-	-	±3	%	LVDS clock=71 MHz center spread

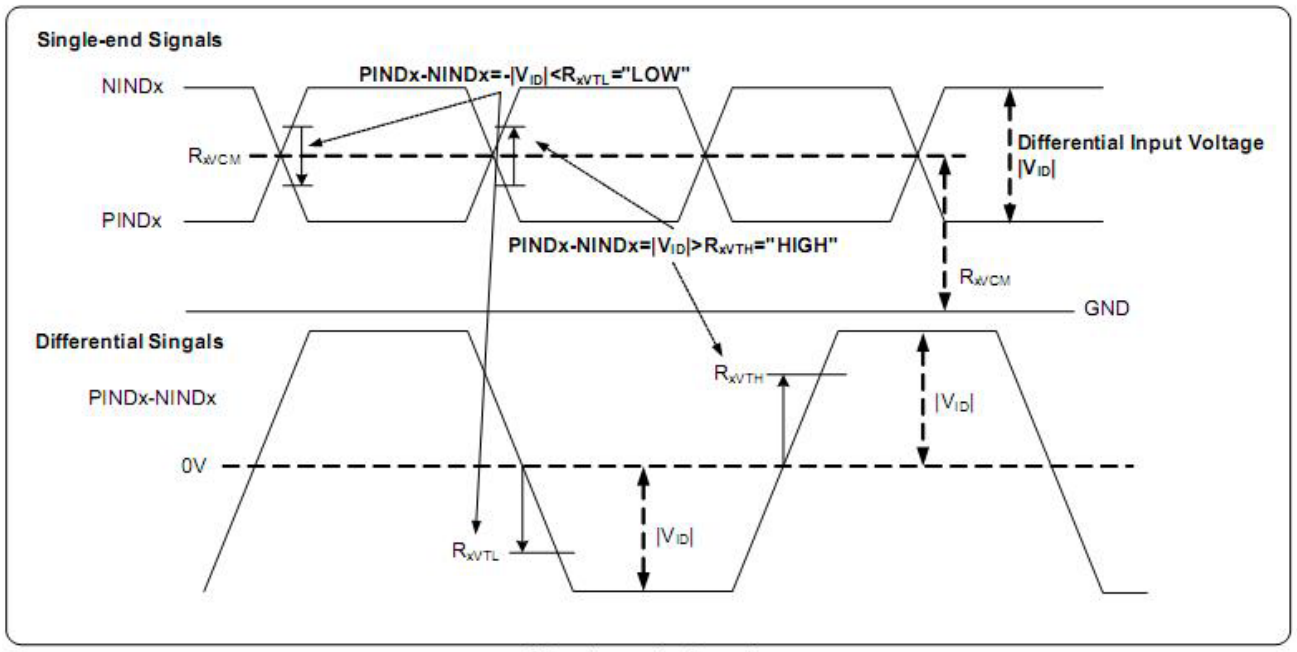
3.4.2 DC Electrical Characteristics

(VDD=LCD_PWR=2.7~3.6V, AVDD=6.5~13.5V, GND=AGND=0V, TA=-20℃~+85℃)

Parameter	Symbol	Spec.			Unit	Condition
		Min.	Typ.	Max.		
Power supply voltage	VDD	2.7	-	3.6	V	-
Power supply voltage	AVDD	6.5	-	13.5	V	-
Power supply voltage	AVDDL	6.5	-	13.5	V	Full range application
		-	V8+0.1	-	V	Half AVDD application
Power supply voltage	AGNDH		0		V	Full range application
		-	V7-0.1	-	V	Half AVDD application
Low level input voltage	V_{IL}	0	-	0.3VDD	V	For digital circuit
High level input voltage	V_{IH}	0.7VDD	-	VDD	V	For digital circuit
Output low voltage	V_{OL}	-	-	GND+0.4	V	I_{OL}=400μA
Output high voltage	V_{OH}	VDD-0.4	-	-	V	I_{OH}=-400μA
Pull low/high resistance	R_I	200	250	300	kΩ	For the digital input pin @VDD=3.3V
Input leakage current	Ii	-	-	±1	uA	For digital circuit
Digital Operation current	Idd	-	12	20	mA	Fclk=50MHz, LD=48KHz,VDD=3.3V, No load
Digital stand-by current	Ist1	-	10	50	μA	Clock & all functions are stopped
Analog Operating current	Idda	-	8	10	mA	No load, Fclk=50MHz,LD=48KHz @ AVDD=10V, V1=8V, V14=0.4V
Analog Stand-by current	Ist2	-	10	50	μA	No load, clock & all functions are stopped
Input level of V1~V7	Vref1	0.4AVDD	-	AVDD-0.1	V	Gamma correction voltage input
Input level of V8~V14	Vref2	0.1	-	0.6AVDD	V	Gamma correction voltage input
Output Voltage deviation	Vod1	-	±20	±35	mV	Vo=AGND+0.1V~AGND+0.5V & Vo=AVDD-0.5V~AVDD-0.1V
Output Voltage deviation	Vod2	-	±15	±20	mV	Vo=AGND+0.5V~AVDD-0.5V
Output Voltage Offset between Chips	Voc	-	-	±20	mV	Vo=AGND+0.5V~AVDD-0.5V
Dynamic Range of Output	Vdr	0.1	-	AVDD-0.1	V	SO1~SO1200
Sinking Current of Outputs	IOLy	80	-	-	μA	SO1~SO1200; Vo=0.1V vs. 1.0V, AVDD=13.5V
Driving Current of Outputs	IOHy	80	-	-	μA	SO1~SO1200 ;Vo=0.1V vs. 12.5V, AVDD=13.5V
Resistance of Gamma Table	Rg	0.7*Rn	1.0*Rn	1.3*Rn	Ω	Rn: Internal gamma resistor

Parameter	Symbol	Spec.			Unit	Condition
		Min.	Typ.	Max.		
Differential input high Threshold voltage	R_{XVTH}	-	-	+0.1	V	R_{XVCM}=1.2V
Differential input low threshold voltage	R_{XVTL}	-0.1	-	-	V	
Input voltage range (singled-end)	R_{XVIN}	0	-	VDD-1.2+ $\|V_{ID}\|/2$	V	-
Differential input common Mode voltage	R_{XVCM}	$\|V_{ID}\|/2$	-	VDD-1.2	V	-
Differential input voltage	$\|V_{ID}\|$	0.2	-	0.6	V	-
Differential input leakage Current	RV_{Xliz}	-10	-	+10	μA	-
LVDS Digital Operating Current	Iddlvds	-	15	30	mA	Fclk=65MHz, VDD=3.3V
LVDS Digital Stand-by Current	Istlvds	-	10	50	μA	Clock & all Functions are stopped

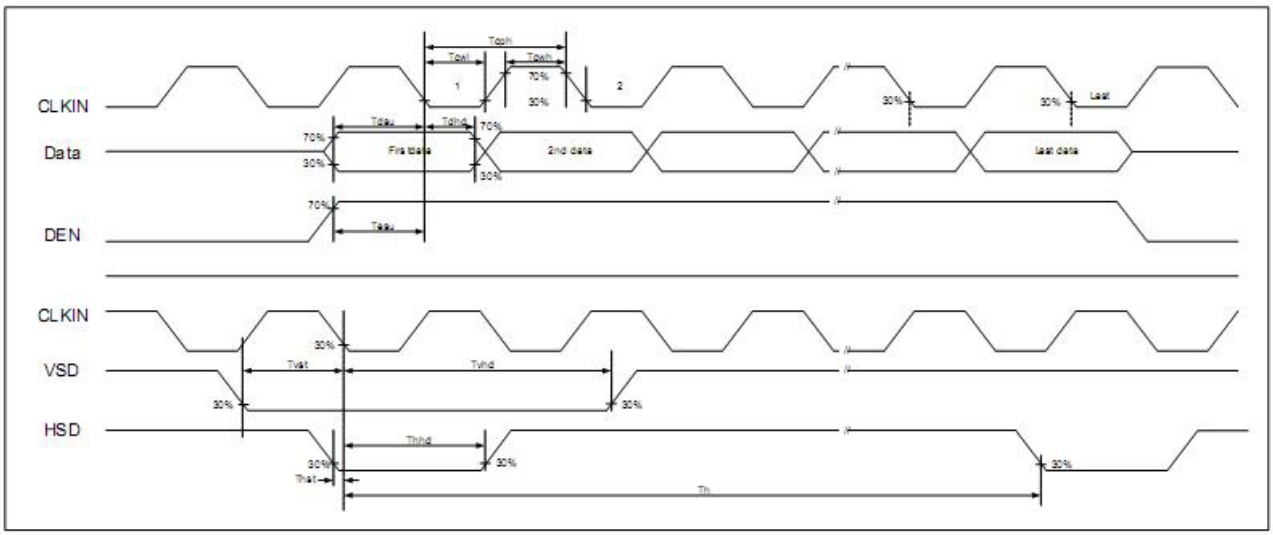
LVDS mode DC electrical characteristics



Single-end signals

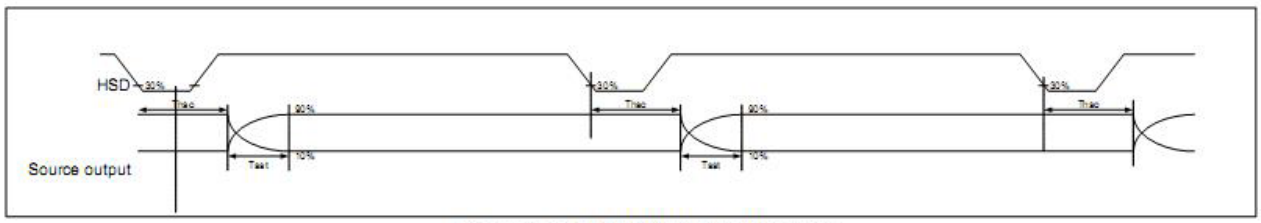
3.4.3 Timing

Input clock and data timing diagram

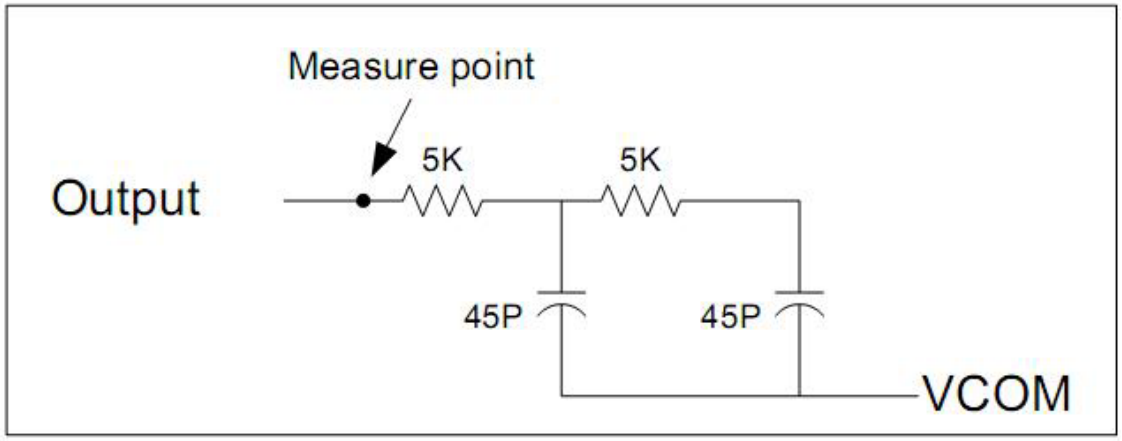


Input clock and data timing diagram

Source output timing diagram (Cascade)

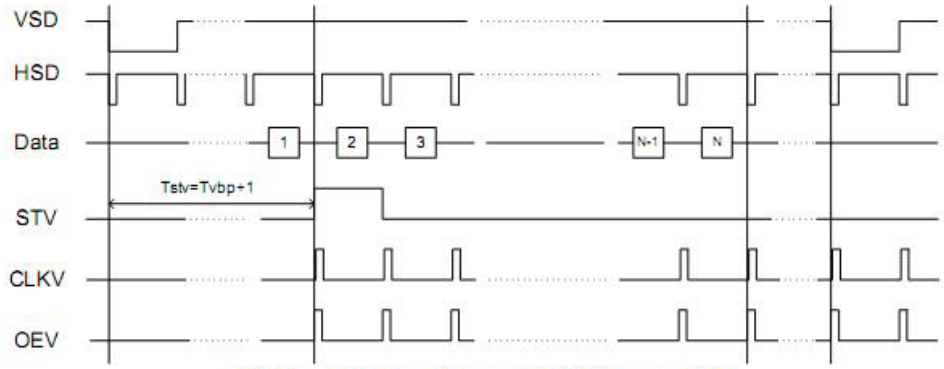


Source output timing diagram



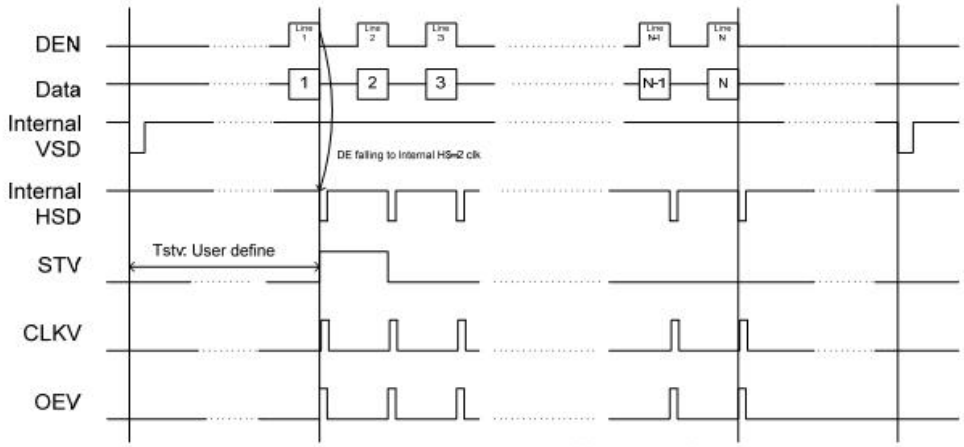
Output load condition

Vertical timing diagram HV (Cascade)



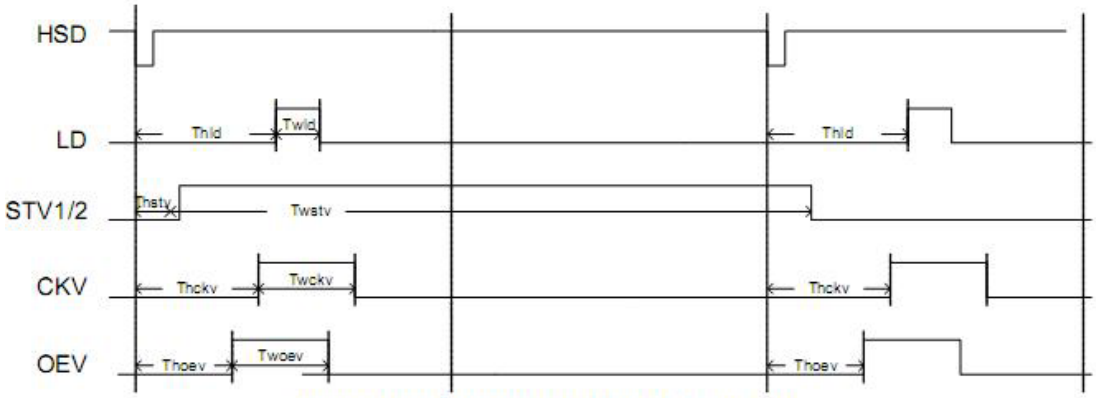
Vertical timing diagram HV (Cascade)

Vertical timing diagram DE (Cascade)



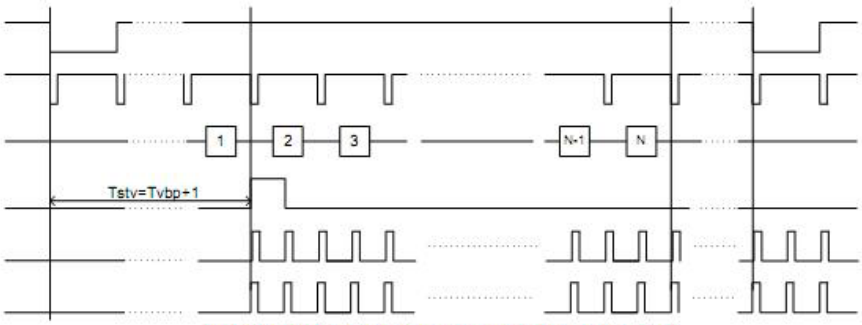
Vertical timing diagram DE (Cascade)

Gate output timing diagram (Cascade)



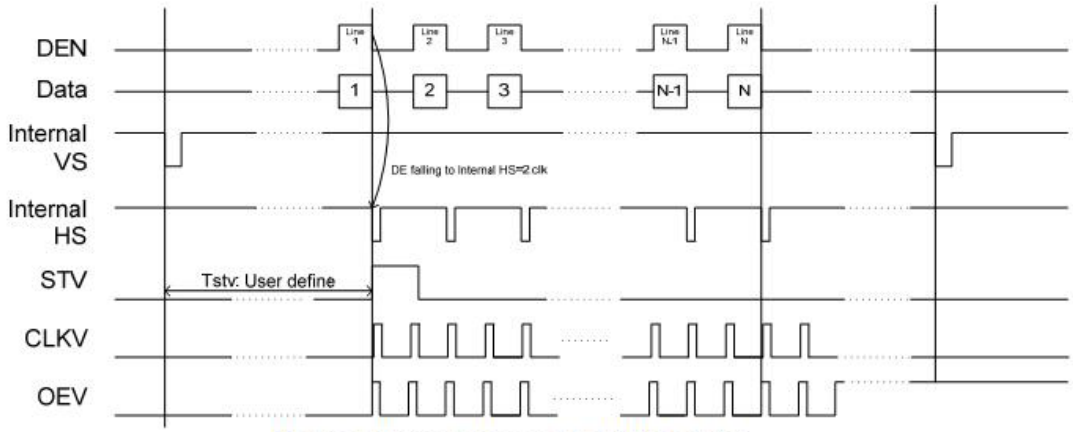
Gate output timing diagram (Cascade)

Vertical timing diagram HV (Dual gate)



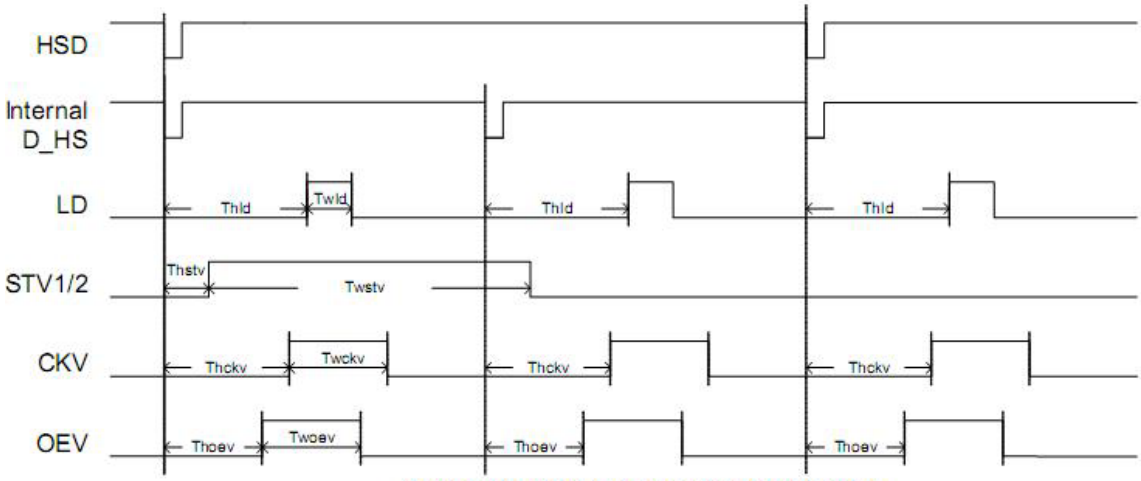
Vertical timing diagram HV (Dual gate)

Vertical timing diagram DE (Dual gate)



Vertical timing diagram DE (Dual gate)

Gate output timing diagram (Dual gate)

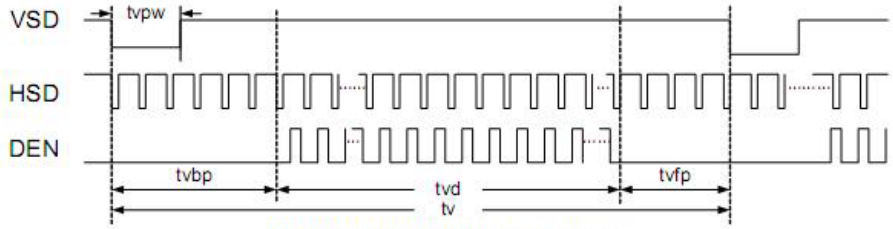


Gate output timing diagram (Dual gate)

3.4.4 Data Input Format

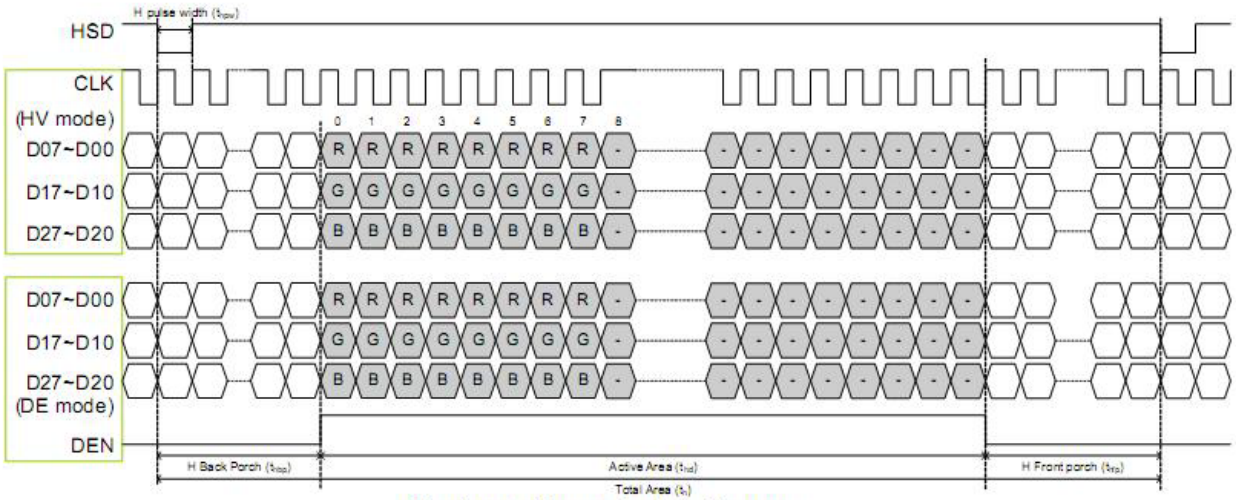
3.4.4.1 TTL Mode Data Input Format

Vertical timing



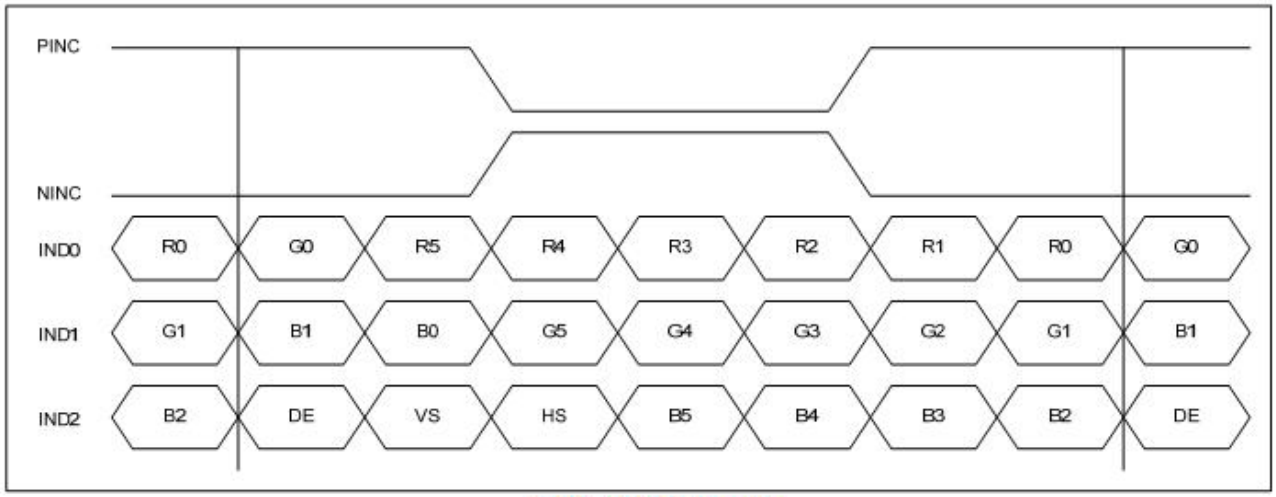
Vertical input timing diagram

Horizontal timing



Horizontal input timing diagram

3.4.4.2 LVDS Mode Data Input Format (VESA Mode)



6-bit LVDS input

Horizontal timing

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
DCLK Frequency	fclk	57	65	70.5	MHz
Horizontal Display Area	thd		1024		DCLK
HSD Period	th	1200	1344	1400	DCLK
HSD Pulse Width	thpw	1	-	140	DCLK
HSD Back Porch	thbp		160		DCLK
HSD Front Porch	thfp	16	160	216	DCLK

HV mode horizontal timing (1024x768)

Vertical timing

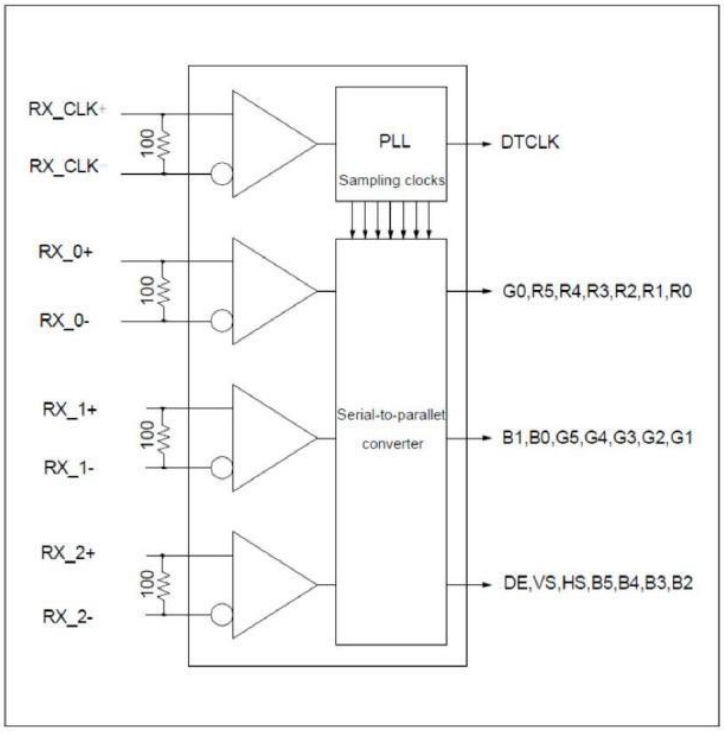
Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Vertical Display Area	tvd		768		T_H
VSD Period	tv	792	806	840	T_H
VSD Pulse Width	tvpw	1	-	20	T_H
VSD Back Porch	tvbp		23		T_H
VSD Front Porch	tvfp	1	15	49	T_H

HV mode vertical timing (1024x768)

3.4.5 LVDS Internal Circuit

LVDS receiver. The LCD module equips termination resistors for LVDS links.

LVDS Receiver Internal Circuit



3.4.6 Power On/Off Sequence

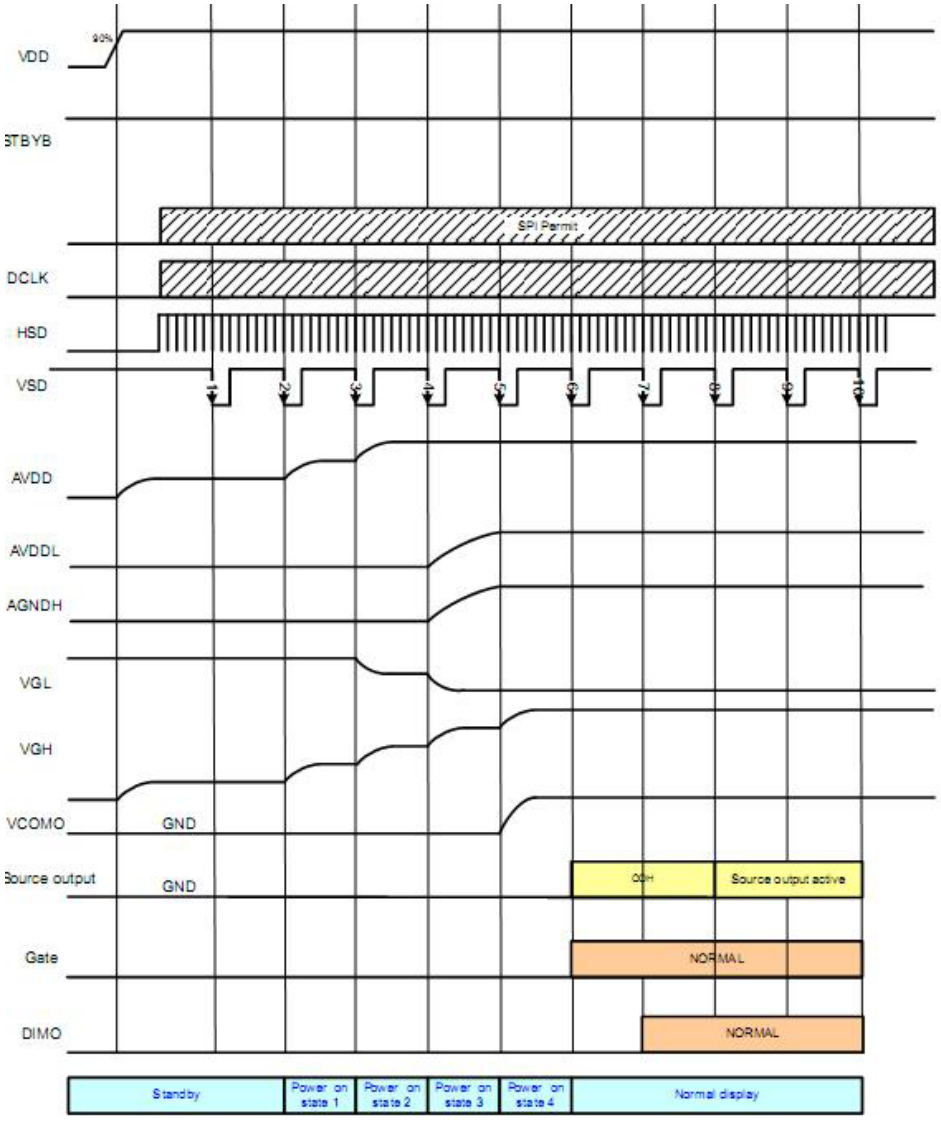
To prevent the device damage from latch up, the power on/off sequence shown below must be followed.

Power on: VDD, GND→AVDD, AGND→V1 to V14

Power off: V1 to V14 → AVDD, AGND→ VDD, GND

3.4.6.1 Power On/Off Control

HX8282-A01 has a power on/off sequence control function. In order to prevent IC from power on reset fail, the rising time (T POR) of the digital power supply VDD should be maintained within the given specifications. Please refer to “AC Characteristics” for more detail on timing.



Power on timing sequence

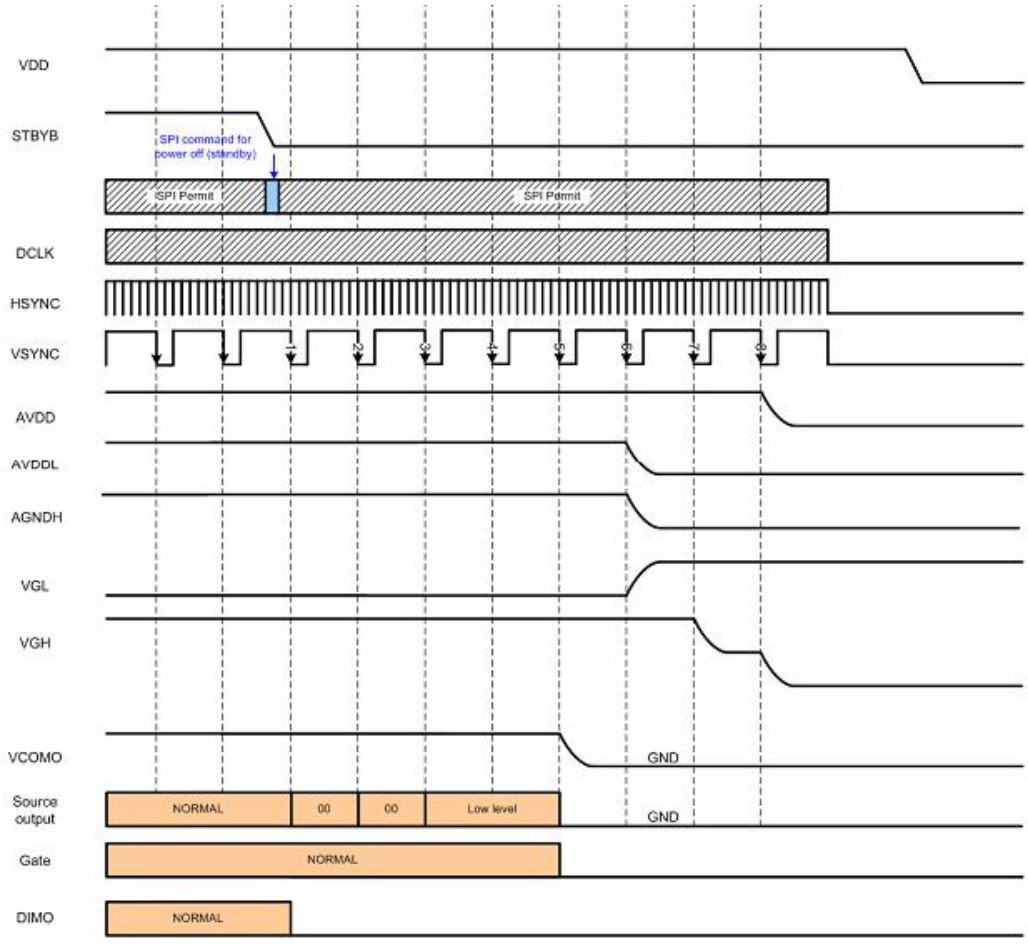


Figure Power off timing sequence

Note: Low level=3FH, when NBW=L (Normally white), Low level=00H, when NBW=H (Normally black)

4. Electrical Specification Touch

4.1 Electrical Characteristics

4.1.1 Absolute Maximum Ratings

Item	Symbol	Min	Typ.	Max	Unit	Note
USB 5V Input Power Supply Voltage	VDD5V	-0.3	-	6.0	V	-
VDD3A to GND	VDD3A	-0.3	-	3.6	V	-
VDD3D to GND	VDD3D	-0.3	-	3.6	V	-
VDDIO to GND	VDDIO	-0.3	-	3.6	V	-
VDD16 to GND	VDD16	-0.3	-	1.65	V	-
VGH to GND	VGH	-0.3	-	32	V	-
VTX to GND	VTX	-0.3	-	32	V	-
ESD Susceptibility HBM (Human Body Mode) (Note 1)	HBM	-	-	4000	V	-
ESD Susceptibility MM (Machine Mode)	MM	-	-	400	V	-

Note 1: Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2: Devices are ESD sensitive. Handling precaution is recommended.

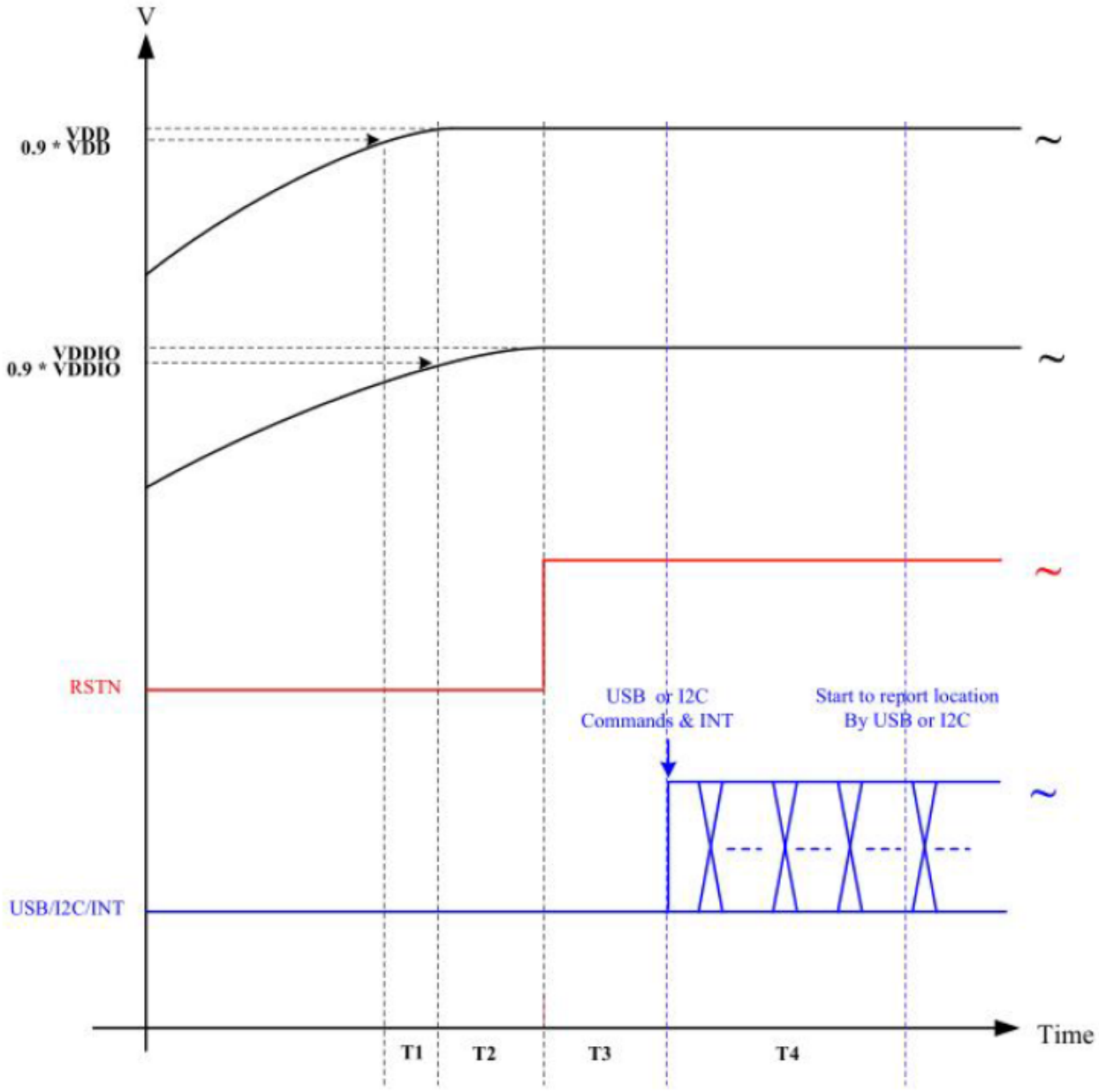
4.1.2 Recommended Operating Conditions

Item	Symbol	Min	Typ.	Max	Unit	Note
USB 5V Input Power Supply Voltage	VDD5V	4.4	-	5.5	V	-
VDD3A to GND	VDD3A	3.0	-	3.6	V	-
VDD3D to GND	VDD3D	3.0	-	3.6	V	-
VDDIO to GND	VDDIO	1.8	-	3.6	V	-
VGH to GND	VGH	-0.3	-	32	V	-
VTX to GND	VTX	-0.3	-	32	V	-
Operating Ambient Temperature Range	TA	-40	-	105	°C	-
Operating Junction Temperature Range	TJ	-40	-	125	°C	-
Storage Ambient Temperature Range	TSTs	-40	-	150	°C	-

Note: The device is not guaranteed to function outside its operating conditions.

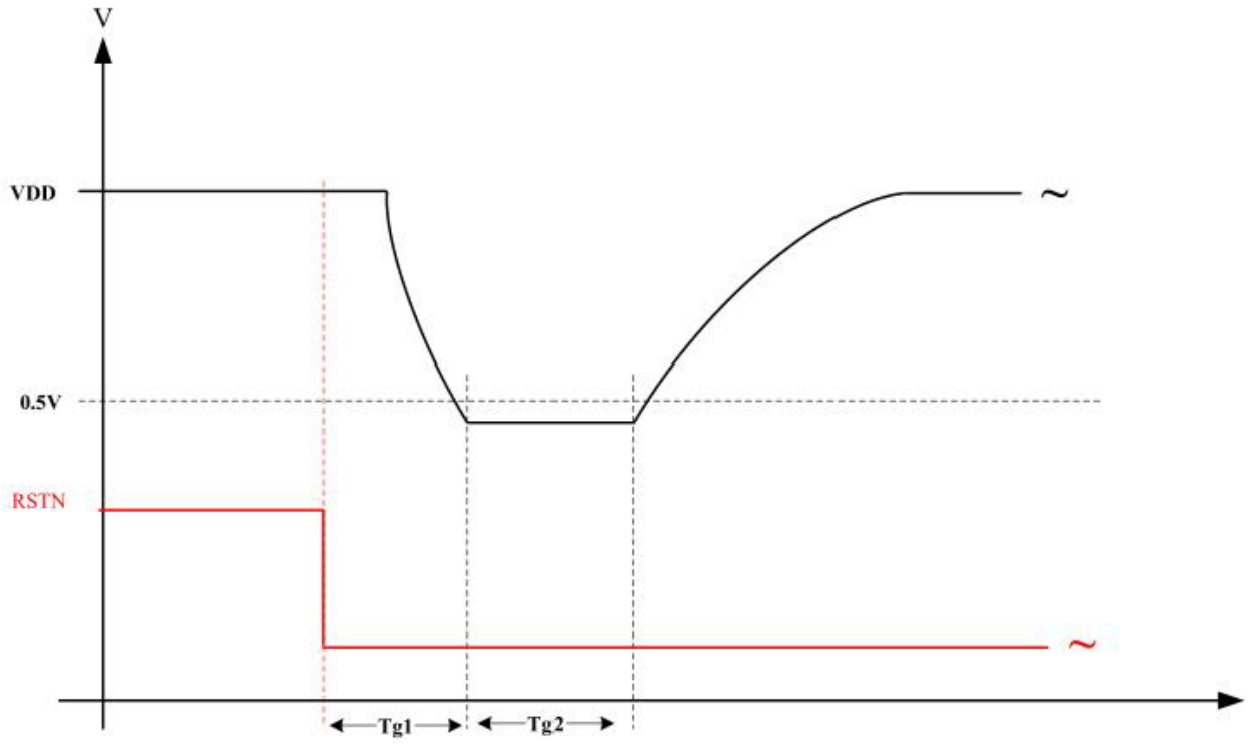
4.2 Touch Panel Power Sequence

4.2.1 Power On Sequence



Note1: T1: the time difference between 0.9*VDD and 0.9*VDDIO. T1 must be ≥ 0 sec.
Note2: T2: the time difference between 0.9*VDDIO and RSTN. T2 must be ≥ 200 us.
Note3: T3: the time difference between RSTN and Commands.T3 must be ≥ 150 ms.
Note4: T4: IC start to report point location to host. T4 must be ≥ 300 ms.

4.2.2 Power Off Sequence



Tg1 : the time difference between power-off and power-on. Tg1 must be > 10us.
Tg2 : the time difference between power-off and power-on. Tg2 must be > 10us.

Note. During the power off time, the VDD must be lower than 0.5V that make sure the touch controller have been correctly reset.

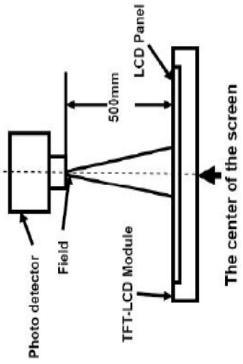
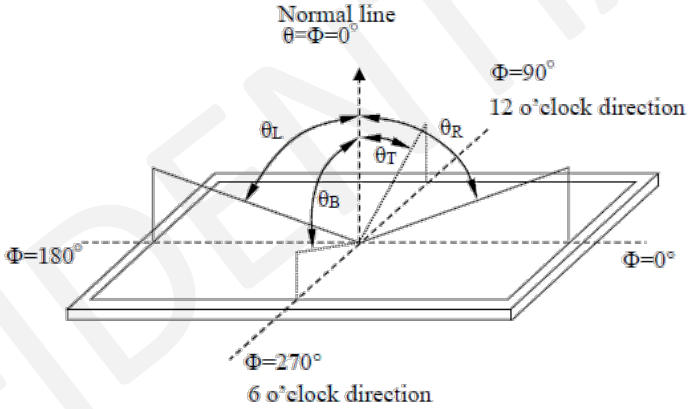
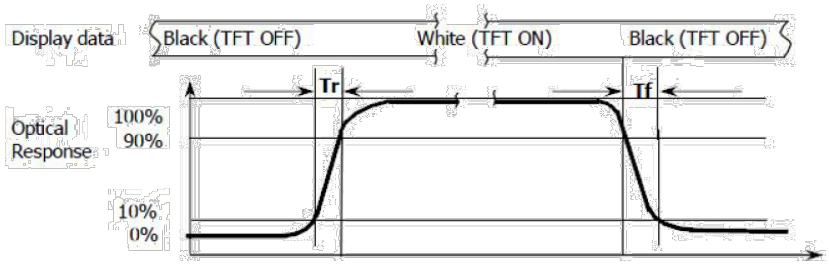
5. Optical Specification

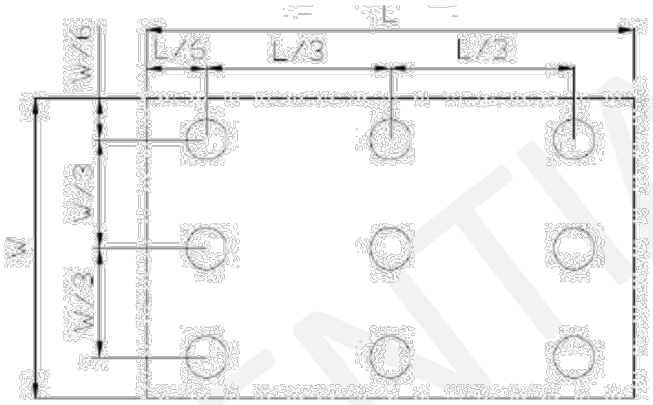
5.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ=0 Normal Viewing Angle 25°C	700	850	-	-	1, 3
Response time		TR + TF		-	20	-	ms	1, 4
Viewing Angle	Left	θ_x-	CR≥10	-	89	-	-	2
	Right	θ_x+		-	89	-		
	Up	θ_Y+		-	89	-		
	Down	θ_Y-		-	89	-		
Colour Chromaticity	Red	Rx	θ=0 Normal Viewing Angle	0.570	0.610	0.650	-	1, 5
		Ry		0.295	0.335	0.375		
	Green	Gx		0.289	0.329	0.369		
		Gy		0.539	0.579	0.619		
	Blue	Bx		0.108	0.148	0.188		
		By		0.080	0.120	0.160		
	White	Wx		0.257	0.297	0.337		
		Wy		0.275	0.315	0.355		
Uniformity		U	-	70	--	-	%	5
Luminance		L	-	300	350	-	cd/m^2	1, 5

Measuring Condition: in dark room, at ambient temperature = 25±2°C, 15 min. warm-up time

Test Condition: BKL_PWR =5V, LCD_PWR =3.3V, the ambient temperature is 25°C.

Note	Item	Test method
1	Definition of Optical Measurement System	The optical characteristics should be measured in dark room. After 5Minutes operation, the optical properties are measured at the center point of the LCD screen. ALL input terminals LCD panel must be ground when measuring the center area of the panel.  Item / Photo detector / Field Contrast Ratio, Luminance, Lum Uniformity: CS1000: 1° Chromaticity: CS1000 Response Time: DMS703: -
2	Definition of Viewing Angle	
3	Definition of Contrast Ratio (CR)	Measured at the center point of panel $CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$
4	Definition of Response Time	The response time is defined as the LCD optical switching time interval between "White"state and "Black" state. Rise time (TON)is the time between photo detector output intensity changed from 90% to 10%.And fall time (TOFF)is the time between photo detector output intensity changed from 10% to90%. 

Note	Item	Test method
5	Definition of Color Chromaticity	Color coordinates measured at center point of LCD. Color coordinates are subject to actual measurement. If the data has a bracket, that means reference value of TFT panel or one sample of module, the values of module TBD.
6	Definition of Luminance Uniformity	Active area is divided into 9 measuring areas(Refer Fig.2).Every measuring point is placed at the center of each measuring area. Luminance Uniformity (U)=Lmin/Lmax L-Active area length W-Active area width. 

6. LED Backlight Specification

Ta = 25℃

Item	Symbol		Min	Typ.	Max	Unit	Note
Backlight Power Voltage	BKL_PWR		4.5	5	5.5	V	-
LED Power Consumption	PBKL		-	4.05	-	W	-
LED Forward Voltage	VF		8.1	9.0	10.2	-	-
LED Forward current	IF		-	360	-	-	-
PWM Signal Voltage	VPWM_EN	High	1.5	-	-	V	-
		Low	-	-	0.4	V	-
LED Enable Voltage	VLED_EN	High	1.5	-	-	V	-
		Low	-	-	0.6	V	-
Input PWM Frequency	Fpwm		100	-	20000	Hz	-
LED Life Time	LT		20000	-	-	Hrs	-
Duty Ratio	PWM		1	-	100	%	-

Note1: The LED life time define as the estimated time to 50% degradation of initial luminous.

Note 2: Operating temperature 25°C.

Note 3: Refer to the specifications for MP3387A for details be reduced.

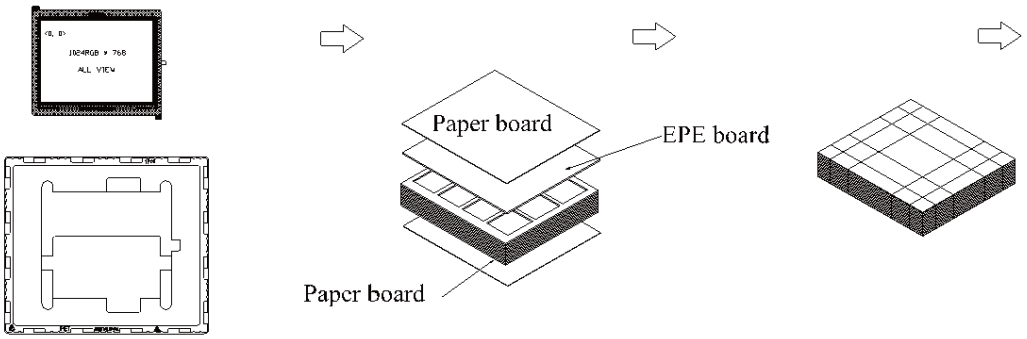
7. Packaging

PACKLING ORDER:

1) Putting 1 pcs Modules on each EPE tray.

2) Putting 2 pcs PET trays together with EPE paper on the top of EPE tray.

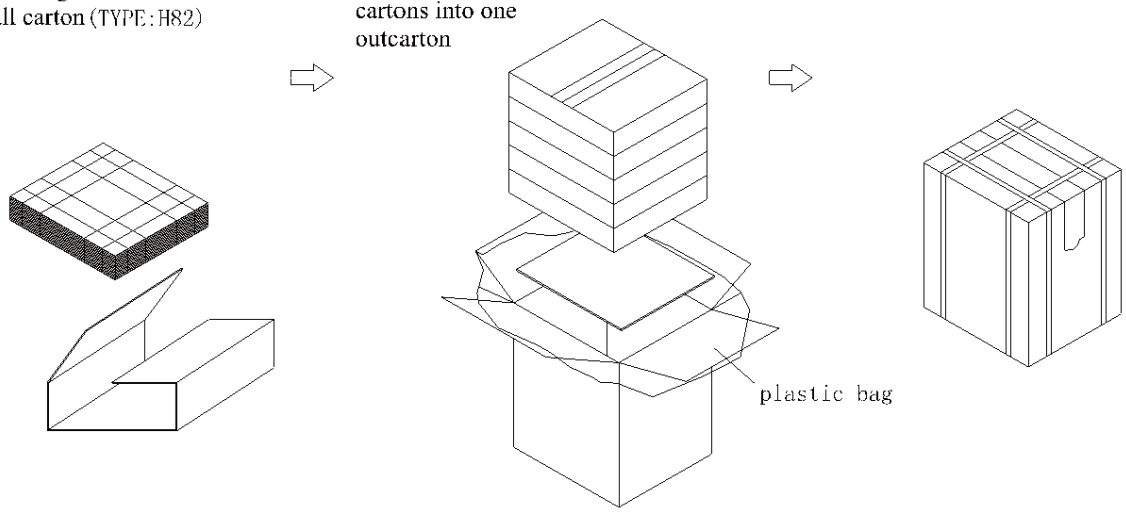
3) Assembling the boards and the tray together with adhesive tape



4) Putting in the inner small carton (TYPE:H82)

5) Putting 5 small cartons into one outcarton

6) Packing finished



Note: 1 pcs in a tray, 2 trays in a inner carton, 5 inner cartons in a out carton, so 1x2x5=10pcs/Outcarton

Dimension (Small carton): 385*325*87mm Dimension (Out carton): 394*344*470mm

8. Quality Assurance Specification

8.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

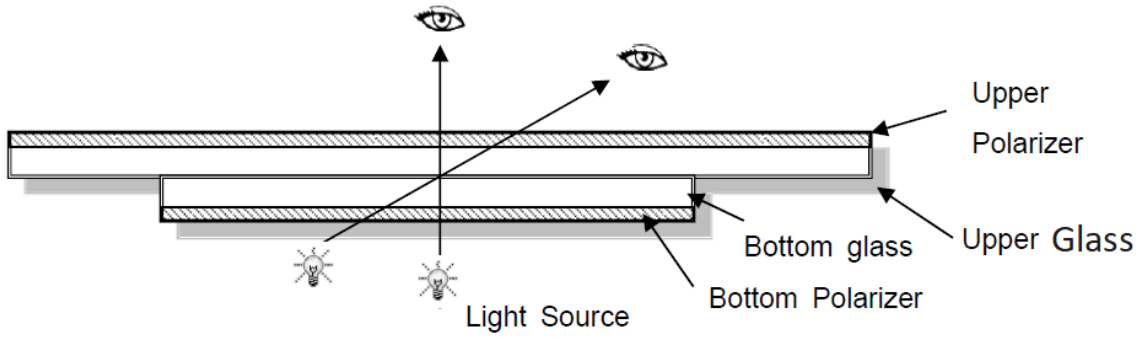
8.2 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

Temperature:	25 ± 5 ◦ C
Humidity:	65% ± 5% RH
Viewing Angle:	Normal viewing angle
Illumination:	Single fluorescent lamp (300 to 700Lux)
Viewing distance:	35±5cm

Finger glove (or finger cover) must be worn by the inspector.

Inspection table or jig must be anti-electrostatic.

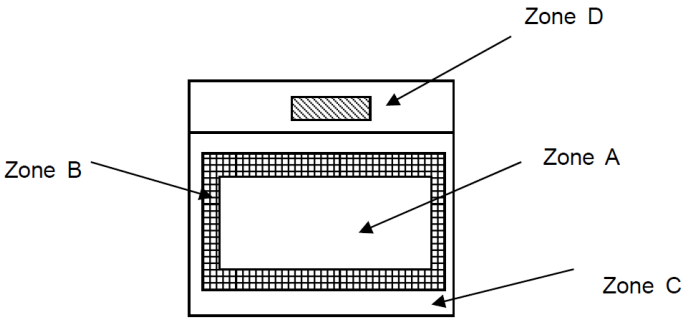


8.3 Delivery Assurance

8.3.1 Delivery Inspection Standards

Class II, Normal Inspection, MIL-STD-105E

8.3.2 Zone Definition



Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Outside (Zone A + Zone B) Area which cannot be seen after assembly by customer.

Zone D: IC Bonding Area

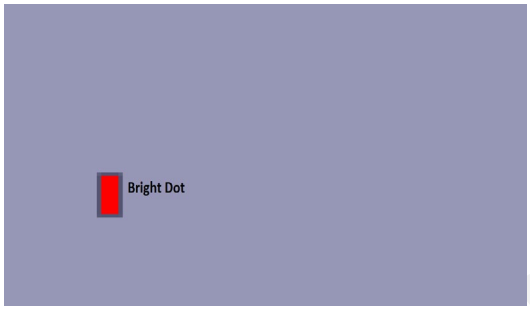
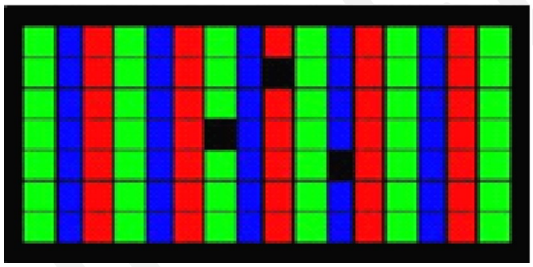
Note: Generally, visual defects in Zone C can be ignored when it doesn't affect product function or appearance after assembly by customer

8.3.3 Criteria & Acceptable Quality Level

Partition	AQL	Item
Major	0.65	1. Liquid crystal leakage 2. Wrong polarizer 3. Outside dimension 4. Bright dot,Dark dot 5. Display abnormal 6. Class crack
Minor	1.0	1. Spot Defect (Including black spot, white spot, pinhole, foreign particle, bubbles, hurt) 2. Fragment 3. Line Defect (Including black line, white line, scratch) 4. Incision defect 5. Newton's ring 6. Other visual defects

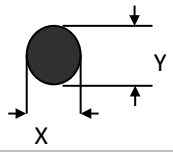
8.3.4 Criteria & Classification

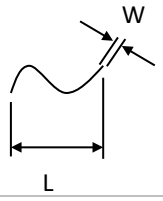
8.3.4.1 Bright/ Dark Dots Explain

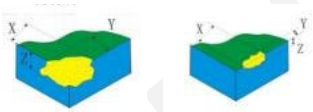
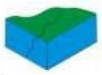
Name	Explain	Definition
Bright dot	Dots bright and unchanged in size in which LCD panel is displaying black pattern 	The definition of dot: The size of a defective dot over 1/2 of single pixel dot is regarded as one defective dot. Note: One pixel consists of 3 sub-pixels, including R, G, and B dot. (Sub-pixel=Dot)
Dark Dot	Dots appear dark and unchanged in size in which LCD panel is displaying pure red, green, blue pattern 	
Accidented Dot	Adjacent two sub-pixel are defect (define two dot defect)	

8.3.4.2 Inspection Standard

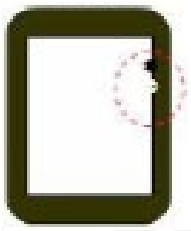
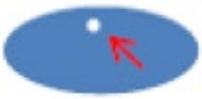
Class	Item	Criteria
Major	Bright / Dark Dot	1) LCD≤4.3"
		Bright dot: N≤2, Dark dot: N≤3, Total: N≤4
		2) 4.3"＜LCD＜7"
		Bright dot: N≤3, Dark dot: N≤4, Total: N≤6
		3) 7"≤LCD≤12"
		Bright dot: N≤4, Dark dot: N≤5, Total: N≤8
		4) LCD＞12"
		Bright dot: N≤5, Dark dot: N≤6, Total: N≤10

Class	Item	Criteria
		The distance between the two defect dots shall be greater than 5mm The distance between two defect dots above 7 inches shall be more than 10 mm **Note:** Adjacent dot defect N≤0
Minor	Spot Defects (Black spot, white spot, Pinhole, foreign matter, dent, backlight foreign matter）	Round type: as per following drawing, ∅ = (X+Y)/2 
		1) LCD≤4.3"
		D≤0.15, Ignore 0.15＜D≤0.3, N≤3 0.3＜D, N=0
		2) 4.3"＜LCD＜7"
		D≤0.2, Ignore 0.2＜D≤0.5, N≤4 0.5＜D, N=0
		3) 7"≤LCD≤12"
		D≤0.2, Ignore 0.2＜D≤0.5, N≤5 0.5＜D, N=0
		4) LCD＞12"
		D≤0.2, Ignore 0.2＜D≤0.5, N≤6 0.5＜D, N=0
Minor	Bubble	1) LCD≤4.3"
		D≤0.2, Ignore 0.2＜D≤0.5, N≤3 0.5＜D, N=0
		2) 4.3"＜LCD＜7"
		D≤0.2, Ignore 0.2＜D≤0.5, N≤4 0.5＜D, N=0
		3) 7"≤LCD≤12"
		D≤0.2, Ignore 0.2＜D≤0.5, N≤5 0.5＜D, N=0

Class	Item	Criteria
		4) LCD＞12"
		D≤0.2, Ignore 0.2＜D≤0.5, N≤6 0.5＜D, N=0
Minor	Line Defect (Black/white line, backlight foreign matter)	Line type: as per following drawing 
		1) LCD≤4.3"
		W≤0.03, Ignore 0.03＜W≤0.06, L≤5, N≤3 W＞0.06, L＞5, N=0
		2) 4.3"＜LCD＜7"
		W≤0.03, Ignore 0.03＜W≤0.1, L≤5, N≤4 W＞0.1, L＞5, N=0
		3) 7"≤LCD≤12"
		W≤0.03, Ignore 0.03＜W≤0.1, L≤5, N≤5 W＞0.1, L＞5, N=0
		4) LCD＞12"
		W≤0.03, Ignore 0.03＜W≤0.1, L≤5, N≤6 W＞0.1, L＞5, N=0
Minor	Scratch	1) LCD≤4.3"
		W≤0.03, Ignore 0.03＜W≤0.2, 1.0＜L≤ 5.0, N≤3 W＞0.2, L＞5 N=0
		2) 4.3"＜LCD＜7"
		W≤0.03, Ignore 0.03＜W≤0.2, 1.0＜L≤ 5.0, N≤4 W＞0.2, L＞5, N=0
		3) 7"≤LCD≤12"
		W≤0.03, Ignore

Class	Item	Criteria	
		0.03＜W≤0.2, 1.0＜L≤ 5.0, N≤5 W＞0.2, L＞5, N=0	
		4) LCD＞12"	
		W≤0.03, Ignore 0.03＜W≤0.2, 1.0＜L≤ 5.0, N≤6 W＞0.2, L＞5, N=0	
Major	Display Abnormal	Not allowed	
Major	Outside Dimension	Accord with drawing	
Major	Glass Crack	Not allowed	
Major	Leak	Not allowed	
Minor	Corner and Side Fragment		1. Comer fragment: X, Y≤1mm Z≤T/2: allowed 2. Side fragment: X≤2.0mm Y≤1mm Z≤T/2: allowed
Major	Crack		NG
Minor	Newton's Ring (CTP or Cover Board)		Newton's ring＜1/9 area, after lightened ,no influence on words and lines

TP Standard

No.	Item	Picture	Criterion	Checking Manner	Defect Class
1	Outside dimension	-	Accord with drawing	Calipers & Eyes	Minor
2	Color deviation	Difference of ink color	Obvious deviation compared with samples	Eyes	Minor
3	Ink pinhole		No any holes near VA side 3mm Out of VA: D≤0.15mm N≤1, no present in reflection condition.	Eyes Film	Minor
4	Ink saw tooth		W≤0.15mm N=1	Eyes Film	Minor
5	Ink light leakage		1. width of light leakage at the edge area ≤0.15mm OK 2. width of light leakage at the edge area >0.15mm NG	Eyes Film	Minor
6	Cover glass profile	-	No ink, adhesive, oil stain, etc	Eyes	Minor
7	IR(LED)dot/black white dot		φ≤0.2、N≤1 0.15< φ 、not allowed	Eyes& Film	MIN
8	IR(LED)dot black white dot/different color		no present when use all viewing angle to determine at 35cm, allowed	Eyes	MIN
9	Shooting hole		φ≤0.2、N≤1 0.15< φ 、not allowed	Eyes& Film	MIN

No.	Item	Picture	Criterion	Checking Manner	Defect Class
10	LOGO/ICON black-white dot		Diagram clear φ≤0.2、N≤1	Eyes& Film	Minor
11	FPC warped		OK	Eyes	Minor
12	FPC broken, stained, oxidation		NG	Eyes	Major
13	Stain	-	No evident fingerprint, oil Print, gelatinoids, etc.	Eyes	Minor
14	Sponge	-	Presented in AA area. NG	Eyes	Minor
15	Protection foil	Finished Protection foil	1. Protection foil stain: In Normal inspection condition, fingerprint, pen print and gelatinoids are presented. NG 2. Bubble≤5.0mm, or according to client's limited sample 3. Protection foil worn and Warped: NG 4. Scratch: W≤0.10mm, ignore length；0.10mm＜W≤0.20mm, L≤30mm, and N≤4,d＞15mm；OK; L＞30mm or W＞20mm; NG	Eyes& Film	Min

8.4 Dealing with Customer Complaints

8.4.1 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.

If the analysis cannot be completed on time, Densitron must inform the purchaser.

8.4.2 Handling of Non-conforming Displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.

Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.

Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

9. Reliability Specification

9.1 Reliability Tests

Test Item	Test Condition	Inspection after Test
High Temperature Operation	50±2℃/240 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.Missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value.
Low Temperature Operation	0±2℃/240 hours	
High Temperature Storage	60±2℃/240 hours	
Low Temperature Storage	-20±2℃/240 hours	
Temperature Cycle	-20℃~ 25℃~ 60℃ × 10cycles (30min.) (5min.) (30min.)	
Damp Proof Test	40℃±5℃×90%RH/240 hours	
Vibration Test	Frequency：10Hz~55Hz~10Hz Amplitude：1.5mm, X，Y，Z direction for total 3hours (Packing condition)	
Dropping Test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
ESD Test	Voltage:±8KV, R: 330Ω C: 150pF Air discharge, 10time	
	Voltage:±6KV, R: 330Ω C: 150pF Contact discharge, 10time	

Note 1: The test samples should be applied to only one test item.

Note 2: Sample size for each test item is 5~10pcs.

Note 3: For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.

Note 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.

Note 5: Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

Note 6: Please use automatic switch menu(or roll menu) testing mode when test operating mode.

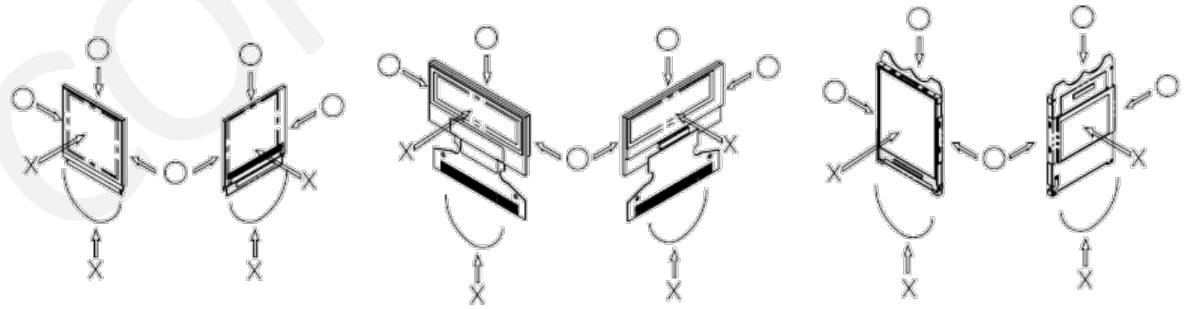
9.1.1 Inspection Check Standard

After the completion of the described reliability test, the samples are to be left at room temperature for 4 hrs prior to conducting the inspection check at 25±5 °C, 65±5% RH.

10. Handling Precautions

10.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such us dropping from a high position.
2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
4) If pressure is applied to the display surface or its neighbourhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
   a. Scotch Mending Tape No. 810 or an equivalent
   b. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
   c. Also, pay attention that the following liquid and solvent may spoil the polarizer:
      - Water
      - Ketone
      - Aromatic Solvents
7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will



influence the display performance. Also, secure sufficient rigidity for the outer cases.
8) Do not apply stress to the LSI chips and the surrounding molded sections.
9) Do not disassemble nor modify the display module.
10) Do not apply input signals while the logic power is off.
11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.

a. Be sure to make human body grounding when handling display modules.
b. Be sure to ground tools to use or assembly such as soldering irons.
c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
d. Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.

12) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

10.2 Storage Precautions

1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you to store these modules in the packaged state when they were shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

10.3 Designing Precautions

1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may be happen.
2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighbouring devices.
5) As for EMI, take necessary measures on the equipment side basically.
6) When fastening the display module, fasten the external plastic housing section.
7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

10.4 Operation Precautions

1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
2) Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
3) Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
   a. Pins and electrodes
   b. Pattern layouts such as the FPC
5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
   a. Design the product and installation method so that the driver may be shielded from light in actual usage.
   b. Design the product and installation method so that the driver may be shielded from light during the inspection processes.
6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
7) We recommend you to construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

10.5 Other Precautions

1) Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.