MODEL NO : ET020HV03-OT

MODEL VERSION: 01

SPEC VERSION : 1.0

ISSUED DATE: 2017-12-05

■**Preliminary Specification**

□**Final Product Specification**

Customer :_____

Approved by	Notes

Table of Contents

Record of Revision

Rev	Issued Date	Description	Editor
1.0	2017-12-05	Preliminary Specification Release	Xunqiang Ji

1 General Specifications

Feature		Spec
Display Spec.	Size	1.95 inch
	Resolution	320 x RGB x 480
	Technology Type	a-Si
	Pixel Configuration	RGB Vertical Stripe
	Pixel pitch(mm)	0.0286×0.0286
	Display Mode	Transflective/Normally black
	Viewing Direction	Free angle
Mechanical Characteristics	LCM (W x H x D) (mm)	33.25×50×1.8
	Active Area(mm)	27.456×41.184
	With /Without TSP	On-Cell
	LED Numbers	4 LEDS
	LCD Driver IC	ST7796S
	CTP Driver IC	FT3306
	Weight (g)	TBD
Electrical Characteristics	Interface	MIPI 1LANE
	Color Depth	262K

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance: ± 5%

2 Input/Output Interface

2.1 LCM Interface

Pin NO	Symbol	I/O	Description
1	RESX	I	RESET PIN
2	GND	P	Ground
3	TE	I	TE TEST
4	DATA-	I	MIPI DSI lane(-)
5	GND	P	Ground
6	DATA+	I	MIPI DSI lane(+)
7	LED-	P	LED Cathode
8	GND	P	Ground
9	NC	-	NC
10	CLK-	I	MIPI DSI CN lane
11	LED+	P	LED Anode
12	CLK+	I	MIPI DSI CP lane
13	NC	-	NC
14	GND	P	Ground
15	VDDIO	P	VDDIO 3V
16	VDD	P	VDD 3V

2.2 CTP Interface

No.	Symbol	Type	Function
1	GND	P	Ground
2	NC	NC	No connect
3	NC	NC	No connect
4	TP_SDA	I/O	I^2C data
5	VDD_TP(+3.0V)	P	Power supply
6	TP_SCL	I	I^2C clock
7	TP_INT	O	Touch event, active low
8	IOVCC_TP(+1.8V)	P	Power supply
9	GND	P	Ground
10	TP_RST	I	Reset, active low

Note: P: Ground or Power OD :open drain output I :Input only NC: no connection
For more information, refer to the datasheet of this driver IC.

3 Absolute Maximum Ratings

GND=0V

Item	Symbol	MIN	MAX	Unit	Remark
Power Voltage	VCC	-0.3	4.6	V	Note1
Operating Temperature	Top	-30	80	℃	
Storage Temperature	Tst	-40	85	℃	

Table 3 Absolute Maximum Ratings

Note 1: Temperature and relative humidity range are shown in the figure below.

4 Electrical Characteristics

4.1 Driving TFT LCD Panel

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Power Supply Voltage	VDD	2.85	3.0	3.15	V	
Voltage for analog	VDDIO	1.65	1.8	3.15	V	
Input high level voltage	V_{IH}	0.7VDD	--	VDD	V	
Input low level voltage	V_{IL}	0	--	0.3VDD	V	

4.2 CTP Characteristics

No.	Item	Specification	Remark
1	Operating voltage	TP_VDD 3.0V	TP_VDD 2.8~3.6V
		TP_VDDIO 1.8V	TP_VDDIO 1.62~3.6V
2	Power supply ripple	100mv(maximum)	MV(peak to peak)
3	Interface	I2C	OX70

4.3 Backlight Unit

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	V_f	Ta=25 °C,IF=25mA	-	11.6	--	V
Forward Current	I_f	Ta=25 °C, V_F=13.2V	-	25	--	mA
Reverse Voltage	V_R	-	-	5	-	V
Reverse current	I_R		-	-	10	μA
Power dissipation	P_d	Ta=25 °C,I_F=25mA	-	232	--	mW
Drive method	Constant current					
LED Configuration	4 White LEDs in series					

Note: (1) Test condition Ta=25°C.

5 Timing Chart

5.1 Reset Timing

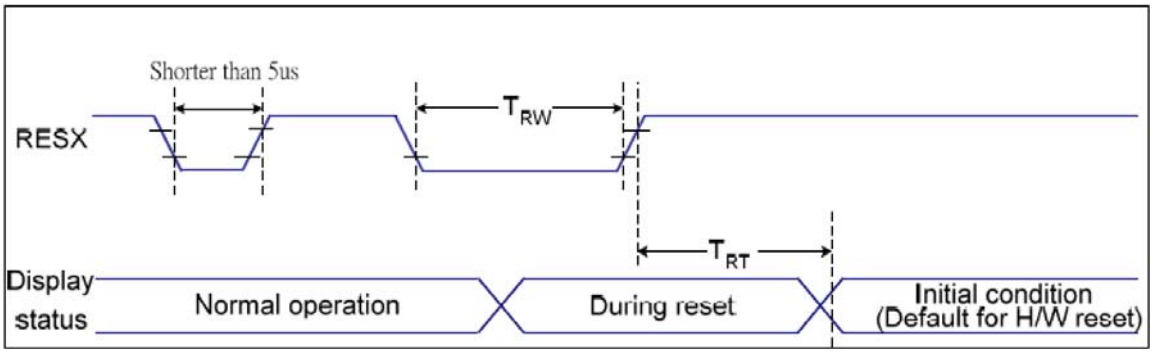


Figure 7 Reset Timing

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 ~ 70 ℃

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Table 8 Reset Timing

Notes:

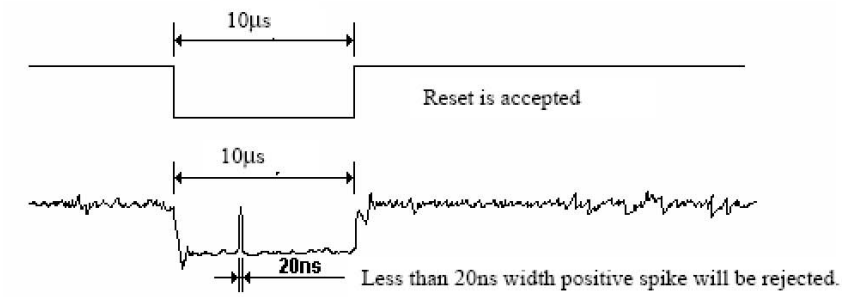
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. 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 Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:



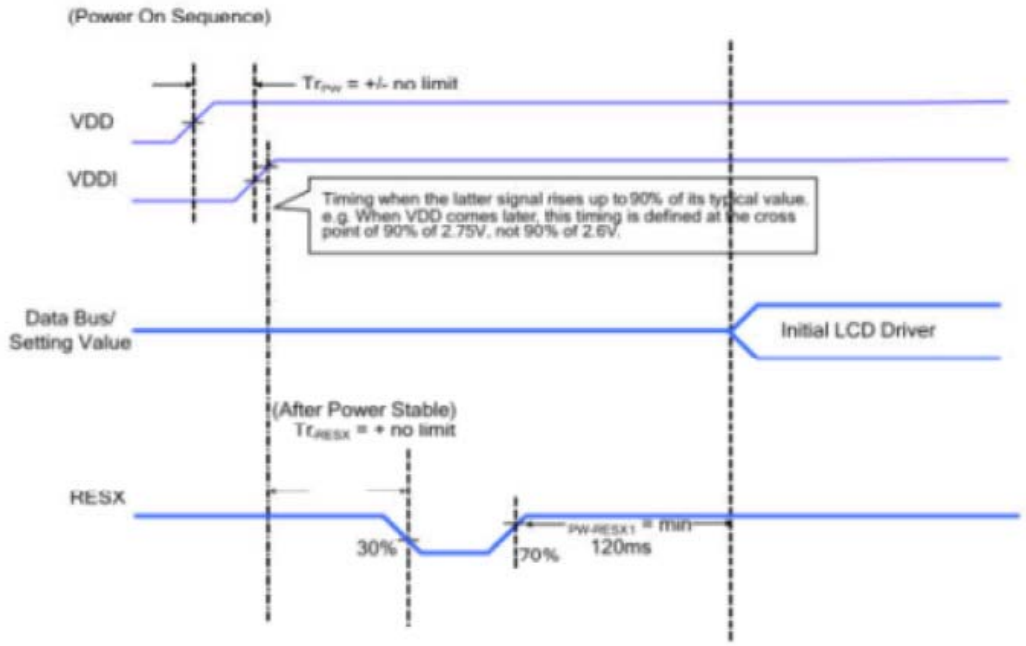
5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

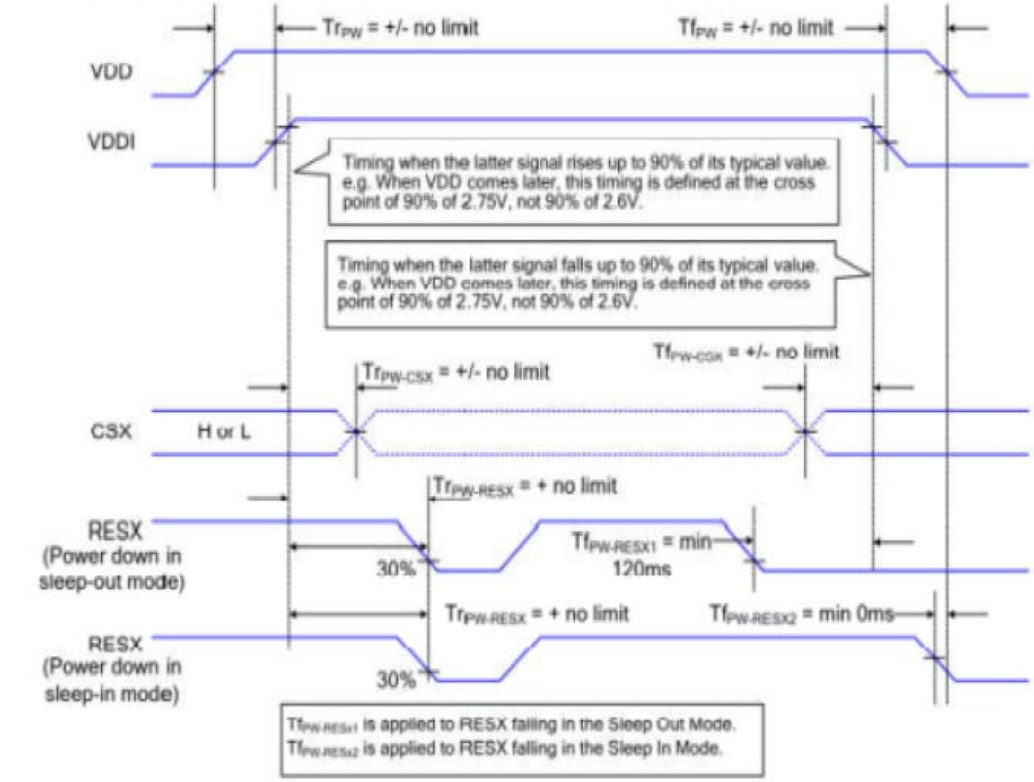
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

5.2 Power Sequence

Power on Sequence



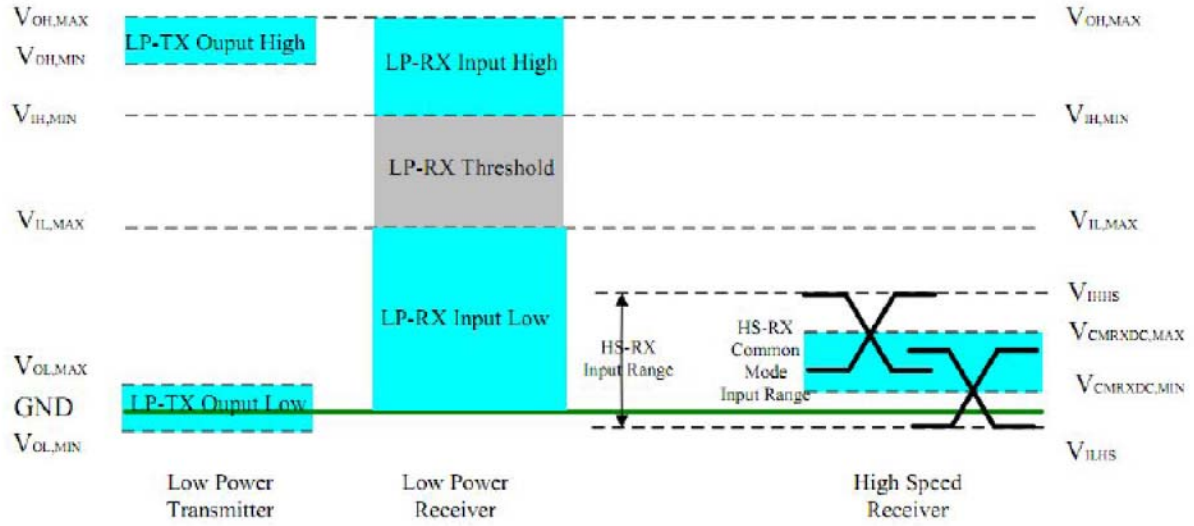
Power off sequence



5.3 General parameters of touch panel

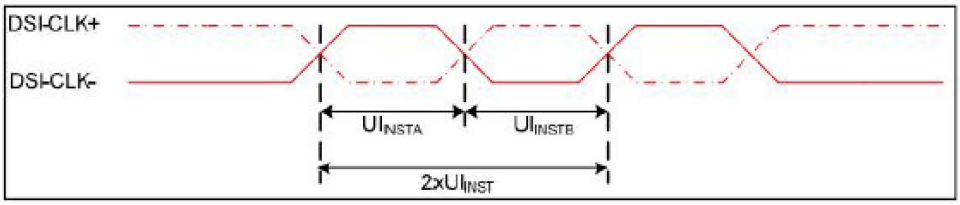
No.	Item	Wedge Spec	Remark
1	Structure Type	Single layer on cell	
		Back side of CF	
2	Input method	Bare hand	
3	Multi-touch support	2 points	
4	IC Type	-----	
5	IC package	QFN-48L,6*6*0.55 mm	
6	Channel numbers	36 ch	
7	Reflesh rate	10ms	
8	Normal finger size	7mm	
9	Accuracy center	1.0mm	
10	Accuracy edge	1.5mm	
11	Finger separation (center to center)	10mm	
12	False touch detection	YES	
13	Water proofing	YES	
14	Palm rejection	YES	
15	Additional gestures	Multi-direction seipe,double tap, Bezel Swipe	

5.4 TFT display DC characteristics for MIPI DSI



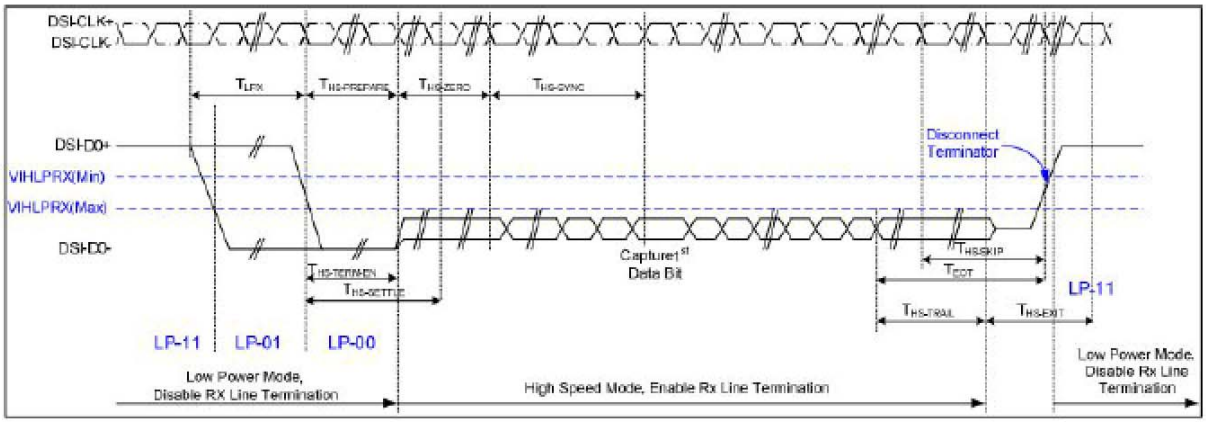
Parameter	Symbol	Specification			Unit
		MIN	TYP	MAX	
Operation Voltage for MIPI Receiver					
Low power mode operating voltage	V_{LPH}	1.1	1.2	1.3	V
MIPI Characteristics for High Speed Receiver					
Single-ended input low voltage	V_{ILHS}	-40	-	-	mV
Single-ended input high voltage	V_{IHHS}	-	-	460	mV
Common-mode voltage	V_{CMRXDC}	70	-	330	mV
Differential input impedance	Z_{ID}	80	100	125	ohm
MIPI Characteristics for Low Power Mode					
Pad signal voltage range	V_I	-50	-	1350	mV
Logic 0 input threshold	V_{IL}	0	-	550	mV
Logic 1 input threshold	V_{IH}	880	-	1350	mV
Output low level	V_{OL}	-50	-	50	mV
Output high level	V_{OH}	1.1	1.2	1.3	V

5.5 MIPI Interface Timing



VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃

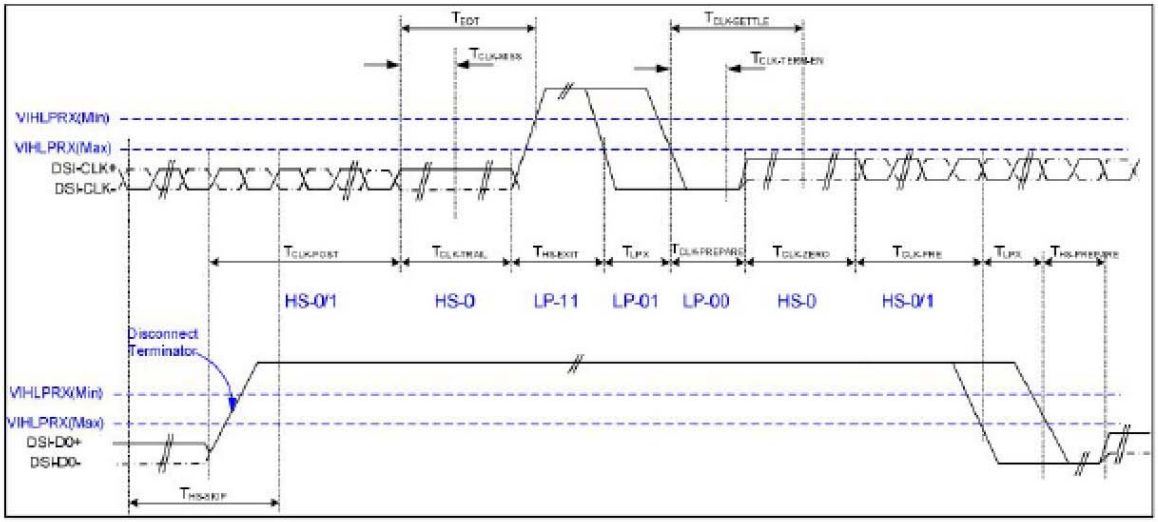
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
DSI-DATA_P/N	2xUI INST	Double UI instantaneous	4	25	ns	
DSI-DATA_P/N	UI INSTA ,UI INSTB	UI instantaneous Half	2	12.5	ns	



VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃

Parameter	Symbol	MIN	TYP	MAX	Unit
Time to drive LP-00 to prepare for HS transmission	$T_{HS-PREPARE}$	40+4UI		85+6UI	ns
Time from start of t HS-TRAIL or t CLK-TRAIL period to start of LP-11 state	T_{EOT}			105+12UI	ns
Time to enable data receiver line termination measured from when Dn crosses VILMAX	$T_{HS-TERM-EN}$			35+4UI	ns
Time to drive flipped differential state after last payload data bit of a HS transmission	$T_{HS-TRAIL}$	60+4UI			ns
Time-out at RX to ignore transition period of EoT	$T_{HS-SKIP}$	40		55+4UI	ns
Time to drive LP-11 after HS burst	$T_{HS-EXIT}$	100			ns
Length of any Low-Power state period	T_{LPX}	50			ns
Sync sequence period	$T_{HS-SYNC}$		8UI		ns
Minimum lead HS-0 drive period before the Sync sequence	$T_{HS-ZERO}$	105+6UI			ns

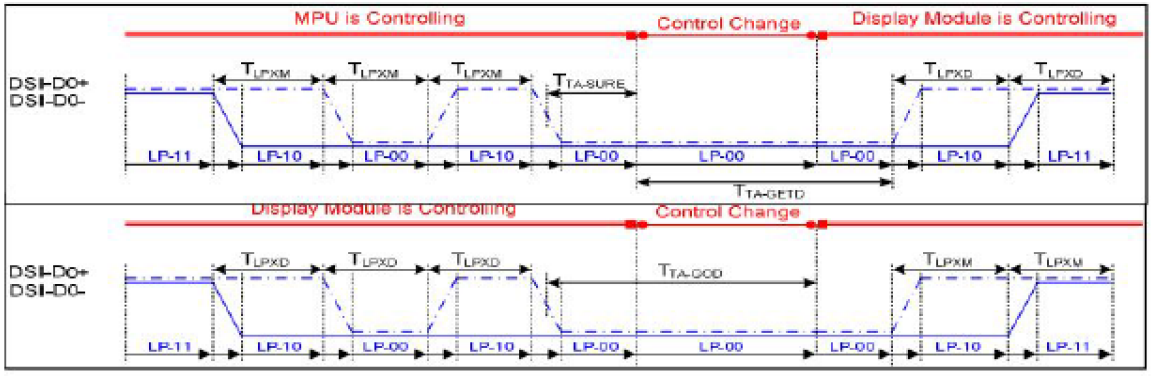
8.3.3. Switch the clock lane between High-Speed and Low-Power Mode



VDDI=1.8V,VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃

Parameter	Symbol	MIN	TYP	MAX	Unit
Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode	$T_{CLK-POST}$	60+52UI			ns
Detection time that the clock has stopped toggling	$T_{CLK-MISS}$			60	ns
Time to drive LP-00 to prepare for HS clock transmission	$T_{CLK-PREPARE}$	38		95	ns
Minimum lead HS-0 drive period before starting Clock	$T_{CLK-PREPARE}$ +$T_{CLK-ZERO}$	300			ns
Time to enable Clock Lane receiver line termination measured from when Dn cross VIL,MAX	$T_{HS-TERM-EN}$			38	ns
Minimum time that the HS clock must be set prior to any associated date lane beginning the transmission from LP to HS mode	$T_{CLK-PRE}$	8			UI
Time to drive HS differential state after last payload clock bit of a HS transmission burst	$T_{CLK-TRAIL}$	60			ns

8.3.4. Bus turnaround procedure



VDDI=1.8V, VDDA=2.8V, AGND=DGND=0V, Ta=25 ℃

Parameter	Symbol	MIN	TYP	MAX	Unit
Length of any Low-Power state period : Master side	T_{LPX}	50		75	ns
Length of any Low-Power state period : Slave side	T_{LPX}	47.5	50	52.5	ns
Ratio of T_{LPX} (MASTER)/ T_{LPX} (SLAVE) between Master and Slave side	Ratio T_{LPX}	2/3		3/2	
Time-out before new TX side start driving	$T_{TA-SURE}$	T_{LPX}		2 T_{LPX}	ns
Time to drive LP-00 by new TX	T_{TA-GET}		5 T_{LPX}		ns
Time to drive LP-00 after Turnaround Request	T_{TA-GO}		4 T_{LPX}		ns

5.6 Touch Panel Interface Timing

8.4.1. START and STOP conditions (See fig.1)

A HIGH to LOW transition on the SDA line while SCL is HIGH indicates a START condition.

A LOW to HIGH transition on the SDA line while SCL is HIGH defines a STOP condition.

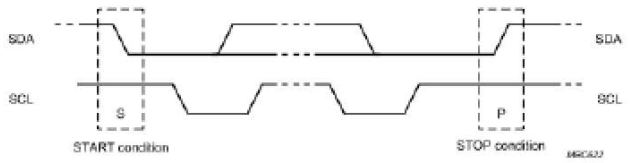


Fig.1 START and STOP conditions.

8.4.2. TRANSFERRING DATA

The data on the SDA line must be stable during the HIGH period of clock. The HIGH or LOW state of the data line can only change when clock signal on the SCL line is low (see fig.3).

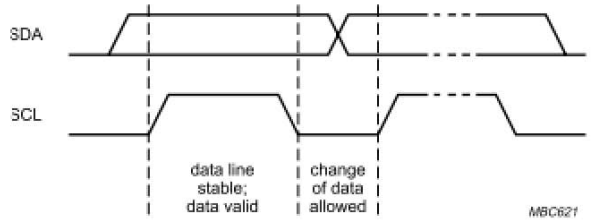


Fig 3 Bit transfer on the I²C-bus.

8.4.3. Acknowledge

The receiver must pull down the SDA line during the acknowledge clock pulse so that it remains stable LOW during the HIGH period of this clock pulse. (See fig.4)

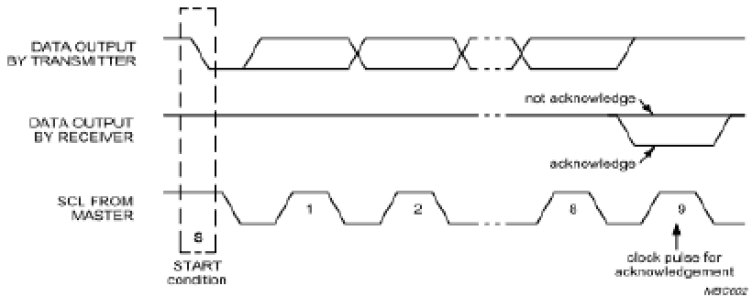


Fig 4 Acknowledge on the I²C-bus.

6. Optical Characteristics

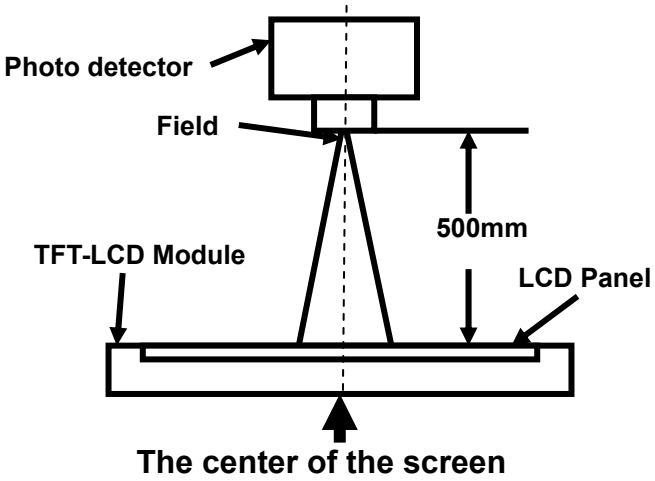
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	80	85	-	Degree	Note2,3
		θB		80	85	-		
		θL		80	85	-		
		θR		80	85	-		
Contrast Ratio		CR	θ=0°	-	1000	-		Note 3
Response Time		T_{ON}	25℃	-	30	40	ms	Note 4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.237	0.287	0.337		Note 1,5
		y		0.272	0.332	0.372		
	Red	x						Note 1,5
		y						
	Green	x						Note 1,5
		y						
	Blue	x						Note 1,5
		y						
Uniformity		U		80	85	--	%	Note 6
Luminance		L		800	1000	-	cd/m^2	Note 7

Test Conditions:

1. I_F= 20 mA, and the ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.

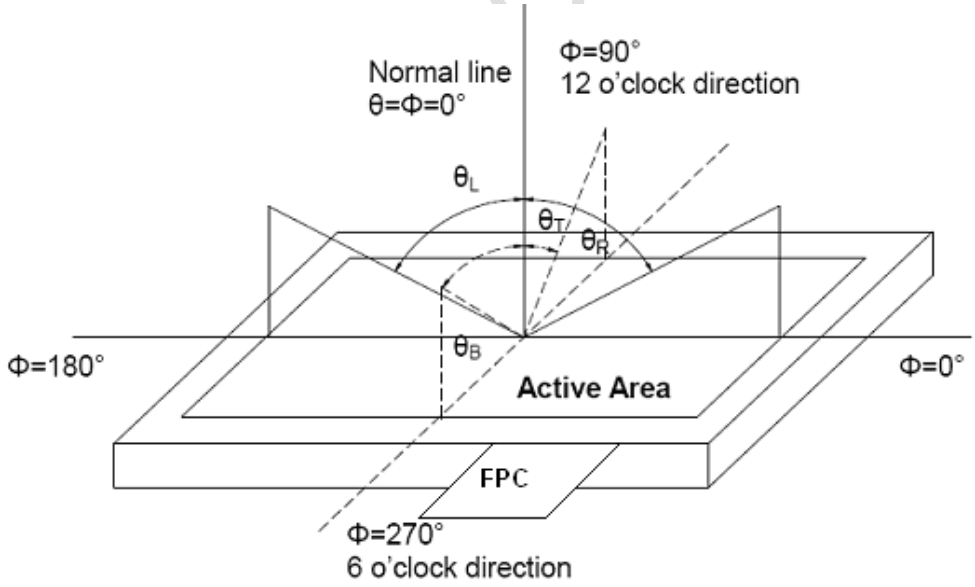
Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes 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.



Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD.



Note 3: Definition of contrast ratio

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

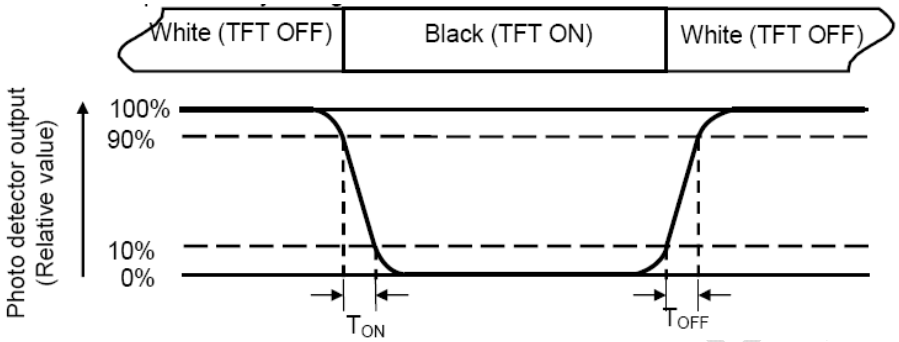
"White state ": The state is that the LCD should drive by Vwhite.

"Black state": The state is that the LCD should drive by Vblack.

Vwhite: To be determined Vblack: To be determined.

Note 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 (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%.



Note 5: Definition of color chromaticity (CIE1931)

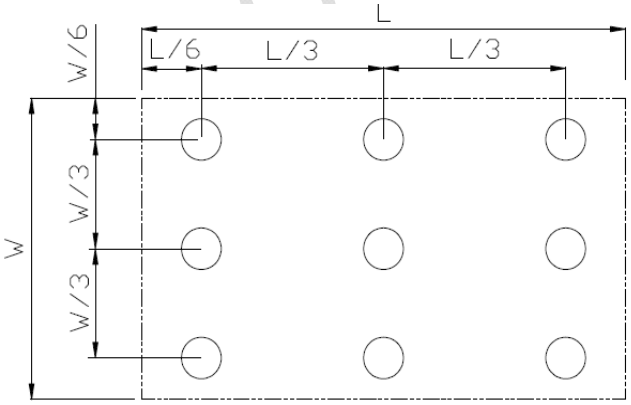
Color coordinates measured at center point of LCD.

Note 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



Lmax: The measured Maximum luminance of all measurement position.

Lmin: The measured Minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

7. Environmental / Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	80℃, 120 Hours	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Operation	-30℃, 120 Hours	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	85℃, 120 Hours	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	-40℃, 120 Hours	IEC60068-2-1:2007 GB2423.1-2008
5	Storage at High Temperature and Humidity	60℃, 90%RH, 120 Hours	IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (non-operation)	-30℃ , 30min.<=> 80℃ , 30min. 10 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22-2002
7	ESD	Voltage:±8KV R:330 ohm,C:150pF Air discharge,10 times	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration Test	Frequency:10~55Hz Amplitude: 1.5mm Sweep Time: 11Mins Test Period: 6 Cycles For Each Direction Of X, Y, Z (Packing Condition)	IEC60068-2-6:1982 GB/T2423.10—1995
10	Package Drop Test	Packed, 100CM free fall 6 sides, 1 corner, 3edges	IEC60068-2-32:1990 GB/T2423.8—1995

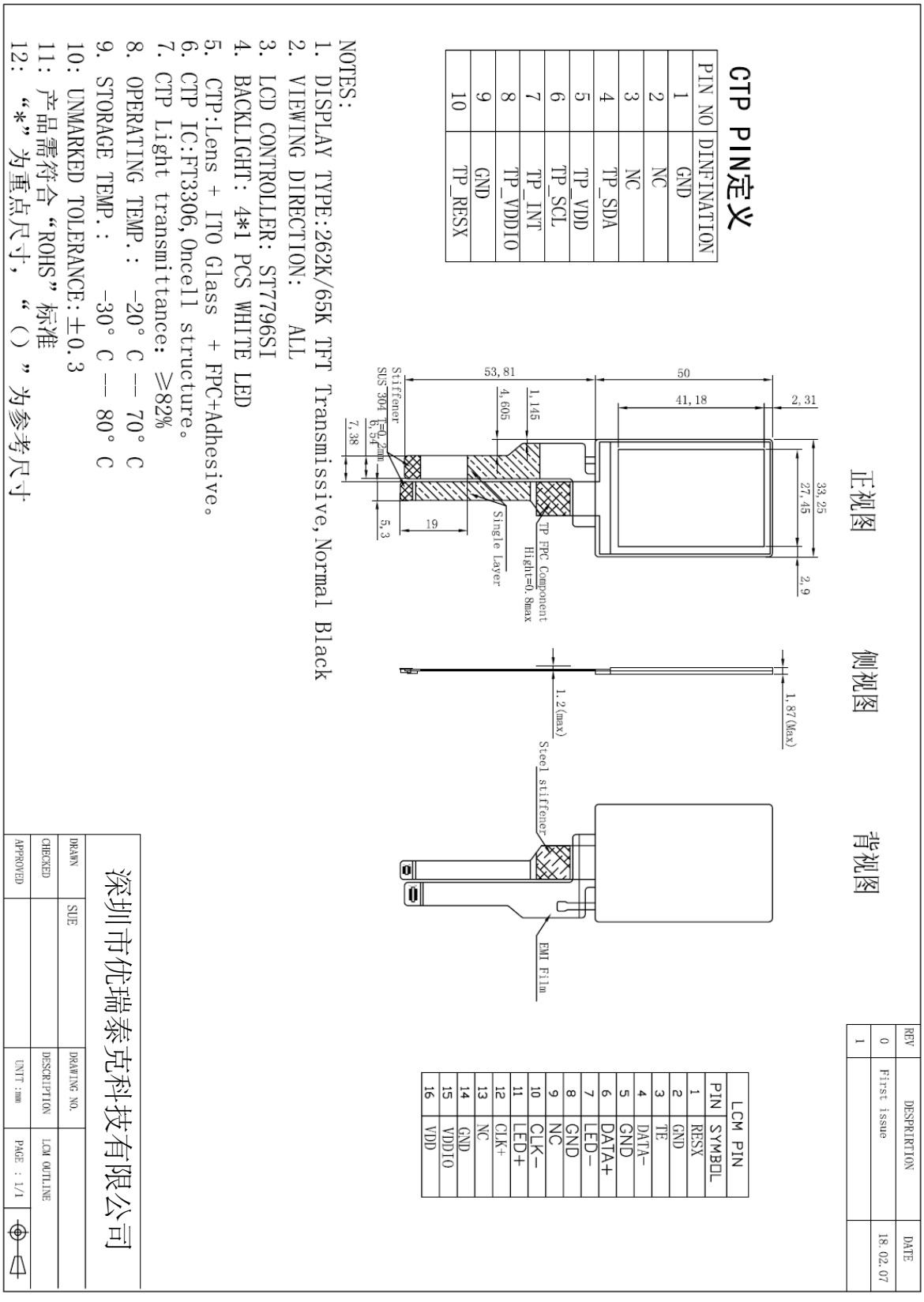
Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of sample.

Note3: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 4: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

8.Outline Dimension



9 Packing Drawing

TBD

10 Precautions for Use of LCD Modules

a) Handling Precautions

i. The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

ii. If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

iii. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

iv. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

v. If the display surface is contaMinated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

vi. Do not attempt to disassemble the LCD Module.

vii. If the logic circuit power is off, do not apply the input signals.

viii. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

10.1.8.1 Be sure to ground the body when handling the LCD Modules.

10.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

10.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

10.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

b) Storage precautions

i. When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

ii. The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃ Relatively humidity: ≤80%

iii. The LCD modules should be stored in the room without acid, alkali and harmful gas.

c) Transportation Precautions

i. The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.