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MODEL NO : ET026QE01-K**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.....	3
1 General Specifications	4
2 Input/Output Terminals	5
3 Absolute Maximum Ratings	6
4 Electrical Characteristics.....	6
5 Timing Chart.....	9
6 Optical Characteristics	15
7 Environmental / Reliability Test	18
9 Packing Drawing	20
10 Precautions for Use of LCD Modules	20

Record of Revision

[illegible]

1 General Specifications

Feature		Spec
Display Spec.	Size	2.6 inch
	Resolution	320 x RGB x 432
	Technology Type	a-Si
	Pixel Configuration	RGB Vertical Stripe
	Pixel pitch(mm)	0.1245(H)*0.1245(V)
	Display Mode	Transflective /Normally Black
	Viewing Direction	ALL
Mechanical Characteristics	LCM (W x H x D) (mm)	46.76*65.85*2.6
	Active Area(mm)	39.84(H)*53.78 (V)
	With /Without TSP	Without TSP
	LED Numbers	6 LEDS
	Driver IC	ILI9488
	Weight (g)	TBD
Electrical Characteristics	Interface	1-lane MIPI
	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: $\pm 5\%$

2 Input/Output Terminals

1	NC	NC	
2	LEDK	Cathode pin of backlight.	P
3	NC	NC	
4	LEDA	Anode pin of backlight.	P
5	NC	NC	
6	VCI	Supply Voltage (3.3V).	P
7	IOVCC	I/O power supply voltage.(1.8~3.3V)	P
8	TE	-Tearing effect output Leave the pin to open when not in use.	O
9	RESET	- The external reset input. Initializes the chip with a low input. Be sure to execute a power-on reset after supplying power.	I
10	GND	Ground.	P
11	NC	NC	--
12	NC	NC	--
13	GND	Ground.	P
14	MIPI_CLP	MIPI DSI differential clock pair (DSI-CLK+/-).	I
15	MIPI_CLN	Leave the pin open when not in use.	I
16	GND	Ground.	P
17	MIPI_D0P	MIPI DSI differential data pair (DSI-Dn+/-).	I/O
18	MIPI_D0N	Leave the pin open when not in use.	I/O
19	GND	Ground.	P
20	GND	Ground.	P

3 Absolute Maximum Ratings

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	V _{CI}	-0.3	3.3	V
Digital interface supply Voltage	IOVCC	-0.3	3.3	V
Operating temperature	T _{OP}	-30	+85	°C
Storage temperature	T _{ST}	-40	+85	°C

NOTE: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

4 Electrical Characteristics

4.1 Driving TFT LCD Panel

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	V _{CI}	2.5	3.3	--	V	
Digital interface supply Voltage	IOVCC	1.65	1.8	3.3	V	
Normal mode Current consumption	I _{DD}	--	13	--	mA	
Level input voltage	V _{IH}	0.7IOVCC		IOVCC	V	
	V _{IL}	-0.3		0.3IOVCC	V	
Level output voltage	V _{OH}	0.8IOVCC		IOVCC	V	
	V _{OL}	GND		0.2IOVCC	V	

4.2 Backlight Unit

The backlight system is an edge-lighting type with 6 LED. The characteristics of the LED are shown in the following tables.

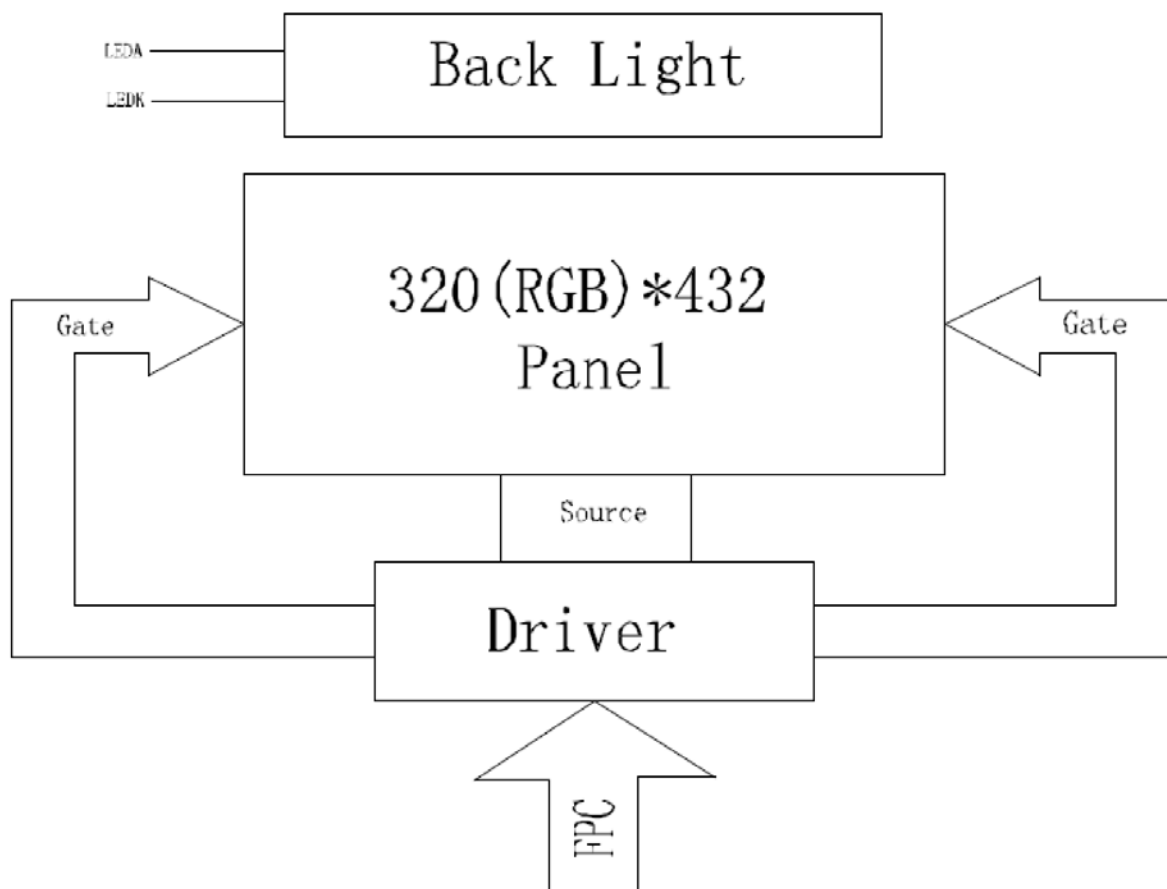
Item	Symbol	MIN	TYP	MAX	Unit	Remark
Backlight forward voltage	V_F	-	19.2	-	V	6 LEDs
Backlight forward current	I_F	-	20	-	mA	
LED life time	-	50000	-	-	Hrs	

Note 1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25\pm3\text{ }^{\circ}\text{C}$, typical IL value indicated in the above table and the $f_L=50\text{k Hz}$ until the brightness becomes less than 50%.



LED(B/L) CIRCUIT

4.3 Block Diagram LCD Module diagram



5 Timing Chart

5.1 MIPI Interface Characteristics

5.1.1 High Speed Mode – Clock Channel Timing

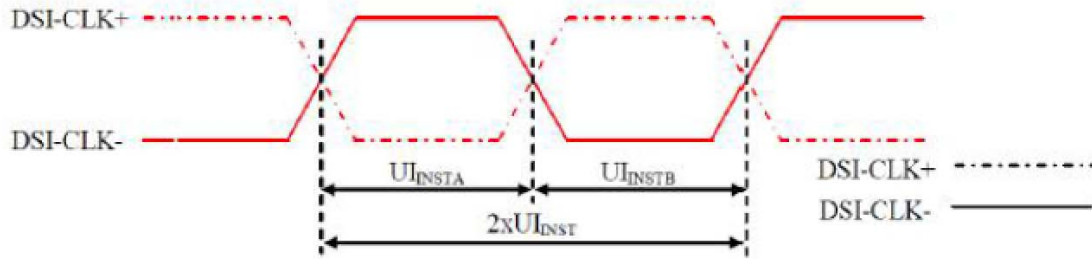


Figure 114 DSI Clock Channel Timing

Table 45 DSI Clock Channel Timing

Signal	Symbol	Parameter	Min	Max	Unit
DSI-CLK+/-	$2xUI_{INST}$	Double UI instantaneous	4	25	ns
DSI-CLK+/-	UI_{INSTA}, UI_{INSTB}	UI instantaneous Half	2	12.5	ns

Note: $UI = UI_{INSTA} = UI_{INSTB}$

5.2.2 High Speed Mode – Data Clock Channel Timing

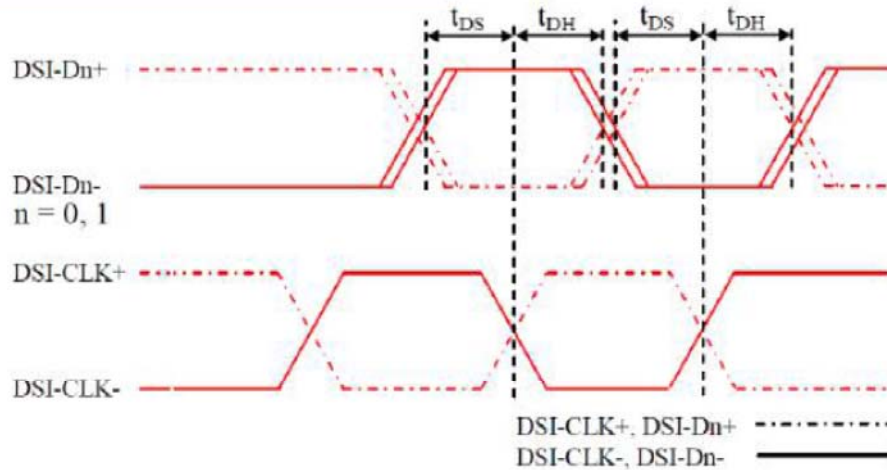


Figure 115 DSI Data to Clock Channel Timings

Table 46 DSI Data to Clock Channel Timings

Signal	Symbol	Parameter	Min	Max
DSI-Dn+/- , n=0 and 1	t_{DS}	Data to Clock Setup time	$0.15xUI$	-
	t_{DH}	Clock to Data Hold Time	$0.15xUI$	-

5.3.3 High Speed Mode – Rise and Fall Timings

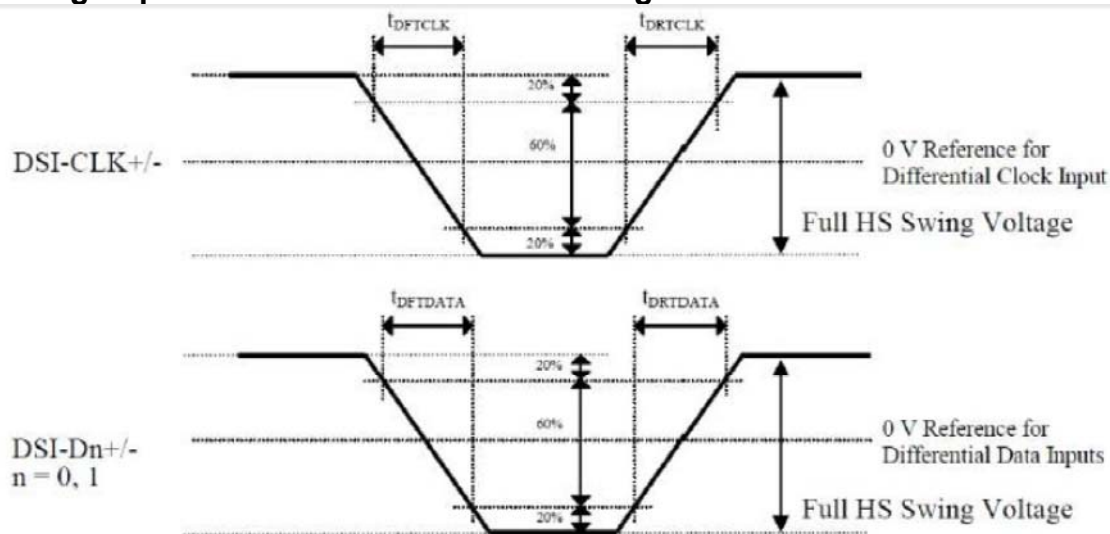


Figure 116 Rise and Fall Timings on Clock and Data Channels

Table 47 Rise and Fall Timings on Clock and Data Channels

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
Differential Rise Time for Clock	t_{DFTCLK}	DSI-CLK+/-	-	-	150 (Note)	ps
Differential Rise Time for Data	$t_{DRTDATA}$	DSI-Dn+/- n=0 and 1	-	-	150 (Note)	ps
Differential Fall Time for Clock	t_{DFTCLK}	DSI-CLK+/-	-	-	150 (Note)	ps
Differential Fall Time for Data	$t_{DFTDATA}$	DSI-Dn+/- n=0 and 1	-	-	150 (Note)	ps

Note: The display module has to meet timing requirements, what are defined for the transmitter (MPU) on MIPI D-Phy standard

5.4.4 Low Speed Mode – Bus Turn Around

Lower Power Mode and its State Periods are illustrated for reference purposes on the Bus Turnaround (BTA) from the MPU to the Display Module (ILI9806E) sequence below.

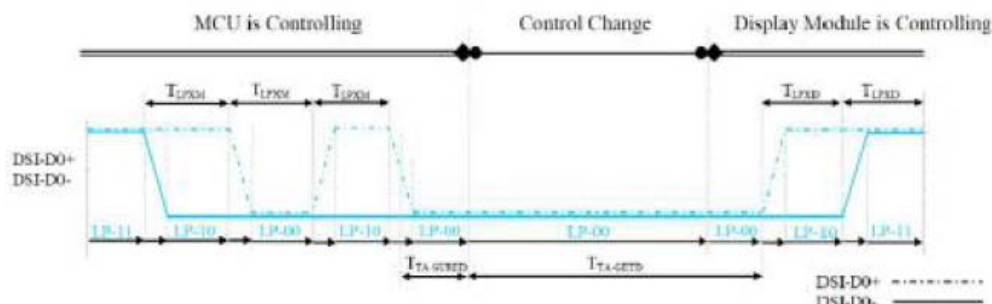


Figure 117 BTA from the MPU to the Display Module

Lower Power Mode and its State Periods are illustrated for reference purposes on the Bus Turnaround (BTA) from the Display Module (ILI9806E) to the MPU sequence below.

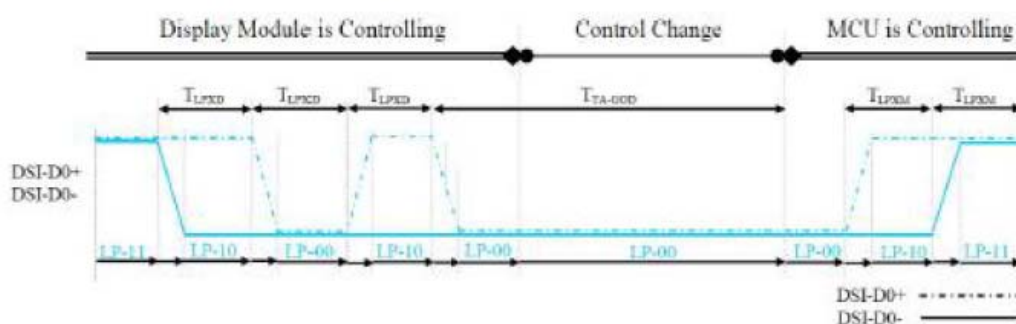


Figure 118 BTA from the Display Module to the MPU

Table 48 Low Power State Period Timings – A

Signal	Symbol	Description	Min	Max	Unit
DSI-D0+/-	T_{LPXM}	Length of LP-00, LP-01, LP-10 or LP-11 periods MPU → Display Module (ILI9806E)	50	75	ns
DSI-D0+/-	T_{LPXD}	Length of LP-00, LP-01, LP-10 or LP-11 periods Display Module (ILI9806E) → MPU	50	75	ns
DSI-D0+/-	$T_{TA-GETD}$	Time-out before the Display Module (ILI9806E) starts driving	T_{LPXD}	$2 \times T_{LPXD}$	ns

Table 49 Low Power State Period Timings – B

Signal	Symbol	Description	Time	Unit
DSI-D0+/-	$T_{TA-GETD}$	Time to drive LP-00 by Display Module (ILI9806E)	$5 \times T_{LPXD}$	ns
DSI-D0+/-	T_{TA-ODD}	Time to drive LP-00 after turnaround request – MPU	$4 \times T_{LPXD}$	ns

5.5.5 Data Lanes from Low Power Mode to High Speed Mode

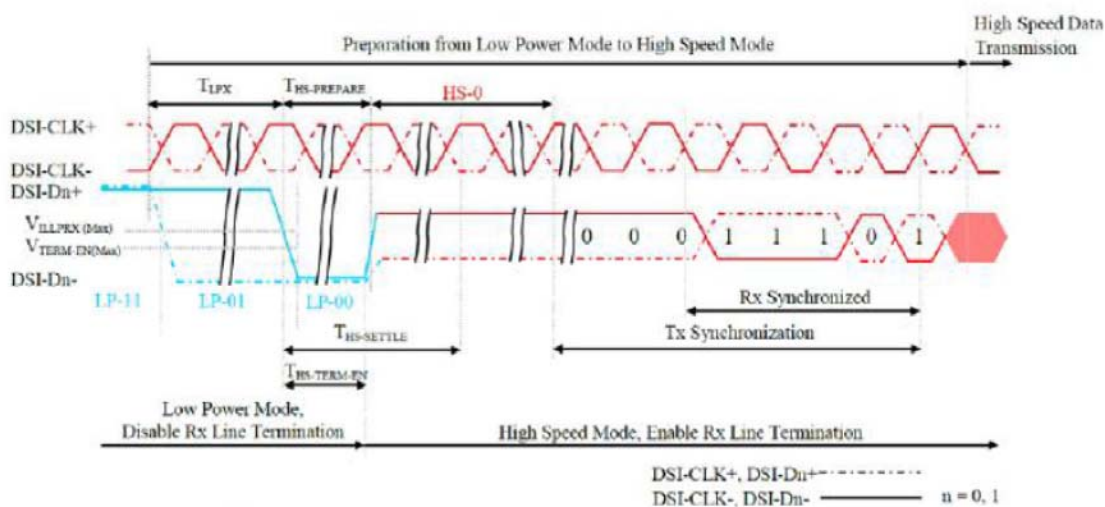


Figure 119 Data Lanes – Low Power Mode to High Speed Mode Timings

Table 50 Data Lanes – Low Power Mode to High Speed Mode Timings

Signal	Symbol	Description	Min	Max	Unit
DSI-Dn+/-, n=0 and 1	T_{LPX}	Length of any Low Power State Period	50	-	ns
DSI-Dn+/-, n=0 and 1	$T_{HS-PREPARE}$	Time to drive LP-00 to prepare for HS Transmission	$40+4xUI$	$85+6xUI$	ns
DSI-Dn+/-, n=0 and 1	$T_{HS-TERM-EN}$	Time to enable Data Lane Receiver line termination measured from when Dn crosses V_{ILMAX}	-	$35+4xUI$	ns

5.6.6 Data Lanes from Low Power Mode to High Speed Mode

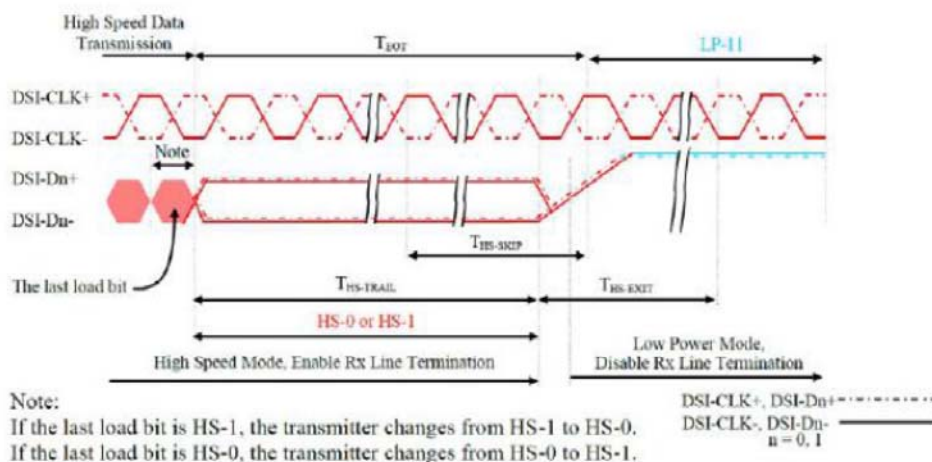


Figure 120 Data Lanes – High Speed Mode to Low Power Mode Timings

Table 51 Data Lanes – High Speed Mode to Low Power Mode Timings

Signal	Symbol	Description	Min	Max	Unit
DSI-Dn+/-, n=0 and 1	$T_{HS-SKIP}$	Time-Out at Display Module (ILI9806E) to ignore transition period of EoT	40	$55+4 \times UI$	ns
DSI-Dn+/-, n=0 and 1	$T_{HS-EXIT}$	Time to driver LP-11 after HS burst	100	-	ns

5.7.7 Reset input timing

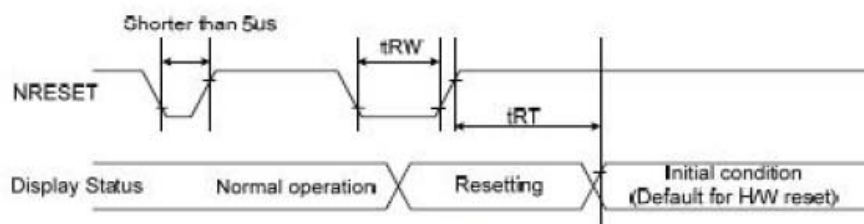


Figure 102 Reset Timing

Table 41 Reset Timing

Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		us
	tRT	Reset cancel		5(note 1,5) 120 (note 1,6,7)	ms

Note:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from OTP to registers. This loading is done every time when there is H/W 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 43.

Table 42 Reset Descript

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:

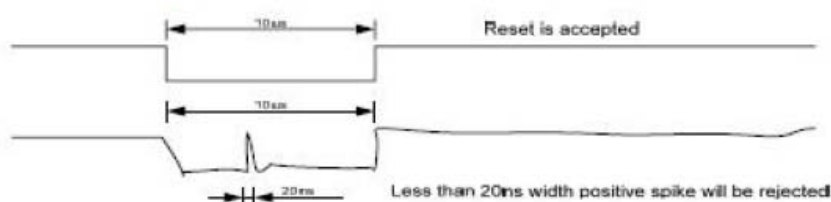


Figure 103 Positive Noise Pulse during Reset Low

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.

6 Optical Characteristics

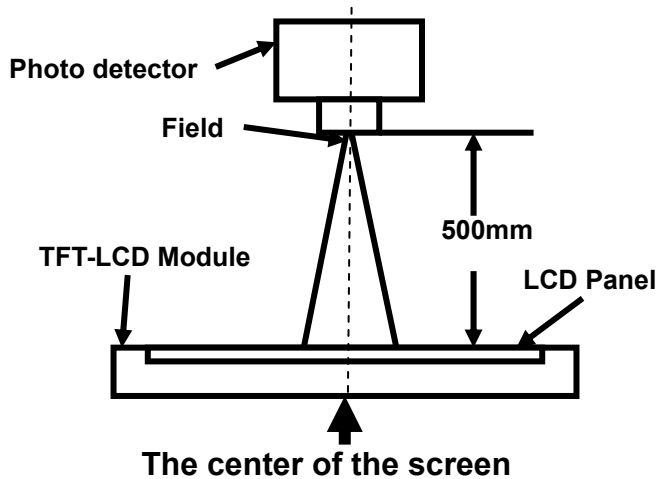
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	-	80	-	Degree	Note2,3
		θB		-	80	-		
		θL		-	80	-		
		θR		-	80	-		
Contrast Ratio		CR	θ=0°	-	600	-		Note 3
Response Time		T _{ON}	25℃	-	30	-	ms	Note 4
		T _{OFF}						
Chromaticity	White	x	Backlight is on	0.278	0.298	0.318		Note 1,5
		y		0.294	0.314	0.334		
	Red	x						Note 1,5
		y						
	Green	x						Note 1,5
		y						
	Blue	x						Note 1,5
		y						
Uniformity		U		75	80	--	%	Note 6
Reflection Ratio (With Polarizer)		R (θ=φ=0°)			2		%	
Luminance		L		450	500	-	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.

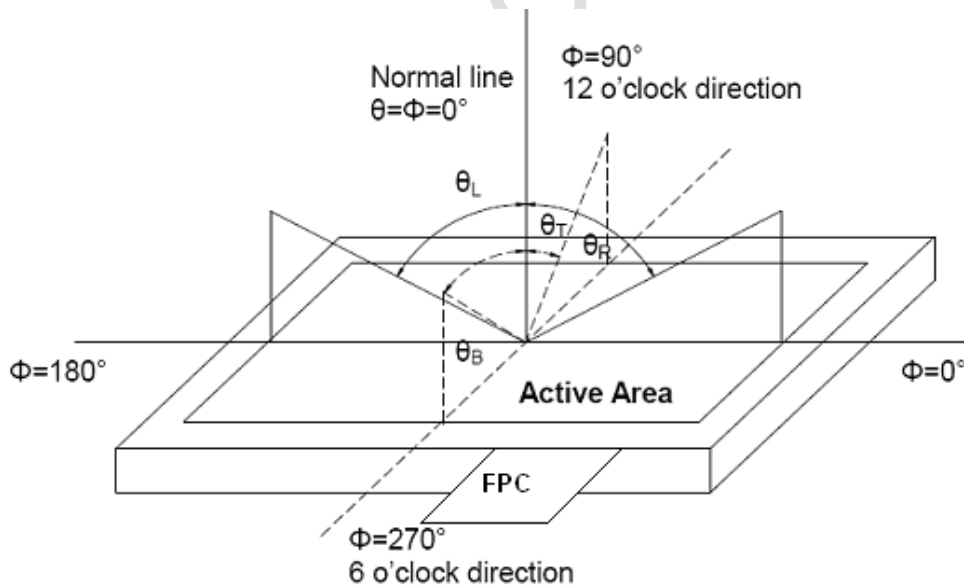
Note 1: Definition of optical measurement system.

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

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

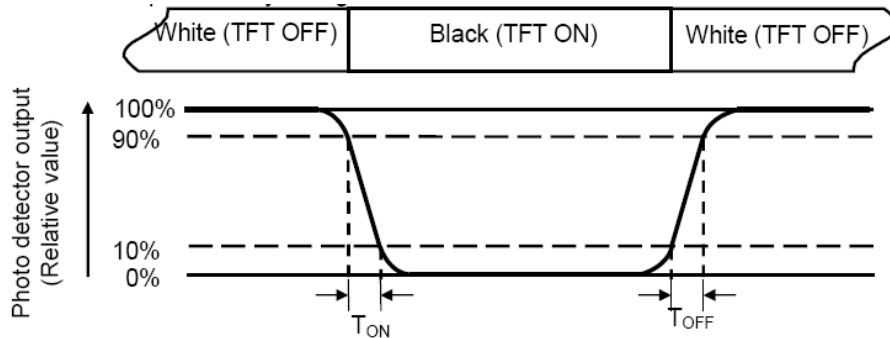
"White state ": The state is that the LCD should drive by V_{white} .

"Black state": The state is that the LCD should drive by V_{black} .

V_{white} : To be determined V_{black} : 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)

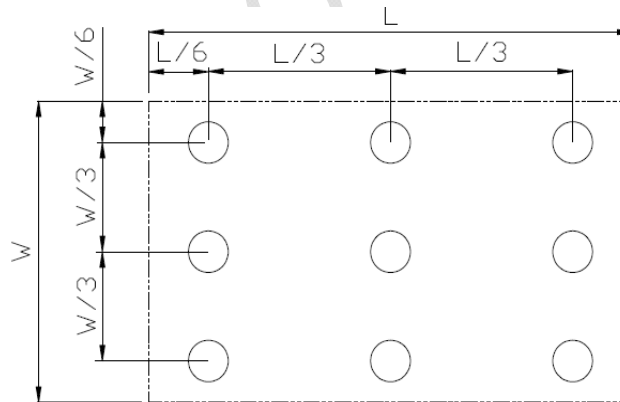
Color coordinates measured at center point of LCD.

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.

$$\text{Luminance Uniformity (U)} = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width



$L_{\max}$: The measured Maximum luminance of all measurement position.

$L_{\min}$: 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	85℃, 120Hours	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)	-10℃ , 30min.<=> 60℃ , 30min. 10 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,G B2423.22-2002
7	ESD	Voltage:±8KV R:330 ohm,C:150pF Air discharge,10 times	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration Test	10 => 55 =>10 => 55 => 10 Hz, within 1 minute;Amplitude:1.5mm. 15 minutes for each Direction (X,Y,Z)	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

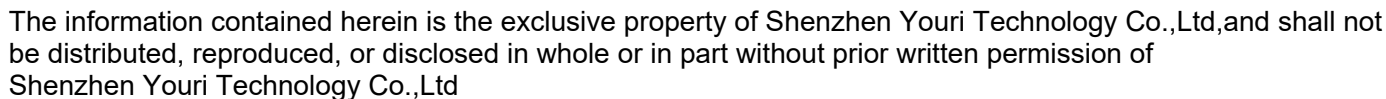
Note1: Ts is the temperature of panel's surface.

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

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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.