



Product Specification

Customer: _____
Model Name: H032HQ40E2561-T
Date: _____
Version: _____

Preliminary Specification

Final Specification

For Customer's Acceptance

Approved by	Comment

Approved by	Reviewed by	Prepared by



Table of Contents

1. Record of Revision.....	3
2. General Specifications.....	4
3. Input/Output Terminals.....	5
4. Absolute Maximum Ratings.....	8
5. Electrical Characteristics.....	8
6. Interface Timing.....	10
7. Optical Characteristics.....	15
8. Environmental / Reliability Tests.....	18
9. Mechanical Drawing.....	18
10. Packing.....	20
11. Precautions For Use of LCD modules.....	21



1. Record of Revision

Rev	Issued Date	Description	Editor
1.0	2021/12/18	First Release	



2. General Specifications

	Feature	Spec
Characteristics	Size	3.2 inch
	Resolution	240(horizontal)*320(Vertical)
	Interface	3Wire/4Wire SPI/8Bit/16Bit MCU
	Connect type	Soldering
	Display Colors	262K
	Technology type	a-Si
	Pixel pitch (mm)	0.2025 x 0.2025
	Pixel Configuration	R.G.B.Stripe
	Display Mode	Normally White
	Driver IC	ST7789V
	Viewing Direction	12 O'clock
	Gray Scale Inversion Direction	6 O'clock
Mechanical	LCM+TP (W x H x D) (mm)	55.04*77.4*3.83
	Active Area(mm)	48.6*64.8
	With /Without TSP	With TP
	Weight (g)	15 g
	LED Numbers	6 LEDs

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: RoHS

Note 3: LCM weight tolerance: +/- 5%



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3. Input/output Terminals

PIN No.	Symbol	Description
1	X(L)	Touch panel control pin (触摸屏控制脚)
2	Y(U)	Touch panel control pin (触摸屏控制脚)
3	X(R)	Touch panel control pin (触摸屏控制脚)
4	Y(D)	Touch panel control pin (触摸屏控制脚)
5	GND	Ground (接地脚)
6	IOVCC	Power supply for LCM (2.8V-3.3V) (屏供电脚)
7	VCI	Power supply for LCM (2.8V-3.3V) (屏供电脚)
8	FMARK	Tearing effect output pin to synchronize MPU to frame writing, activated by S/W command. When this pin is not activated, this pin is low. If not used, open this pin. (帧同步信号, 不用时悬空)
9	CS/SPI CS	Chip select pin ("Low" enable) (屏驱动芯片片选脚, 低电平有效)
10	RS/SPI SCL/SCK	This pin is used to select "Data or Command" in the parallel interface or serial data interface. (用于并口或者串口) Parallel(并口): When RS= '1', data is selected.(选择数据) When RS= '0', command is selected.(选择寄存器) Serial(串口): This pin is used serial interface clock in 3-wire 9-bit / 4-wire 8-bit serial data interface. (3线串口或者4线串口的时钟信号)



		If not used, this pin should be connected to IOVCC or GND. (不用时接 IOVCC 或者接地)
11	WR/A0 (4 线)	Serves as a write signal and writes data at the rising edge. - 4-line system (D/CX): Serves as command or parameter select. <i>Fix to IOVCC level when not in use.</i> (并口的写控制脚或者 4 线串口的寄存器/数据选择, 不用时接 IOVCC)
12	RD	Serves as a read signal and MCU read data at the rising edge. <i>Fix to IOVCC level when not in use.</i> (并口的读控制脚, 不用时接 IOVCC)
13	SPI SDI/SDA	Serial input signal. The data is applied on the rising edge of the SCL signal. If not used, fix this pin at IOVCC or GND (串口数据输入信号, 不用时接 IOVCC 或者接地)
14	SPI SDO	Serial output signal. The data is outputted on the falling edge of the SCL signal. If not used, open this pin (串口数据输出信号, 不用时悬空)
15	RESET	LCM Reset pin Signal is active low. (屏复位脚, 低电平复位)
16	GND	Ground (接地脚)
17-24	DB0-DB7	Data bus <i>Fix to GND level when not in use</i> (低 8 位数据线, 不用时接地)
25-32	DB8-DB15	Data bus <i>Fix to GND level when not in use</i> (高 8 位数据线, 不用时接地)
33	A	Anode of Backlight (3.0V-3.4V Typical:3.2V) (背光正极供电脚, 电压范围:3.0-3.4V, 典型值:3.2V)
34-36	K	Cathode of Backlight (背光负极供电脚)
37	GND	Ground (接地脚)



38	IM0	<p>Select the MCU interface mode (接口选择)</p> <p>IM2 IM1 IM0</p> <table border="1"> <tr> <td>0</td> <td>0</td> <td>0</td> <td>80 MCU 16-bit bus interface II</td> <td>D[8:1]</td> <td>D[17:10], D[8:1]</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>80 MCU 8-bit bus interface II</td> <td>D[17:10]</td> <td>D[17:10]</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>80 MCU 18-bit bus interface II</td> <td>D[8:1]</td> <td>D[17:0]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>80 MCU 9-bit bus interface II</td> <td>D[17:10]</td> <td>D[17:9]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>3-wire 9-bit data serial interface II</td> <td colspan="2">SDI: In SDO: Out</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>4-wire 8-bit data serial interface II</td> <td colspan="2">SDI: In SDO: Out</td> </tr> </table>	0	0	0	80 MCU 16-bit bus interface II	D[8:1]	D[17:10], D[8:1]	0	0	1	80 MCU 8-bit bus interface II	D[17:10]	D[17:10]	0	1	0	80 MCU 18-bit bus interface II	D[8:1]	D[17:0]	0	1	1	80 MCU 9-bit bus interface II	D[17:10]	D[17:9]	1	0	1	3-wire 9-bit data serial interface II	SDI: In SDO: Out		1	1	0	4-wire 8-bit data serial interface II	SDI: In SDO: Out	
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1	1	0	4-wire 8-bit data serial interface II	SDI: In SDO: Out																																		
39	IM1																																					
40	IM2	<p>NOTE:</p> <p>D[8:1]即低 8 位数据线 DB7-DB0D</p> <p>D[17:10]即高 8 位数据线 DB15-DB8</p>																																				

关于供电说明:

IOVCC 和 VCC 连一起，用 2.8V-3.3V 供电；背光 LED 可以单独供电 (3.0-3.4 V)，也可以和 VCC 共用一组电压 (A 为正接 VCC，K 连一起作为负接地)。



4. Absolute Maximum Ratings

Item	Symbol	MIN	MAX	Unit	Remark
Supply Voltage	V _{CC}	2.5	4.5	V	
Input Voltage	IOVCC	1.65	4.5	V	
Operating Temperature	T _{OPR}	-20	70	°C	
Storage Temperature	T _{STG}	-30	80	°C	

5. Electrical Characteristics

5.1 Driving TFT LCD Panel

Ta = 25 °C

Item	Symbol	MIN	TYP	MAX	Unit	Remark	
Analog Supply Voltage	V _{CC}	2.5	-	3.3	V		
Logic Signal Input /Output Voltage	IOVCC	1.65		3.3	V		
Input Signal Voltage	Low Level	V _{IL}	VSS	-	0.3x IOVCC	V	
	High Level	V _{IH}	0.7x IOVCC	-	IOVCC	V	
TFT Common Electrode	V _{COM}	-1.5	-	3.5	V		
TFT Gate ON Voltage	V _{GH}	12.2	-	14.97	V		
TFT Gate ON Voltage	V _{GL}	-12.5	-	-7.6	V		



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5.2 Driving Backlight

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	-	90		mA	
Forward Voltage	V_F	-	3.2	3.3	V	
Backlight Power consumption	W_{BL}	-	0.256	0.33	W	
LED Lifetime		25000	-	-	Hrs	

Note 1: Each LED: $I_F = 15 \text{ mA}$, $V_F = 3.2 \text{ V}$.

Note 2: Optical performance should be evaluated at $T_a = 25^\circ \text{C}$ only.

Note 3: If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness.

Typical operating life time is estimated data.



6. Interface Timing

6.1 Timing Parameter

6.1.1 Parallel 18/16/9/8 bit interface timing(8080-II system)

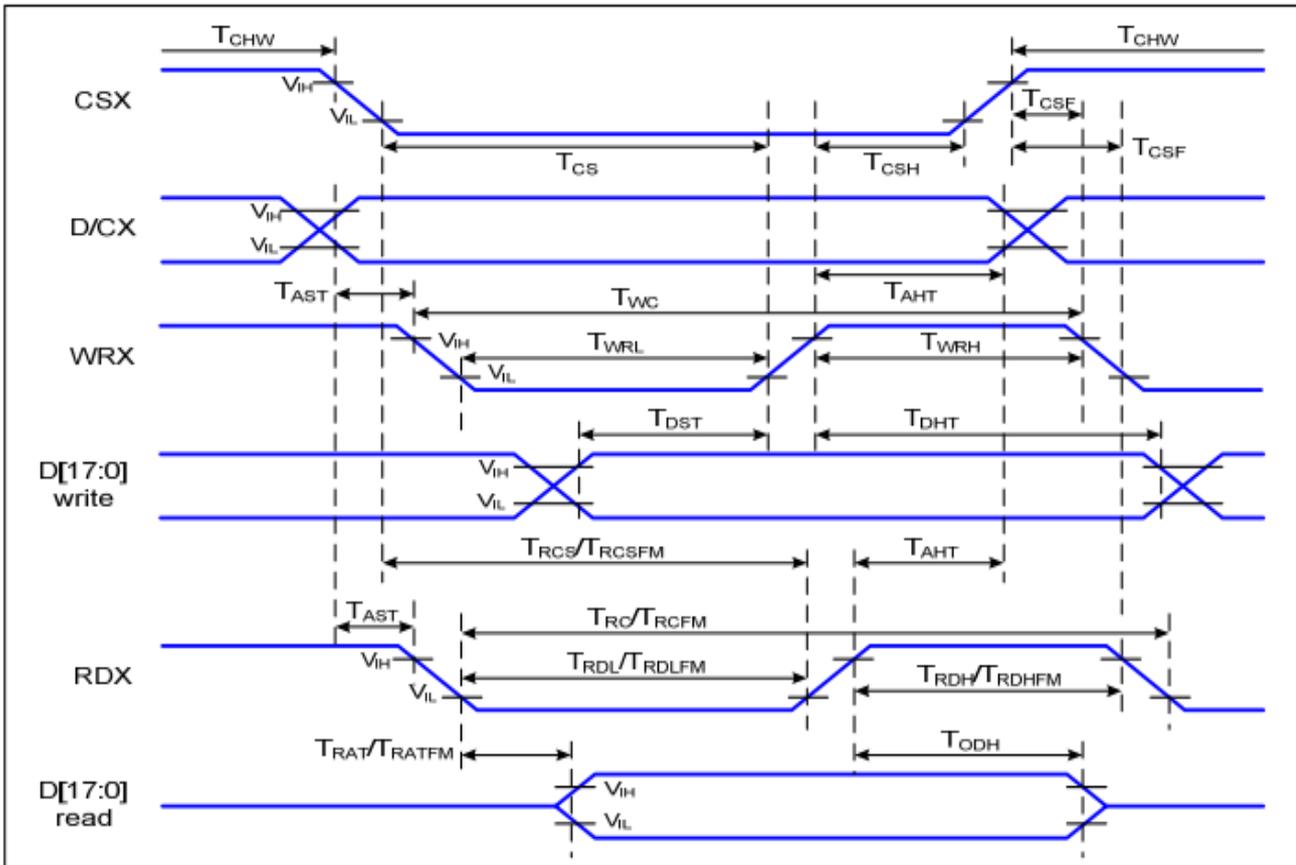


Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)



Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select "H" pulse width	0		ns	
	T_{CS}	Chip select setup time (Write)	15		ns	
	T_{RCS}	Chip select setup time (Read ID)	45		ns	
	T_{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T_{CSF}	Chip select wait time (Write/Read)	10		ns	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		ns	
	T_{WRH}	Control pulse "H" duration	15		ns	
	T_{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID data
	T_{RDH}	Control pulse "H" duration (ID)	90		ns	
	T_{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T_{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T_{DST}	Data setup time	10		ns	For CL=30pF
	T_{DHT}	Data hold time	10		ns	
	T_{RAT}	Read access time (ID)		40	ns	
	T_{RATFM}	Read access time (FM)		340	ns	
	T_{ODH}	Output disable time	20	80	ns	

Table 4 8080 Parallel Interface Characteristics

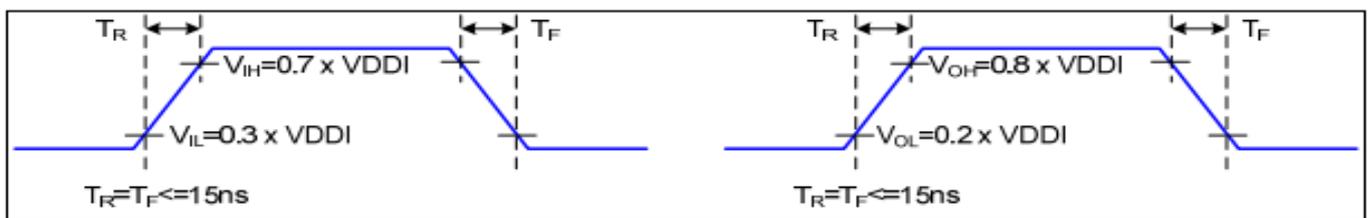


Figure 2 Rising and Falling Timing for I/O Signal

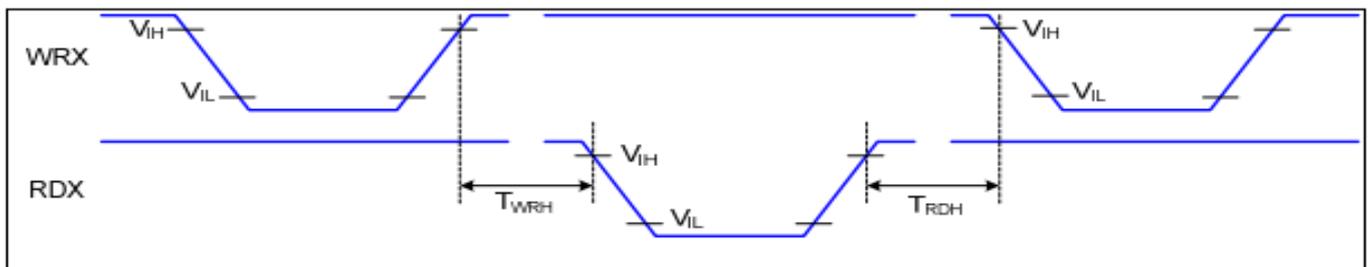


Figure 3 Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (T_r , T_f) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.



6.1.2 Serial interface timing characteristics(3-line SPI system)

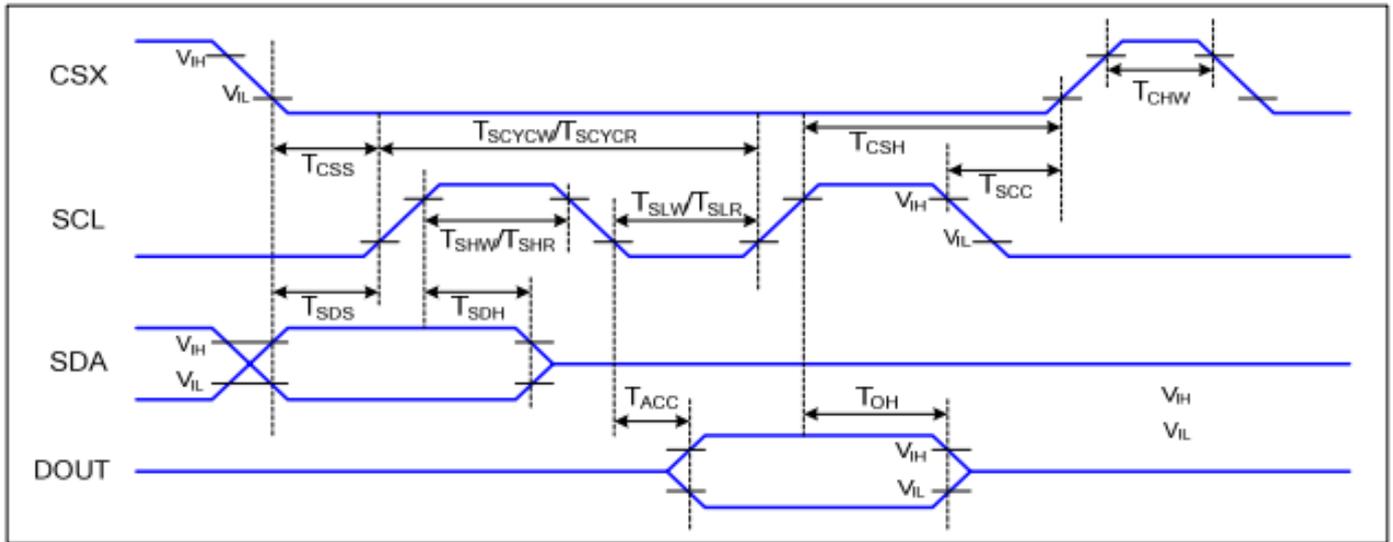


Figure 4 3-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

Table 5 3-line serial Interface Characteristics



6.1.3 Serial interface timing characteristics(4-line SPI system)

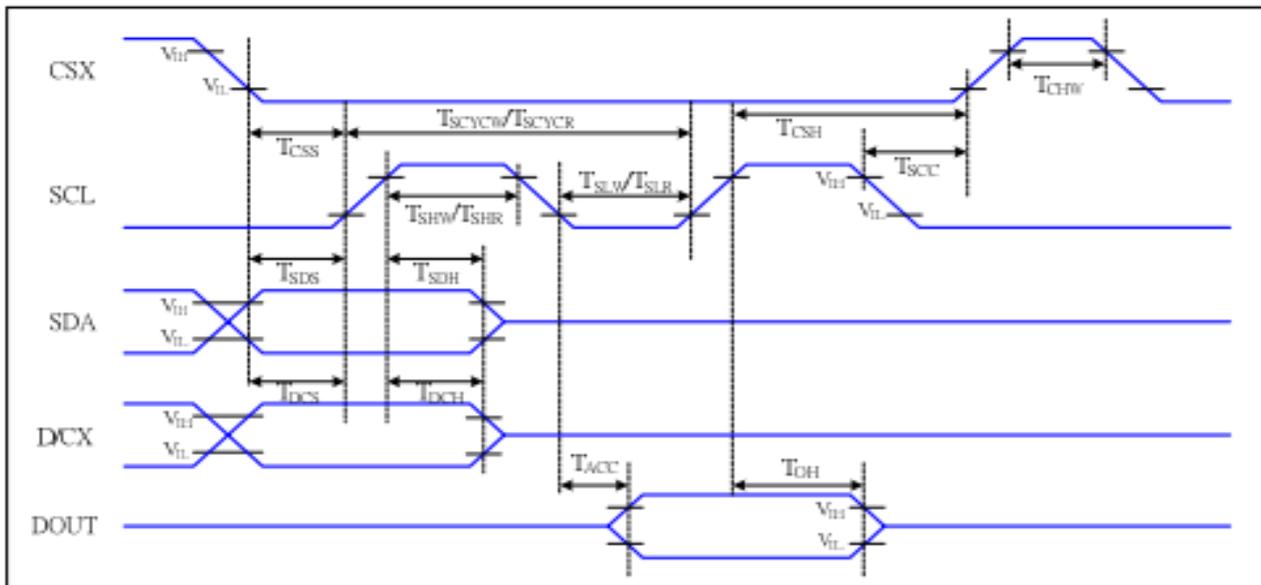


Figure 5 4-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

Table 6 4-line serial Interface Characteristics



6.2 Reset Timing Characteristics

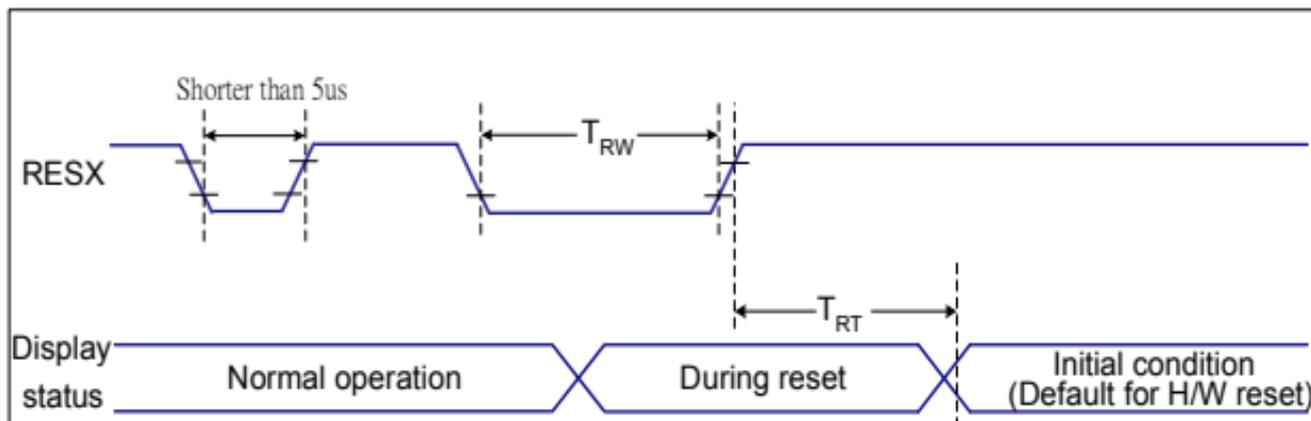


Figure 7 Reset Timing

VDD1=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C

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 9 Reset Timing

Notes:

- 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.
- 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

- 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.



7. Optical Characteristics

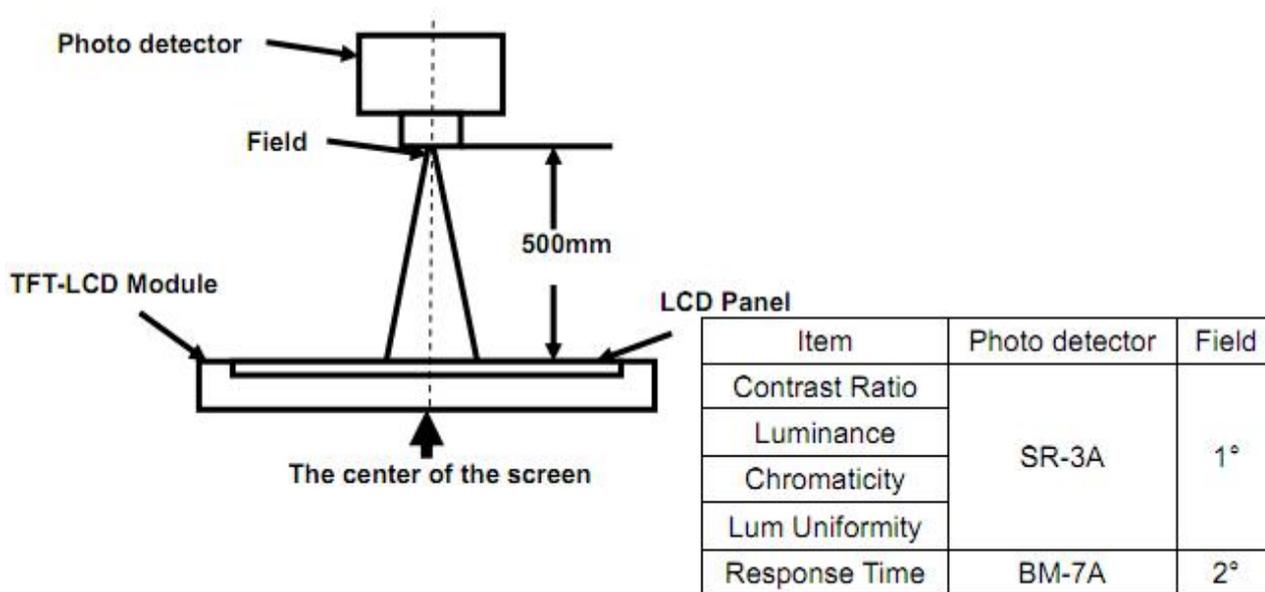
Items	Symbol	Condition	Min	Typ	Max	Unit	Remark	
Viewing angles	θ_T	Center CR \geq 10	-	65	-	Degree	Note2	
	θ_B		-	55	-			
	θ_L		-	65	-			
	θ_R		-	65	-			
Contrast Ratio	CR	$\Theta = 0$	300	350	-	-	Note1, Note3	
Response Time	T_{ON}	25°C	-	20	30	ms	Note1, Note4	
	T_{OFF}		-	25	35			
Chromaticity	White	X_W	Backlight is on	0.26	0.31	0.36	-	Note1, Note5
		Y_W		0.28	0.33	0.38	-	
Uniformity	U		80	-	-	%	Note1, Note6	
NTSC			-	50	-	%	Note5	
Luminance	L		-	250	-	nits	Note1, Note7	

Test Conditions:

1. IF= 20mA (one channel), 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 by CONOSCOPE (ergo-80).

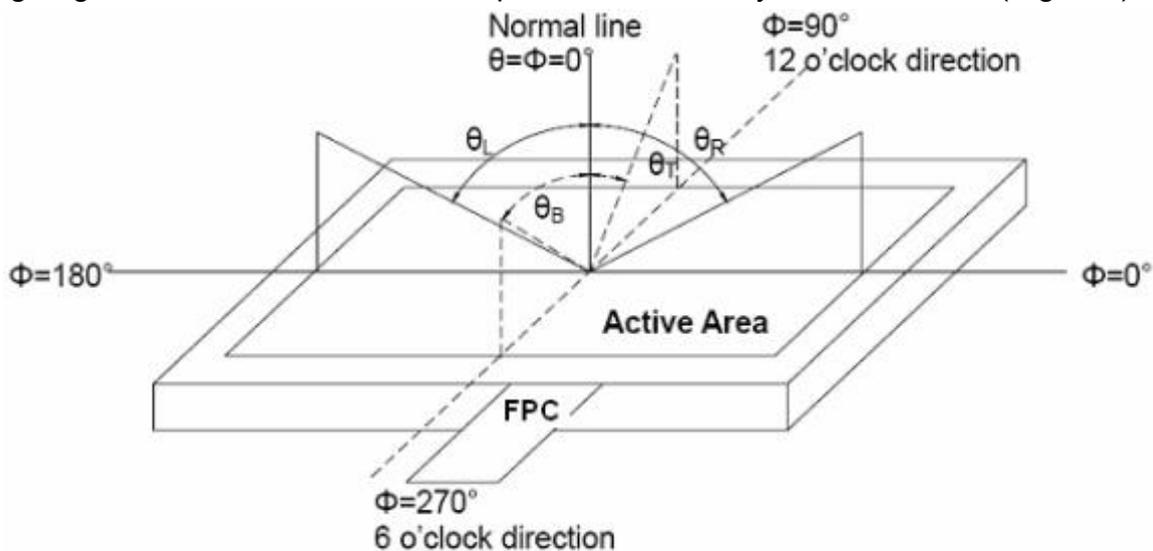


Fig. 1 Definition of viewing angle

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}.

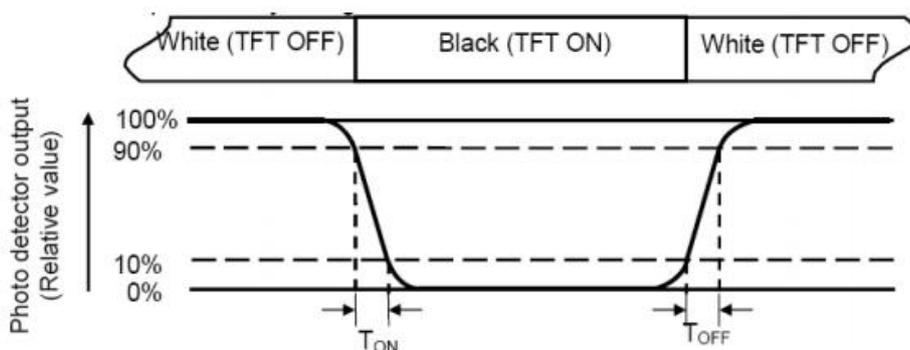


“Black state”: The state is that the LCD should drive by Vblack.

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 (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% 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) = L_{min} / L_{max}

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

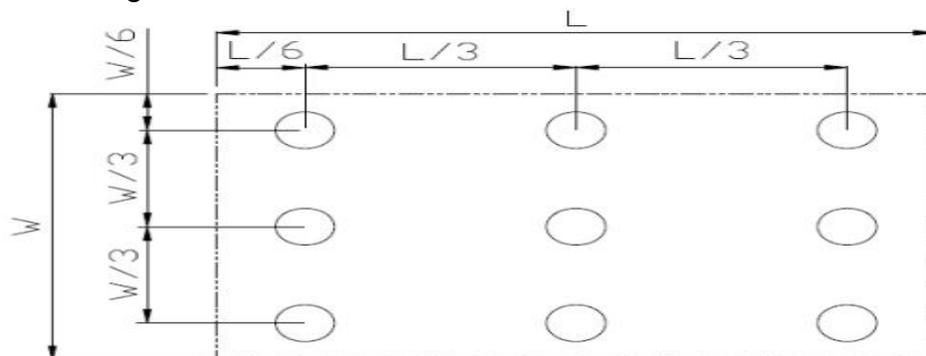


Fig. 2 Definition of uniformity

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.



8. Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts= +60°C, 240hrs	Note 1 IEC60068-2-2, GB2423. 2-89
2	Low Temperature Operation	Ta= -10°C, 240hrs	Note 2 IEC60068-2-1 GB2423.1-89
3	High Temperature Storage	Ta= +70°C, 240hrs	IEC60068-2-2 GB2423. 2-89
4	Low Temperature Storage	Ta= -20°C, 240hrs	IEC60068-2-1 GB/T2423.1-89
5	High Temperature & Humidity Storage	Ta= +60°C, 90% RH max, 160 hours	IEC60068-2-3 GB/T2423.3-2006
6	Thermal Shock (Non-operation)	-20°C 30 min ~ +70°C 30 min Change time: 5min, 30 Cycle	Start with cold temperature, end with high temperature IEC60068-2-14, GB2423.22-87
7	Electro Static Discharge (Operation)	C=150pF, R=330 Ω, 5 points/panel Air:±8KV, 5 times; Contact: ±4KV, 5times; (Environment: 15°C ~35°C, 30% ~ 60%, 86Kpa ~ 106Kpa)	IEC61000-4-2 GB/T17626.2-1998
8	Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke: 1.mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X .Y. Z. (package condition)	IEC60068-2-6 GB/T2423.5-1995
9	Shock (Non-operation)	60G 6ms, ± X, ±Y , ± Z,3 times for each direction	IEC60068-2-27 GB/T2423.5-1995
10	Package Drop Test	Height: 80 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8-1995

Note: 1. TS is the temperature of panel's surface.

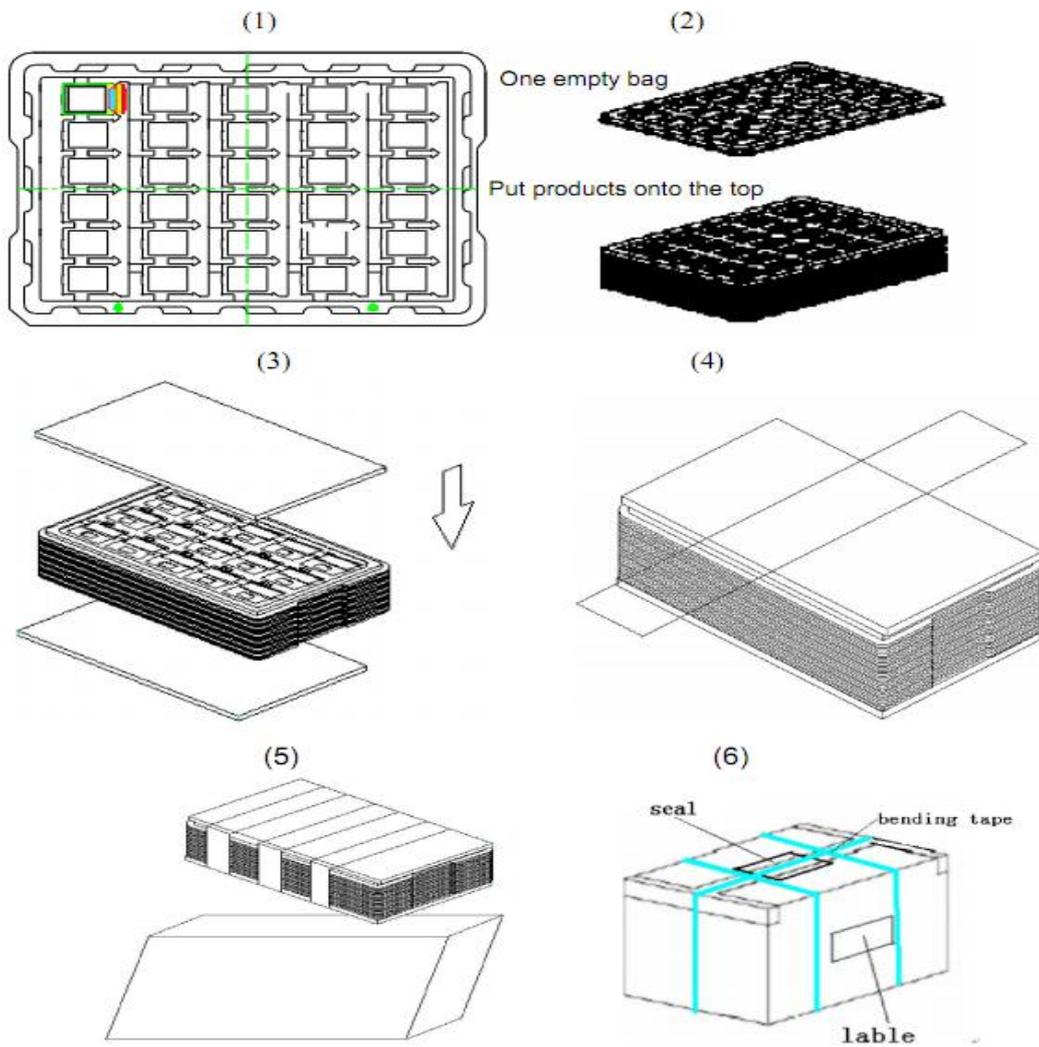
Note: 2. Ta is the ambient temperature of sample.

9. Mechanical Drawing



10. Packing

Packing Method



1. Put module into tray cavity:
2. Tray stacking
3. Put 1 cardboard under the tray stack and 1 cardboard above:
4. Fix the cardboard to the tray stack with adhesive tape:
5. Put the tray stack into carton.
6. Carton sealing with adhesive tape.



11. Precautions for Use of LCD modules

11.1 Handling Precautions

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

11.1.2 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.

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

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

11.1.5 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

11.1.6 Do not attempt to disassemble the LCD Module.

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

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

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

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

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

11.1.8.4 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.

11.2 Storage Precautions

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

11.2.2 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%

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

11.3 Transportation Precautions

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