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PRODUCT SPECIFICATIONS

For Customer: _____

: APPROVAL FOR SPECIFICATION

Customer Model No. _____

: APPROVAL FOR SAMPLE

Module No.: ZW-T024HQI-13CP

Date : 2019-12-24

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For Customer's Acceptance:

Approved By	Comment

PREPARED	CHECKED	VERIFIED BY QA DEPT	VERIFIED BY R&D DEPT
SSX	YGM		

3. General Specifications

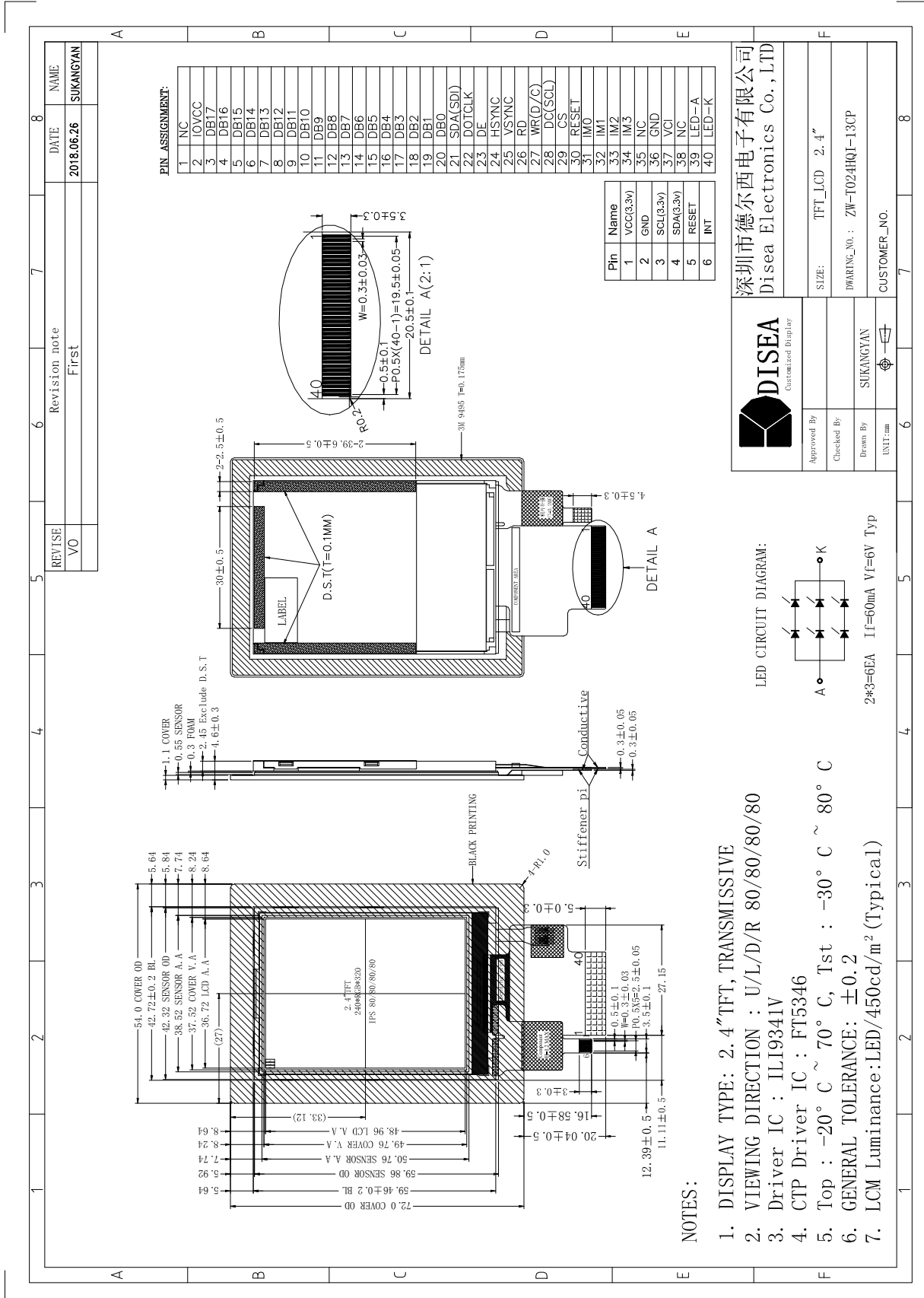
ZW-T024HQI-13CP is a TFT-LCD module. It is composed of a TFT-LCD panel, driver IC, FPC, a back light and CTP unit . The 2.4'' display area contains 240X(RGB)x320 pixels and can display up to 262K colors. This product accords with ROHS environmental criterion.

Item	Contents	Unit	Note
LCD Type	TFT	-	
Display color	262K	color	1
Viewing Direction	ALL	O'Clock	
Operating temperature	-20~+70	°C	
Storage temperature	-30~+80	°C	
Module size	54.00X72.00X4.60	mm	2
Active Area(W×H)	36.72X48.96	mm	
Number of Dots	240×320	dots	
Controller	ILI9341V	-	
CTP Controller	FT5346	-	
Power Supply Voltage	2.8	V	
Backlight	2S3P-LEDs (white)	pcs	
Weight	---	g	
Interface	RGB+MCU+SPI	-	

Note 1: Color tune is slightly changed by temperature and driving voltage.

Note 2: Without FPC and Solder. With CTP.

4.Outline.Drawing



深圳市德爾西電子有限公司
Disea Electronics Co., LTD

Approved By	TFT_LCD 2.4"
Checked By	DRAWING_NO : ZW-T024HQ1-13CP
Drawn By	SUKANGYAN
UNIT:mm	CUSTOMER_NO.

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

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

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V _{CI}	-0.3	4.6	V	1,2
	IOVCC	-0.3	4.6		
	CTP_VCC	2.7	3.6		

Notes:

1. If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.
2. $V_{CI} > V_{SS}$ must be maintained.
3. Please be sure users are grounded when handing LCD Module.

5.2 Environmental Absolute Maximum Ratings.

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-30 $^\circ\text{C}$	80 $^\circ\text{C}$	-20 $^\circ\text{C}$	70 $^\circ\text{C}$	1,2
Humidity	-	-	-	-	3

Notes:

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

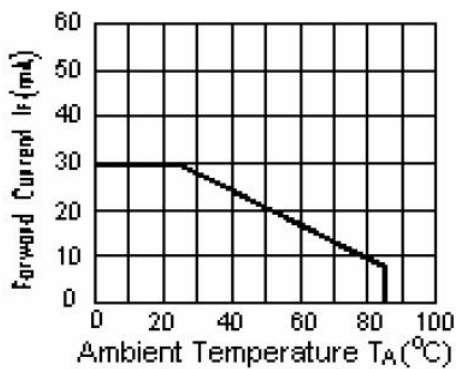
6. Electrical Specifications

6.1 Electrical characteristics ($V_{SS}=0V, T_a=25^\circ C$)

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Power supply		VCI	$T_a=25^\circ C$	2.5	2.8	3.3	V
		IOVCC	$T_a=25^\circ C$	1.65	2.8	3.3	
		CTP_VCC	$T_a=25^\circ C$	3.0	3.3	3.6	
Input voltage	'H'	V_{IH}	$T_a=25^\circ C$	$0.7 \cdot IOVCC$	-	IOVCC	V
	'L'	V_{IL}	$T_a=25^\circ C$	0	-	$0.3 \cdot IOVCC$	

6.2 LED backlight specification ($V_{SS}=0V, T_a=25^\circ C$)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage	V_f	$I_f=60mA$	5.4	6.0	6.6	V	
Uniformity	ΔB_p	$I_f=60mA$	75	80	-	%	
Life Time	time	$I_f=60mA$	20K	-		hours	1



Note 1: Brightness to be decreased to 50% of the initial value at ambient temperature $T_A=25^\circ C$

6.3 Interface signals

Pin No.	Symbol	I/O	Function
1	NC	-	No connect
2	IOVCC	P	Power for interface logic circuits
3-20	DB17-DB0	I	Data input
21	SDA(SDI)	I	Serial Input /output data bus
22	DOTCLK	I	Data clock
23	DE	I	Data enable pin
24	HSYNC	I	Line sync signal
25	VSYNC	I	Frame sync signal
26	RD	I	Read data control signal
27	WR(D/C)	I	8080-I/8080-II system: serves as a write signal an MCU write data at the rising edge. 4-line system:serves as Data or Command select. In serial interface “2-data-lane data” transfers mode, serves as a second data pin
28	DC(SCL)	I	DC: This pin is used to select “Data or Command” in the parallel interface SCL: Serial data clock in serial bus system
29	CS	I	Chip select pin
30	RESET	I	Reset the display,active “L”
31-34	IM0-IM3	I	MCU parallel interface bus and serial interface select
35	NC	-	No connect
36	GND	P	Ground
37	VCI	P	Power for analog circuits
38	NC	-	No connect
39	LED-A	P	LED back light(Anode)
40	LED-K	P	LED back light(Cathode)

CTP interface

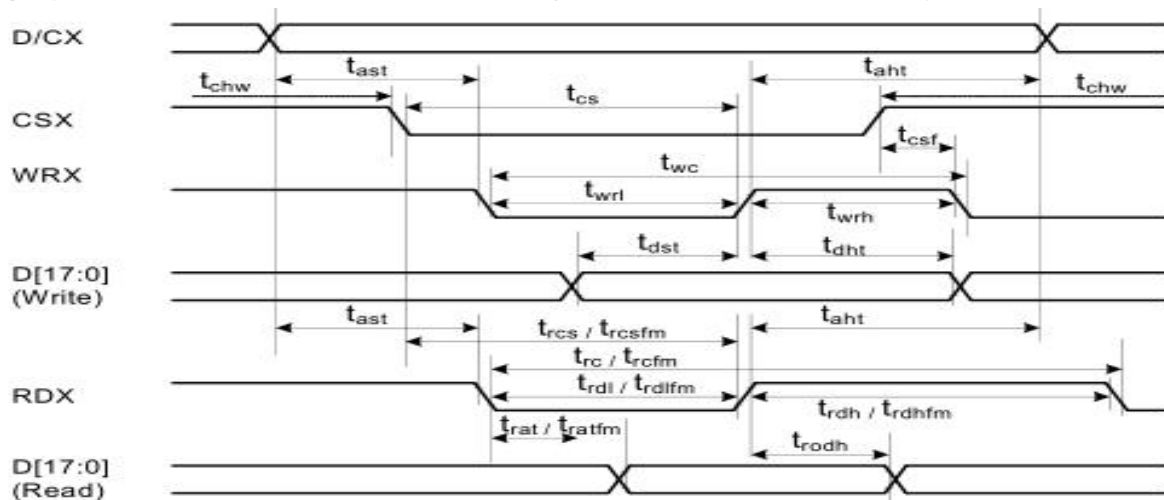
Pin No.	Symbol	I/O	Function
1	VCC	P	CTP Power supply
2	GND	P	Ground
3	SCL(3.3V)	I	I2C clock
4	SDA(3.3V)	I	I2C data
5	RESET	I	CTP reset pin,active “L”
6	INT	I	External Interrupt to the IC of CTP

The selection of interface is done by setting external pins IM [3:0] as shown in the following table.

IM3	IM2	IM1	IM0	MCU-Interface Mode	Pins in use	
					Register/Content	GRAM
0	0	0	0	8080 MCU 8-bit bus interface I	D[7:0]	D[7:0], WRX, RDX, CSX, D/CX
0	0	0	1	8080 MCU 16-bit bus interface I	D[7:0]	D[15:0], WRX, RDX, CSX, D/CX
0	0	1	0	8080 MCU 9-bit bus interface I	D[7:0]	D[8:0], WRX, RDX, CSX, D/CX
0	0	1	1	8080 MCU 18-bit bus interface I	D[7:0]	D[17:0], WRX, RDX, CSX, D/CX
0	1	0	1	3-wire 9-bit data serial interface I	SCL, SDA, CSX	
0	1	1	0	4-wire 8-bit data serial interface I	SCL, SDA, D/CX, CSX	
1	0	0	0	8080 MCU 16-bit bus interface II	D[8:1]	D[17:10], D[8:1], WRX, RDX, CSX, D/CX
1	0	0	1	8080 MCU 8-bit bus interface II	D[17:10]	D[17:10], WRX, RDX, CSX, D/CX
1	0	1	0	8080 MCU 18-bit bus interface II	D[8:1]	D[17:0], WRX, RDX, CSX, D/CX
1	0	1	1	8080 MCU 9-bit bus interface II	D[17:10]	D[17:9], WRX, RDX, CSX, D/CX
1	1	0	1	3-wire 9-bit data serial interface II	SCL, SDI, SDO, CSX	
1	1	1	0	4-wire 8-bit data serial interface II	SCL, SDI, D/CX, SDO, CSX	

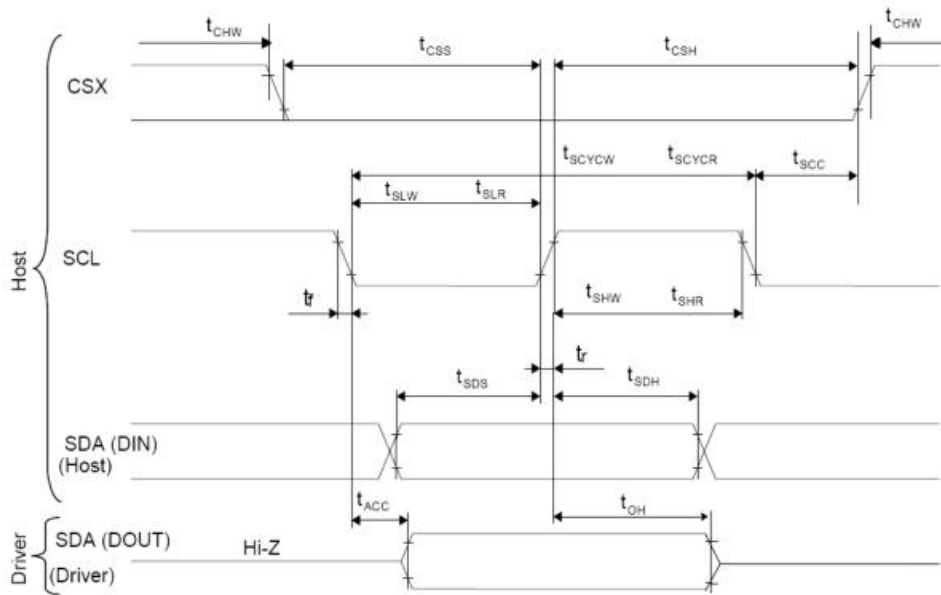
6.4 AC Characteristics

6.4.1 Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080- I system)



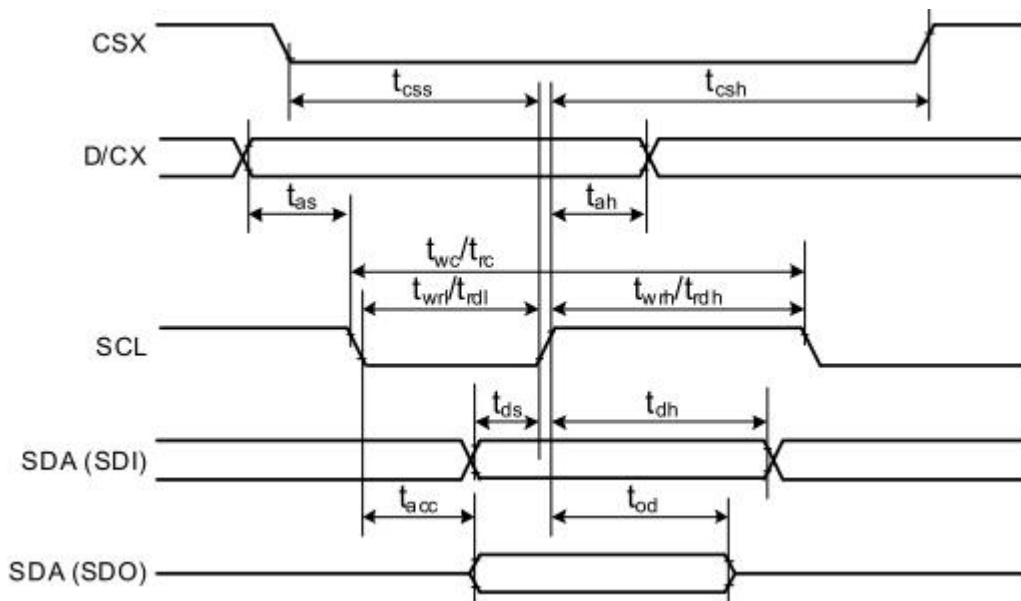
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	t_{ast}	Address setup time	0	-	ns	
	t_{ah}	Address hold time (Write/Read)	0	-	ns	
CSX	t_{chw}	CSX "H" pulse width	0	-	ns	
	t_{cs}	Chip Select setup time (Write)	15	-	ns	
	t_{rcs}	Chip Select setup time (Read ID)	45	-	ns	
	t_{rcsfm}	Chip Select setup time (Read FM)	355	-	ns	
	t_{csf}	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	t_{wc}	Write cycle	66	-	ns	
	t_{wrh}	Write Control pulse H duration	15	-	ns	
	t_{wrl}	Write Control pulse L duration	15	-	ns	
RDX (FM)	t_{rcfm}	Read Cycle (FM)	450	-	ns	
	t_{rdhfm}	Read Control H duration (FM)	90	-	ns	
	t_{rdlfm}	Read Control L duration (FM)	355	-	ns	
RDX (ID)	t_{rc}	Read cycle (ID)	160	-	ns	
	t_{rdh}	Read Control pulse H duration	90	-	ns	
	t_{rdl}	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	t_{dst}	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	t_{dht}	Write data hold time	10	-	ns	
	t_{rat}	Read access time	-	40	ns	
	t_{ratfm}	Read access time	-	340	ns	
	t_{rod}	Read output disable time	20	80	ns	

6.4.2 Display Serial Interface Timing Characteristics (3-line SPI system)



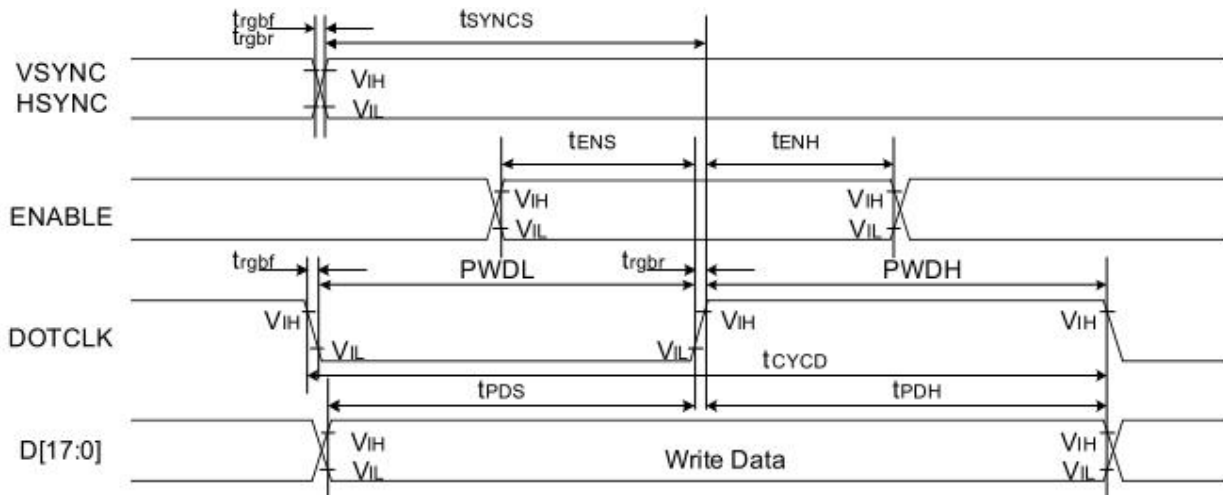
Signal	Symbol	Parameter	min	max	Unit	Description
SCL	tscycw	Serial Clock Cycle (Write)	100	-	ns	
	tshw	SCL "H" Pulse Width (Write)	40	-	ns	
	tslw	SCL "L" Pulse Width (Write)	40	-	ns	
	tscycr	Serial Clock Cycle (Read)	150	-	ns	
	tshr	SCL "H" Pulse Width (Read)	60	-	ns	
	tslr	SCL "L" Pulse Width (Read)	60	-	ns	
SDA / SDI (Input)	tsds	Data setup time (Write)	30	-	ns	
	tsdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	
	toh	Output disable time (Read)	10	50	ns	
CSX	tsc	SCL-CSX	20	-	ns	
	tch	CSX "H" Pulse Width	40	-	ns	
	tcs	CSX-SCL Time	60	-	ns	
	tch		65	-	ns	

6.4.3 Display Serial Interface Timing Characteristics (4-line SPI system)



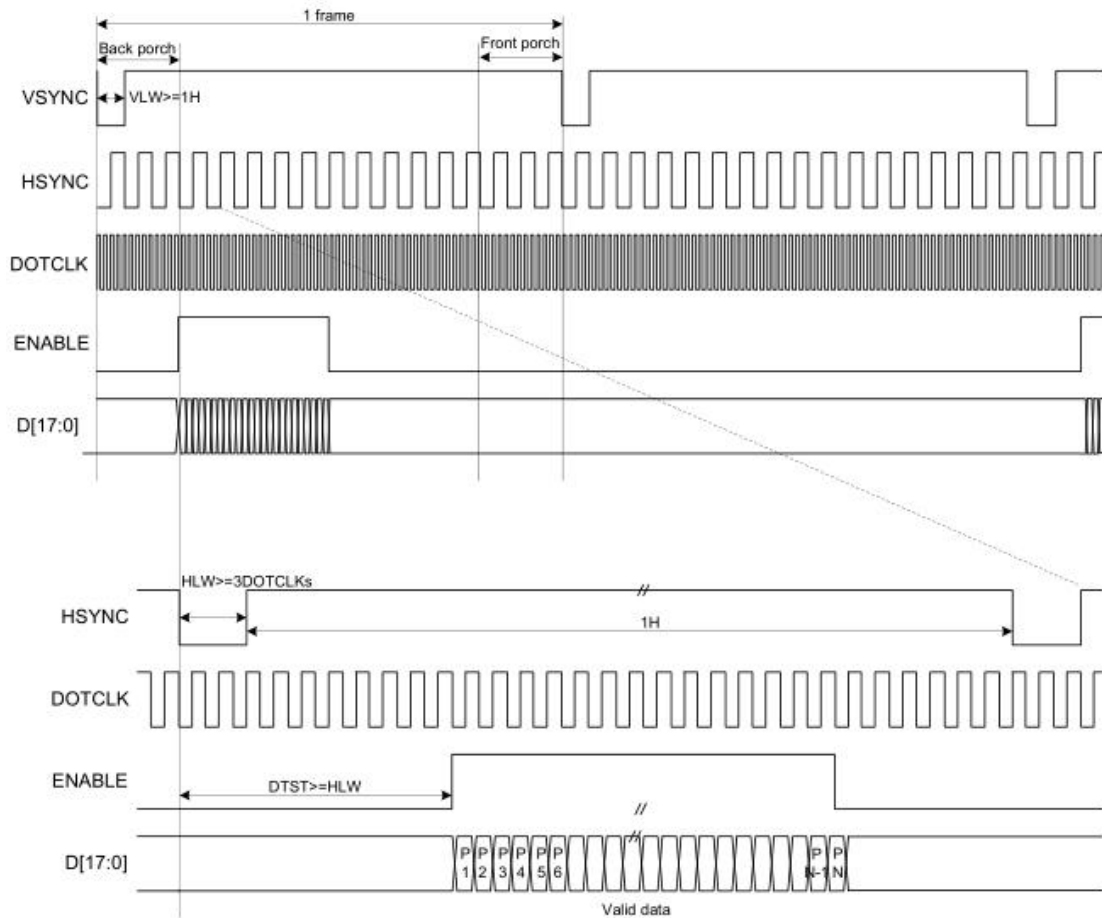
Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	40	-	ns	
	tcsH	Chip select hold time (Read)	40	-	ns	
SCL	twc	Serial clock cycle (Write)	100	-	ns	
	twrh	SCL "H" pulse width (Write)	40	-	ns	
	twrl	SCL "L" pulse width (Write)	40	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL "H" pulse width (Read)	60	-	ns	
	trdl	SCL "L" pulse width (Read)	60	-	ns	
D/CX	tas	D/CX setup time	10	-		
	tah	D/CX hold time (Write / Read)	10	-		
SDA / SDI (Input)	tds	Data setup time (Write)	30	-	ns	
	tdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	For maximum CL=30pF
	tod	Output disable time (Read)	10	50	ns	For minimum CL=8pF

6.4.4 Parallel 18/16/6-bit RGB Interface Timing Characteristics



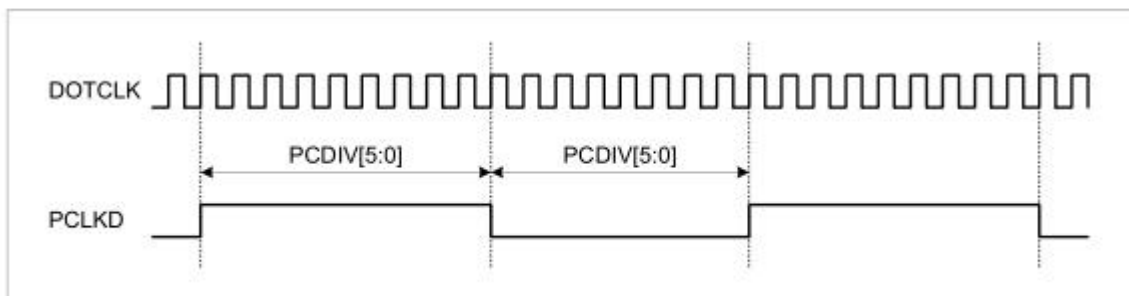
Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	18/16-bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns	
	PWDL	DOTCLK low-level period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	100	-	ns	
	t_{rgbr}, t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	6-bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level pulse period	15	-	ns	
	PWDL	DOTCLK low-level pulse period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	50	-	ns	
	t_{rgbr}, t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

The timing chart of 18-/16-bit RGB interface mode is shown as below



R

VLW : VSYNC Low Width
HLW : HSYNC Low Width
DTST : Data Transfer Startup Time
P : Pixel : N=240X320=76800



Note 1: The DE signal is not needed when RGB interface SYNC mode is selected.

Note 2: VSPL='0', HSPL='0', DPL='0' and EPL='0' of "Interface Mode Control (B0h)" command.

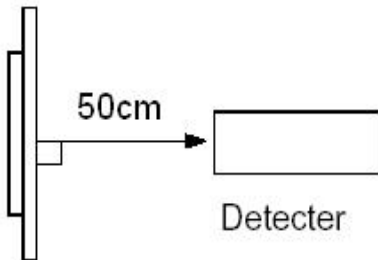
7. Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Brightness	Bp	$\theta=0^\circ$	-	450	-	Cd/m ²	1	
Uniformity	ΔBp	$\Phi=0^\circ$	75	80	-	%	1,2	
Viewing Angle	3:00	Cr \geq 10	-	80	-	Deg	3	
	6:00		-	80	-			
	9:00		-	80	-			
	12:00		-	80	-			
Contrast Ratio	Cr	$\theta=0^\circ$	640	800	-	-	4	
Response Time	T _r +T _f	$\Phi=0^\circ$	-	35	45	ms	5	
Color of CIE Coordinate	W	x	$\theta=0^\circ$ $\Phi=0^\circ$	Typ -0.05	Typ +0.05	-	1,6	
		y				-		
	R	x				0.308		-
		y				0.330		-
	G	x				0.649		-
		y				0.318		-
	B	x				0.352		-
		y				0.601		-
	x	0.140	-					
	y	0.063	-					
NTSC Ratio	S	-	70	-	%			

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

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full

white. The brightness is the average value of 9 measured spots. Measurement equipment BM-7



(Φ5mm)

Measuring condition:

- *Measuring surroundings: Dark room.*
- *Measuring temperature: $T_a=25\text{ }^\circ\text{C}$.*
- *Adjust operating voltage to get optimum contrast at the center of the display.*

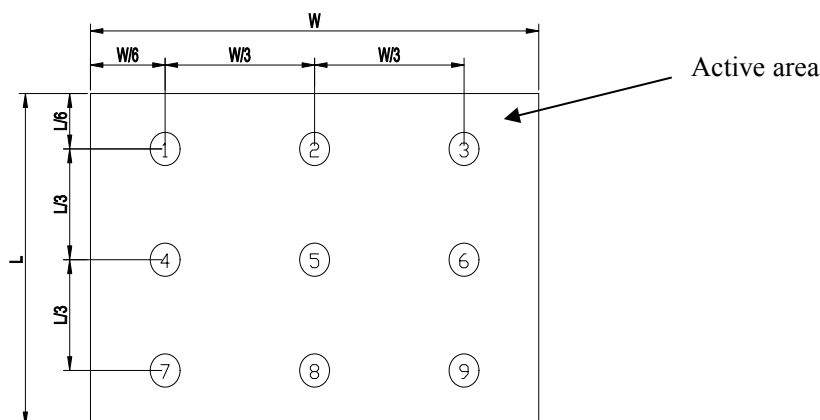
Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

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

$$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100 (\%)$$

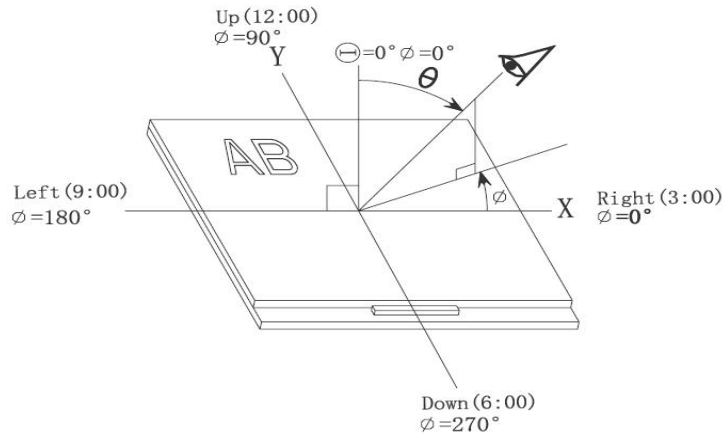
$B_p (\text{Max.})$ = Maximum brightness in 9 measured spots

$B_p (\text{Min.})$ = Minimum brightness in 9 measured spots.

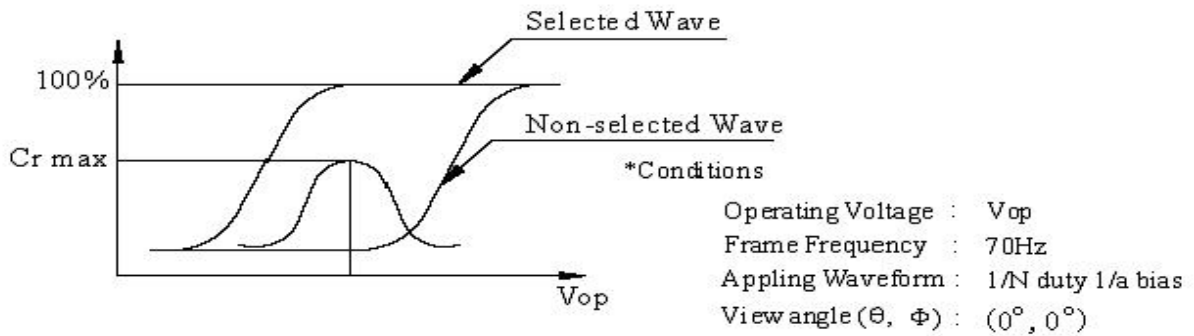


Note 3: The definition of viewing angle:

Refer to the graph below marked by θ and Φ



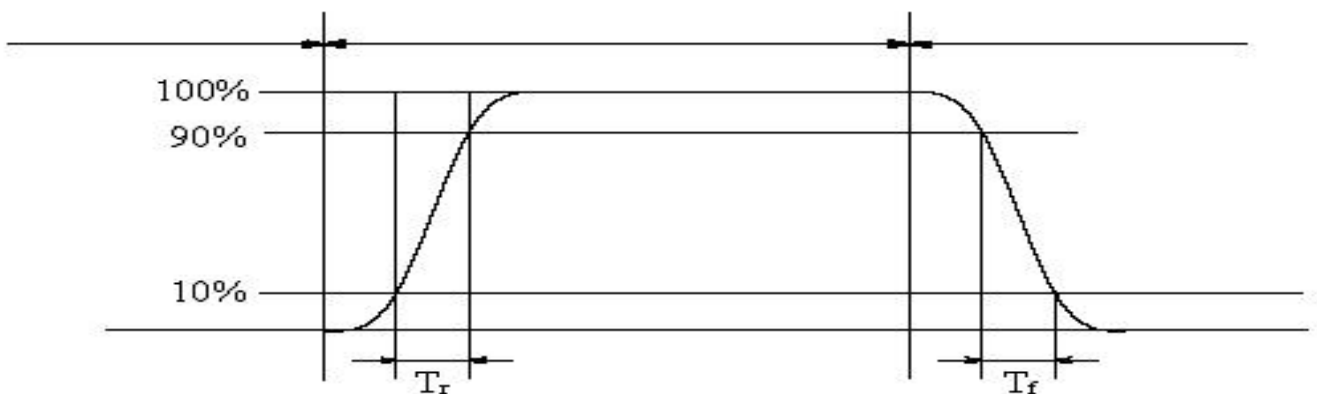
Note 4: Definition of contrast ratio.(Test LCD using DMS501)



$$\text{Contrast ratio}(Cr) = \frac{\text{Brightness of selected dots}}{\text{Brightness of non-selected dots}}$$

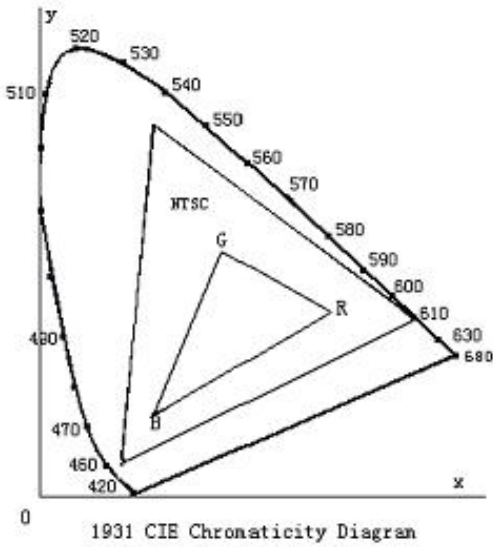
Note 5: Definition of Response time. (Test LCD using DMS501):

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



The definition of response time

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

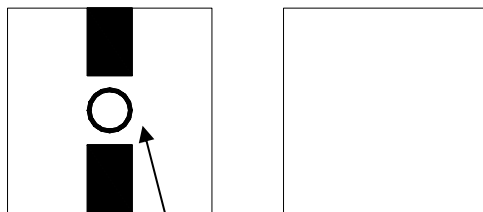


Color gamut:

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

Note 7: Definition of cross talk.

Cross talk ratio(%) = $\frac{\text{pattern A Brightness} - \text{pattern B Brightness}}{\text{pattern A Brightness}} \times 100$



Pattern A

Pattern B

Measurement point(center)

Electric volume value = $3F \pm 3Hex$

8. Reliability Test Items and Criteria

Test Item	Test condition	Remark
High Temperature Storage	Ta = 80°C 96hrs	Note1,Note3, 4
Low Temperature Storage	Ta = -30°C 96hrs	Note1,Note3, 4
High Temperature Operation	Ts = 70°C 96hrs	Note2,Note3, 4
Low Temperature Operation	Ta = -20°C 96hrs	Note1,Note3, 4
Operation at High Temperature/Humidity	+60°C, 90%RH 96hrs	Note3, 4
Thermal Shock	-30°C/30 min ~ +80°C/30 min for a total 10 cycles, Start with cold temperature and end with high temperature.	Note3, 4
Vibration Test	Frequency range:10~55Hz Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	±2KV, Human Body Mode, 100pF/1500Ω	

Note 1: Ta is the ambient temperature of samples.

Note 2: Ts is the temperature of panel's surface.

Note 3: 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.

Note 4: Before cosmetic and function test, the product must have enough recovery time,at least 2 hours at room temperature

9. Precautions for Use of LCD Modules

9.1 Handling Precautions

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

9.1.2 *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.*

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

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

9.1.5 *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

9.1.6 *Do not attempt to disassemble the LCD Module.*

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

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

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

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

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

d. 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.

9.2 Storage precautions

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

9.2.2 *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 °C ~ 40 °C

Relatively humidity: ≤80%

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

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

END

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