



晶采光電科技股份有限公司
AMPIRE CO., LTD.

SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
CUSTOMER PART NO.	
AMPIRE PART NO.	AM-320240LQTZQW-60H
APPROVED BY	
DATE	

Approved For Specifications

Approved For Specifications & Sample

AMPIRE CO., LTD.

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APPROVED BY	CHECKED BY	ORGANIZED BY

RECORD OF REVISION

Revision Date	Page	Contents	Editor
2019/01/15	--	New Release.	Raymond
2019/03/26	11	Update BL life time	Raymond

1 General Description and Features

3.5 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) module. This module is composed of a 3.5" TFT-LCD panel, a driver circuit and backlight unit.

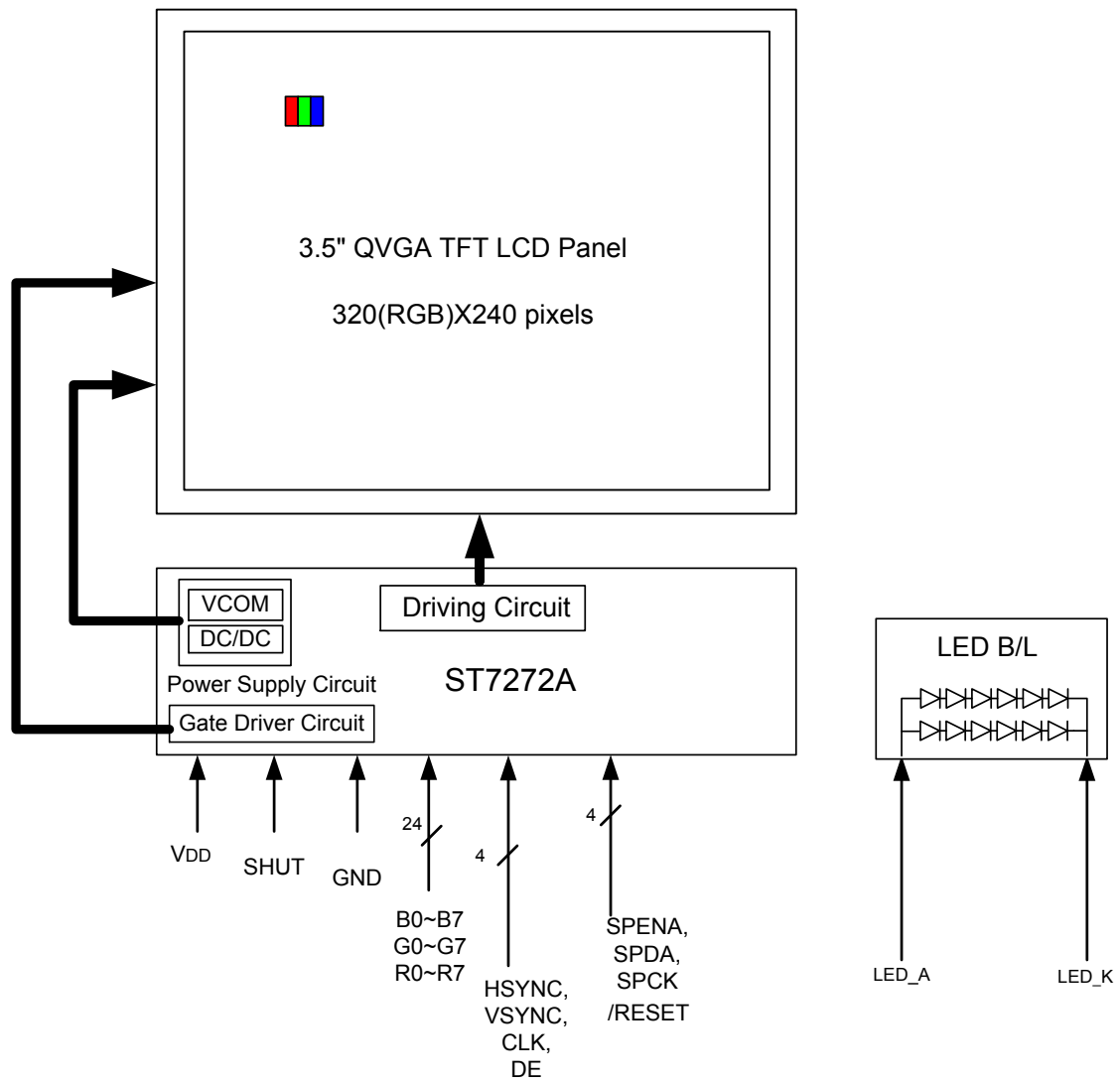
- 1.1 Construction: 3.5" IPS TFT-LCD, White LED Backlight.
- 1.2 Resolution (pixel): 320(R.G.B) X240.
- 1.3 Number of the Colors: 16.7M (R, G, B 8 bit digital each).
- 1.4 LCD type: Transmissive Color TFT LCD
- 1.5 24Bit RGB Interface/3-wire SPI interface
- 1.6 Interface: 50 pin.
- 1.7 Power Supply Voltage: 3.3V single power input. Built-in power supply circuit.

2 Physical specifications

Item	Specifications	unit
Display Resolution	320(RGB)(W) x 240(H)	dot
Active area	70.08 x 52.56	mm
Screen size	3.5(Diagonal)	inch
Pixel pitch	0.219 (W) x 0.219 (H)	mm
Color configuration	R.G.B – Vertical stripe	
Overall Dimension	76.9(W) x 63.9(H) x 3.15(T)	mm
Input interface	digital 24-bits RGB	
Backlight unit	White LED	
Display Mode	Normally Black	

Note 1: Requirements on Environmental Protection: RoHS

3 Functional Block Diagram



4 Electrical Specifications

TFT LCD Panel FPC Descriptions

Pin no	Symbol	I/O	Description	Remark
1	LED_K	P	LED backlight Cathode	
2	LED_K	P	LED backlight Cathode	
3	LED_A	P	LED backlight Anode	
4	LED_A	P	LED backlight Anode	
5	NC	--	No Connect	
6	RESET	I	low active; internal initialization procedure is executed	
7	SPENA	I	Serial communication chip selection	
8	SPCK	I	SPI Serial Clock input	
9	SPDA	I/O	SPI Serial Data input and output	
10	NC	--	No Connect	
11	B7	I	Blue Data Bit 7	
12.	B6	I	Blue Data Bit 6	
13.	B5	I	Blue Data Bit 5	
14.	B4	I	Blue Data Bit 4	
15.	B3	I	Blue Data Bit 3	
16.	B2	I	Blue Data Bit 2	
17.	B1	I	Blue Data Bit 1	
18.	B0	I	Blue Data Bit 0	
19.	G7	I	Green Data Bit 7	
20.	G6	I	Green Data Bit 6	
21.	G5	I	Green Data Bit 5	
22.	G4	I	Green Data Bit 4	
23.	G3	I	Green Data Bit 3	
24.	G2	I	Green Data Bit 2	
25.	G1	I	Green Data Bit 1	
26.	G0	I	Green Data Bit 0	
27.	R7	I	Red Data Bit 7	
28.	R6	I	Red Data Bit 6	
29.	R5	I	Red Data Bit 5	
30.	R4	I	Red Data Bit 4	
31.	R3	I	Red Data Bit 3	
32.	R2	I	Red Data Bit 2	
33.	R1	I	Red Data Bit 1	
34.	R0	I	Red Data Bit 0	
35.	CLK	I	Data Clock	

36.	HSYNC	I	Horizontal Synchronous Signal	
37.	VSYNC	I	Vertical Synchronous Signal	
38.	DEN	I	Data enabling signal	
39.	VDD	P	Power supply (3.3V)	
40	VDD	P	Power supply (3.3V)	
41	VDD	P	Power supply (3.3V)	
42	VDD	P	Power supply (3.3V)	
43	NC	--	Must keep floating.	
44	NC	--		
45	NC	--		
46	NC	--		
47	Shutdown	I	High level: Normal display mode Low level: Standby mode	
48	NC	--	No Connect	
49	GND	P	Ground	
50	GND	P	Ground	

Note 2-1:

I/O definition: I – Input O – Output P – Power/Ground

6 Absolute Maximum Ratings

(The following are maximum values which, if exceeded, may cause operation or damage to the unit.)

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	VDD	-0.3	4.0	V	
Operating Temperature	T _{OP}	-30	85	°C	
Storage Temperature	T _{ST}	-30	85	°C	

Note:

*1. Non-condensation.

*2. Temp. ≤ 60°C, 90%RH Max.

Temp. > 60°C, Absolute humidity shall be less than 90%RH.

7 Electrical Characteristics

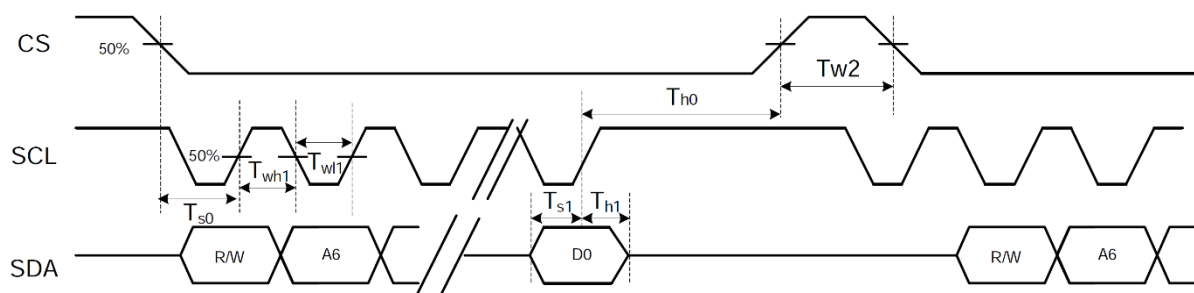
7.1 DC Electrical characteristic of the LCD

Typical operating conditions (GND=0V, Ta=25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply	VDD	3.0	3.3	3.6	V	
Input Voltage for logic	H Level	V_{IH}	$0.7 \cdot VDD$	-	VDD	V
	L Level	V_{IL}	0	-	$0.3 \cdot VDD$	V
Supply Current	RUN Mode	--	20	--	mA	FR=60Hz
	Standby mode	--	.	50	uA	

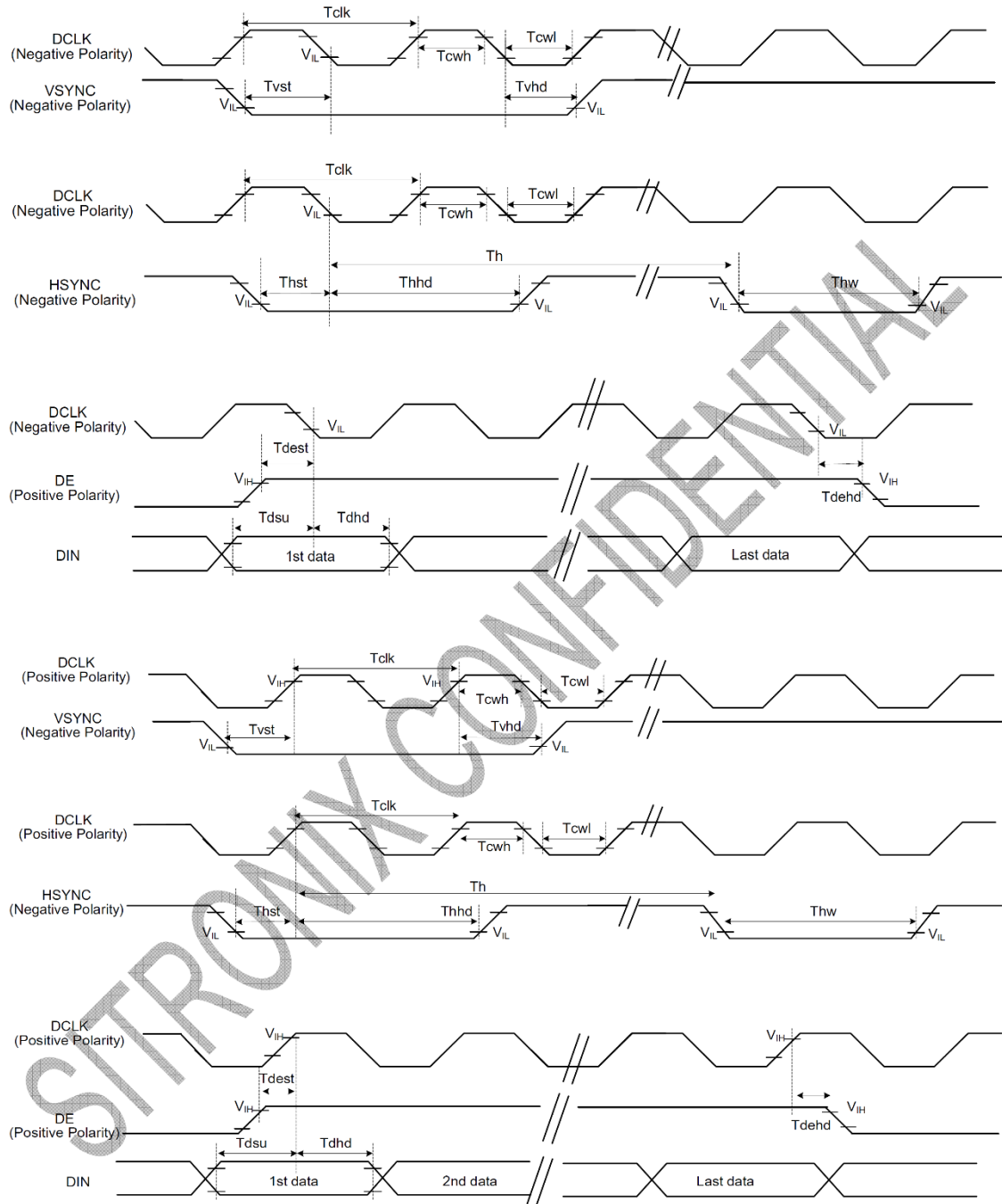
7.2 AC Electrical characteristic of the LCD

7.2.1 System Bus Timing of 3-Wire SPI interface



Item	Symbol	Min	Typ	Max	Unit	Conditions
CS Input Setup Time	T_{s0}	50	-	-	ns	
Serial Data Input Setup Time	T_{s1}	50	-	-	ns	
CS Input Hold Time	T_{h0}	50	-	-	ns	
Serial Data Input Hold Time	T_{h1}	50	-	-	ns	
SCL Write Pulse High Width	T_{wh1}	50	-	-	ns	
SCL Write Pulse Low Width	T_{wl1}	50	-	-	ns	
SCL Read Pulse High Width	T_{rh1}	300			ns	
SCL Read Pulse Low Width	T_{rl1}	300			ns	
CS Pulse High Width	T_{w2}	400	-	-	ns	

7.2.2 System Bus Timing for RGB Interface



Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK Pulse Duty	T_{clk}	40	50	60	%	
HSYNC Width	T_{hw}	2	-	-	DCLK	
HSYNC Period	T_h	55	60	65	us	
VSYNC Setup Time	T_{vst}	12	-	-	ns	
VSYNC Hold Time	T_{vhd}	12	-	-	ns	
HSYNC Setup Time	T_{hst}	12	-	-	ns	
HSYNC Hold Time	T_{hhd}	12	-	-	ns	
Data Setup Time	T_{dsu}	12	-	-	ns	
Data Hold Time	T_{dhd}	12	-	-	ns	
DE Setup Time	T_{dest}	12	-	-	ns	
DE Hold Time	T_{dehd}	12	-	-	ns	

7.3 Electrical characteristic of LED Back-light

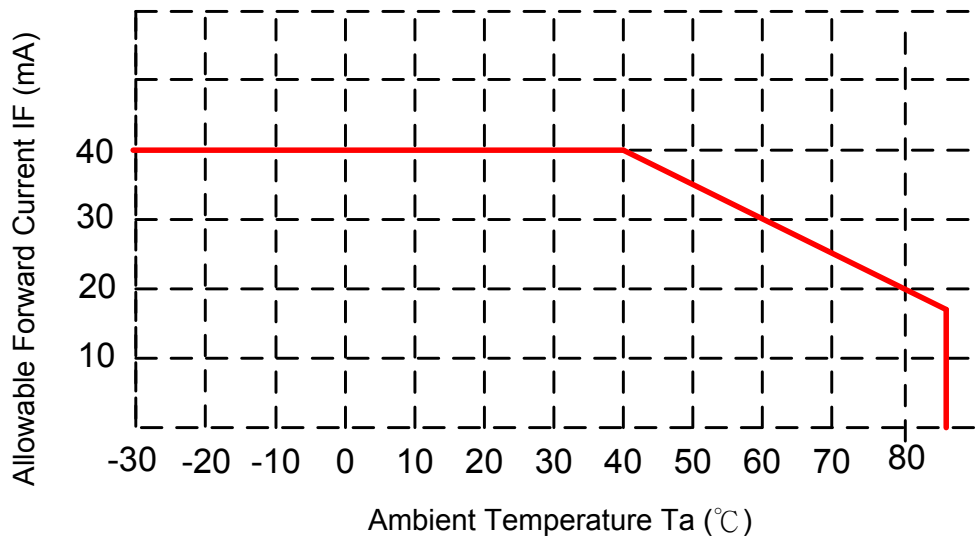
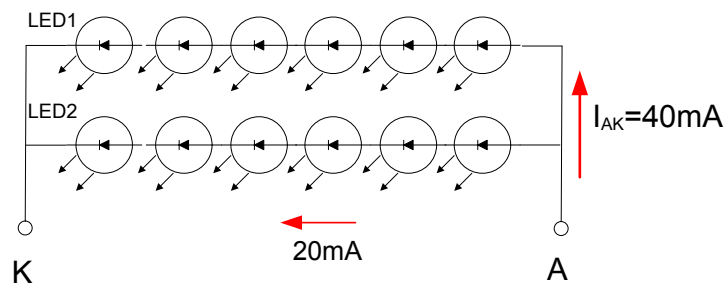
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward current	IF	-	40	--	mA	
Forward voltage	VF	-	18		V	
Power consumption	WBL	-	720	-	mW	
Operating Life time			50		kHrs	Ta=25°C

Note1: The figure below shows the connection of backlight LED.

Note2: Optical performance should be evaluated at Ta=25°C only.

Note3: IF LED is driven by high current, high ambient temperature & humidity condition, the life time of LED will be reduced.

Note4: Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.



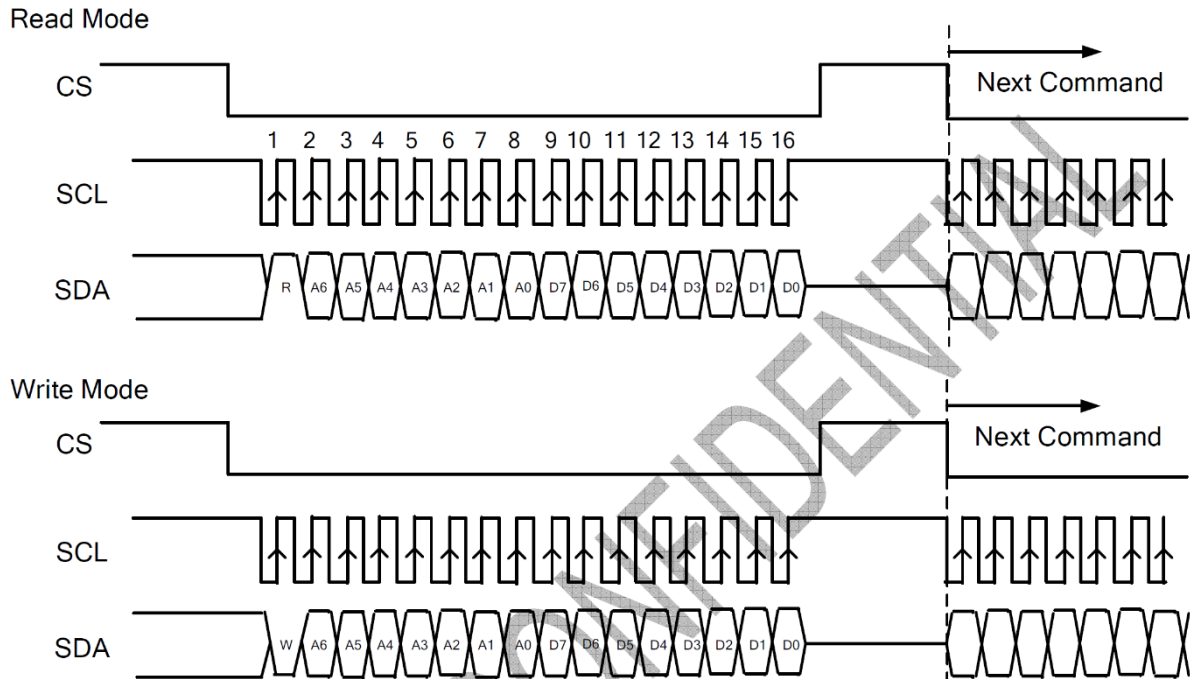
8 Communication Interface

8.1 3-wire Serial Interface

R/W: Read/Write mode control bit.

R/W=1: Read mode

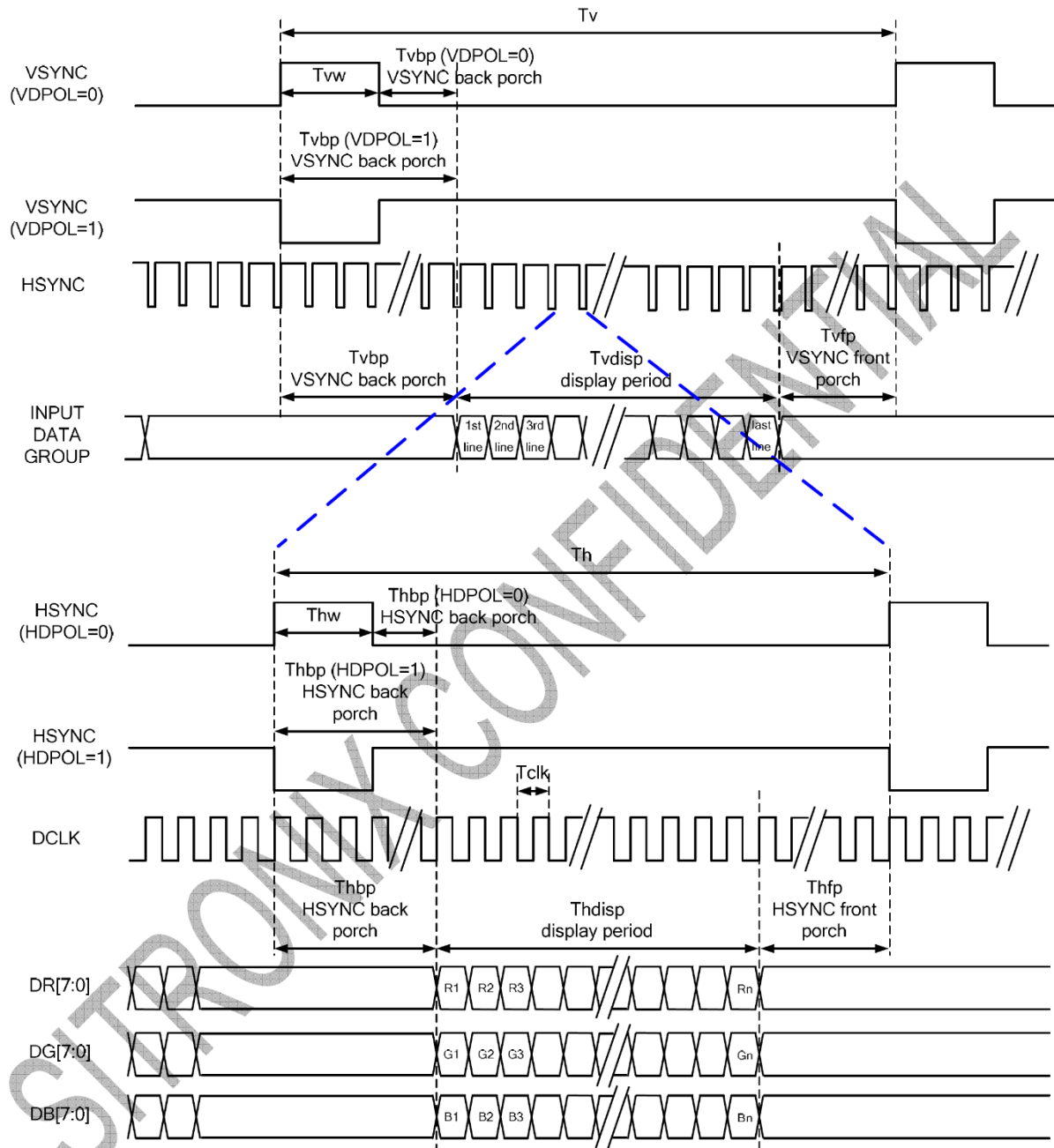
R/W=0: Write mode



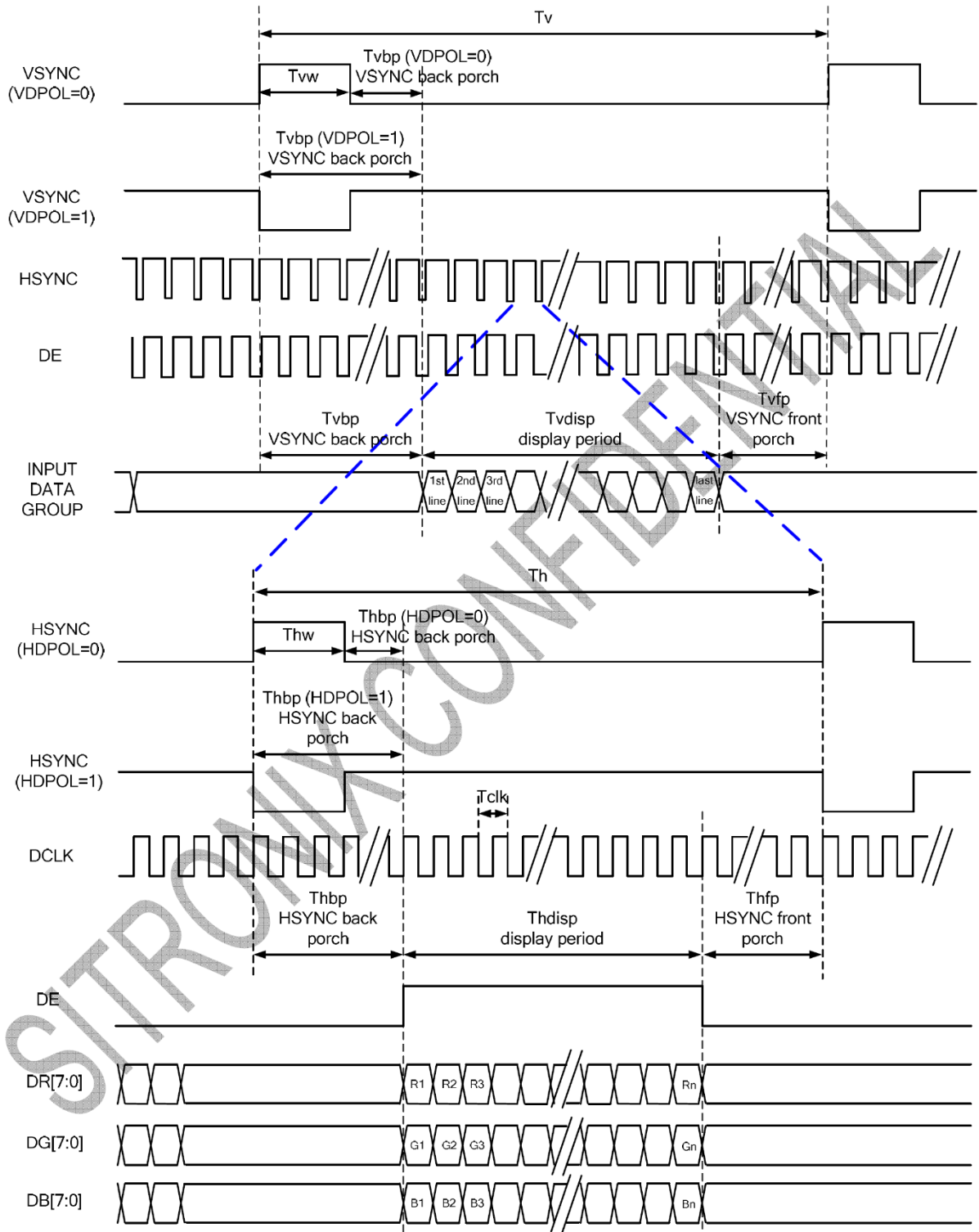
- Each serial command consists of 16 bits of data which is loaded one bit a time at the rising edge of serial clock SCL.
- Command loading operation starts from the falling edge of CS and is completed at the next rising edge of CS.
- The serial control block is operational after power on reset, but commands are established by the VSYNC signal. If command is transferred multiple times for the same register, the last command before the VSYNC signal is valid.
- If less than 16 bits of SCL are input while CS is low, the transferred data is ignored.
- If 16 bits or more of SCL are input while CS is low, the previous 16 bits of transferred data before then rising edge of CS pulse are valid data.
- Serial block operates with the SCL clock
- Serial data can be accepted in the power save mode.
- After power on reset or GRB reset, it is required 100ms delay to begin SPI communication.

8.2 RGB Interface

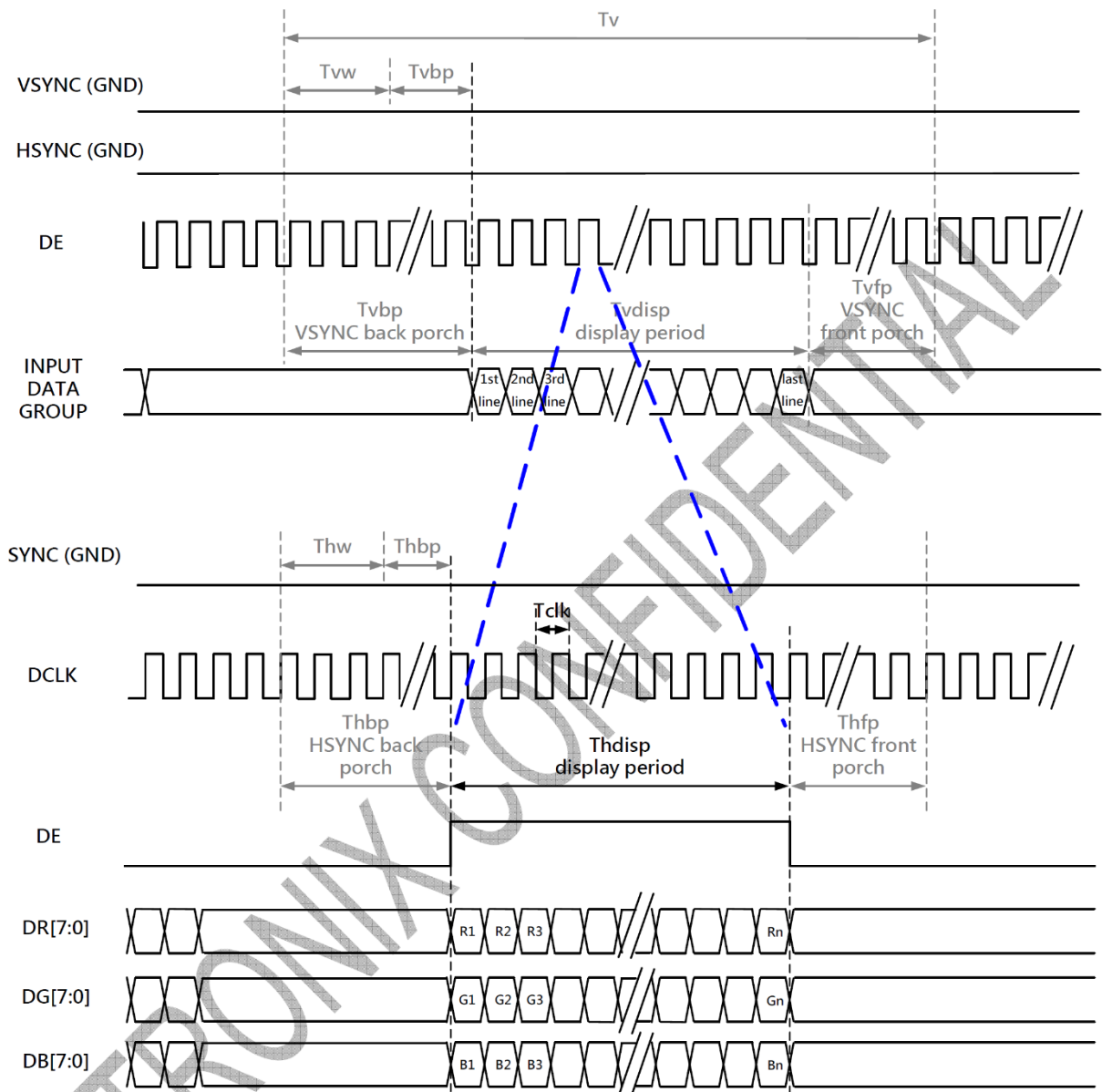
8.2.1 SYNC Mode



8.2.2 SYNC-DE Mode



8.2.3 DE Mode



RGB Mode Selection Table	DCLK	HSYNC	VSYNC	DE
SYNC - DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

Note: "Input" means these signals are driven by host side.

8.2.4 Parallel 24-bit RGB Input Timing Table

Parallel 24-bit RGB Input Timing (PVDD=VDD=VDDI= 3.3V, AGND= 0V, TA=25°C)

Serial 8-bit RGB Input Timing Table							
Item	Symbol	Min.	Typ.	Max.	Unit	Remark	
DCLK Frequency	Fclk	5	6	8	MHz		
DCLK Period	Tclk	125	167	200	ns		
HSYNC	Period Time	Th	325	371	438	DCLK	
	Display Period	Thdisp		320		DCLK	SYNC mode back porch control by H_BLANKING[7:0] setting Thbp= H_BLANKING[7:0]
	Back Porch	Thbp	3	43	43	DCLK	
	Front Porch	Thfp	2	8	75	DCLK	
	Pulse Width	Thw	2	4	43	DCLK	
VSYNC	Period Time	Tv	244	260	289	HSYNC	
	Display Period	Tvdisp		240		HSYNC	SYNC mode back porch control by V_BLANKING[7:0] setting Tvbp= V_BLANKING[7:0]
	Back Porch	Tvbp	2	12	12	HSYNC	
	Front Porch	Tvfp	2	8	37	HSYNC	
	Pulse Width	Tvw	2	4	12	HSYNC	

Note:

It is necessary to keep Tvbp =12 and Thbp =43 in sync mode. DE mode is unnecessary to keep it.

8.2.5 Serial 8-bit RGB Input Timing Table

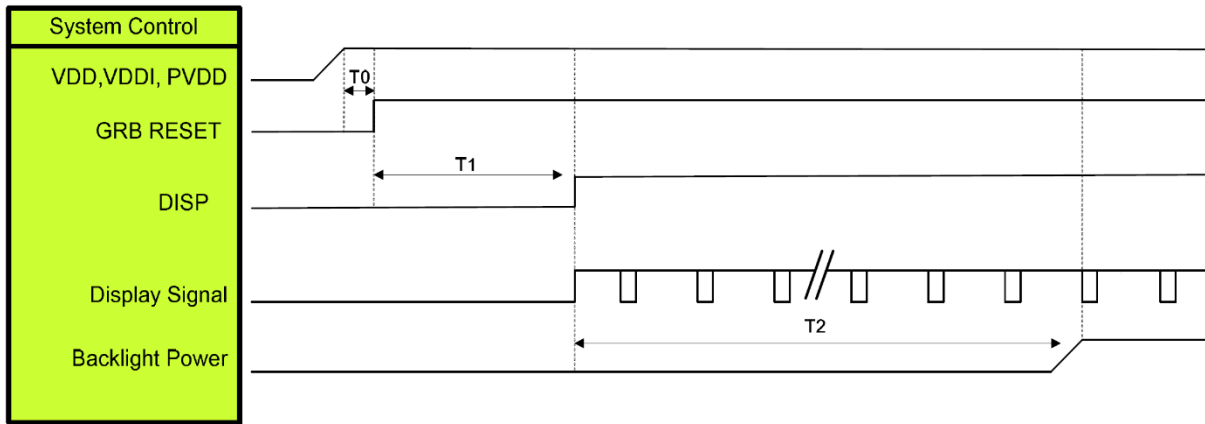
Serial 8-bit RGB Input Timing (PVDD=VDD=VDDI= 3.3V, AGND= 0V, TA=25°C)

Serial 8-bit RGB Input Timing Table							
Item	Symbol	Min.	Typ.	Max.	Unit	Remark	
DCLK Frequency	Fclk	15	18	21	MHz		
DCLK Period	Tclk	47	55	66	ns		
HSYNC	Period Time	Th	965	1011	1078	DCLK	
	Display Period	Thdisp		960		DCLK	SYNC mode back porch control by H_BLANKING[7:0] setting Thbp= H_BLANKING[7:0]
	Back Porch	Thbp	3	43	43	DCLK	
	Front Porch	Thfp	2	8	75	DCLK	
	Pulse Width	Thw	2	4	43	DCLK	
VSYNC	Period Time	Tv	244	260	289	HSYNC	
	Display Period	Tvdisp		240		HSYNC	SYNC mode back porch control by V_BLANKING[7:0] setting Tvbp= V_BLANKING[7:0]
	Back Porch	Tvbp	2	12	12	HSYNC	
	Front Porch	Tvfp	2	8	37	HSYNC	
	Pulse Width	Tvw	2	4	12	HSYNC	

Note:

It is necessary to keep Tvbp =12 and Thbp =43 in sync mode. DE mode is unnecessary to keep it.

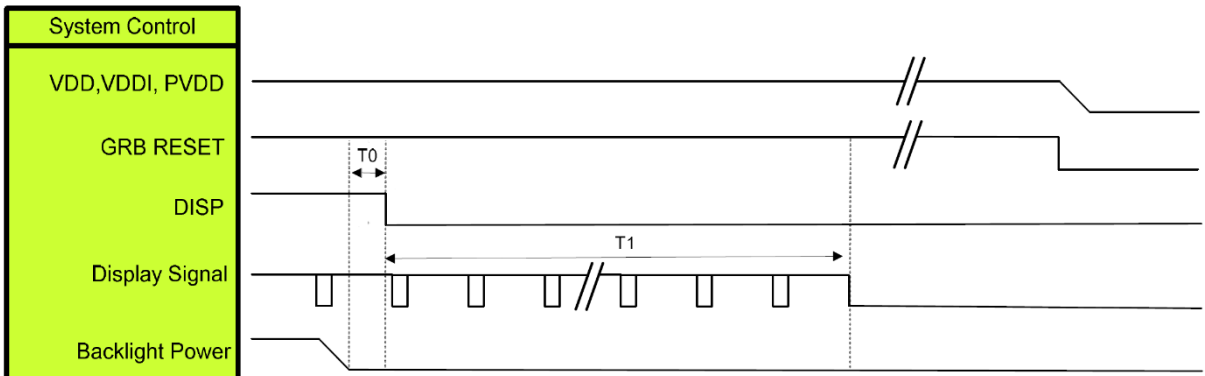
8.3 Power on sequence



Symbol	Description	Min. Time	Unit
T0	System power stability to GRB RESET signal	0	ms
T1	GRB RESET= "High" to DISP="High"	10	ms
T2	Display Signal output to Backlight Power on	250	ms

Note: Display signal: DCLK; VSYNC; HSYNC; DE; DR[7:0]; DG[7:0]; DB[7:0]

8.4 Power off sequence



Symbol	Description	Min. Time	Unit
T0	Backlight Power off to DISP="Low"	5	ms
T1	DISP="Low" to IC internal voltage discharge complete	80	ms

Note: Display signal: DCLK; VSYNC; HSYNC; DE; DR[7:0]; DG[7:0]; DB[7:0]

9 Optical specification

9.1 Optical characteristic of the LCD

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast	CR	$\Theta=0$ Normal viewing angle	640	800	—		(1)(2)	
Response time	T_{R+T_F}		—	30	40	msec	(1)(3)	
White luminance (Center)	Y_L		800	1000	—	cd/m ²	(1)(4)	
Color chromaticity (CIE1931)	White		W_x	-0.06	0.317	+0.06		(1)(4)
			W_y		0.339			
	Red		R_x		0.646			
			R_y		0.332			
	Green		G_x		0.323			
			G_y		0.567			
	Blue		B_x		0.134			
		B_y	0.121					
Viewing angle	Hor.	Θ_L	CR>10	75	85	—		
		Θ_R		75	85	—		
	Ver.	Θ_U		75	85	—		
		Θ_D		75	85	—		

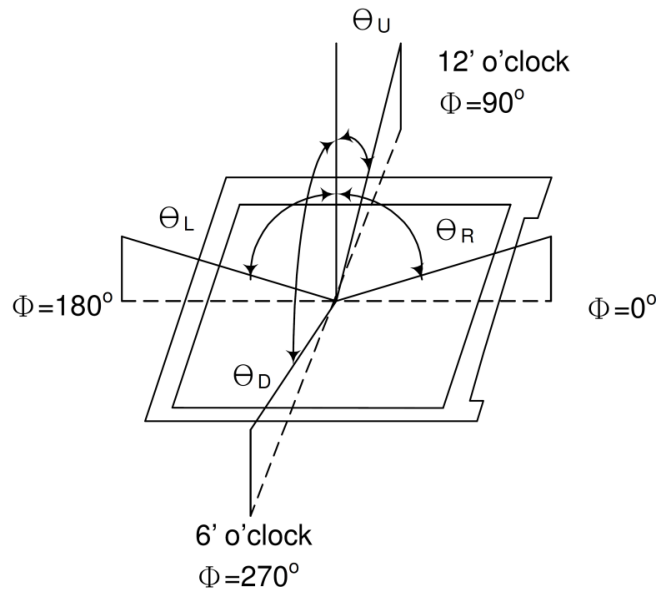
Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature : 25±2°C
- 15min. warm-up time.

Measuring Equipment

Measuring Equipment is BM-7

Note 1 Definition of viewing angle

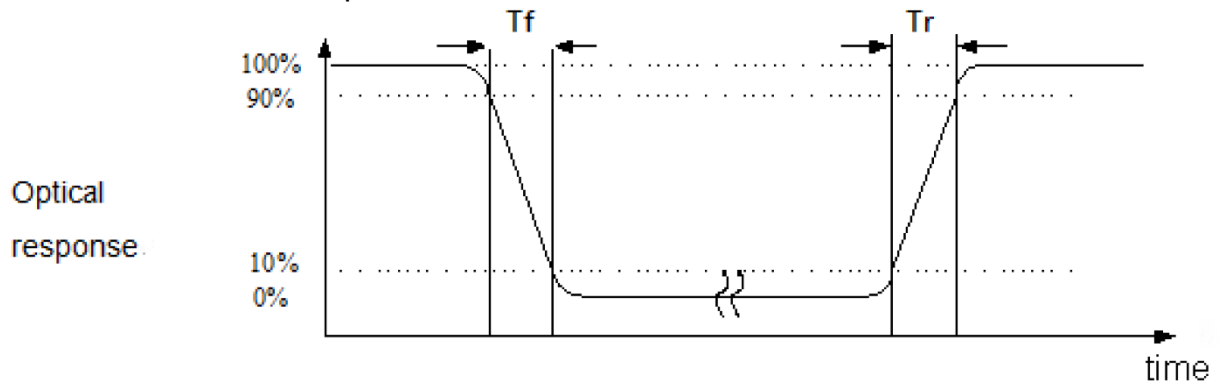


Note 2: Definition of contrast ratio (CR)

Measured at the center point of panel

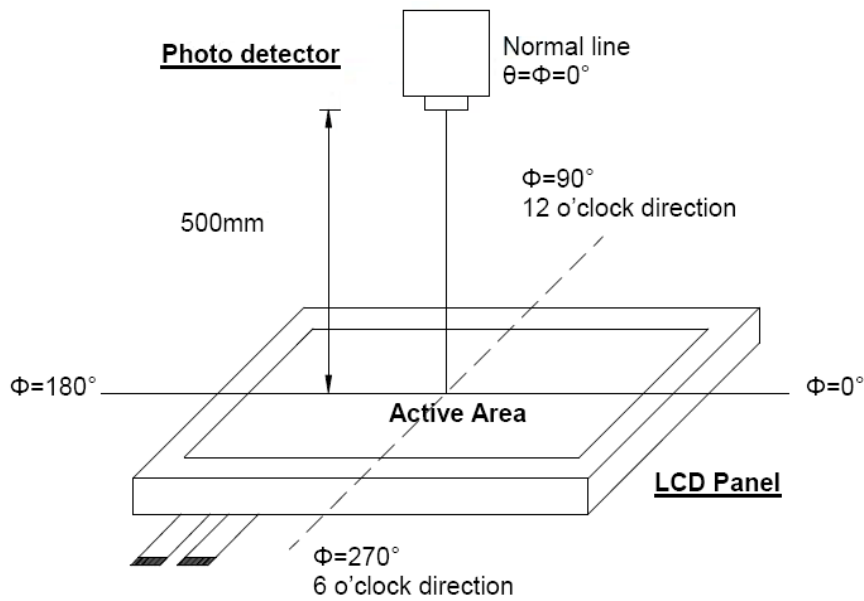
$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note 3: Definition of response time: Sum of T_R and T_F



Note 4: Definition of optical measurement setup

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/Field of view: 1° / Height: 500mm.)



10 Reliability Test

The reliability test items and its conditions are shown below.

Test Item	Test Conditions	Note
High Temperature Operation	85±3°C , t=240 hrs	
Low Temperature Operation	-30±3°C , t=240 hrs	
High Temperature Storage	85±3°C , t=240 hrs	1,2
Low Temperature Storage	-30±3°C , t=240 hrs	1,2
Storage at High Temperature and Humidity	60°C, 90% RH , 240 hrs	1,2
Vibration Test (Packing)	Sweep frequency : 10~55~10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axes Duration : 30 min/each axis	2

Note 1: Condensation of water is not permitted on the module.

Note 2: The module should be inspected after 1 hour storage in normal conditions (15-35°C, 45-65%RH).

Note 3: The module shouldn't be tested more than one condition, and all the test conditions are independent.

Note 4: All the reliability tests should be done without protective film on the module.

11 USE PRECAUTIONS

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 alcoholSolvents 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°C ~ 40°C 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.

11.4 Other

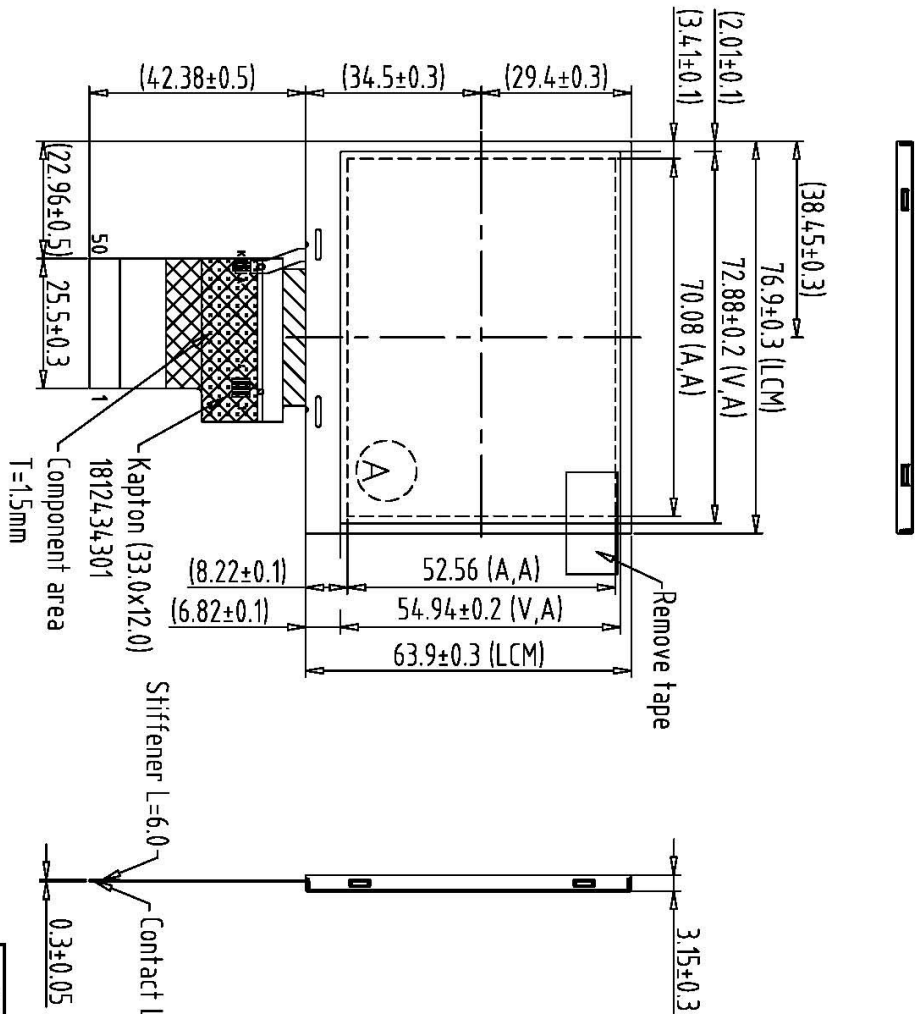
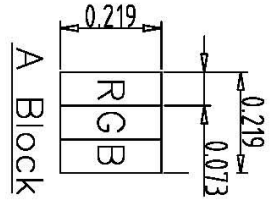
- 11.4.1. AMIPRE will provide one year warrantee for all products and three months warrantee for all repairing products.
- 11.4.2. Do not keep the LCD at the same display pattern continually. The residual image will happen and it will damage the LCD. Please use screen saver.

12 Mechanical Dimensions

1	LED_K	26	G0
2	LED_K	27	R7
3	LED_A	28	R6
4	LED_A	29	R5
5	NC	30	R4
6	RESET	31	R3
7	SPEA	32	R2
8	SPCK	33	R1
9	SPDA	34	R0
10	NC	35	CLK
11	B7	36	HSYNC
12	B6	37	VSYNC
13	B5	38	DEN
14	B4	39	VDD
15	B3	40	VDD
16	B2	41	VDD
17	B1	42	VDD
18	B0	43	NC
19	G7	44	NC
20	G6	45	NC
21	G5	46	NC
22	G4	47	Shutdown
23	G3	48	NC
24	G2	49	GND
25	G1	50	GND

Note:

1. Unless indicated, Tolerance "±0.3"
2. UV Glue For CLB Protection.



REV	REVISION RECORD	DATE	NAME
0	NEW RELEASE		M-S-SNOW
1	Rename TF320240-149-0 to 320240LQ-60		M-S-SNOW

1	320240LQ-50	7		TOLERANCE GRADE(F)	A	B	DIM.	MM	DWN.	SNOW	DATE	TITLE
2	TF320240-149-0	8					IE NO.		CHK.		DATE	320240LQ-60
3		9					PARTS NO. LCM	320240LQ-60	APPD.		DATE	(3.5") IPS
4		10									DATE	SHEET 1 OF 1
5		11									DATE	
6		12									DATE	

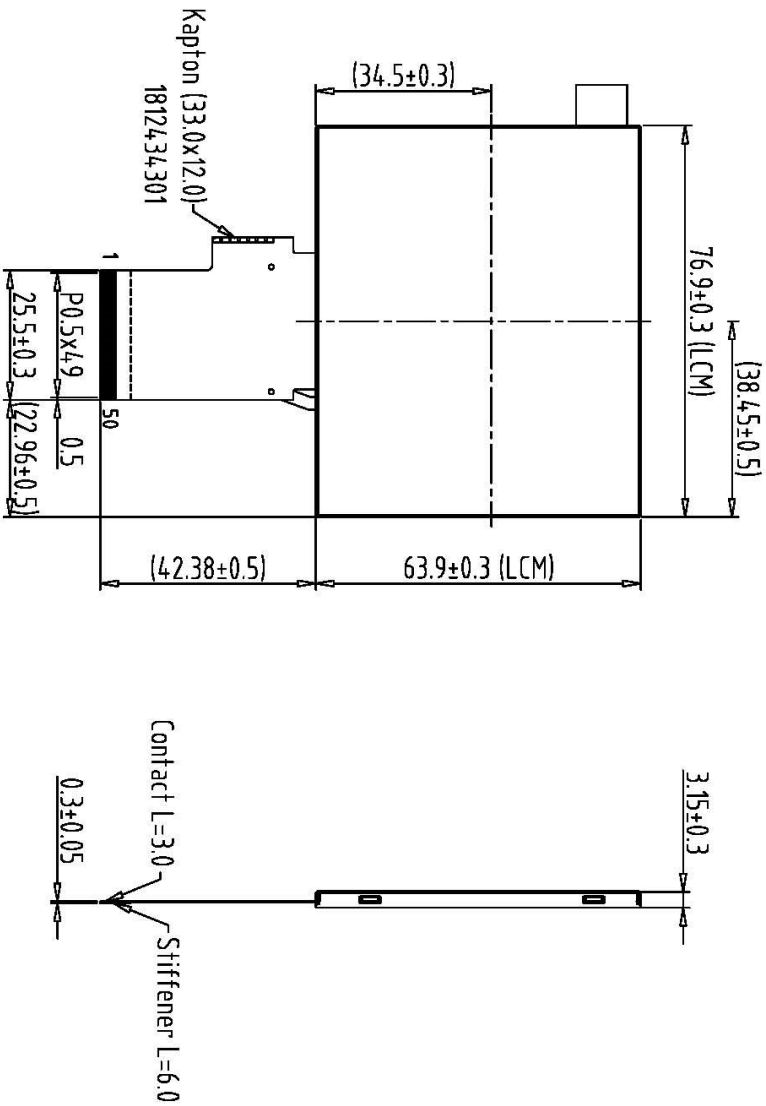
AMPIRE 晶采光電科技

REV	REVISION RECORD	DATE	NAME
0	NEW RELEASE		H-B-SNOW
1	Rename TF320240-149-0 to 320240LQ-60		H-B-SNOW

1	LED_K	26	G0
2	LED_K	27	R7
3	LED_A	28	R6
4	LED_A	29	R5
5	NC	30	R4
6	RESET	31	R3
7	SPENA	32	R2
8	SPCK	33	R1
9	SPDA	34	R0
10	NC	35	CLK
11	B7	36	HSYNC
12	B6	37	VSYNC
13	B5	38	DEN
14	B4	39	VDD
15	B3	40	VDD
16	B2	41	VDD
17	B1	42	VDD
18	B0	43	NC
19	G7	44	NC
20	G6	45	NC
21	G5	46	NC
22	G4	47	Shutdown
23	G3	48	NC
24	G2	49	GND
25	G1	50	GND

Note:

1. Unless indicated, Tolerance "±0.3"
2. UV Glue For OLB Protection.



Back View

1	320240LQ-50	7		TOLERANCE	GRADE(±)	A	B	DIM.	MM	DWN.	SNOW	DATE	TITLE
2	TF320240-149-0	8										10-05-18	320240LQ-60
3		9						IE NO.		CHEK.		DATE	(3.5") IPS
4		10						PARTS NO.	LQM-1APPD.			DATE	DWG. NO.
5		11						320240LQ-60				DATE	*181039MA
6		12										DATE	SHEET 1 OF 1

AMPIRE 晶采光电科技