LMT035DNJFWD-NAN

LCD Module User Manual

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Date: 2023-08-31	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary New release	2020-06-22
0.2	Update Electrical Characteristics	2020-07-16
0.3	Add interface mode selection	2022-07-06
0.4	Update Basic Specifications and the hardware system interface selection of the 1.2 terminal function	2023-03-29
0.5	Modify 1.2 Terminal Function Description，Unified I/O voltage name	2023-04-12
0.6	Modify 1.2 Hardware system interface select of 4-SPI，Remove CTP /RTP Mounting Instructions for 7 and 8	2023-08-31

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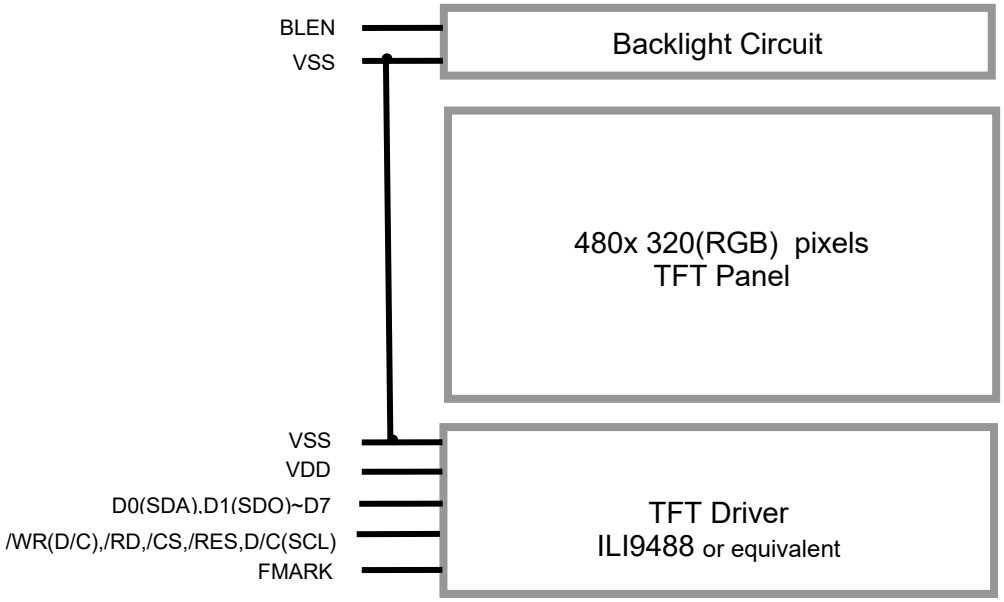
1. Basic Specifications

Screen Size(Diagonal) :	3.5”
Active Area :	48.96x73.44(mm)
Number of dots :	480x320(RGB)
Pixel Pitch：	0.153x0.153(mm)
Color Depth:	65K/262K Color
Display Technology :	a-Si TFT active matrix
Display Mode :	Transmissive With Normally white
Display Interface :	RGB
Viewing Direction :	3 o’ clock (gray scale inverse)(*1)
	9 o’ clock (*2)
Polarizer Surface Treatment:	HC
Operating Temperature :	-20 ~ +70°C (No Condensation)
Storage Temperature :	-30 ~ +80°C (No Condensation)

Note:

*1. For saturated color display content (eg. pure-red, pure-green, pure-blue or pure-colors-combinations).
*2. For “color scales” display content.
*3. Color tone may slightly change by temperature and driving condition.

1.1 Block Diagram



1.2 Terminal Functions

Pin No. (K1)	Pin Name	I/O	Descriptions		
			80-8bit(default)	3-SPI	4-SPI
1	VSS	P	Negative power supply,0V		
2	VSS				
3	BLEN	I	Backlight enable BLEN = H: turn off Backlight BLEN = L: turn on Backlight (*1)		
4	VDD	P	Positive power supply		
5	VDD				
6	/RD	I	Read enable input, active low	Please fix this pin at IOVCC	
7	/WR(D/C)	I	Write enable input, active low	Please fix this pin at IOVCC.	Display data/command selection pin in 4-line serial interface.
8	D/C(SCL)	I	Register Select D/C=H, Transferring the Display Data D/C = L, Transferring the Control Data	This pin is used to be serial interface clock.	
9	/CS	I	Chip Select /CS=L, enable access to the LCD module /CS=H, disable access to the LCD module		
10	D0(SDA)	I/O	Data Input	The data is latched on the rising edge of the SCL signal.	
11	D1(SDO)	I/O		SPI interface output pin. The data is output on the rising edge of the SCL signal.	
:	:	:		Please fix this pin at IOVCC or GND level.	
17	D7	I/O			
18	/RES	I	Reset signal /RES = L, Initialization is executed /RES = H, Normal running.		
19	FMARK	O	Displaying Timing Frame Signal		
20~28	NC	-	-		

Hardware system interface select

Mode	Install	No install
80-8bit (default)	R23,R24(0R,0603,5%)	R22,R25
3-SPI	R22,R25,R7,R8,R9,R10(100R,0603,5%)	R23,R24,R2,R3
4-SPI	R22,R24,R7,R8,R9,R10,R11(100R,0603,5%)	R23,R25,R2,R3

Note:
*1 :The PWM frequency is between 2k Hz and 10kHz.

2. Absolute Maximum Ratings

VDD =5V, VSS=0V, T_{OP}=25 C

Items	Symbol	Min.	Max.	Unit	Condition
Power Voltage	VDD	-0.3	+5.5	V	V_{SS} = 0V
Input Voltage	V_{IN}	-0.3	+5.5	V	V_{SS} = 0V
Operating Temperature	T_{OP}	-20	+70	°C	No Condensation
Storage Temperature	T_{ST}	-30	+80	°C	No Condensation

Cautions:
Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

3. Electrical Characteristics

3.1 DC Characteristics

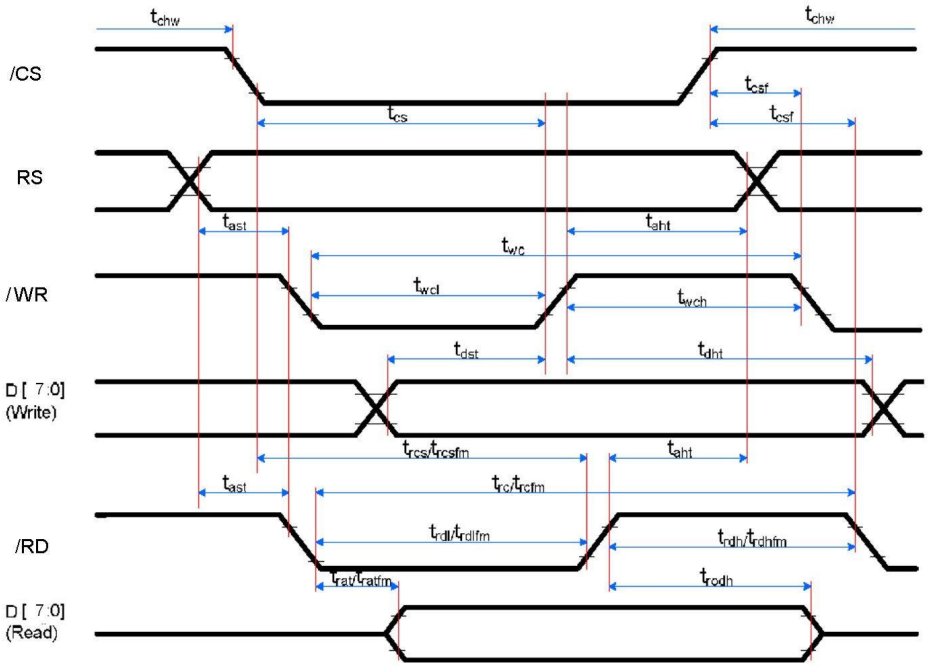
VDD =5V, IOVCC=3.3V,VSS=0V, T_{OP}=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition / Application Pin
Operating Voltage	VDD	4.8	5.0	5.2	V	VDD
Input High Voltage	V_{IH}	0.7*IOVCC	-	IOVCC	V	/RES,D0(SDA), D1(SDO)~D7 /CS,/RD,/WR,BLEN, D/C(SCL)
Input Low Voltage	V_{IL}	-0.3	-	0.3*IOVCC	V	
Output High Voltage	V_{OH}	0.8*IOVCC	-	IOVCC	V	D0~D7, SDO,FMARK
Output Low Voltage	V_{OL}	0	-	0.2*IOVCC	V	
Operating Current	I_{DD}	-	105	-	mA	Backlight are ON
		-	4.8	-	mA	Backlight are OFF

4. AC Characteristics

4.1 DBI Type B

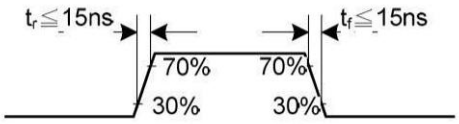
4.1.1 DBI Type B Timing Characteristic



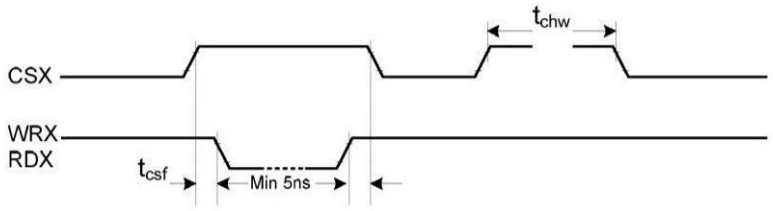
Signal	Symbol	Parameter	min	max	Unit	Description
RS	tast	Address setup time	0	-	ns	-
	that	Address hold time (Write/Read)	0	-	ns	-
/CS	tchw	CSX "H" pulse width	0	-	ns	-
	tcs	Chip Select setup time (Write)	19	-	ns	-
	trcs	Chip Select setup time (Read ID)	58	-	ns	-
	trcsfm	Chip Select setup time (Read FM)	461	-	ns	-
	tcsf	Chip Select Wait time (Write/Read)		-	ns	-
/WR	twc	Write cycle	52	-	ns	-
	twrh	Write Control pulse H duration	19	-	ns	-
	twrl	Write Control pulse L duration	19	-	ns	-
/RD(FM)	trcfm	Read Cycle (FM)	585	-	ns	When read from Frame Memory
	trdhfm	Read Control H duration (FM)	117	-	ns	
	trdlfm	Read Control L duration (FM)	461	-	ns	
/RD(ID)	trc	Read cycle (ID)	208	-	ns	When read ID data
	trdh	Read Control pulse H duration	117	-	ns	
	trdl	Read Control pulse L duration	58	-	ns	
D[7:1]	tdst	Write data setup time	13	-	ns	For maximum, CL=30pF For minimum, CL=8pF
	tdht	Write data hold time	13	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Notes:

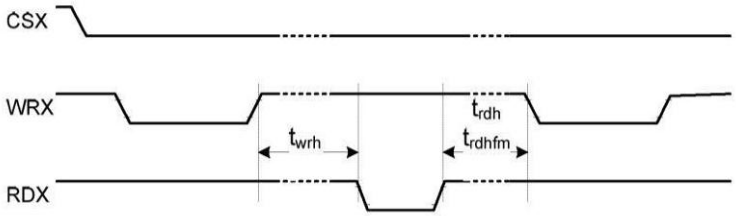
1. Ta = -30 to 70 ℃, IOVCC、VDD= 2.5V to 3.3V, VSS = 0V
2. Logic high and low levels are specified as 30% and 70% of IOVCC for input signals.
3. Input signal rising time and falling time:



4. The CSX timing:

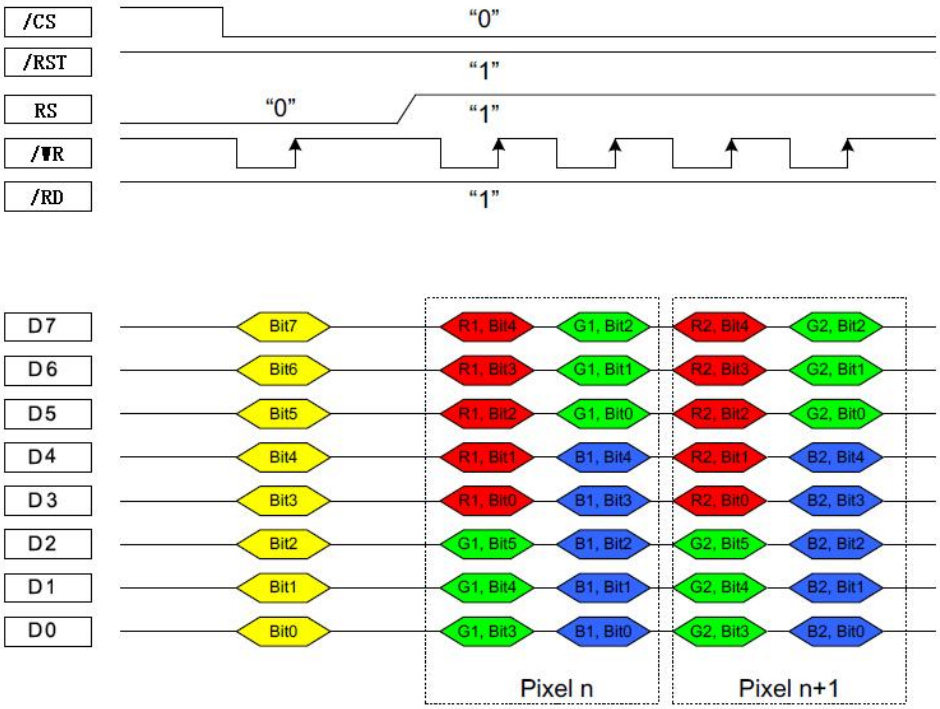


5. The Write to Read or the Read to Write timing:

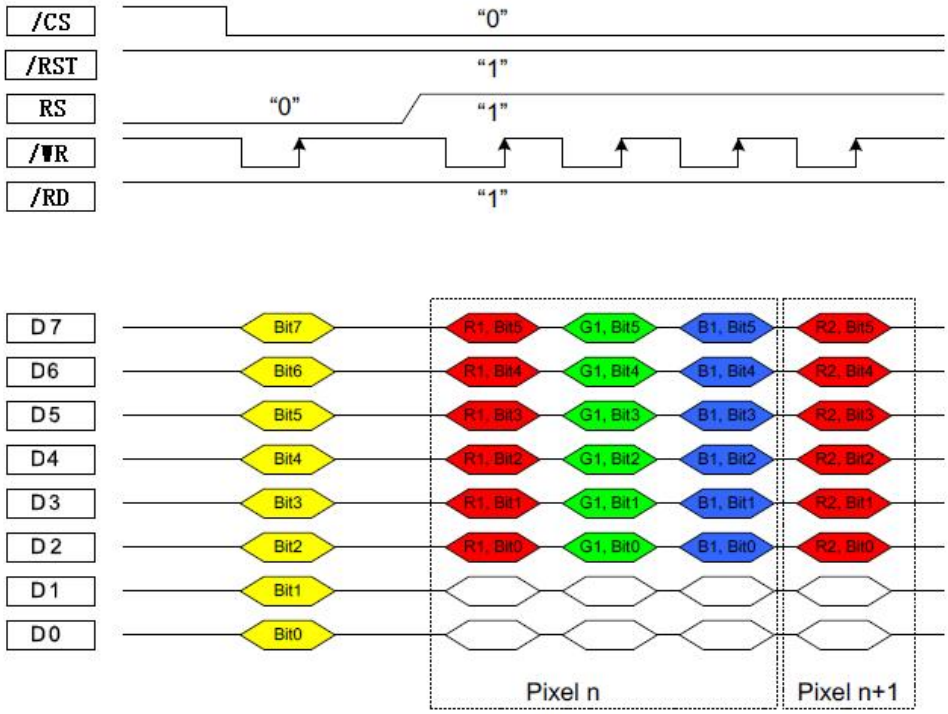


4.1.2 DBI Type B Data Bus

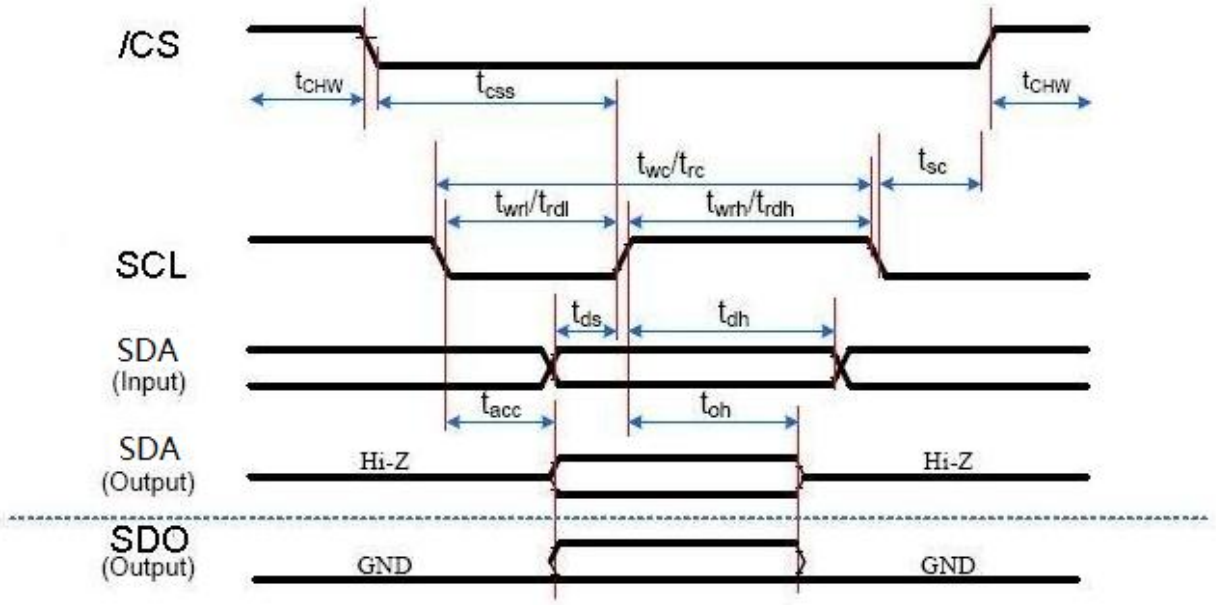
8-bit Data Bus for 16-bit/pixel (RGB 5-6-5 Bits Input), 65K-color



8-bit Data Bus for 18-bit/pixel (RGB 6-6-6 Bits Input), 262K-color

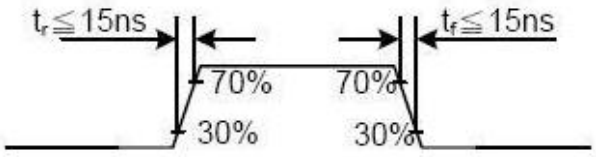


4.2 3-Line SPI Interface Timing Characteristic

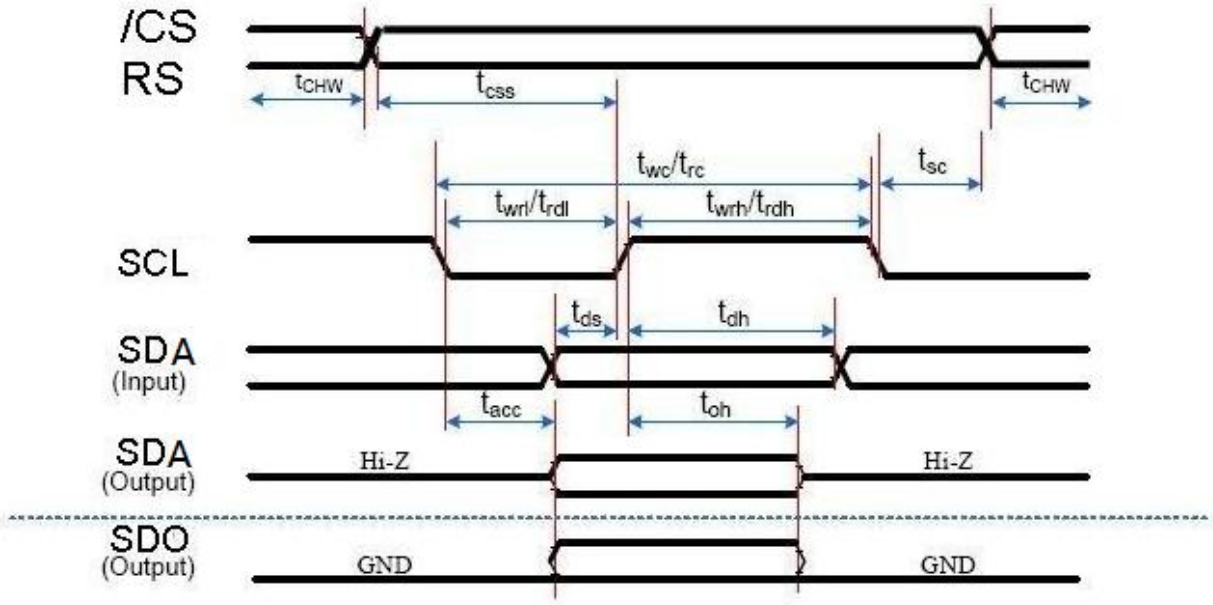


Signal	Symbol	Parameter	min	max	Unit	Description
/CS	tsc	SCL- /CS	19	-	ns	
	tchw	/CS H Pulse Width	52	-	ns	
	tcss	Chip select time (Write)	88	-	ns	
	tcsh	Chip select hold time (Read)	84	-	ns	
SCL	twc	Serial Clock Cycle (Write)	85	-	ns	
	twrh	SCL H Pulse Width (Write)	19	-	ns	
	twrl	SCL L Pulse Width (Write)	19	-	ns	
	trc	Serial Clock Cycle (Read)	195	-	ns	
	trdh	SCL H Pulse Width (Read)	78	-	ns	
	trdl	SCL L Pulse Width (Read)	78	-	ns	
SDA (Input)	tds	Data setup time (Write)	13	-	ns	
	tdh	Data hold time (Write)	13	-	ns	
SDA/SDO (Output)	tacc	Access time (Read)	13	65	ns	For maximum CL=30pF
	toh	Output disable time (Read)	19	35	ns	For minimum CL=8pF

Note: Ta = -30 to 70 °C, IOVCC、VDD= 2.5V to 3.3V, VSS = 0V, T = 10+/-0.5ns

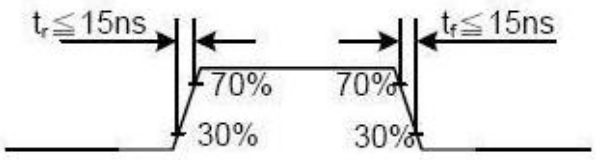


4.3 4-Line SPI Interface Timing Characteristic

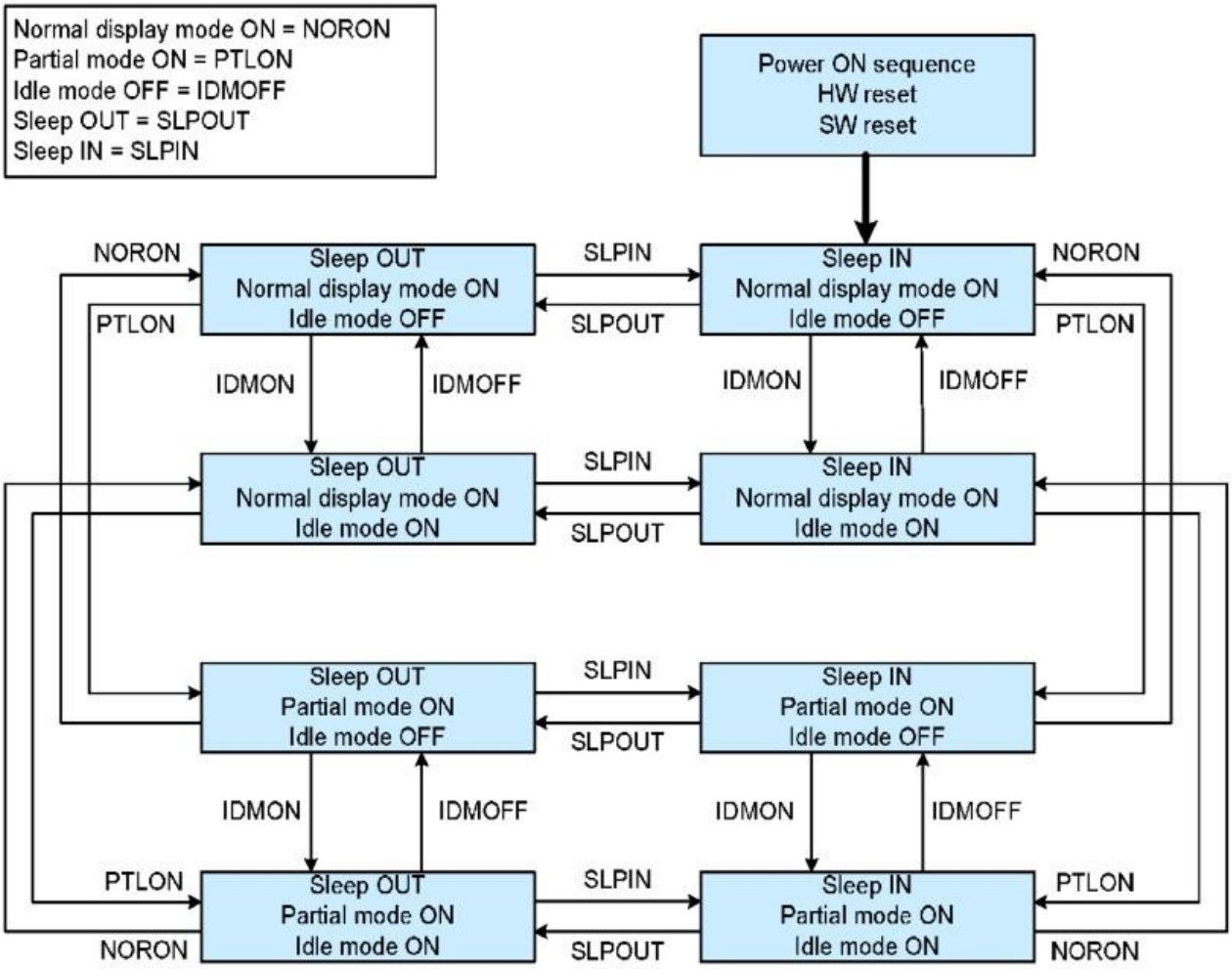


Signal	Symbol	Parameter	min	max	Unit	Description
/CS	tsc	SCL- /CS	19	-	ns	
	tchw	/CS H Pulse Width	52	-	ns	
	tcss	Chip select time (Write)	88	-	ns	
	tcsh	Chip select hold time (Read)	84	-	ns	
SCL	twc	Serial Clock Cycle (Write)	85	-	ns	
	twrh	SCL H Pulse Width (Write)	19	-	ns	
	twrl	SCL L Pulse Width (Write)	19	-	ns	
	trc	Serial Clock Cycle (Read)	195	-	ns	
	trdh	SCL H Pulse Width (Read)	78	-	ns	
	trdl	SCL L Pulse Width (Read)	78	-	ns	
SDA (Input)	tds	Data setup time (Write)	13	-	ns	
	tdh	Data hold time (Write)	13	-	ns	
SDA/SDO (Output)	tacc	Access time (Read)	13	65	ns	For maximum CL=30pF
	toh	Output disable time (Read)	34	35	ns	For minimum CL=8pF

Note: Ta = -30 to 70 °C, IOVCC、VDD= 2.5V to 3.3V, VSS = 0V, T = 10+/-0.5ns



4.5 Power ON/OFF Sequence



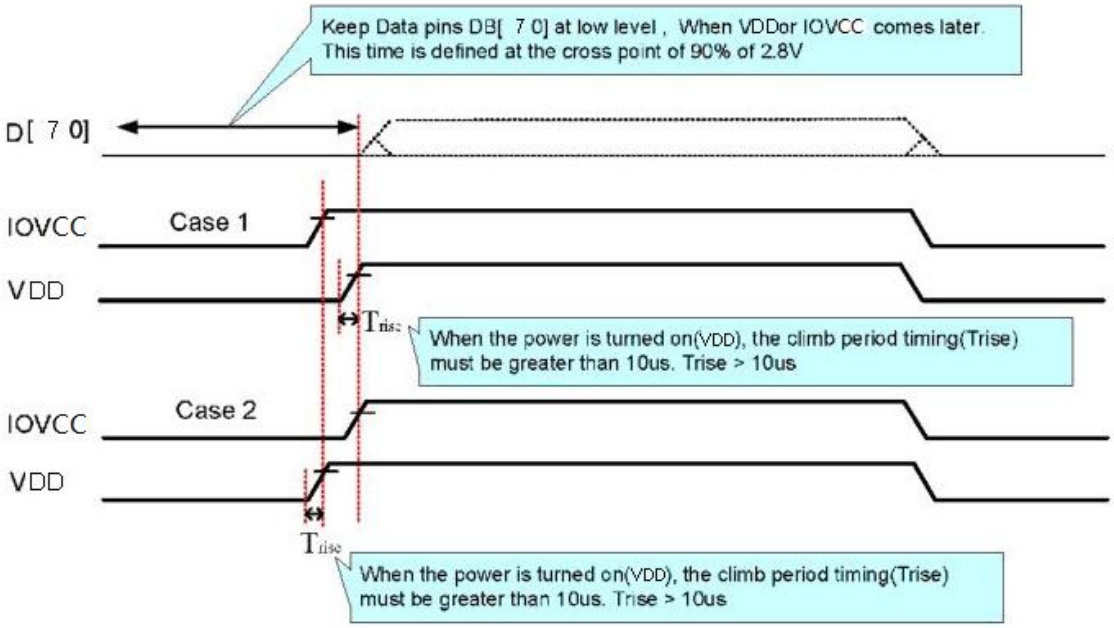
Notes:

1. There are not any abnormal visual effects when one power mode changes to another power mode.
2. There is not any limitation, which is not specified by users, when one power mode changes to another power mode.

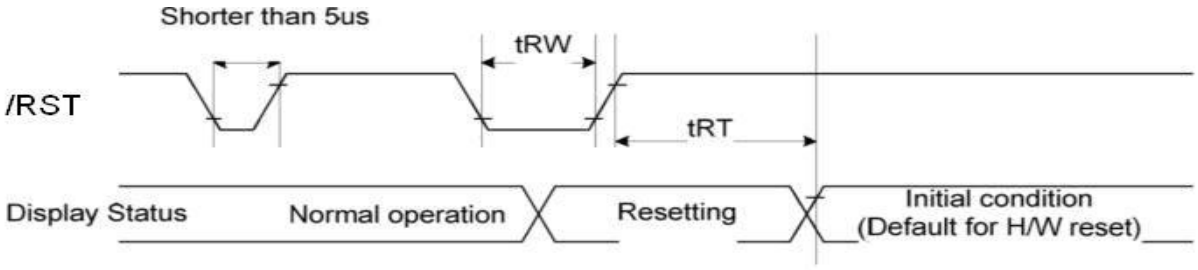
IOVCC and VDD can be applied or powered down in any order. During the Power Off sequence ,if the LCD is in the Sleep In mode, VDD and IOVCC must be powered down with a minimum of 120 msec.If the LCD is in the Sleep In mode, VDD and IOVCC can be powered down with a minimum of 0msec after the /RST has been released. /CS can be applied at any time or can be permanently grounded. /RST has priority over /CS.

Notes:

1. There will be no damage to the ILI9488 if the power sequences are not met.
2. There will be no abnormal visible effects on the display panel during the Power On/Off Sequence.
3. There will be no abnormal visible effects on the display between the end of the Power On Sequence and before receiving the Sleep Out command, and also between receiving the Sleep In command and the Power Off Sequence.
4. If the /RST line is not steadily held by the host during the Power On Sequence as defined in Sections 11.1 and 11.2 (ILI9488 datasheet), then it will be necessary to apply the Hardware /RST after the completion of the Host Power On Sequence to ensure correct operations. Otherwise, all the functions are not guaranteed.
5. When the power is turned on, the climb period timing (Trise) must be greater than 10us.
6. Keep data pins D[17:0] at low level, or IOVCC comes later



4.6 Reset timing



Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset LOW pulse width	t_{RW}	1.0	-	-	us
Reset time	T_{RT}	-	-	120	ms

5 . Optical Characteristics

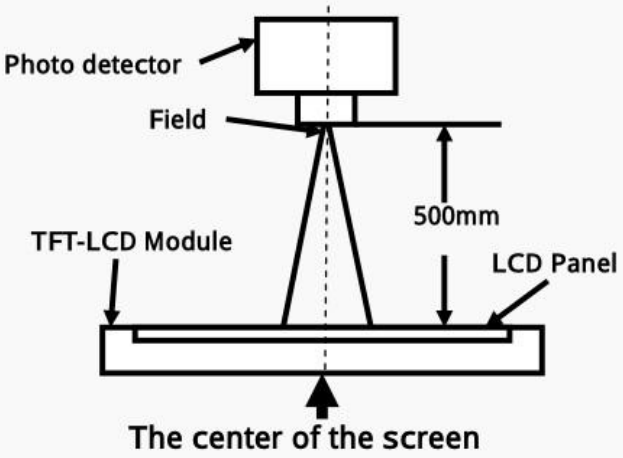
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	60	70		Degree	Note2,3
		θB		50	60			
		θL		60	70			
		θR		60	70			
Contrast Ratio		CR	θ=0°	400	500			Note 3
Response Time		T_{ON}	25℃		25	35	ms	Note 4
		T_{OFF}						
Chromaticity	White	x	Backlight is on		0.286			Note 1,5
		y			0.304			
	Red	x			0.608			Note 1,5
		y			0.336			
	Green	x			0.341			Note 1,5
		y			0.604			
	Blue	x			0.146			Note 1,5
		y			0.073			
Uniformity		U			80		%	Note 6
NTSC					60		%	Note 5
Luminance		L		250			cd/m^2	Note 7

Test Conditions:

1. I_{BLA} = 120 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.

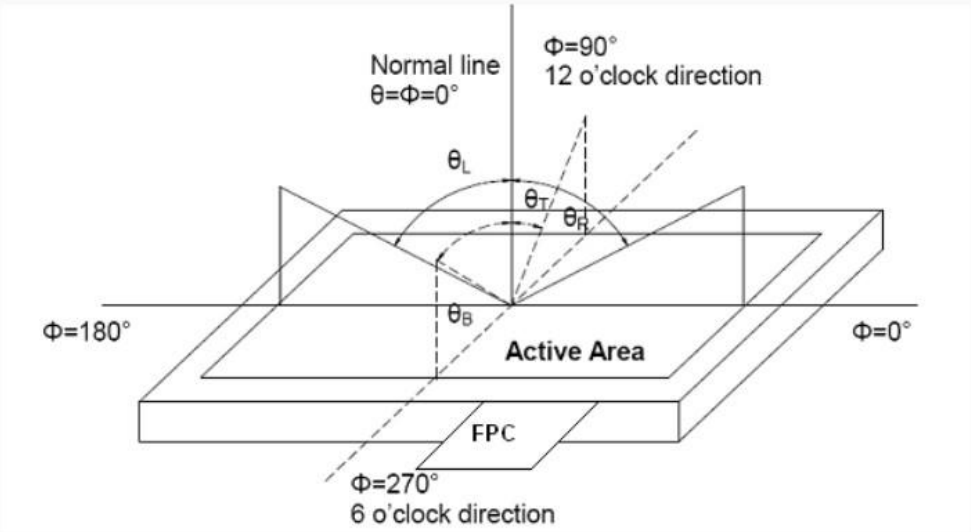
The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

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)。



Note 3: Definition of contrast ratio

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

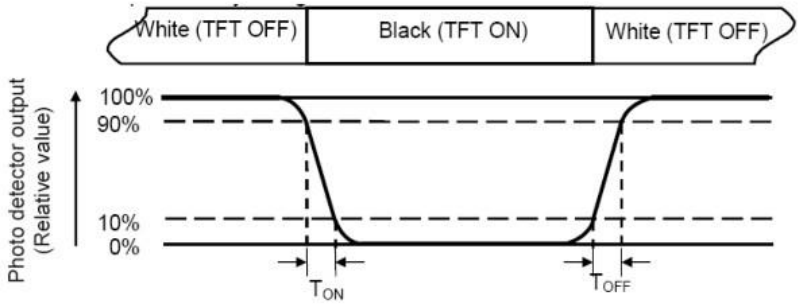
"White state ": The state is that the LCD should drive by Vwhite.

"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)

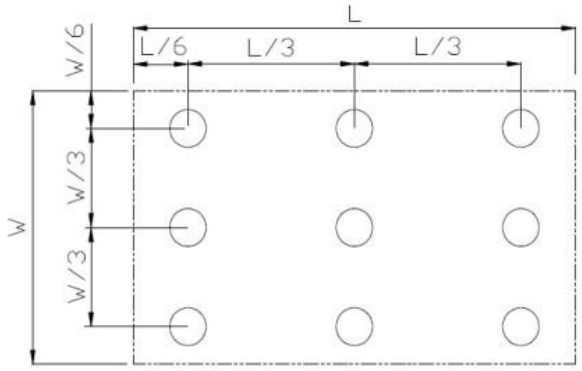
Color coordinates measured at center point of LCD.

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.

6. LCD Module Design and Handling Precautions

- Please ensure V0, VCOM is adjustable, to enable LCD module get the best contrast ratio under different temperatures, view angles and positions.

- Normally display quality should be judged under the best contrast ratio within viewable area. Unexpected display pattern may com out under abnormal contrast ratio.
- Never operate the LCD module exceed the absolute maximum ratings.
- Never apply signal to the LCD module without power supply.

- Keep signal line as short as possible to reduce external noise interference.
- IC chip (e.g. TAB or COG) is sensitive to light. Strong light might cause malfunction. Light sealing structure casing is recommended.

- Make sure there is enough space (with cushion) between case and LCD panel, to prevent external force passed on to the panel; otherwise that may cause damage to the LCD and degrade its display result.
- Avoid showing a display pattern on screen for a long time (continuous ON segment).

- LCD module reliability may be reduced by temperature shock.
- When storing and operating LCD module, avoids exposure to direct sunlight, high humidity, high or low temperature. They may damage or degrade the LCD module.
- Never leave LCD module in extreme condition (max./min storage/operate temperature) for more than 48hr.
- Recommend LCD module storage conditions is 0℃~40℃<80%RH.
- LCD module should be stored in the room without acid, alkali and harmful gas.
- Avoid dropping & violent shocking during transportation, and no excessive pressure press, moisture and sunlight.
- LCD module can be easily damaged by static electricity. Please maintain an optimum anti-static working environment to protect the LCD module. (eg. ground the soldering irons properly)
- Be sure to ground the body when handling LCD module.
- Only hold LCD module by its sides. Never hold LCD module by applying force on the heat seal or TAB.
- When soldering, control the temperature and duration avoid damaging the backlight guide or diffuser which might degrade the display result such as uneven display.
- Never let LCD module contact with corrosive liquids, which might cause damage to the backlight guide or the electric circuit of LCD module.
- Only clean LCD with a soft dry cloth, Isopropyl Alcohol or Ethyl Alcohol. Other solvents (e.g. water) may damage the LCD.
- Never add force to components of LCD module. It may cause invisible damage or degrade the module's reliability.
- When mounting LCD module, please make sure it is free from twisting, warping and bending.

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- Do not add excessive force on surface of LCD, which may cause the display color change abnormally.
- LCD panel is made with glass. Any mechanical shock (e.g. dropping from high place) will damage the LCD module.
- Protective film is attached on LCD screen. Be careful when peeling off this protective film, since static electricity may be generated.
- Polarizer on LCD gets scratched easily. If possible, do not remove LCD protective film until the last step of installation.
- When peeling off protective film from LCD, static charge may cause abnormal display pattern. The symptom is normal, and it will turn back to normal in a short while.
- LCD panel has sharp edges, please handle with care.
- Never attempt to disassemble or rework LCD module.
- If display panel is damaged and liquid crystal substance 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.

Warranty

This product has been manufactured to our company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

- We cannot accept responsibility for any defect, which may arise form additional manufacturing of the product (including disassembly and reassembly), after product delivery.
- We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
- We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed our company's acceptance inspection procedures.
- When the product is in CCFL models, CCFL service life and brightness will vary according to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.
- We cannot accept responsibility for intellectual property of a third part, which may arise through the application of our product to our assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.

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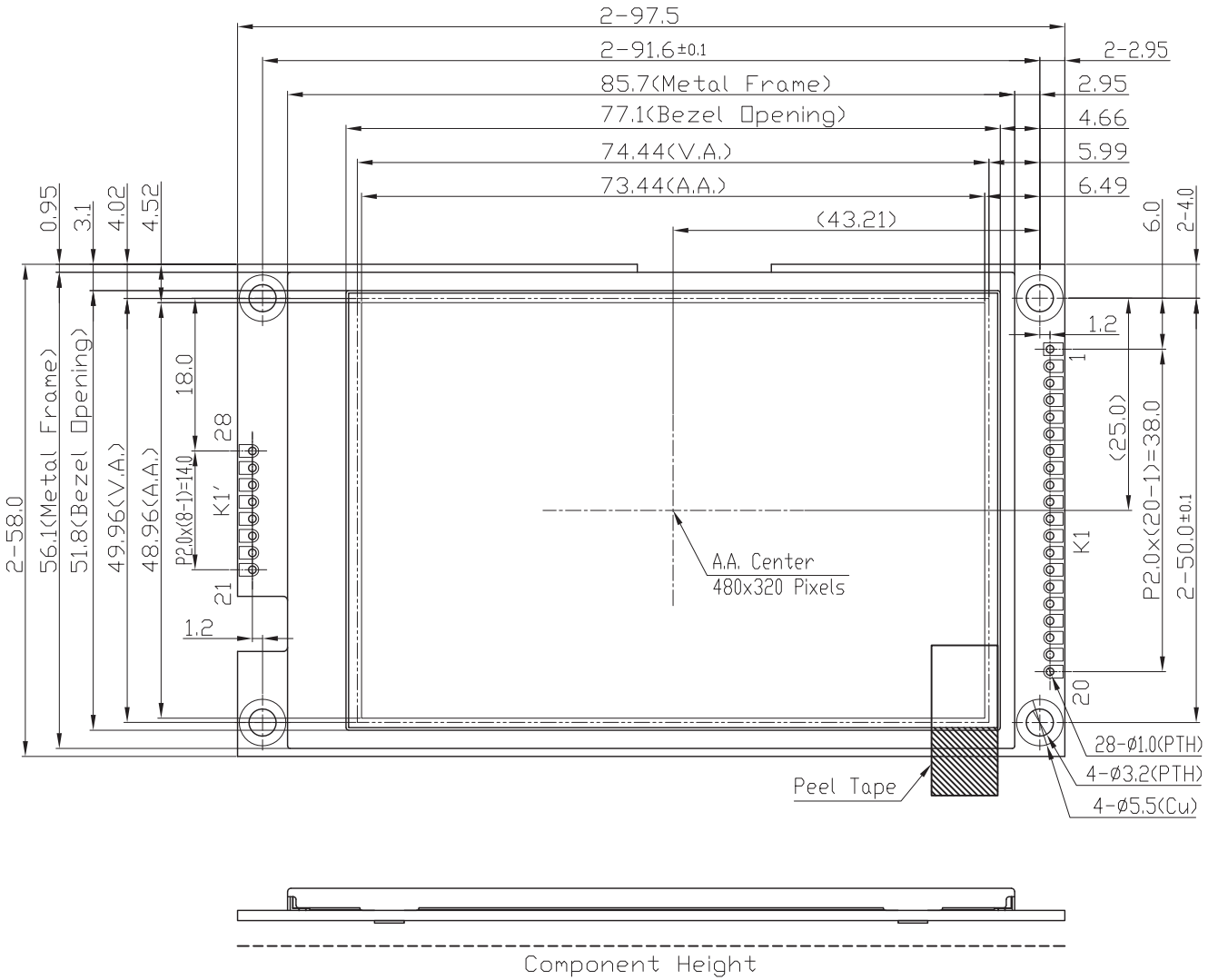
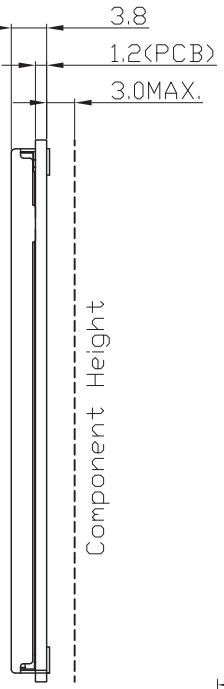
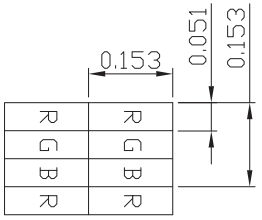




K1 Terminal	
No	Pin Name
1	VSS
2	VSS
3	BLEN
4	VDD
5	VDD
6	/RD
7	/WR(D/C)
8	D/C(SCL)
9	/CS
10	D0(SDA)
11	D1(SDO)
12	D2
13	D3
14	D4
15	D5
16	D6
17	D7
18	/RES
19	FMARK
20	NC
21	NC
22	NC
23	NC
24	NC
25	NC
26	NC
27	NC
28	NC



Pixel Details
Scale=100/1

Note:
*1. LCD Display Type : TFT, Transmissive
*2. Operating Voltage : 5.0V, Logic Voltage : 3.3V
*3. Backlight : White LEDs
*4. Pixel Arrangment : RGB-STRIPE
*5. Color Depth : 262k Colors
*6. Signal Interface : MCU 8bit/SPI
*7. Connector:
K1: P2.0,1x20+1x8 PCB Pad
*8. Operating Temperature : -20°C~70°C
*9. Storage Temperature : -30°C~80°C

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INTELLIGENT DISPLAY SOLUTIONS

C		
B		
A		
Rev	Note	Date

Dwg Title: LMT035DNJFWD-NAN Outline Dwg
Dwg No.: MK-006933-1-1
Date: 2020-06-19
Scale: 5/3 | Tol.: ±0.3 | Unit: mm | Paper Size: A3
Approved | Checked | Drawn: Qiu Shaoping