

Product Specification

NHD-5.0-800480AF-ASXP-CTP

TFT Liquid Crystal Display

NHD -	Newhaven Display
5.0 -	5.0" Diagonal
800480 -	800xRGBx480 Pixels
AF -	Model
A -	Built-In Driver / Controller
S -	High Brightness, White LED Backlight
X -	TFT
P -	IPS, Wide Temperature
CTP -	Capacitive Touch Panel

Table of Contents

Document Revision History	2
Mechanical Drawing	3
Pin Description	4
RGB Interface Mode Selection	5
Electrical Characteristics	5
Optical Characteristics	6
Capacitive Touch Panel Material Characteristics	6
Driver Information	6
Capacitive Touch Panel Registers	7
Timing Characteristics for TFT	10
Timing Characteristics for Capacitive Touch Panel	16
Quality Information	19

Additional Resources

- **Support Forum:** <http://www.nhdforum.newhavendisplay.com>
- **Github:** <https://github.com/newhavendisplay>
- **Example Code:** https://www.newhavendisplay.com/example_code.html
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** https://www.newhavendisplay.com/quality_center.html
- **Precautions for using LCDs/LCMs:** <https://www.newhavendisplay.com/specs/precautions.pdf>
- **Warranty / Terms & Conditions:** <https://www.newhavendisplay.com/terms.html>



Document Revision History

Revision	Date	Description	Changed By
0	02/15/2022	Initial Release	JT
1	04/13/2022	Include SYNC, SYNC-DE, & DE Information	ZP
2	06/10/2022	RGB Interface Mode Selection Included, Mechanical Drawing Updated	JT

Mechanical Drawing

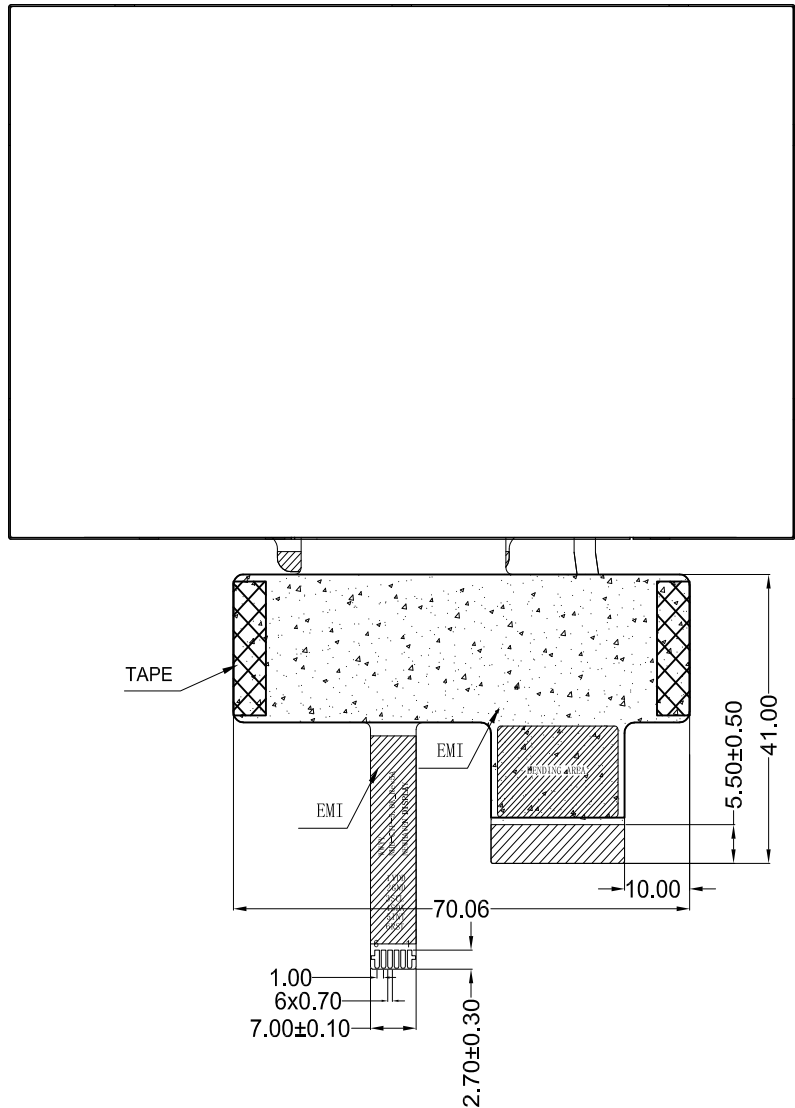
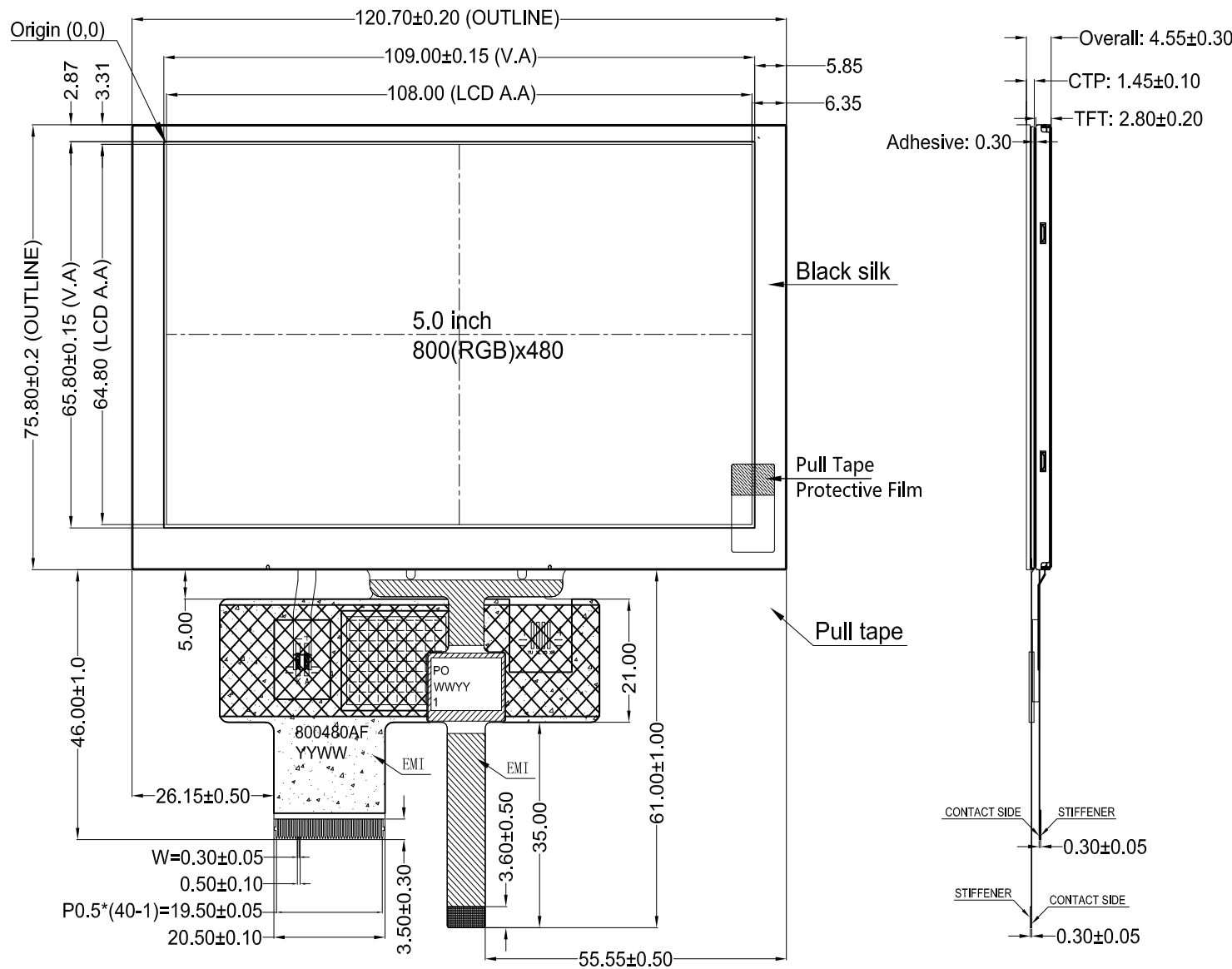
SYMBOL	REVISION	DATE

Newhaven Display

NHD-5.0-800480AF-ASXP-CTP

Date Code

Part Label (type/format may vary)



TFT PIN DEFINE

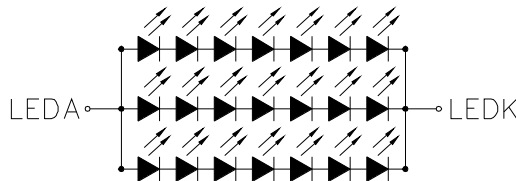
NO.	PIN NAME
1	VLED-
2	VLED+
3	GND
4	VDD
5	R0
6	R1
7	R2
8	R3
9	R4
10	R5
11	R6
12	R7
13	G0
14	G1
15	G2
16	G3
17	G4
18	G5
19	G6
20	G7
21	B0
22	B1
23	B2
24	B3
25	B4
26	B5
27	B6
28	B7
29	GND
30	CLKIN
31	STBYB
32	HSD
33	VSD
34	DEN
35	NC
36	GND
37	NC(XR)
38	NC(YD)
39	NC(XL)
40	NC(YU)

CTP PIN DEFINE

PIN No.	SYMBOL
1	VDD
2	GND
3	SCL
4	SDA
5	INT
6	RESET

Product Description: 5.0" IPS TFT w/ Capacitive Touch

1. TFT Driver IC: ST7262, CTP IC: FT5426DQ8-003
2. TFT Interface: 24-Bit RGB, CTP Interface: I2C
3. TFT Power Requirement: 3.3V, Backlight: 60mA/21.1V (Typ)
4. Optical Features: Transmissive, Normally Black, 900 cd/m2
5. TFT Mating Connector: 40pin, 0.5mm pitch; Ex. Molex 54104-4031
6. CTP Mating Connector: 6pin, 1.0mm pitch; Ex. Molex 52271-067



CONSTANT CURRENT: 60mA
BACKLIGHT DRIVER CIRCUIT DIAGRAM

Standard Tolerance:
(Unless otherwise specified)

Linear: ±0.3mm

Unless otherwise specified:

• Dimensions are in Millimeters

• Third Angle Projection

NEWHAVEN DISPLAY
INTERNATIONAL

Drawing/Part Number:

NHD-5.0-800480AF-ASXP-CTP

Revision:

-

Size:

A3

Scale:

NS

Do Not Scale Drawing

Sheet 1 of 1

This drawing is solely the property of Newhaven Display International, Inc.
The information it contains is not to be disclosed, reproduced or copied in
whole or part without written approval from Newhaven Display.

Pin Description

Pin No.	Symbol	External Connection	Function Description
1	LED-	LED Power Supply	Ground for Backlight
2	LED+	LED Power Supply	Backlight Power Supply (60mA @ 21.7V)
3	GND	Power Supply	Ground
4	V _{DD}	Power Supply	Power supply for LCD and logic (3.3V)
5-12	[R0-R7]	MPU	Red Data Signals
13-20	[G0-G7]	MPU	Green Data Signals
21-28	[B0-B7]	MPU	Blue Data Signals
29	GND	Power Supply	Ground
30	CLKIN	MPU	Clock for input data (Rising Edge)
31	STBYB	MPU	1: Normal Operation; 0: Standby Mode
32	HSD	MPU	Line synchronization signal
33	VSD	MPU	Frame synchronization signal
34	DEN	MPU	Data Enable signal
35	NC	-	No Connect
36	GND	Power Supply	Ground
37	XR	-	No Connect
38	YD	-	No Connect
39	XL	-	No Connect
40	YU	-	No Connect

Recommended LCD connector: 0.5mm pitch 40-Conductor FFC. Molex p/n: 54104-4031 (top contact)

Backlight connector: on LCD connector

Mates with: ---

Capacitive Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	V _{CC}	Power Supply	Power supply for logic (3.0V)
2	GND	Power Supply	Ground
3	SCL	MPU	Serial I2C Clock (Requires pull-up resistor)
4	SDA	MPU	Serial I2C Data (Requires pull-up resistor)
5	/INT	MPU	Interrupt signal from touch panel module to host
6	/RESET	MPU	Active LOW Reset signal (Do not tie to V _{CC})

Recommended connector: 1.0mm pitch 6-Conductor FFC. Molex p/n: 52271-0679

RGB Interface Mode Selection

The Sitronix ST7262 driver IC is user configurable for DE Mode, SYNC mode, or SYNC-DE mode RGB interface.

DE Mode is enabled when HSYNC and VSYNC signals are set to logic-low state, and DE signal is toggled high for valid pixel data. Data is clocked in using DCLK signal. DE mode is recommended to enable the ST7262 driver IC to synchronize the display image on TFT panel without depending on specific horizontal and vertical sync timing from host controller.

SYNC mode is enabled when the DE signal is set to logic-low state, and HSYNC and VSYNC signals are used to explicitly define the horizontal and vertical sync timing to synchronize the display image on TFT panel. Data is clocked in using DCLK signal. Any change to the HSYNC or VSYNC values may prevent the image from correctly appearing on the display.

SYNC-DE Mode is enabled when HSYNC and VSYNC signals are used to explicitly define the horizontal and vertical sync timing to synchronize the display image on TFT panel. DE signal is used as an additional indicator for transmission of valid pixel data. Data is clocked in using DCLK signal. Any change to the HSYNC or VSYNC values may prevent the image from correctly appearing on the display.

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

Electrical Characteristics

TFT:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T _{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage	V _{DD}	-	3.0	3.3	3.6	V
Supply Current	I _{DD}	V _{DD} = 3.3V	41	62	93	mA
"H" Level input	V _{IH}	-	0.7 * V _{DD}	-	V _{DD}	V
"L" Level input	V _{IL}	-	GND	-	0.3 * V _{DD}	V
"H" Level output	V _{OH}	-	V _{DD} - 0.4	-	V _{DD}	V
"L" Level output	V _{OL}	-	GND	-	GND + 0.4	V
Backlight Supply Current	I _{LED}	-	50	60	72	mA
Backlight Supply Voltage	V _{LED}	I _{LED} = 60mA	19.6	21.1	23.1	V
Backlight Lifetime*	-	T _{OP} = 25°C	30,000	-	-	Hrs.

*Backlight lifetime is rated as Hours until **half-brightness**, under normal operating conditions. The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

Capacitive Touch Panel:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T _{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T _{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage	V _{DD}	-	2.7	3.3	3.6	V
Supply Current – Operating	I _{DD}	V _{DD} = 3.0V T _{OP} = 25°C	3	12	19	mA
Supply Current – Hibernate	I _{DD}		-	60	120	uA
"H" Level Input	V _{IH}	-	0.7 * V _{DD}	-	V _{DD}	V
"L" Level Input	V _{IL}	-	V _{SS}	-	0.3 * V _{DD}	V
"H" Level Output	V _{OH}	-	0.7 * V _{DD}	-	V _{DD}	V
"L" Level Output	V _{OL}	-	V _{SS}	-	0.3*V _{DD}	V



Optical Characteristics:

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	$\phi Y+$	-	70	80	-	°
	Bottom	$\phi Y-$		70	80	-	°
	Left	$\theta X-$		70	80	-	°
	Right	$\theta X+$		70	80	-	°
Contrast Ratio		CR	-	800	1000	-	-
Luminance		L _V	I _{LED} = 60 mA	680	900	1275	cd/m ²
Response Time (Rise + Fall)		T _R + T _F	T _{OP} = 25°C	-	30	45	ms
Chromaticity	Red	X _R	-	-0.03	0.6001	+0.03	-
		Y _R	-		0.3535		-
	Green	X _G	-		0.3732		-
		Y _G	-		0.5492		-
	Blue	X _B	-		0.1388		-
		Y _B	-		0.1073		-
	White	X _W	-		0.3100		-
		Y _W	-		0.3300		-

Capacitive Touch Panel Material Characteristics:

Property	Requirement	Unit
IC	FT5426DQ8-003	-
ITO Glass thickness	0.55	mm
Surface Hardness	≥6	H
Light transmission	>85%	-
Operating Humidity	20~85	RH
Storage Humidity	20~85	RH

Driver Information

TFT:

Built-in ST7262 Source Driver: https://www.newhavendisplay.com/resources_dataFiles/datasheets/LCDs/ST7262.pdf

Capacitive Touch Panel:

Built-in FocalTech FT5426DQ8-003 controller.

Please download specification at <http://www.newhavendisplay.com/appnotes/datasheets/touchpanel/FT5x26.pdf>



Capacitive Touch Panel Registers

Register No.	Access	Register Name	Bits	Value	Description
01h	RO	Gesture ID	[7:0]	10	Swipe Up
				18h	Swipe Down
				1Ch	Swipe Left
				14h	Swipe Right
				48h	Zoom Out
				49h	Zoom In
				00	No gesture
02h	RO	Touch Points	[7:0]	0-Ah	0: No touch detected A: 10 touch points detected
03h	RO	TOUCH1_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
03h	RO	TOUCH1_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
04h	RO	TOUCH1_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
05h	RO	TOUCH1_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
06h	RO	TOUCH1_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
07h	RO	TOUCH1_Weight	[7:0]		Touch Weight
08h	RO	TOUCH1_Misc	[3:0]	00-0Fh	Touch Area
09h	RO	TOUCH2_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
09h	RO	TOUCH1_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
0Ah	RO	TOUCH2_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
0Bh	RO	TOUCH2_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
0Ch	RO	TOUCH2_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
0Dh	RO	TOUCH2_Weight	[7:0]		Touch Weight
0Eh	RO	TOUCH2_Misc	[3:0]	00-0Fh	Touch Area
0Fh	RO	TOUCH3_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
0Fh	RO	TOUCH3_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
10	RO	TOUCH3_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
11h	RO	TOUCH3_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
12h	RO	TOUCH3_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
13h	RO	TOUCH3_Weight	[7:0]		Touch Weight
14h	RO	TOUCH3_Misc	[3:0]	00-0Fh	Touch Area
15h	RO	TOUCH4_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
15h	RO	TOUCH4_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
16h	RO	TOUCH4_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
17h	RO	TOUCH4_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
18h	RO	TOUCH4_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
1Ah	RO	TOUCH4_Misc	[3:0]	00-0Fh	Touch Area
18h	RO	TOUCH5_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved

Register No.	Access	Register Name	Bits	Value	Description
1Bh	RO	TOUCH5_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
1Ch	RO	TOUCH5_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
1Dh	RO	TOUCH5_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
1Eh	RO	TOUCH5_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
1Fh	RO	TOUCH5_Weight	[7:0]		Touch Weight
20	RO	TOUCH5_Misc	[3:0]	00-0Fh	Touch Area
21h	RO	TOUCH6_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
21h	RO	TOUCH6_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
22h	RO	TOUCH6_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
23h	RO	TOUCH6_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
24h	RO	TOUCH6_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
25h	RO	TOUCH6_Weight	[7:0]		Touch Weight
26h	RO	TOUCH6_Misc	[3:0]	00-0Fh	Touch Area
27h	RO	TOUCH7_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
27h	RO	TOUCH7_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
28h	RO	TOUCH7_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
29h	RO	TOUCH7_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
2Ah	RO	TOUCH7_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
2Bh	RO	TOUCH7_Weight	[7:0]		Touch Weight
2Ch	RO	TOUCH7_Misc	[3:0]	00-0Fh	Touch Area
2Dh	RO	TOUCH8_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
2Dh	RO	TOUCH8_XH	[3:0]	0 – 1	Upper 4 bits of X touch coordinate
2Eh	RO	TOUCH8_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
2Fh	RO	TOUCH8_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
30	RO	TOUCH8_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
31h	RO	TOUCH8_Weight	[7:0]		Touch Weight
32h	RO	TOUCH8_Misc	[3:0]	00-0Fh	Touch Area
33h	RO	TOUCH9_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
33h	RO	TOUCH9_XH	[3:0]	0 – 1	Upper 4 bits of X touch coordinate
34h	RO	TOUCH9_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
35h	RO	TOUCH9_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
36h	RO	TOUCH9_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
37h	RO	TOUCH9_Weight	[7:0]		Touch Weight
38h	RO	TOUCH9_Misc	[3:0]	00 – 0Fh	Touch Area
39h	RO	TOUCH10_Event_Flag	[7:6]	0	Put Down
				1	Put Up
				2	Contact
				3	Reserved
39h	RO	TOUCH10_XH	[3:0]	0 – 1	Upper 4 bits of X touch coordinate
3Ah	RO	TOUCH10_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
3Bh	RO	TOUCH10_YH	[3:0]	0 – 1	Upper 4 bits of Y touch coordinate
3Ch	RO	TOUCH10_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch coordinate



Register No.	Access	Register Name	Bits	Value	Description
3Dh	RO	TOUCH10_Weight	[7:0]	00-FFh	Touch Weight
3Eh	RO	TOUCH10_Misc	[3:0]	00-0Fh	Touch Area
A1h	RO	ID_G_LIB_VERSION_H	[7:0]	00-FFh	App library version high-byte Default: 0
A2h	RO	ID_G_LIB_VERSION_L	[7:0]	00-FFh	App library version low-byte Default: 2h
A3h	RO	ID_G_CHIPER_HIGH	[7:0]	00-FFh	Chip Vendor ID Default: 0x54
A6h	RO	ID_G_FIRMID	[7:0]	00-FFh	Firmware ID Number Default: 1
A8h	RO	ID_G_VENODRID	[7:0]	00-FFh	CTPM Vendor's Chip ID Default: 79h

Timing Characteristics – TFT Display

Horizontal Input Timing

Parameter	Symbol	Value			Unit	Note
Horizontal Display Area	T_{HDISP}	800			DCLK	
DCLK Frequency	F_{CLK}	Min	Typ	Max		
		23	25	27	MHz	
1 Horizontal Line	T_H	808	816	896	DCLK	
HSYNC Pulse Width	T_{HW}	2	4	8		
HSYNC Back Porch (Blanking)	T_{HBP}	4	8	48		
HSYNC Front Porch	T_{HFP}	4	8	48		

Vertical Input Timing

Parameter	Symbol	Min	Typ	Max	Unit	Note
Vertical Display Area	$T_{V DISP}$	480			HSYNC	
VSNC Period Tim	T_V	488	496	504		
VSNC Pulse Width	T_{VW}	2	4	8		
VSNC Back Porch (Blanking)	T_{VBP}	4	8	12		
VSNC Front Porch	T_{VFP}	4	8	12		

AC Characteristics

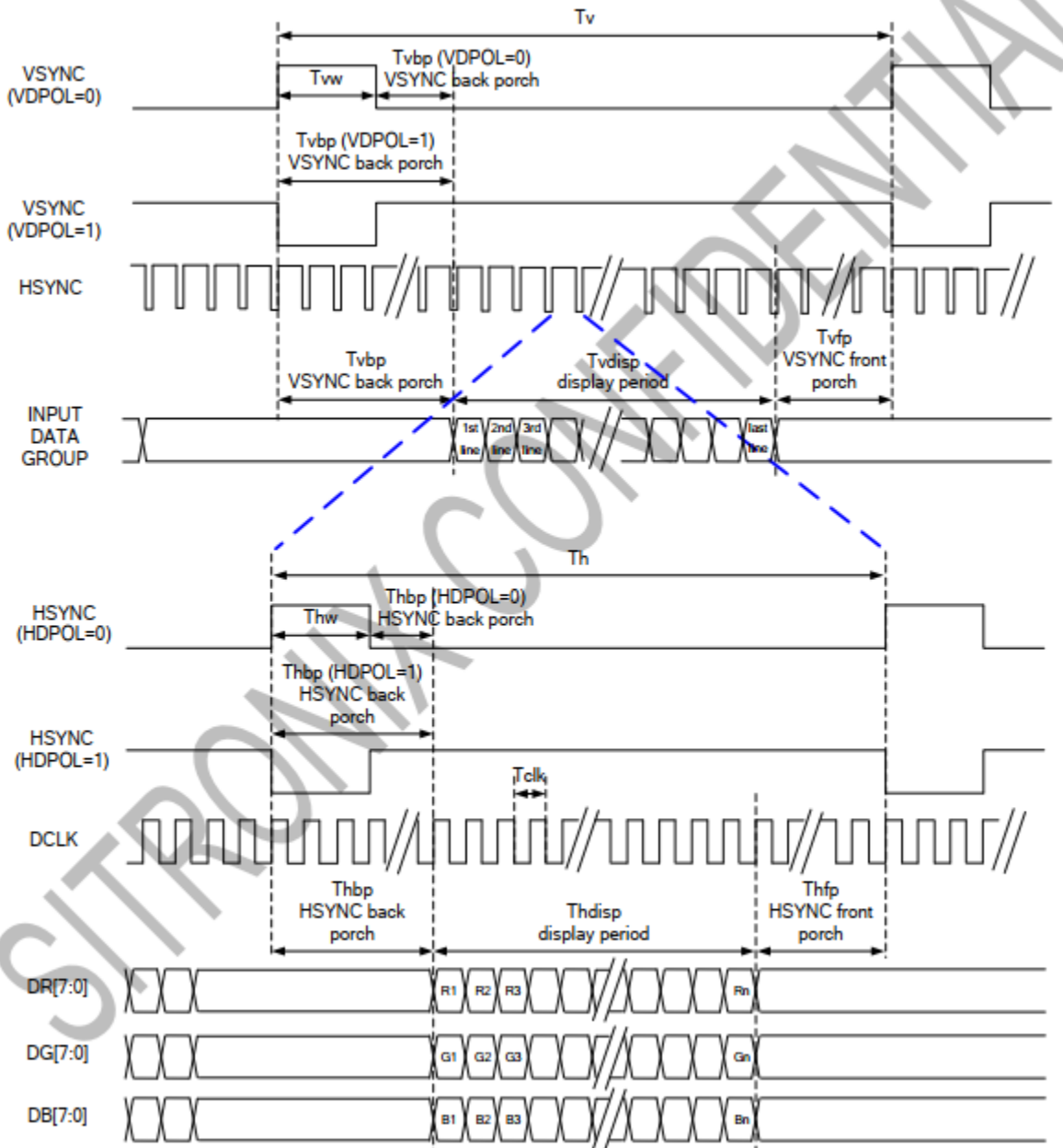
Parameter	Symbol	Min	Typ	Max	Unit	Conditions
V_{DD} Power ON Slew Rate	T_{POR}	-	-	20	ms	From 0V to 99% V_{DD}
CLKIN pulse duty	T_{cwh}	40	50	60	%	
HSYNC Width	T_{hw}	2	-	-	DCLK	
HSYNC Period	T_h	55	60	65	μs	
VSNC setup time	T_{vst}	10	-	-	ns	
VSNC hold time	T_{vhd}	10	-	-	ns	
HSYNC setup time	T_{hst}	10	-	-	ns	
HSYNC hold time	T_{hhd}	10	-	-	ns	
Data set-up time	T_{dsu}	10	-	-	ns	
Data hold time	T_{dhd}	10	-	-	ns	
DE setup time	T_{esu}	10	-	-	ns	
DE hold time	T_{ehd}	10	-	-	ns	
Output stable time	T_{sst}	-	-	TBD	μs	

RGB Interface

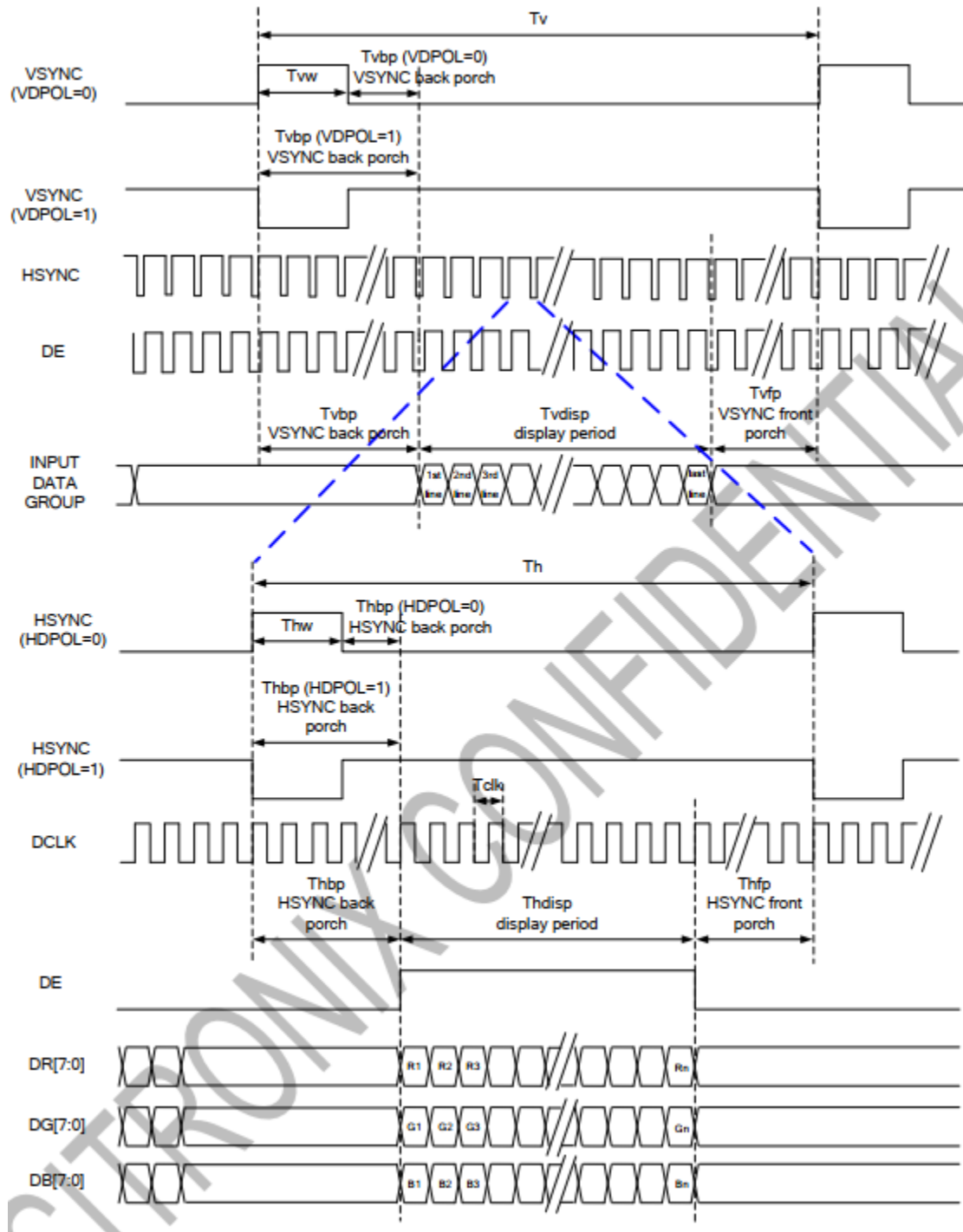
RGB Mode Selection Table	DCLK	HSYNC	VSYNC	DE
SYNC - DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

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

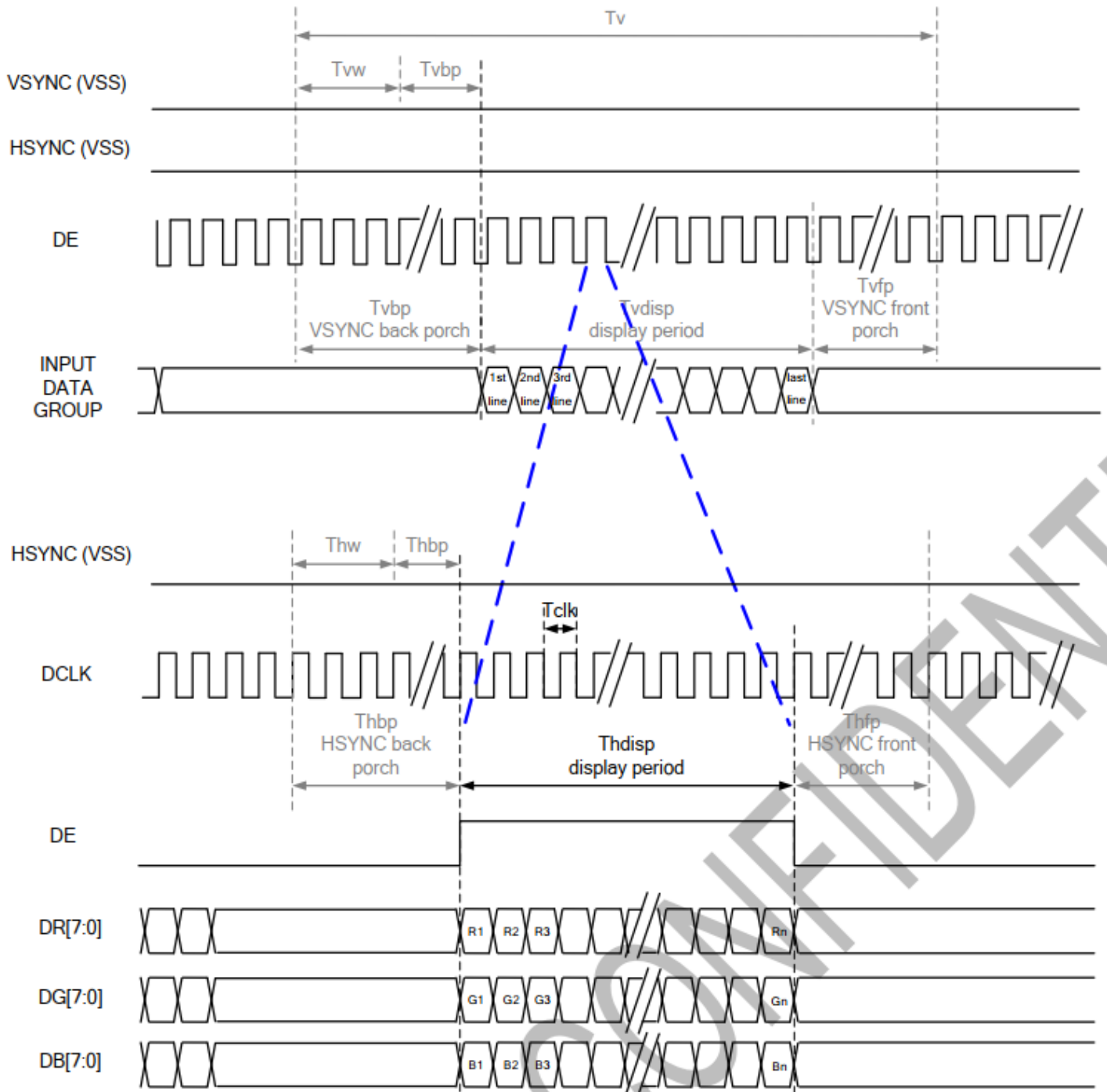
SYNC Mode



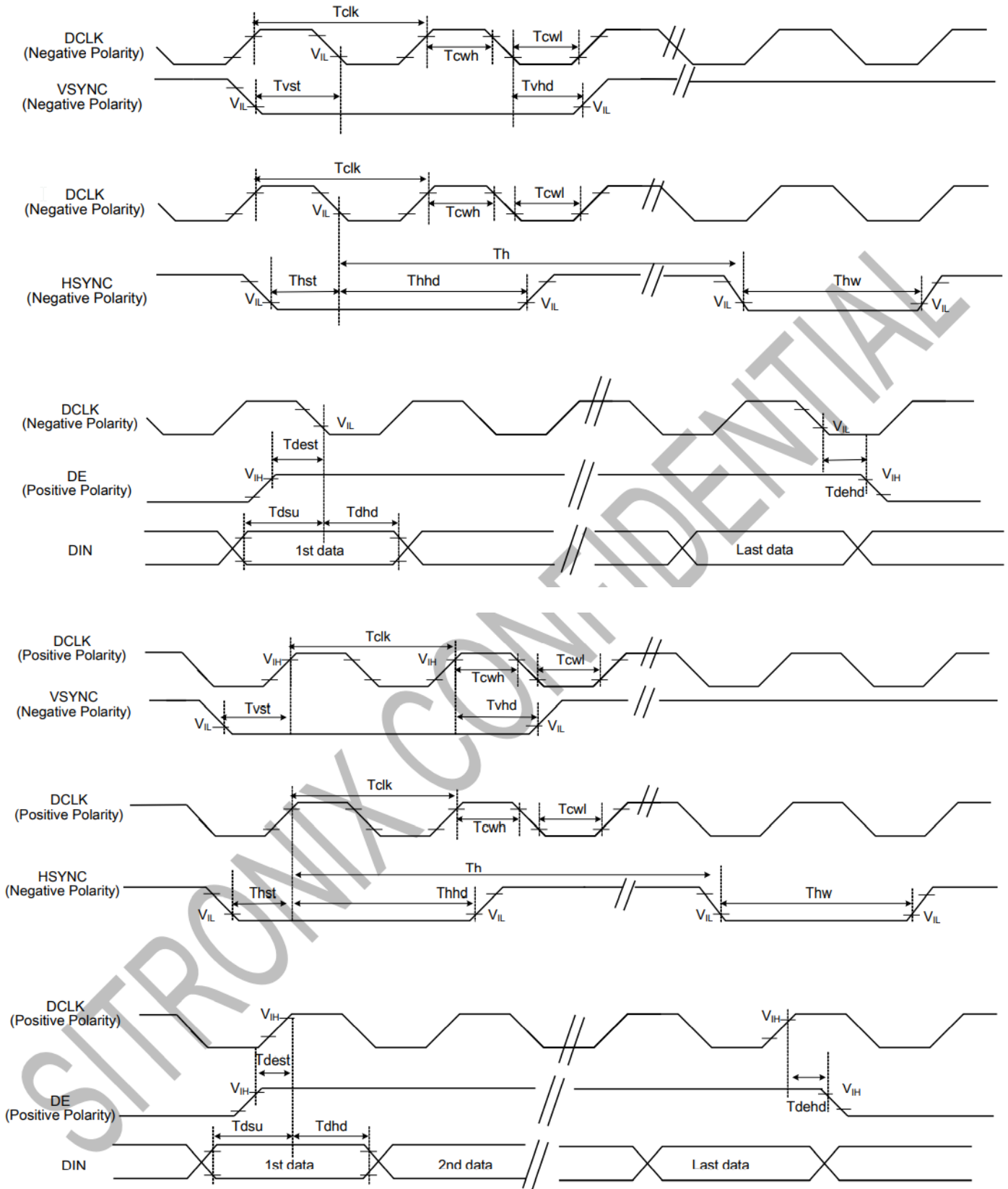
SYNC-DE Mode



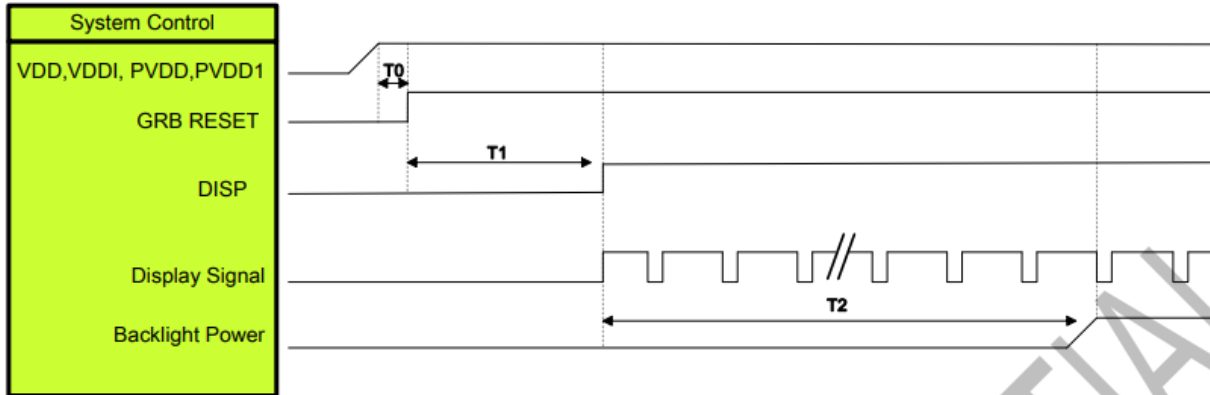
DE Mode



System Bus Timing for RGB Interface



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

Power Off Sequence

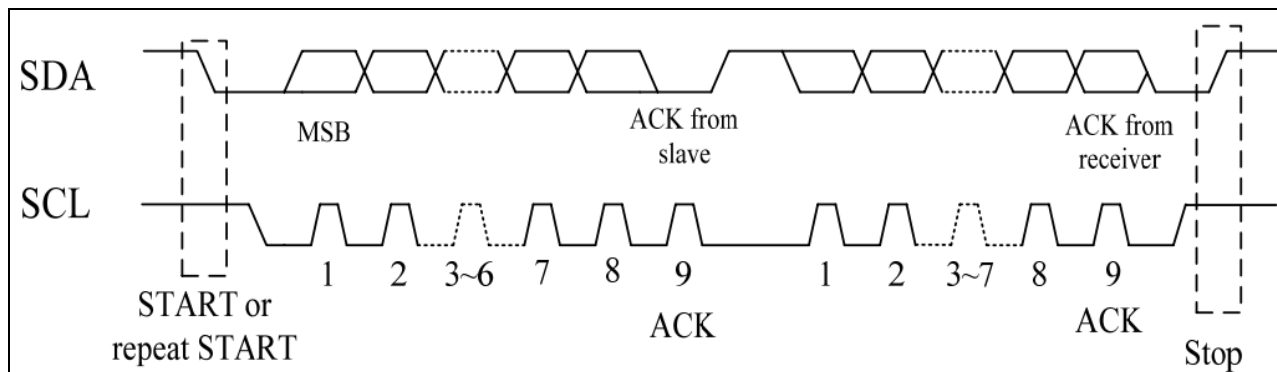


Symbol	Description	Min. Time	Unit
T0	Backlight Power off to DISP="Low"	5	ms
T1	DISP="Low" to IC internal voltage discharge complete	100	ms

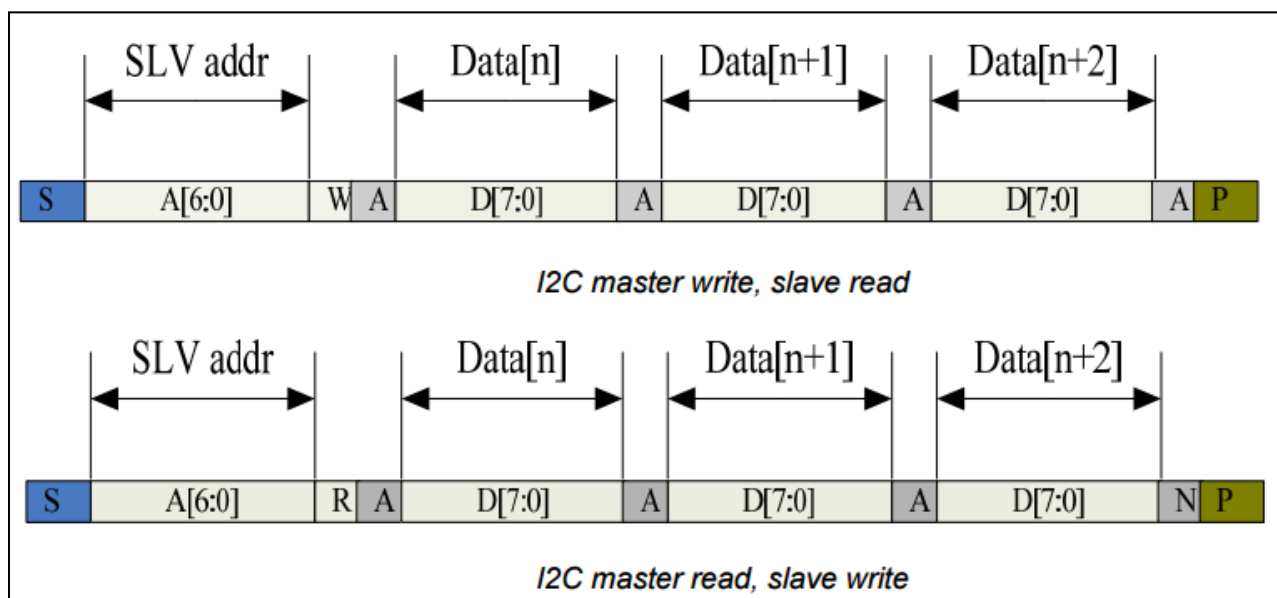
Note: RGB interface Display signal: DCLK; VSYNC; HSYNC; DE; DR[7:0]; DG[7:0]; DB[7:0]

Timing Characteristics – Capacitive Touch Panel

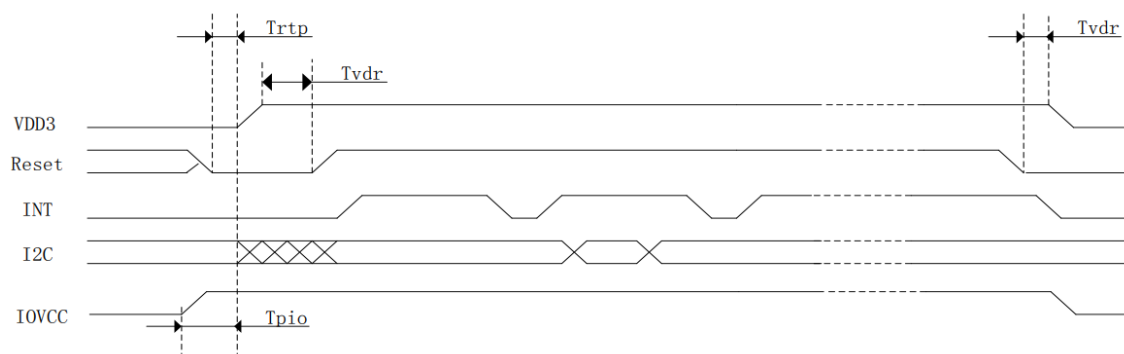
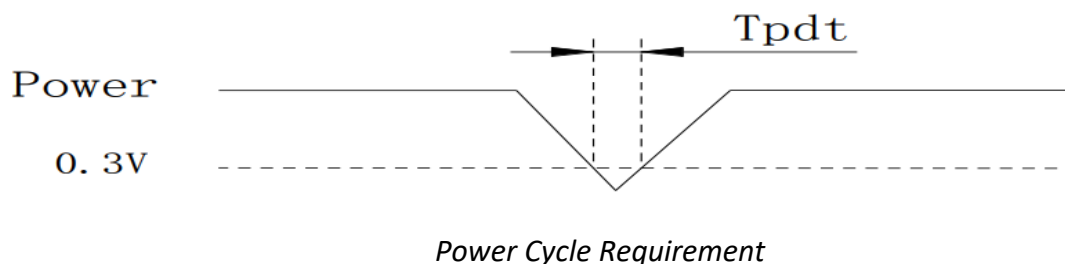
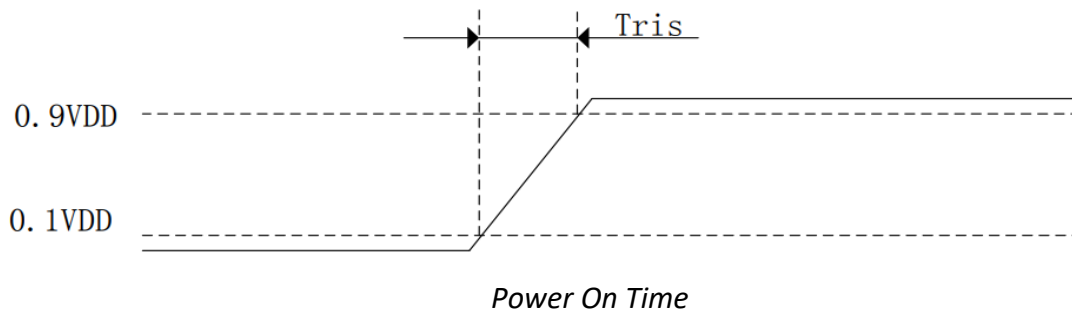
Data Transfer Format



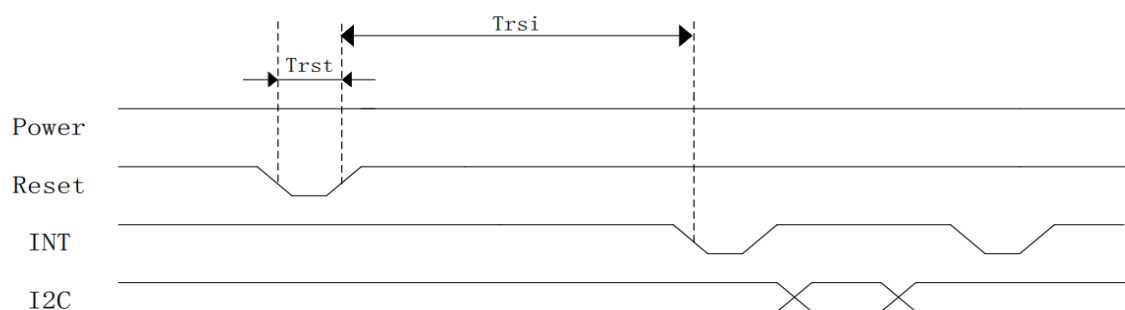
Parameter	Min	Max	Unit
SCL Frequency	0	400	KHz
Bus free time between a STOP & START condition	1.3	-	μs
Hold time Repeated START condition	0.6	-	μs
Data Setup Time	100	-	ns
Setup time for a repeated START condition	0.6	-	μs
Setup time for a STOP condition	0.6	-	μs



Power ON/Reset Sequence



Power ON Sequence

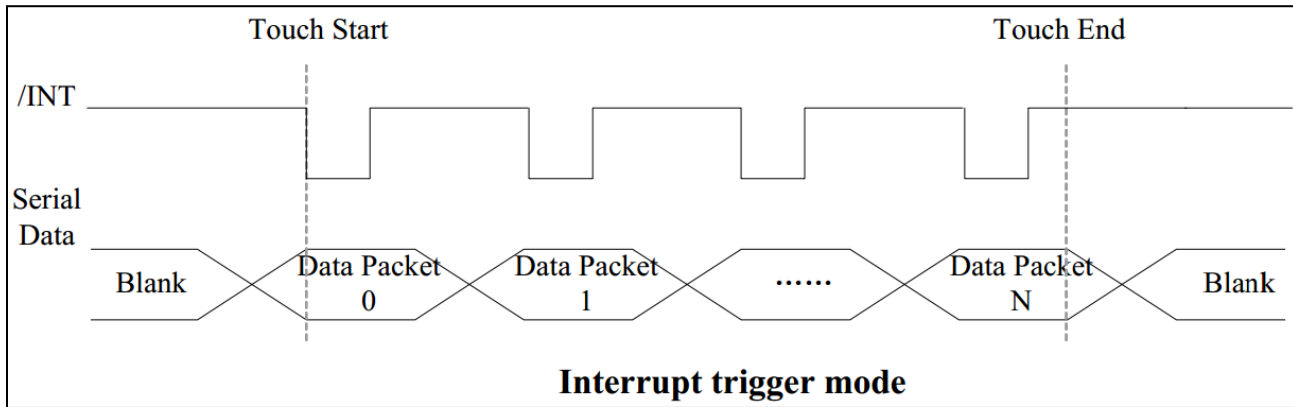


Reset sequence

Parameter	Description	Min	Max	Unit
T_{ris}	Rise time from 0.1V _{DD} to 0.9V _{DD}	-	5	ms
$T_{pd\ t}$	Time of the voltage of supply being below 0.3V	5	-	ms
T_{rtp}	Time of resetting to be low before powering on	100	-	μs
T_{pon}	Time to start reporting after power on	-	200	ms
T_{vdr}	Reset time after applying V _{DD}	1	-	ms
T_{rsi}	Time to start reporting after reset	-	200	ms
T_{rst}	Reset Time	1	-	ms

*If Reset is tied to V_{CC} data corruption can occur.





Sample code to read touch data:

```
i2c_start();
i2c_tx(0x70);    //Slave Address (Write)
i2c_tx(0x00);    //Start reading address
i2c_stop();

i2c_start();
i2c_tx(0x71);    //Slave Address (Read)
for(i=0x00;i<0x1F;i++)
{touchdata_buffer[i] = i2c_rx(1);}
i2c_stop();
```

Sample code to overwrite default register values:

```
i2c_start();
i2c_tx(0x70);    //Slave Address (Write)
i2c_tx(0xA4);    //ID_G_Mode
i2c_tx(0x01);    //Disable interrupt status to host
i2c_stop();
```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	+80°C, 240hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C, 240hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C 120hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C, 120hrs	1,2
High Temperature / Humidity Storage	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+50°C, 90-95% RH, 120hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	-30°C, 30min -> 25°C, 5min - >80°C, 30min = 1 cycle 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	Frequency: 250 r/min Amplitude: 1 inch Time: 45 min	3
Static electricity test	Endurance test applying electric static discharge.	Air: ±8kV; Contact: ±4kV For 5 times each.	

Note 1: No condensation to be observed.

Note 2: Conducted after 4 hours of storage at 25°C, 0%RH.

Note 3: Test performed on product itself, not inside a container.