

# NHD-4.3-480272EF-ATXL#-CTP

## TFT (Thin-Film-Transistor) Color Liquid Crystal Display Module

NHD-	Newhaven Display
4.3-	4.3" Diagonal
480272-	480xRGBx272 Pixels
EF-	Model
A-	Built-in Driver / No Controller
T-	White LED Backlight
X-	TFT
L-	6:00 Optimal View, Wide Temperature
#-	<b>RoHS Compliant</b>
CTP-	Capacitive Touch Panel with Controller

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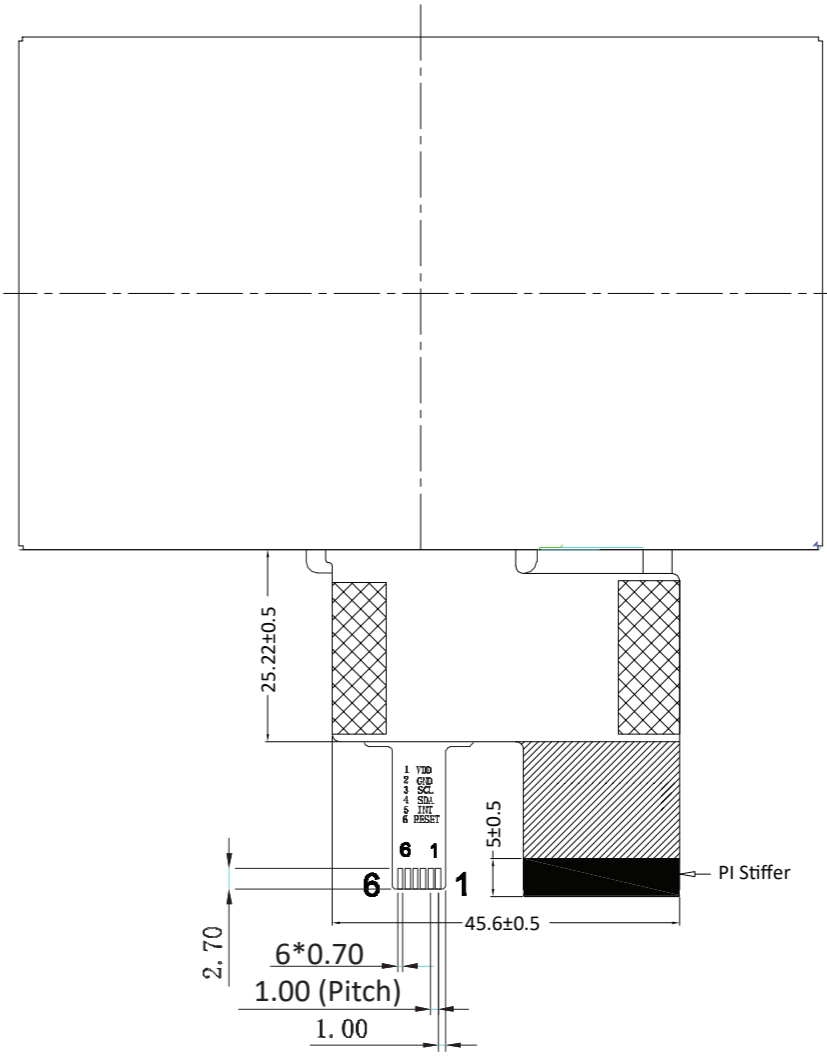
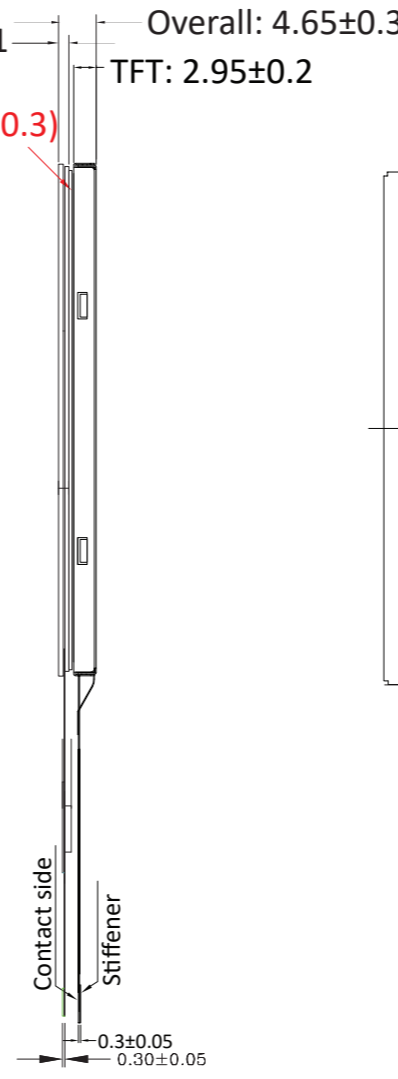
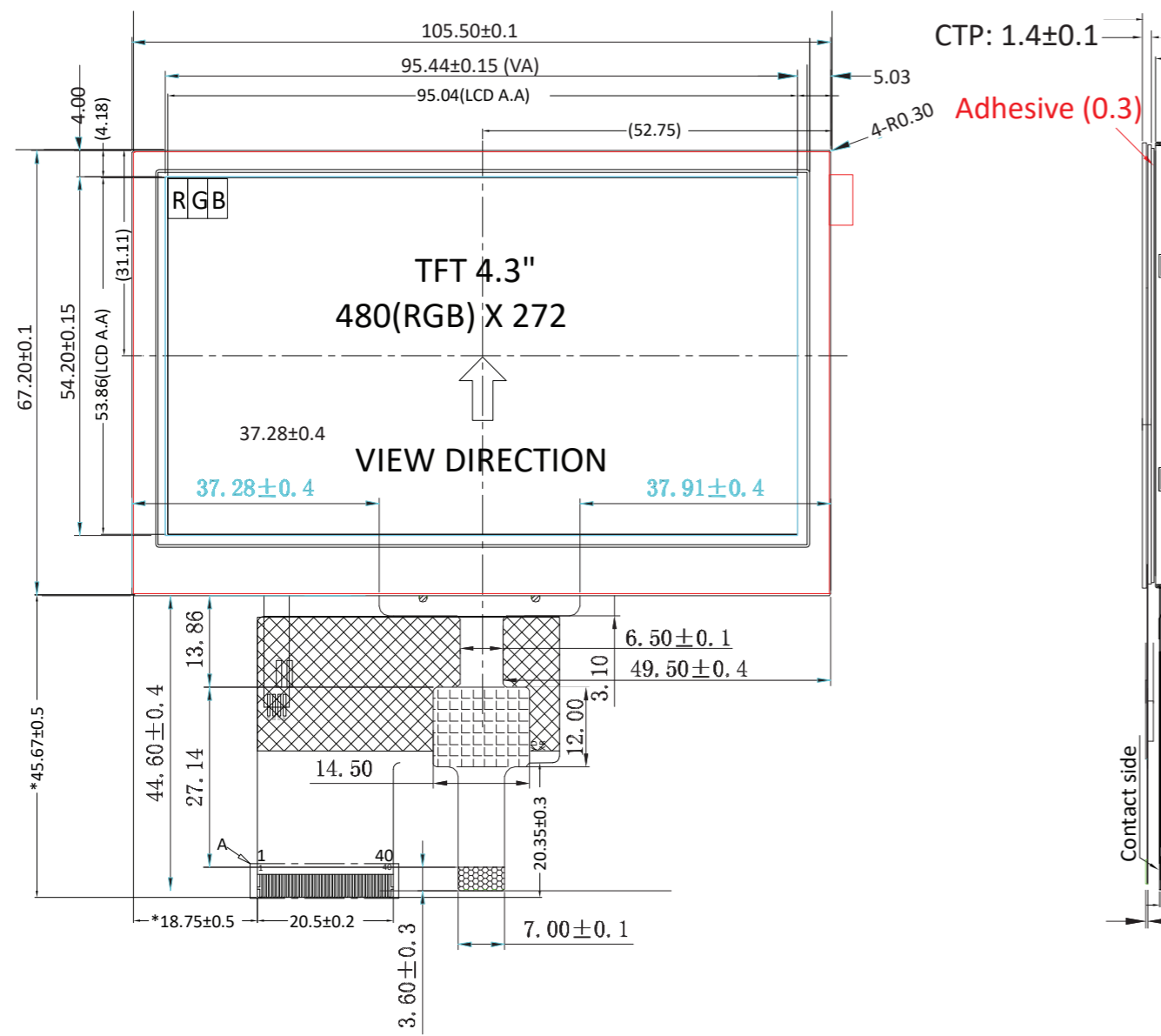
## Document Revision History

Revision	Date	Description	Changed by
0	8/29/2012	Initial Release	AK
1	7/12/2013	Mechanical and Optical characteristics updated	KA
2	02/14/2014	Mechanical drawing updated	KA
3	6/24/2014	Timing characteristics updated	ML
4	12/12/2014	CTP mechanical dimensions updated	AK
5	3/4/2015	CTP registers updated	ML
6	3/16/2015	CTP mechanical dimensions updated	ML
7	8/28/2015	LCD Connector Updated	SB
8	7/7/16	Mechanical Drawing Updated	SB
9	11/10/16	Mechanical Drawing & Electrical Characteristics Updated	SB
10	6/21/17	Driver IC Updated	SB
11	8/4/17	CTP Firmware Updated	SB
12	7/25/18	Display Thickness Updated to Show CTP Adhesive	SB
13	10/4/18	CTP Driver & Panel Updated	SB
14	2/8/19	Backlight Current Corrected	SB
15	5/3/19	CTP Timing Note Added	

## Functions and Features

- 480xRGBx272 resolution, up to 16.7M colors
- 16-LED backlight
- 24-Bit RGB interface
- Capacitive touch panel with controller
  - 10 point multi-touch input
  - Gesture input
    - Zoom In/Out
    - Swipe Up/Down/Left/Right

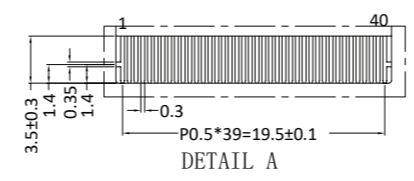
SYMBOL	REVISION	DATE



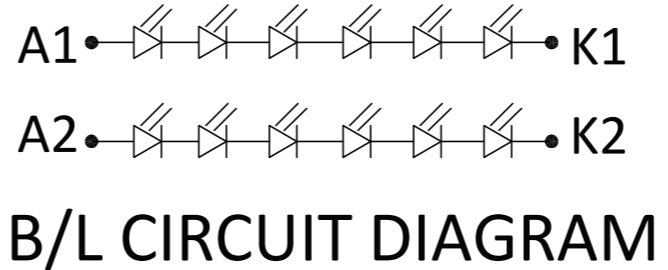
### Pin Assignment

Pin No.	Symbol
1	LEDK
2	LEDA
3	GND
4	V <sub>DD</sub>
5-12	[R0-R7]
13-20	[G0-G7]
21-28	[B0-B7]
29	GND
30	CLK
31	DISP
32	HSYNC
33	VSYNC
34	DEN
35	NC
36	GND
37	NC
38	NC
39	NC
40	NC

Pin No.	Symbol
1	VDD
2	GND
3	SCL
4	SDA
5	/INT
6	/RESET



- Notes:**
1. Display Size: 4.3" TFT
  2. Optimal View: 6:00
  3. Display Mode: Transmissive / Normally White / Anti-Glare
  4. Driver IC: ST7282T2
  5. Supply Voltage: 3.3V
  6. Backlight: White LED / 19.2 V / 40 mA (Typ)
  7. Luminance: 330 cd/m<sup>2</sup> (Typ)
  8. Touch Panel: PCAP



STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED)

LINEAR: ±0.3mm

UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION

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SHEET 1 OF 1

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DRAWING/PART NUMBER: NHD-4.3-480272EF-A TXL#-CTP	
REVISION: 1B	
SIZE: A3	
SCALE: NS	
DRAWN BY: S. Baxi	APPROVED BY: S. Baxi
DRAWN DATE: 02/08/19	APPROVED DATE: 02/08/19

## Pin Description

### TFT:

Pin No.	Symbol	External Connection	Function Description
1	LED-	Power Supply	Backlight Cathode (Ground)
2	LED+	Power Supply	Backlight Anode (40mA @ 25.6V)
3	GND	Power Supply	Ground
4	VDD	Power Supply	Supply Voltage 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	CLK	MPU	Data sample Clock signal
31	DISP	MPU	Display ON/OFF signal
32	HSYNC	MPU	Line synchronization signal
33	VSYNC	MPU	Frame synchronization signal
34	DE	MPU	Data Enable signal
35	NC	-	No Connect
36	GND	Power Supply	Ground
37	NC	-	No Connect
38	NC	-	No Connect
39	NC	-	No Connect
40	NC	-	No Connect

**Recommended LCD connector:** 0.5mm pitch 40-Conductor FFC. Molex p/n: 54104-4033

**Backlight connector:** on LCD connector

**Mates with:** ---

### Capacitive Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	V <sub>DD</sub>	Power Supply	Power supply for logic (3.3V)
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 T.P. module to host (Requires pull-up resistor)
6	/RESET	MPU	Active LOW Reset signal (Do not tie to V <sub>DD</sub> )

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

## Electrical Characteristics

### TFT:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T <sub>OP</sub>	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-30	-	+80	°C
Supply Voltage	V <sub>DD</sub>	-	3.0	3.3	3.6	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = 3.3V	12	25	50	mA
"H" level input	V <sub>IH</sub>	-	0.8 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" level input	V <sub>IL</sub>	-	GND	-	0.3 * V <sub>DD</sub>	V
"H" level output	V <sub>OH</sub>	-	0.9 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" level output	V <sub>OL</sub>	-	GND	-	0.1 * V <sub>DD</sub>	V
Backlight Supply Current	I <sub>LED</sub>	-	-	40	50	mA
Backlight Supply Voltage	V <sub>LED</sub>	I <sub>LED</sub> = 40 mA	16.8	19.2	20.4	V
Backlight Lifetime*	-	I <sub>LED</sub> = 40mA T <sub>OP</sub> = 25°C	20,000	50,000	-	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 <sub>OP</sub>	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-30	-	+80	°C
Supply Voltage	V <sub>DD</sub>	-	3.0	3.3	3.6	V
Supply Current (Operating)	I <sub>DD</sub>	V <sub>DD</sub> = 3.3V	12	13	14.5	mA
Supply Current (Hibernate)	I <sub>DD</sub>	T <sub>OP</sub> = 25°C	-	1.0	-	µA
"H" level input	V <sub>IH</sub>	-	0.7 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" level input	V <sub>IL</sub>	-	GND	-	0.3 * V <sub>DD</sub>	V
"H" level output	V <sub>OH</sub>	-	0.7 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
"L" level output	V <sub>OL</sub>	-	GND	-	0.3 * V <sub>DD</sub>	V

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Optimal Viewing Angles	Top	Cr ≥ 10	-	55	-	°	
	Bottom		-	75	-	°	
	Left		-	75	-	°	
	Right		-	75	-	°	
Contrast Ratio	CR	-	400	500	-	-	
Luminance	L <sub>V</sub>	-	260	330	-	cd/m <sup>2</sup>	
Response Time	Rise + Fall	T <sub>R</sub> + T <sub>F</sub>	T <sub>OP</sub> = 25°C	-	25	30	ms
Chromaticity	Red	X <sub>R</sub>	-	0.531	0.581	0.631	-
		Y <sub>R</sub>	-	0.300	0.350	0.400	-
	Green	X <sub>G</sub>	-	0.263	0.313	0.363	-
		Y <sub>G</sub>	-	0.568	0.618	0.668	-
	Blue	X <sub>B</sub>	-	0.093	0.143	0.193	-
		Y <sub>B</sub>	-	0.050	0.100	0.150	-
White	X <sub>W</sub>	-	0.233	0.283	0.333	-	
	Y <sub>W</sub>	-	0.286	0.336	0.386	-	

## Capacitive Touch Panel Material Characteristics

Property	Requirement	Unit
IC	FT5426	-
ITO Glass Thickness	0.55	mm
Surface Hardness	≥6	H
Transparency	82%	-
Operating Humidity	20~90	RH
Storage Humidity	20~90	RH

## Driver/Controller Information

### TFT:

Built-in Sitronix ST7282T2 Driver.

Please download specification at <http://www.newhavendisplay.com/appnotes/datasheets/LCDs/ST7282T2.pdf>

### Capacitive Touch Panel:

Built-in FocalTech FT5426 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
1Bh	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



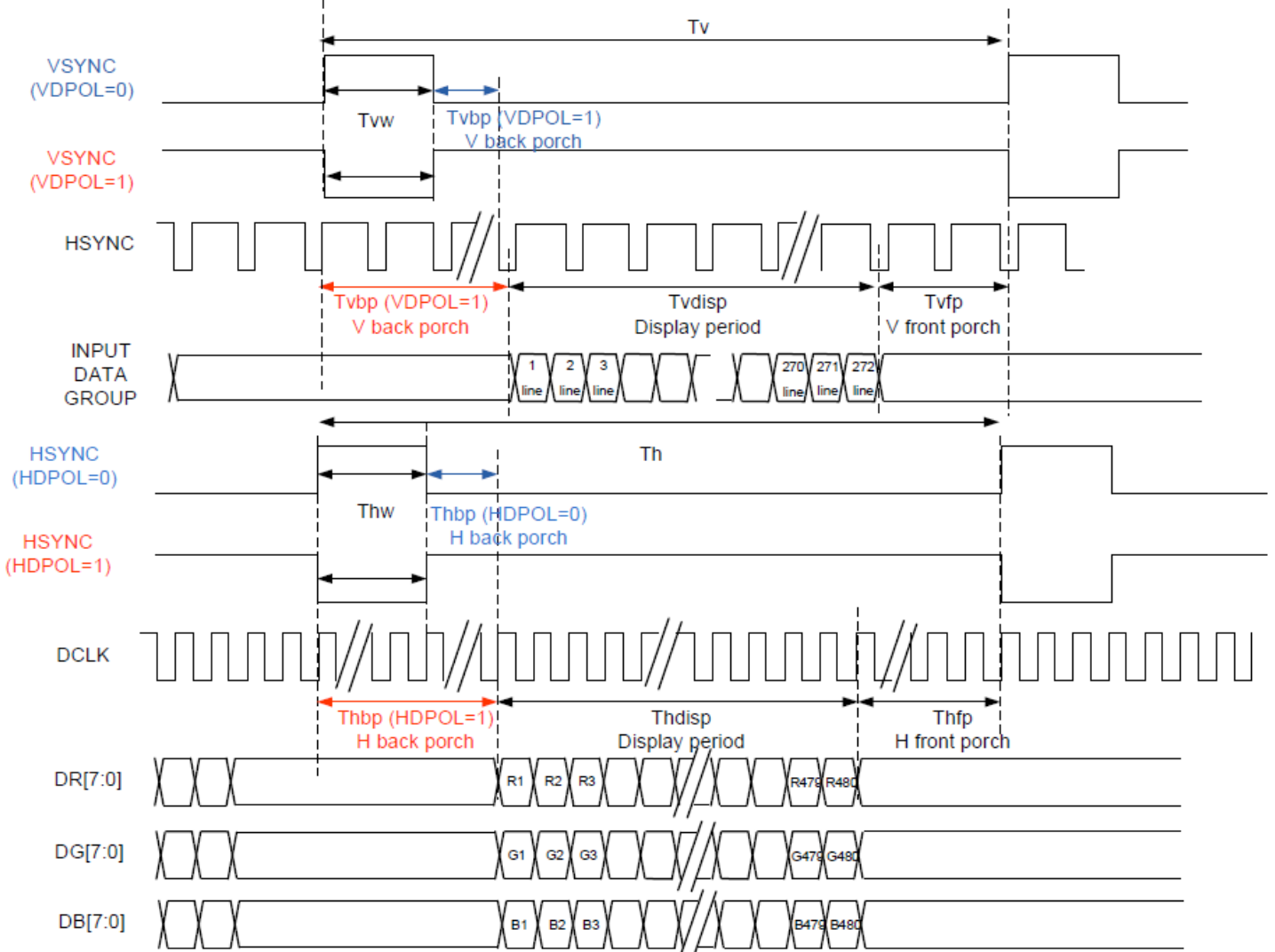
Register No.	Access	Register Name	Bits	Value	Description
3Dh	RO	TOUCH10_Weight	[7:0]	00-FFh	Touch Weight
3Eh	RO	TOUCH10_Misc	[3:0]	00-0Fh	Touch Area
80h	RW	ID_G_MC_THGROUP	[7:0]	00-FFh	Mutual-Capacitive touch Threshold / 4 Default: 4Bh
81h	RW	ID_G_MC_THPEAK	[7:0]	00-FFh	Mutual-Capacitive Peak Threshold / 4 Default: 46h
85h	RW	ID_G_THDIFF	[7:0]	00-FFh	Points Filtering Range Threshold / 16 Default: A0
86h	RW	ID_G_CTRL	[1:0]	0-1	Allowed to switch to monitor mode or not (1: Allowed, 0: Not Allowed)
88h	RW	ID_G_PERIODACTIVE	[3:0]	3h-Eh	Period of Active Status
89h	RW	ID_G_PERIODMONITOR	[7:0]	1Eh-FFh	Timer to enter "idle" while in Monitor (ms)
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: 54h
A4h	RW	ID_G_MODE	[0]	0 1	INT Trigger Mode INT Polling Mode
A5h	RW	ID_G_PMODE	[1:0]	0 1 3	Active Monitor Sleep
A6h	RO	ID_G_FIRMID	[7:0]	00-FFh	Firmware ID Number Default: 2
A8h	RO	ID_G_VENODRID	[7:0]	00-FFh	CTPM Vendor's Chip ID Default: 79h
C0h	RW	ID_G_GLOVE_MODE_EN	[0]	0 1	Glove Mode Switch Disable Glove Mode Switch Enable
C1h	RW	ID_G_COVER_MODE_EN	[0]	0 1	Cover Mode Switch Disable Cover Mode Switch Enable

# Timing Characteristics – TFT Display

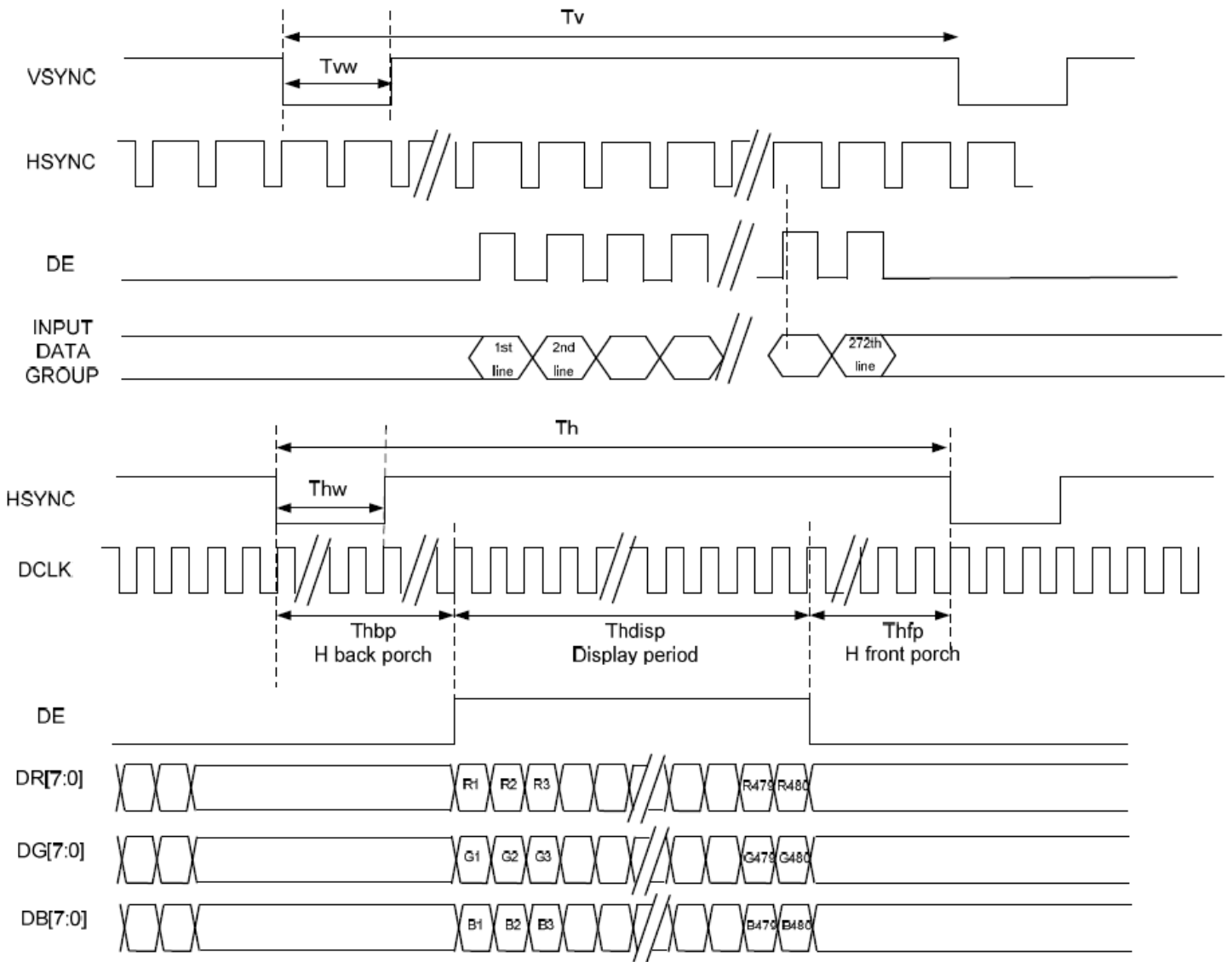
## Parallel RGB input timing requirement

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK Frequency		FCLK	9	12	15	MHz	
DCLK Period		TCLK	10	50	-	μS	R=10KΩ, 1μF
HSYNC	Period Time	Th	485	525	532	DCLK	
	Display Period	Thdisp	-	480	-	DCLK	
	Back Porch	Thbp	3	43	50	DCLK	By H_Blanking Setting
	Front Porch	Thfp	2	2	2	DCLK	
	Pulse Width	Thw	1	1	1	DCLK	
VSYNC	Period Time	Tv	275	285	303	H	
	Display Period	Tvdisp	-	272	-	H	
	Back Porch	Tvbp	2	12	30	H	By V_Blanking Setting
	Front Porch	Tvfp	1	1	1	H	
	Pulse Width	Tvw	1	1	1	H	

- SYNC Mode Timing



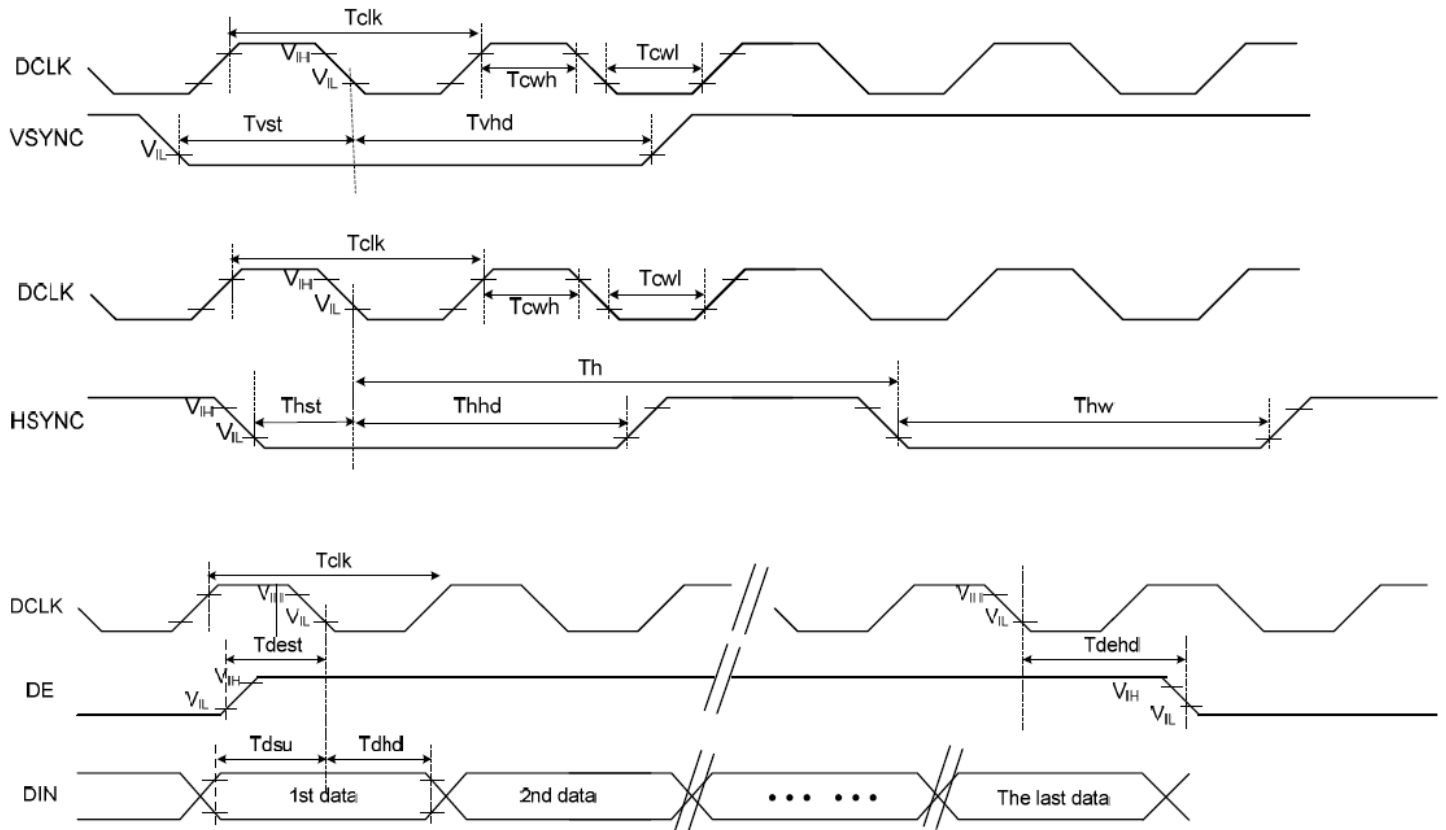
**- SYNC-DE Mode Timing**



## Input setup timing requirement

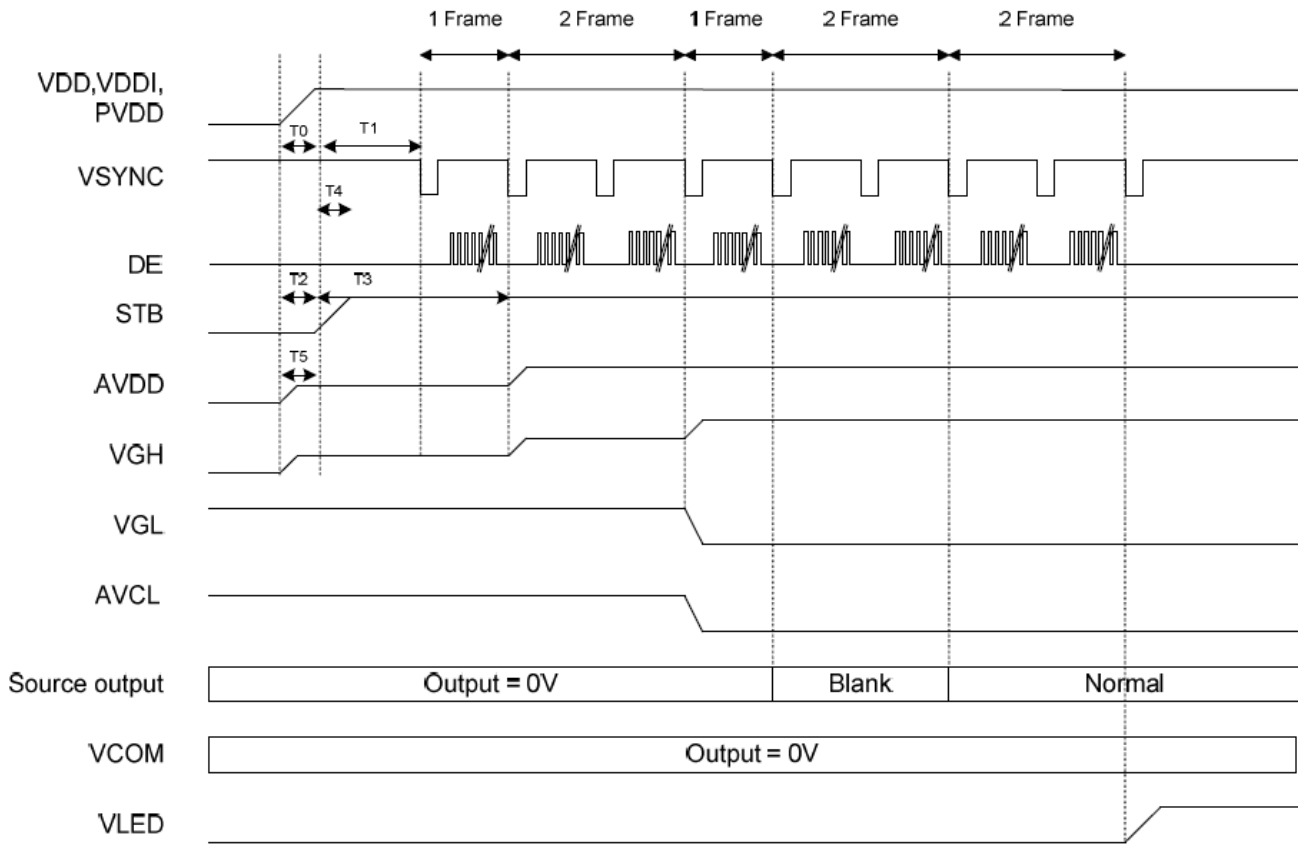
Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
System Operation Timing						
V <sub>DD</sub> Power Source Slew Time	TPOR	-	-	20	ms	From 0V to 99% V <sub>DD</sub>
GRB Pulse Width	tRSTW	10	50	-	μS	R=10KΩ, 1μF
Input / Output Timing						
CLK pulse Duty	TCW	40	50	60	%	
Hsync Width	Thw	1	-	-	DCLK	
Hsync Period	Th	50	60	65	μS	
Vsync setup time	Tvst	12	-	-	ns	
Vsync hold time	Tvhd	12	-	-	ns	
Hsync setup time	Thst	12	-	-	ns	
Hsync hold time	Thhd	12	-	-	ns	
Data setup time	Tdsu	12	-	-	ns	
Data hold time	Tdhd	12	-	-	ns	
SD output stable time	Tst	-	-	12	μS	Output settled within +20mV Loading = 6.8k+28.2pF
GD output rise and fall time	Tgst	-	-	6	μS	Output settled (5%~95%) Loading = 4.7k+29.8pF

### - Clock And Data Input Timing Diagram



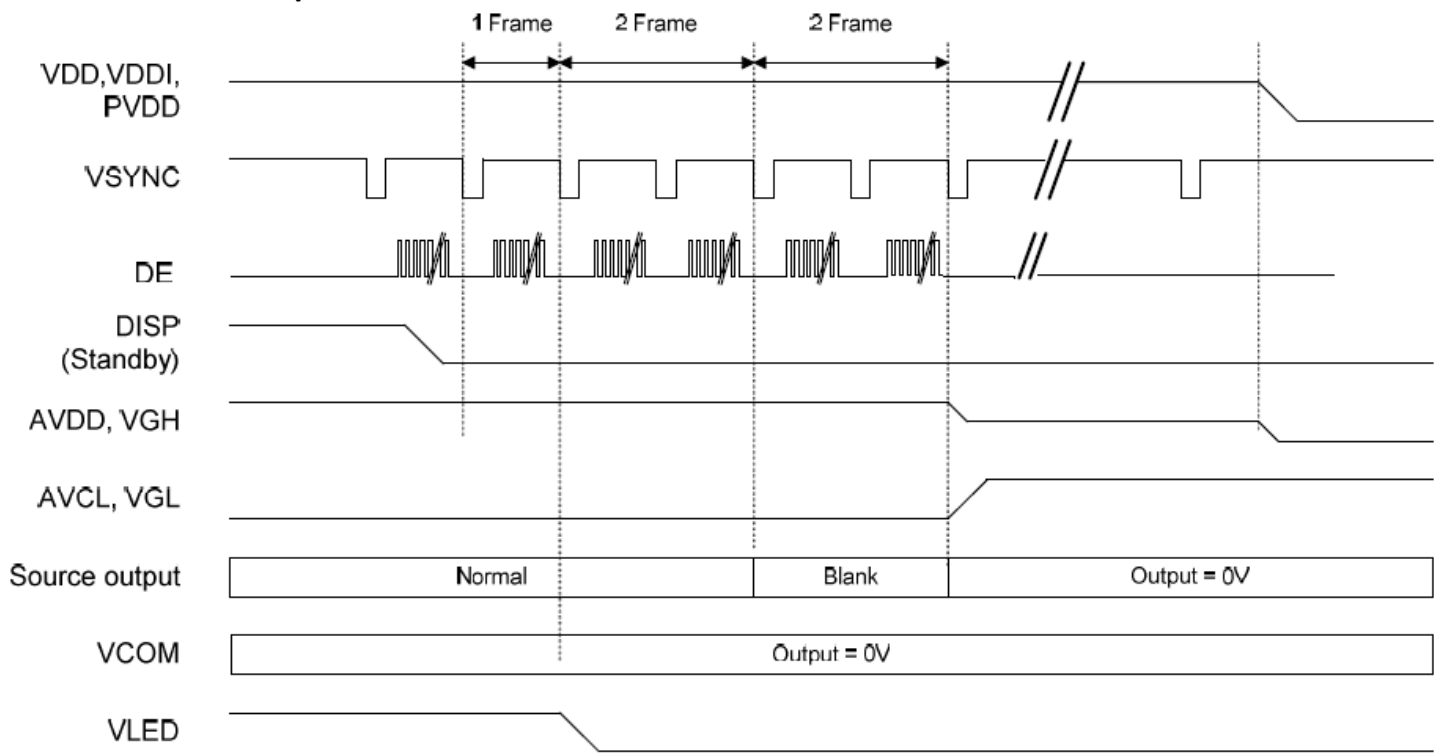
# Power On/Off Sequence

## - Power On Sequence



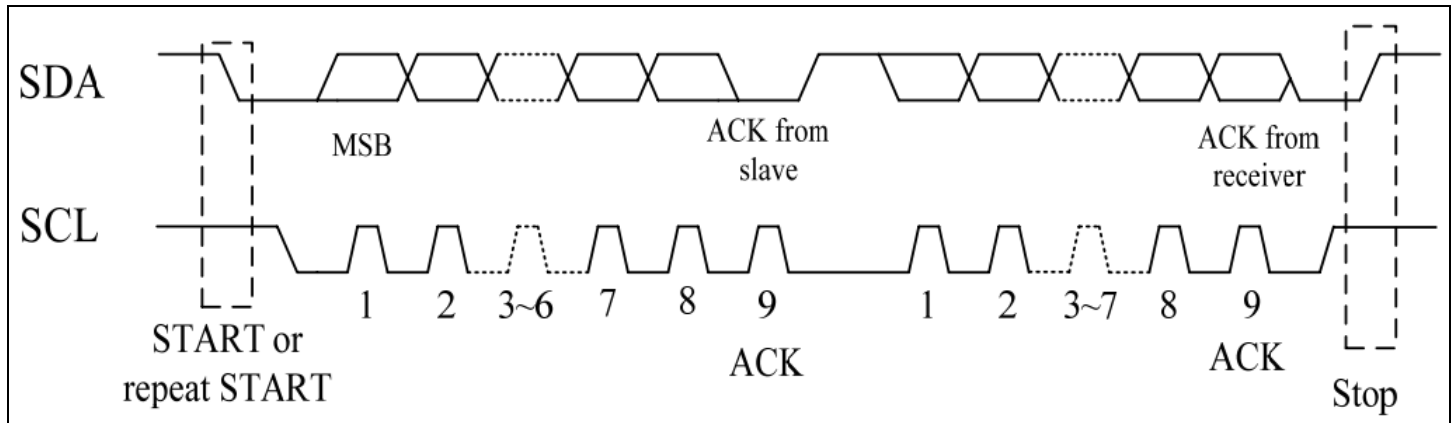
	Description	Min. Time
T0	Determined by the external power	
T1	Time from stable VDD, VDDI, PVDD set-up to the first VSYNC	T1=0
T2	Time from AVDD=0V to AVDD=3.3V	T2=T0
T3	Time from AVDD=3.3V to AVDD=6.0V	T3=T1+ (1*Frame)
T4	Time from stable VDD, VDDI, PVDD set-up to DISP asserted	T4=0
T5	Time from VGH=0V to VGH=3.3V	T5=T0

- **Power Off Sequence**

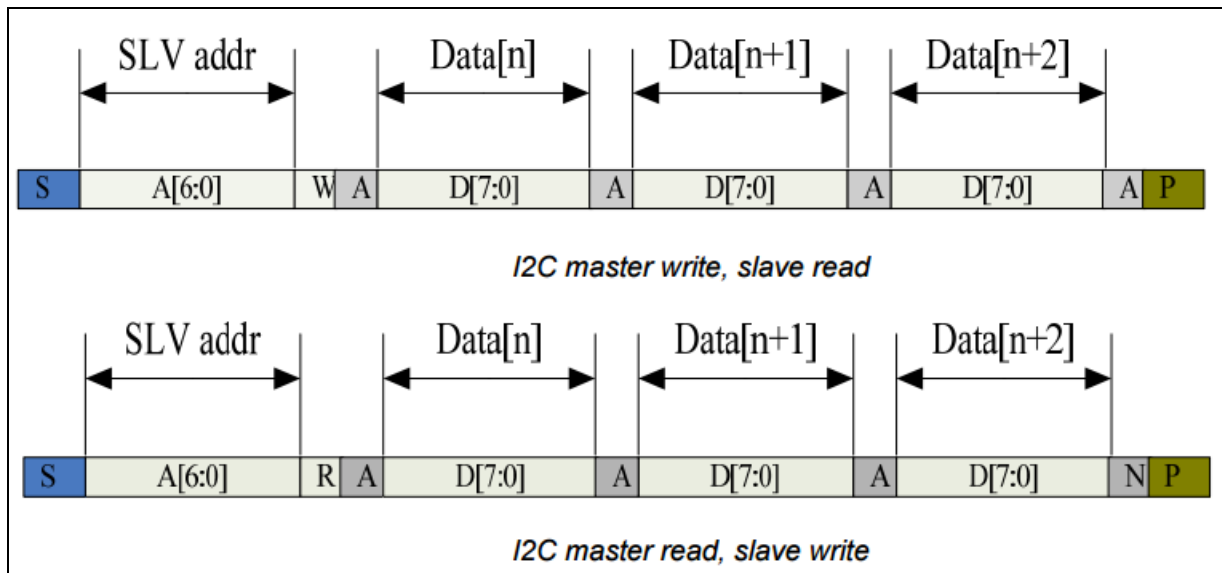


# Timing Characteristics – Capacitive Touch Panel

## Data Transfer Format

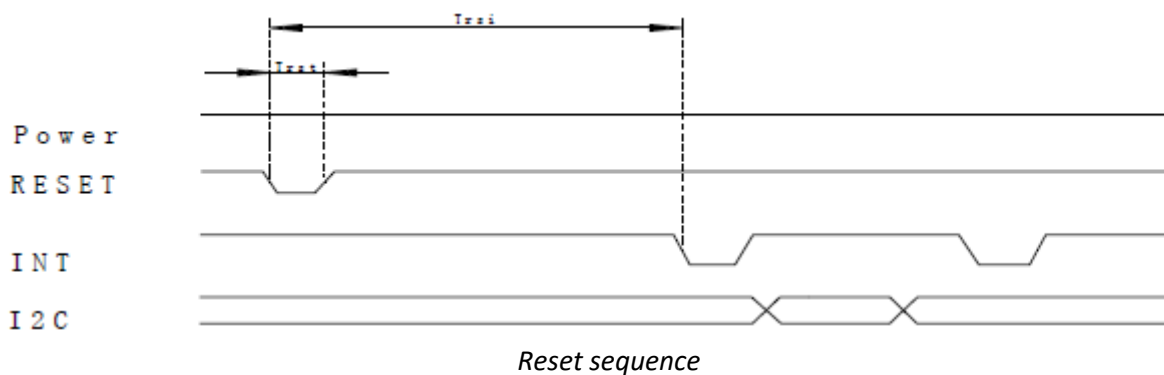
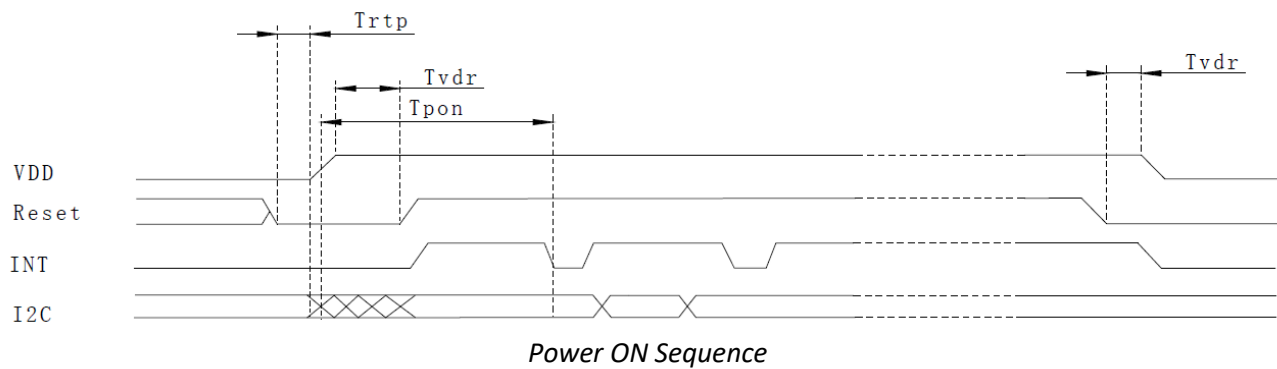
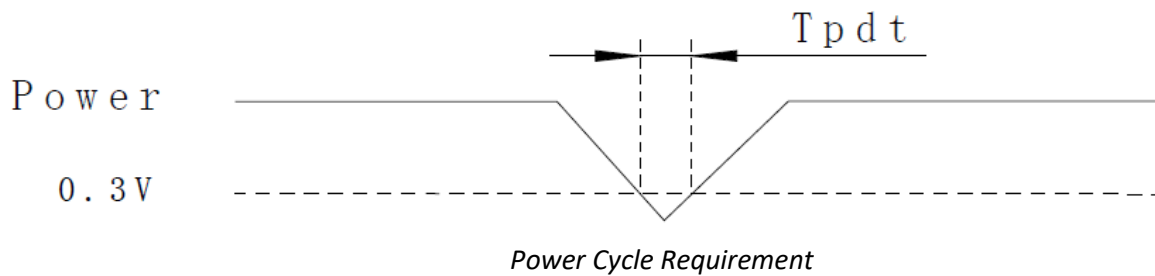
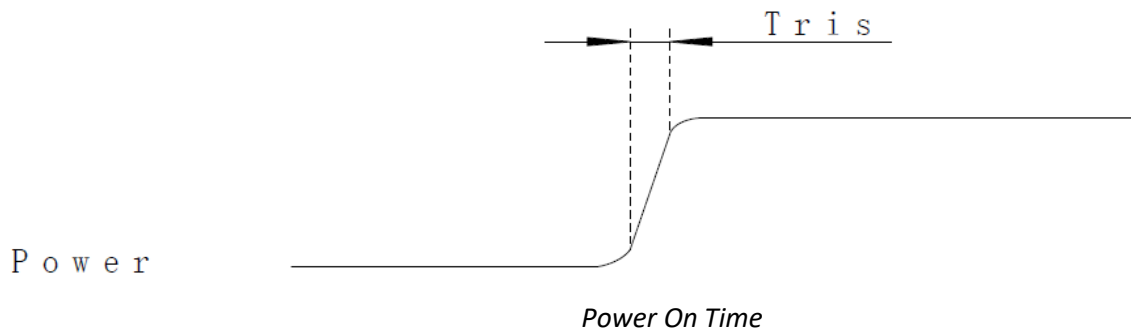


Parameter	Min	Max	Unit
SCL Frequency	0	400	KHz
Bus free time between a STOP & START condition	1.3	-	μs
Hold time Repeated START condition	0.6	-	μs
Data Setup Time	100	-	ns
Setup time for a repeated START condition	0.6	-	μs
Setup time for a STOP condition	0.6	-	μs



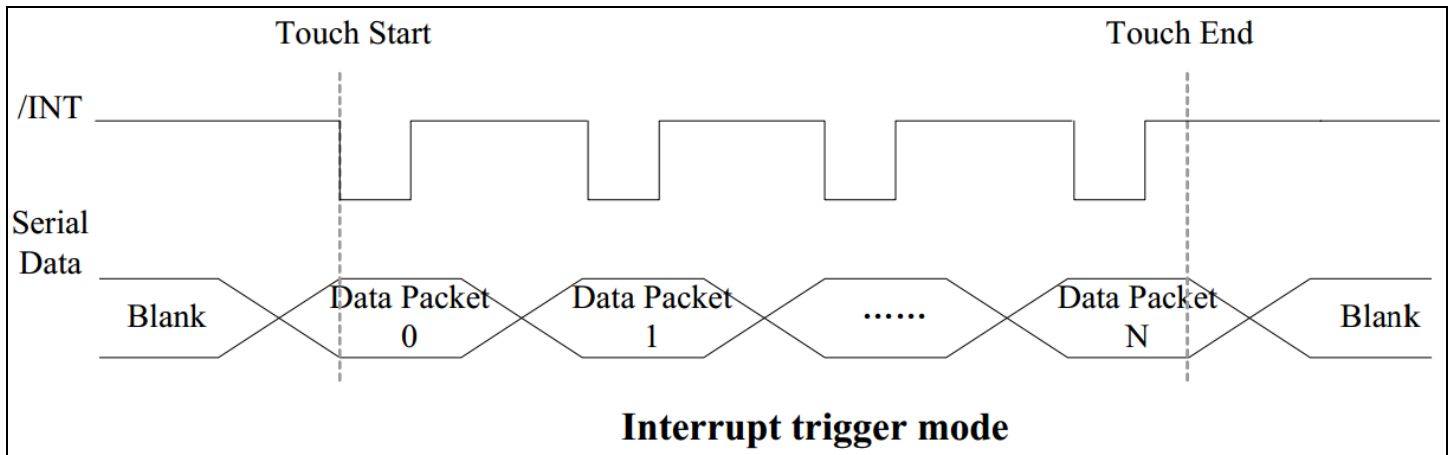


## Power ON/Reset Sequence



Parameter	Description	Min	Max	Unit
$T_{ris}$	Rise time from $0.1V_{DD}$ to $0.9V_{DD}$	-	5	ms
$T_{pdt}$	Time of the voltage of supply being below 0.3V	5	-	ms
$T_{rtp}$	Time of resetting to be low before powering on	100	-	$\mu$ s
$T_{pon}$	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

\*Note: If Reset is tied to  $V_{DD}$  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 , 96 Hrs.	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 96 Hrs.	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C , 96 Hrs.	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 96 Hrs.	1,2
High Temperature / Humidity Operation	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+50°C , 90% RH , 96 Hrs.	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	-20°C,60min -> 25°C,5min ->70°C,60min = 1 cycle 20 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-50Hz , 15mm amplitude. 30 Min. Each Direction X,Y,Z	3
Static electricity test	Endurance test applying electric static discharge.	Air: V <sub>s</sub> =±8KV, Contact: V <sub>s</sub> =±4KV R <sub>s</sub> =330Ω C <sub>s</sub> =150pF 5 Times	

**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.

## Precautions for using LCDs/LCMs

See Precautions at [www.newhavendisplay.com/specs/precautions.pdf](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information

See Terms & Conditions at [http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)