

# NHD-10.1-1024600AF-LSXV#-CTP

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

NHD-	Newhaven Display
10.1-	10.1" Diagonal
1024600-	1024xRGBx600 Pixels
AF-	Model
L-	LVDS Interface
S-	High Brightness, White LED Backlight
X-	TFT
V-	MVA, Transmissive, Standard Temperature
#-	<b>RoHS Compliant</b>
CTP-	Capacitive Touch Panel with Controller

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## Document Revision History

Revision	Date	Description	Changed by
0	5/17/17	Initial Release	SB
1	8/14/17	Backlight Characteristics Added, Pin Descriptions Updated	SB
2	11/8/17	CTP Characteristics Updated	SB
3	3/6/18	Backlight Characteristics Updated	SB
4	7/1/18	Backlight Redesign	SB
5	5/6/19	Display Thickness Correction	SB
6	7/10/19	Electrical Characteristics Updated	SB

## Functions and Features

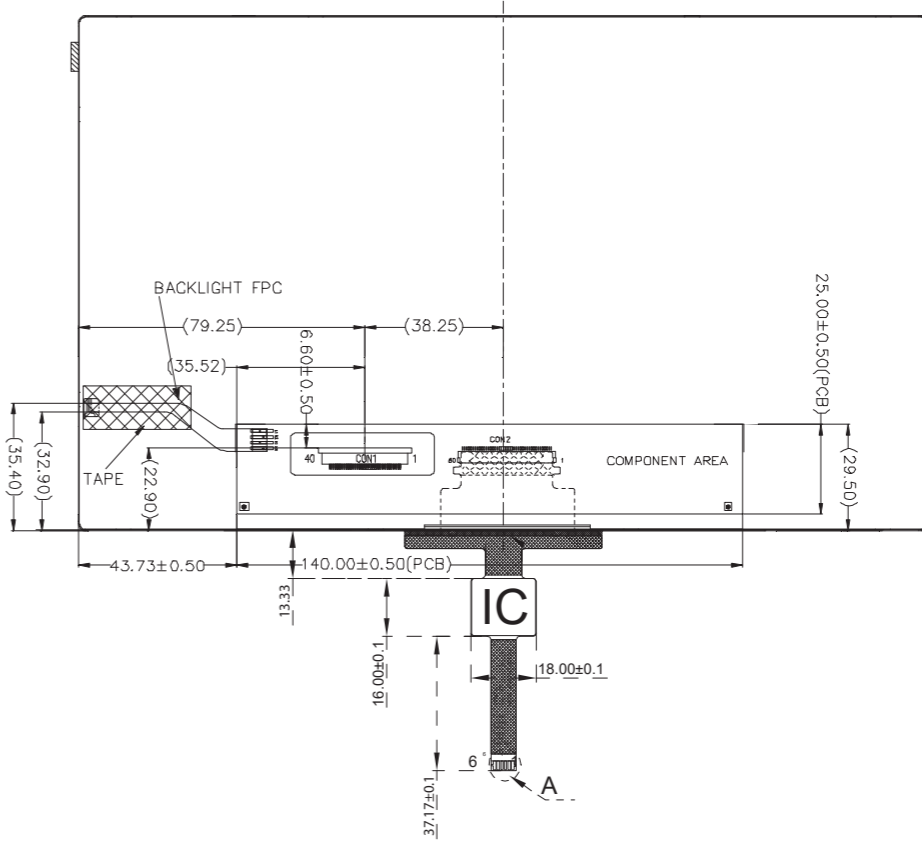
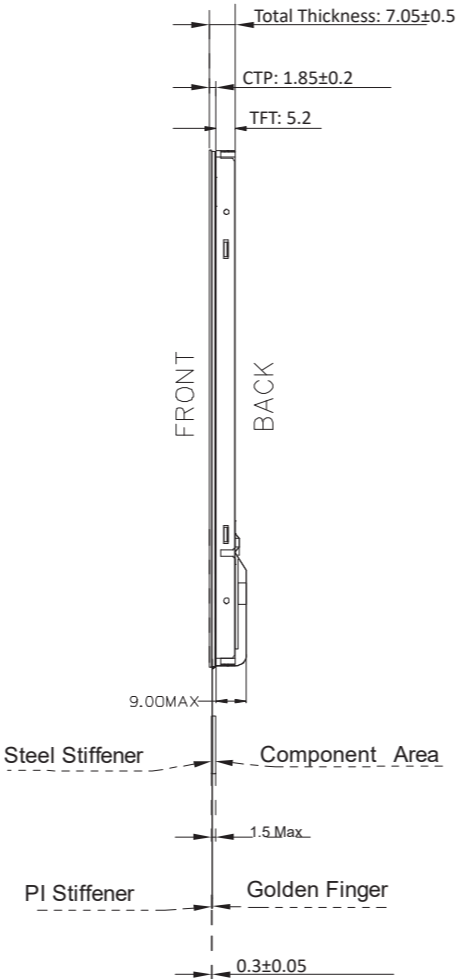
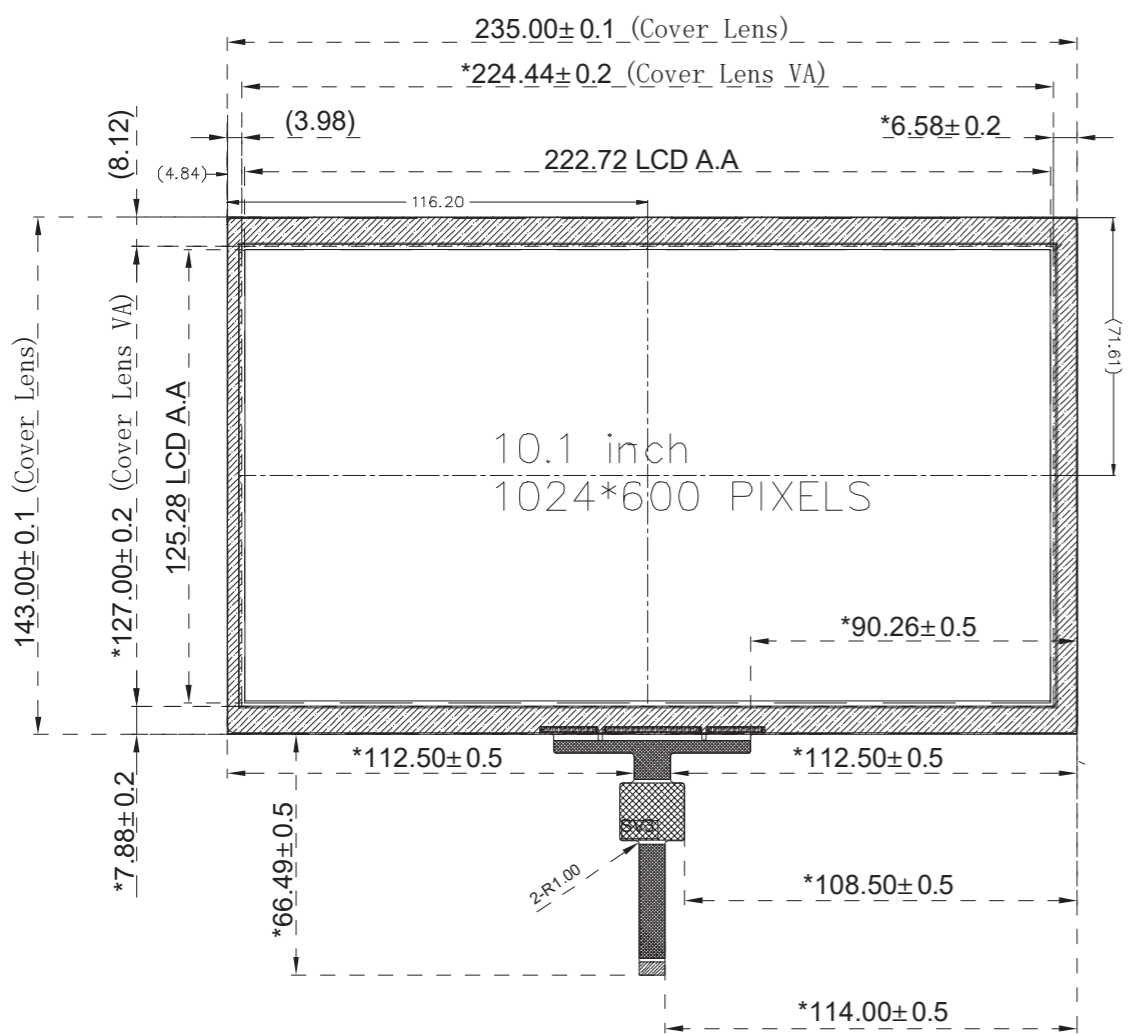
- 1024xRGBx600 resolution
- LED backlight
  - Built-in LED driver
  - PWM brightness control
- LVDS interface
  - 4 LVDS Channels
- 262K colors
- Wide Viewing Angles
- Capacitive touch panel with controller
  - 10-point multi-touch input
  - Gesture input
    - Zoom In/Out
    - Swipe Up/Down/Left/Right

SYMBOL	REVISION	DATE

**Pin Assignment**

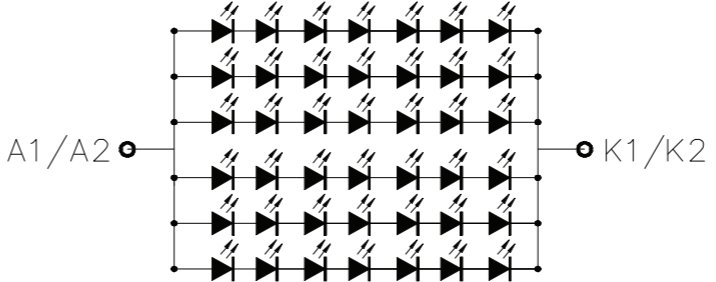
PIN No.	SYMBOL
1	GND
2	VDD
3	VDD
4	V_EDID
5	GND
6	SCL
7	SDA
8	Rin0-
9	Rin0+
10	GND
11	Rin1-
12	Rin1+
13	GND
14	Rin2-
15	Rin2+
16	GND
17	CLKIN-
18	CLKIN+
19	GND
20	Rin3-
21	Rin3+
22	GND
23	INSEL
24	GND
25	GND
26	UPDN
27	SHLR
28	GND
29	RESET
30	STBYB
31	LED-GND
32	LED-GND
33	LED-GND
34	GND
35	LED_PWM
36	LED_EN
37	BIST
38	LED_VDD
39	LED_VDD
40	LED_VDD

PIN	SYMBOL
PIN1	VDD
PIN2	GND
PIN3	SCL
PIN4	SDA
PIN5	INT
PIN6	RESET



- Notes:**
1. Display Size: 10.1" TFT
  2. Display Resolution: 1024 x 600 Pixels
  3. Display Mode: Transmissive / Normally White / Anti-Glare
  4. Optimal View: Full View
  5. Driver IC: HX8282 - LVDS Interface
  6. Power Supply Voltage: 3.3V
  7. Backlight: White LED
  8. Luminance: 700 cd/m<sup>2</sup> (Typ)
  9. Touch Panel: PCAP

**Backlight Circuit**



STANDARD TOLERANCES (UNLESS OTHERWISE SPECIFIED)		<b>NEWHAVEN DISPLAY INTERNATIONAL</b>	
LINEAR: XX. ±0.3 mm XX.X ±0.3 mm XX.XX ±0.3 mm		DRAWING/PART NUMBER: <b>NHD-10.1-1024600AF-LSXV#-CTP</b>	
UNLESS OTHERWISE SPECIFIED		DRAWN BY: S. Baxi	CHECKED BY: S. Baxi
DIMENSIONS ARE IN MILLIMETERS		APPROVED BY: S. Baxi	REVISION: 1C
THIRD ANGLE PROJECTION		DRAWN DATE: 5/6/19	CHECKED DATE: 5/6/19
		APPROVED DATE: 5/6/19	SCALE: NS
DO NOT SCALE DRAWING			SHEET 1 OF 1
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## Pin Description

### TFT:

Pin No.	Symbol	Connection	Function Description
1	GND	Power Supply	Ground
2-3	V <sub>DD</sub>	Power Supply	Supply voltage for LCD (+3.3V)
4	V <sub>EDID</sub>	Power Supply	Supply voltage for EDID (+3.3V)
5	GND	Power Supply	Ground
6	SCL	MPU	Serial Clock
7	SDA	MPU	Serial Data
8	Rin0-	MPU	-LVDS differential data input CH0
9	Rin0+	MPU	+LVDS differential data input CH0
10	GND	Power Supply	Ground
11	Rin1-	MPU	-LVDS differential data input CH1
12	Rin1+	MPU	+LVDS differential data input CH1
13	GND	Power Supply	Ground
14	Rin2-	MPU	-LVDS differential data input CH2
15	Rin2+	MPU	+LVDS differential data input CH2
16	GND	Power Supply	Ground
17	CLKIN-	MPU	-LVDS differential Clock
18	CLKIN+	MPU	+LVDS differential Clock
19	GND	Power Supply	Ground
20	Rin3-	MPU	-LVDS differential data input CH3
21	Rin3+	MPU	+LVDS differential data input CH3
22	GND	Power Supply	Ground
23	INSEL (HSD)	MPU	Data Input Format: INSEL = L 8-Bit LVDS Input (Default) INSEL = H 6-Bit LVDS Input
24-25	GND	Power Supply	Ground
26	UPDN	MPU	Gate Driver Up/Down Scan Setting: UPDN = H: Reverse Scan UPDN = L: Normal Scan (Default)
27	SHLR	MPU	Gate Driver Left/Right Scan Setting: SHLR = H: Normal Scan (Default) SHLR = L: Reverse Scan
28	GND	Power Supply	Ground
29	RESET	MPU	Active Low Reset Signal
30	STBYB	MPU	Active Low Standby Signal
31-33	LED_GND	Power Supply	Ground for Backlight Driver
34	GND	Power Supply	Ground
35	LED_PWM	MPU	Backlight PWM Signal Input (See Table on Page 6)
36	LED_EN	MPU	Backlight Enable; H: Backlight On; L: Backlight Off
37	BIST	MPU	Built in Self-Test BIST = H: Self-Test Enabled BIST = L: Normal Operation (Default)
38-40	LED_V <sub>DD</sub>	Power Supply	Supply Voltage for Backlight Driver

**LCD connector:** 0.5mm pitch 40-Conductor FFC.

**Recommended cable:** 40 POS FFC

### Capacitive Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	VDD	Power Supply	Power Supply (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 touch panel module to host
6	/RESET	MPU	Active LOW Reset signal.

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

## Electrical Characteristics (T<sub>OP</sub> = 25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T <sub>OP</sub>	Absolute Max	0	-	+50	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-20	-	+60	°C
Supply Voltage for LCD	V <sub>DD</sub>	-	3.0	3.3	3.6	V
Supply Voltage for EDID	V <sub>EDID</sub>	-	3.0	3.3	3.6	V
Supply Current for LCD	I <sub>DD</sub>	V <sub>DD</sub> = 3.3V	50	120	180	mA
LVDS Differential input HIGH Voltage	RxVTH	-	-	-	+100	mV
LVDS Differential input LOW Voltage	RxVTL	-	-100	-	-	mV
LVDS Differential input Common Voltage	RxVCM	-	0.7	-	1.6	V
LVDS Differential Voltage	VID	-	200	-	600	mV
Supply Voltage for Backlight Driver	LED_V <sub>DD</sub>	-	5.0	12.0	22.4	V
Supply Current for Backlight Driver <sup>1</sup>	LED_I <sub>DD</sub>	-	160	360	1200	mA
Backlight Enable	LED_EN	-	2.5	3.3	5.5	V
Backlight PWM Voltage	LED_PWM	I <sub>PWM</sub> ≤ 5 mA	2.5	3.3	5.5	V
Backlight Lifetime <sup>2</sup>	-	T <sub>OP</sub> = 25° C	20,000	50,000	-	Hrs.

<sup>1</sup>Minimum supply current occurs when supply voltage is at max; maximum supply current when supply voltage is at minimum.

<sup>2</sup>Backlight lifetime is rated as Hours until **half-brightness**, under normal operating conditions.

## 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>	T <sub>OP</sub> =25°C, V <sub>DD</sub> =3.3V	8	15	23	mA
Supply Current – Hibernate	I <sub>DD</sub>		-	1.0	-	μA
“H” Level Input	V <sub>OH</sub>	-	0.7 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
“L” Level Input	V <sub>IL</sub>	-	V <sub>SS</sub>	-	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>	-	V <sub>SS</sub>	-	0.3 * V <sub>DD</sub>	V

## Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Optimal Viewing Angles	Top	CR ≥ 10	-	75	-	°	
	Bottom		-	75	-	°	
	Left		-	75	-	°	
	Right		-	75	-	°	
Contrast Ratio	CR	-	450	750	-	-	
Luminance	L <sub>v</sub>	-	500	700	-	cd/m <sup>2</sup>	
Response Time	Rise + Fall	T <sub>R</sub> + T <sub>F</sub>	T <sub>OP</sub> = 25°C		-	8	ms
Chromaticity	Red	X <sub>R</sub>	-	0.565	0.605	0.635	-
		Y <sub>R</sub>	-	0.309	0.349	0.379	-
	Green	X <sub>G</sub>	-	0.286	0.326	0.356	-
		Y <sub>G</sub>	-	0.565	0.605	0.635	-
	Blue	X <sub>B</sub>	-	0.112	0.152	0.182	-
		Y <sub>B</sub>	-	0.075	0.115	0.145	-
White	X <sub>W</sub>	-	0.257	0.297	0.327	-	
	Y <sub>W</sub>	-	0.283	0.323	0.353	-	

## LED\_PWM Signal Operating Frequency:

PWM Frequency (F)	Duty Cycle (Min.)	Duty Cycle (Max.)
100Hz < F < 500Hz	5%	100%
500Hz < F < 20KHz	10%	100%

## Capacitive Touch Panel Characteristics:

Property	Requirement	Unit
Surface Hardness	≥6	H
Light transmission	≥82%	-
Operating Humidity	20~85%	RH
Storage Humidity	20~85%	RH
Number of Touches	10	-

## Driver Information

Built-in HX8282-A14 Source Driver: <http://www.newhavendisplay.com/appnotes/datasheets/LCDs/HX8282-A01.pdf>

Built-in HX8696-A00 Gate Driver: <http://www.newhavendisplay.com/appnotes/datasheets/LCDs/HX8696-A.pdf>

## Capacitive Touch Panel:

Built-in FocalTech FT5526EEZ controller.

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

## Capacitive Touch Panel Registers

Register No	Register Name	Bits	Value	Description
00h	Device Mode	[2:0]	000b 100b 001b	Normal Operating Mode Test Mode - read raw data (reserved) System Information Mode (reserved)
01h	Gesture ID	[7:0]	48h 49h 00h	Zoom In Zoom Out No Gesture
02h	Touch Points	[3:0]	000b 001b 010b 011b 100b 101b	0 touch points detected 1 touch point detected 2 touch points detected 3 touch points detected 4 touch points detected 5 touch points detected
03h	Touch 1 Event Flag	[7:6]	00b 01b 10b 11b	Put Down Put Up Contact Reserved
03h	TOUCH1_XH	[3:0]	0h - 1h	Upper 4 bits of X touch coordinate
04h	TOUCH1_XL	[7:0]	00h - FFh	Lower 8 bits of X touch coordinate
05h	TOUCH1_YH	[3:0]	0h - 1h	Upper 4 bits of Y touch coordinate
06h	TOUCH1_YL	[7:0]	00h - FFh	Lower 8 bits of Y touch coordinate
09h	Touch 2 Event Flag	[7:6]	00b 01b 10b 11b	Put Down Put Up Contact Reserved
09h	TOUCH2_XH	[3:0]	0h - 1h	Upper 4 bits of X touch coordinate
0Ah	TOUCH2_XL	[7:0]	00h - FFh	Lower 8 bits of X touch coordinate
0Bh	TOUCH2_YH	[3:0]	0h - 1h	Upper 4 bits of Y touch coordinate
0Ch	TOUCH2_YL	[7:0]	00h - FFh	Lower 8 bits of Y touch coordinate
0Fh	Touch 3 Event Flag	[7:6]	00b 01b 10b 11b	Put Down Put Up Contact Reserved
0Fh	TOUCH3_XH	[3:0]	0h - 1h	Upper 4 bits of X touch coordinate
10h	TOUCH3_XL	[7:0]	00h - FFh	Lower 8 bits of X touch coordinate
11h	TOUCH3_YH	[3:0]	0h - 1h	Upper 4 bits of Y touch coordinate
12h	TOUCH3_YL	[7:0]	00h - FFh	Lower 8 bits of Y touch coordinate
15h	Touch 4 Event Flag	[7:6]	00b 01b 10b 11b	Put Down Put Up Contact Reserved
15h	TOUCH4_XH	[3:0]	0h - 1h	Upper 4 bits of X touch coordinate
16h	TOUCH4_XL	[7:0]	00h - FFh	Lower 8 bits of X touch coordinate
17h	TOUCH4_YH	[3:0]	0h - 1h	Upper 4 bits of Y touch coordinate
18h	TOUCH4_YL	[7:0]	00h - FFh	Lower 8 bits of Y touch coordinate

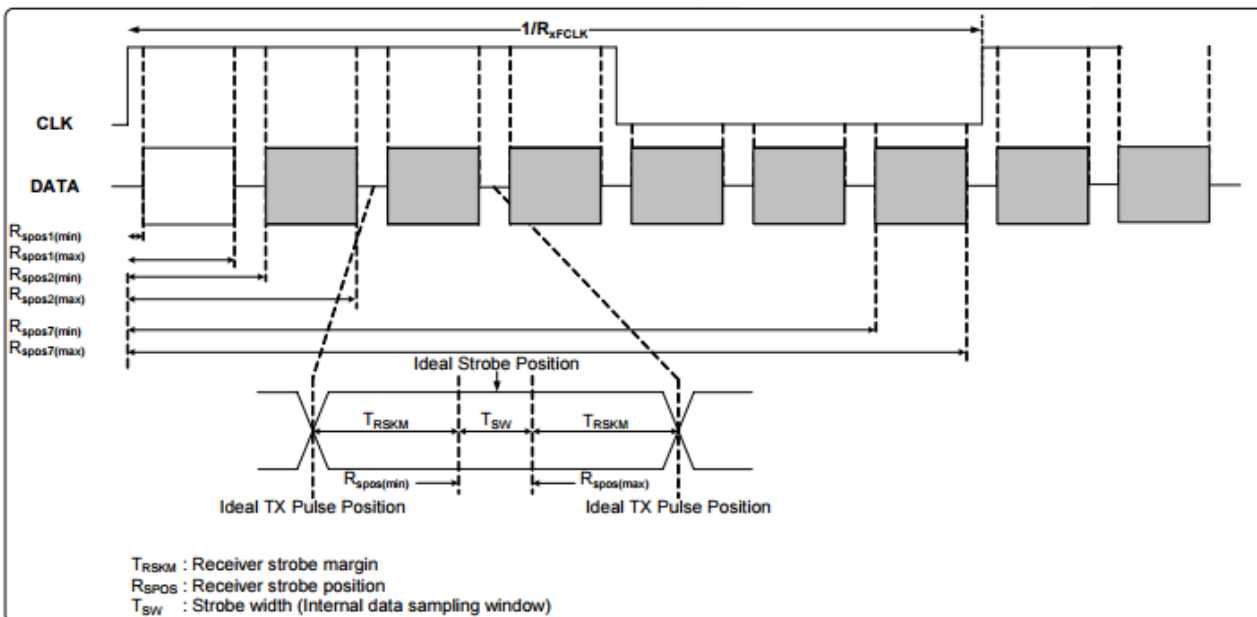
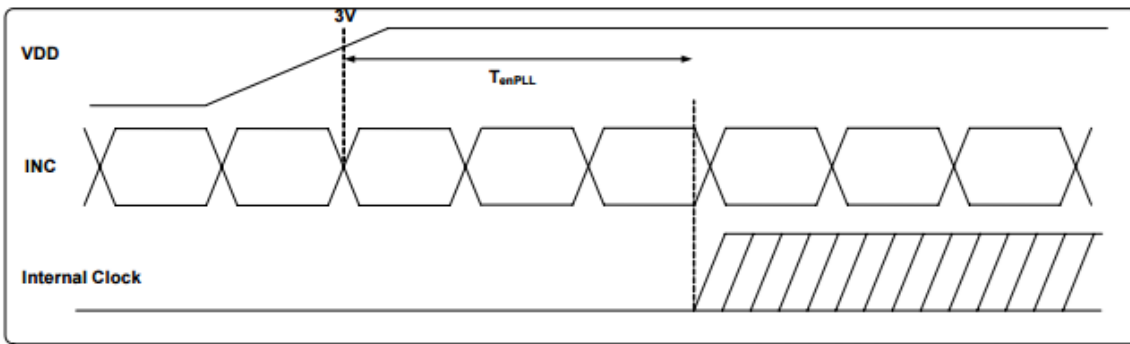
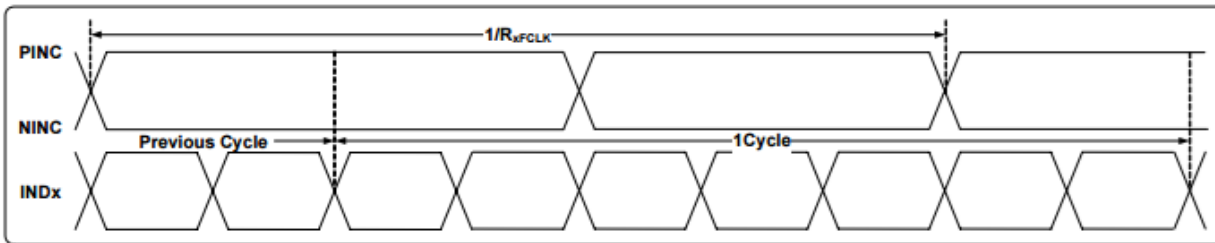
Register No	Register Name	Bits	Value	Description
18h	Touch 5 Event Flag	[7:6]	00b 01b 10b 11b	Put Down Put Up Contact Reserved
18h	TOUCH5_XH	[3:0]	0h - 1h	Upper 4 bits of X touch coordinate
1Ch	TOUCH5_XL	[7:0]	00h - FFh	Lower 8 bits of X touch coordinate
1Dh	TOUCH5_YH	[3:0]	0h - 1h	Upper 4 bits of Y touch coordinate
1Eh	TOUCH5_YL	[7:0]	00h - FFh	Lower 8 bits of Y touch coordinate
80h	ID_G_THGROUP	[7:0]	00h - FFh	Valid touching detect threshold Actual value will be 4 times register's value Recommended: 46h
81h	ID_G_THPEAK	[7:0]	00h - FFh	valid touching peak detect threshold Recommended: 3Ch
82h	ID_G_THCAL	[7:0]	00h - FFh	Touch focus threshold Recommended: 1Dh
83h	ID_G_THWATER	[7:0]	00h - FFh	threshold when there is surface water Recommended: D3h
84h	ID_G_THTEMP	[7:0]	00h - FFh	threshold of temperature compensation Recommended: EBh
85h	ID_G_THDIFF	[7:0]	00h - FFh	Touch difference threshold Actual value is 32 times the register's value Recommended: A0h
86h	ID_G_CTRL	[1:0]	00h 01h	Power Control Mode: Not Auto Jump Power Control Mode: Auto Jump
87h	ID_G_TIME_ENTER_MONITOR	[7:0]	00h-FFh	Delay to enter 'Monitor' status (s) Recommended: C8h
88h	ID_G_PERIODACTIVE	[3:0]	3h-Eh	Period of 'Active' status (ms) Recommended: 6h
89h	ID_G_PERIODMONITOR	[7:0]	1Eh-FFh	Timer to enter 'idle' when in 'Monitor' (ms) Recommended: 28h
A0h	ID_G_AUTO_CLB_MODE	[7:0]	00h FFh	Auto calibration mode: Enable auto calibration Auto calibration mode: Disable auto calibration
A1h	ID_G_LIB_VERSION_H	[7:0]	30h	Firmware Library Version H byte
A2h	ID_G_LIB_VERSION_L	[7:0]	01h	Firmware Library Version L byte
A3h	ID_G_CIPHER	[7:0]	54h	Chip vendor ID
A4h	ID_G_MODE	[0:0]	00h 01h	Interrupt status: Enable interrupt to host Interrupt status: Disable interrupt to host
A5h	ID_G_PMODE	[1:0]	00h 01h 03h	'Active' Mode 'Monitor' Mode 'Hibernate' Mode
A6h	ID_G_FIRMID	[7:0]	06h	Firmware ID
A7h	ID_G_STATE	[7:0]	00h 01h 02h 03h 04h	Running State: Configure Running State: Work Running State: Calibration Running State: Factory Running State: Auto-calibration
A8h	ID_G_FT5201ID	[7:0]	79h	CTPM Vendor's Chip ID
A9h	ID_G_ERR	[7:0]	00h 03h 05h 1Ah	Error Code: OK Error Code: Chip register writing inconsistent with reading Error Code: Chip start fail Error Code: Calibration match fail



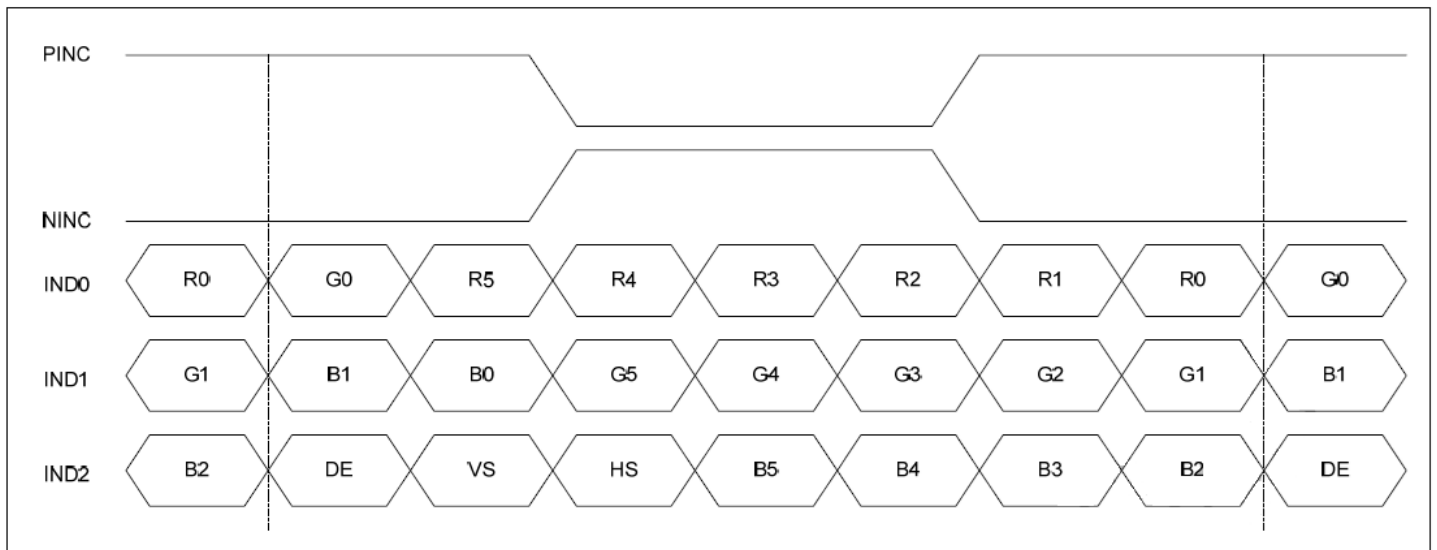
# Timing Characteristics: Display

Parameter	Symbol	Spec			Unit	Condition
		Min.	Typ.	Max.		
Clock frequency	R <sub>XFLK</sub>	20	-	71	MHz	-
Input data skew margin	T <sub>RSKM</sub>	500	-	-	pS	VID  = 400mV R <sub>XVCM</sub> = 1.2V R <sub>XFLK</sub> = 71MHz
Clock high time	T <sub>LVCH</sub>	-	4/(7 * R <sub>XFLK</sub> )	-	nS	-
Clock low time	T <sub>LVCL</sub>	-	3/(7 * R <sub>XFLK</sub> )	-	nS	-
PLL wake-up time	T <sub>emPLL</sub>	-	-	150	μS	-

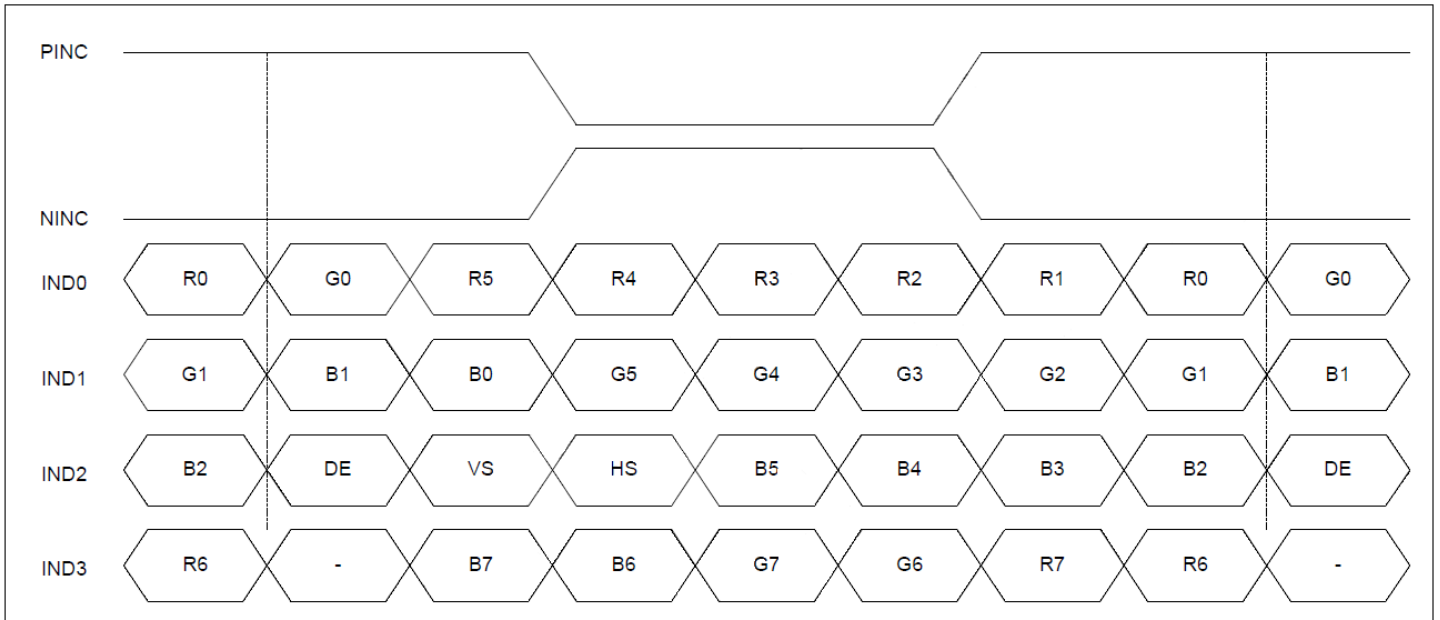
Parameter	Symbol	Spec			Unit	Condition
		Min.	Typ.	Max.		
Modulation Frequency	SSC <sub>MF</sub>	23	-	93	KHz	-
Modulation Rate	SSC <sub>MR</sub>	-	-	±3	%	LVDS Clock = 71 MHz



### 6-bit LVDS data input format:

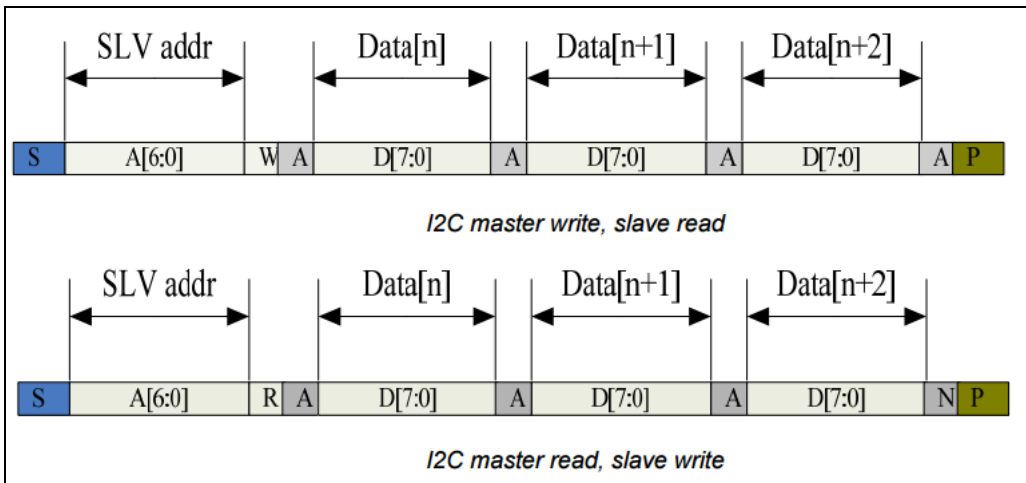
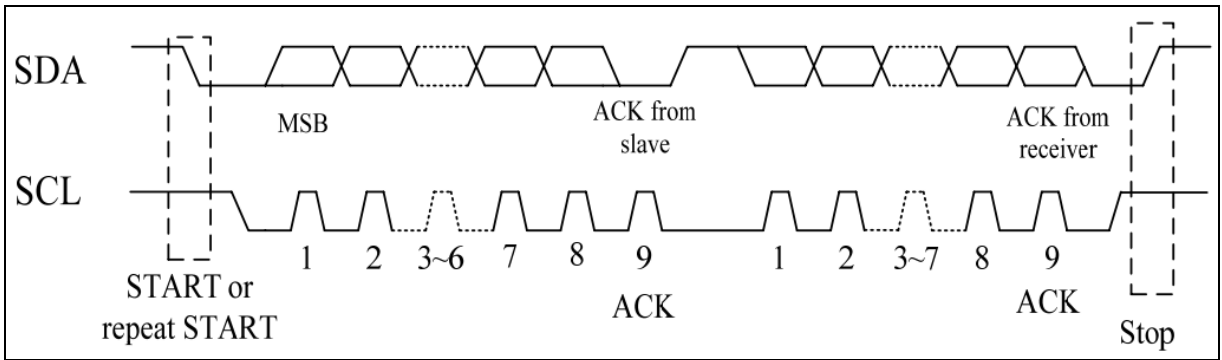


### 8-Bit LVDS Data Input Format:



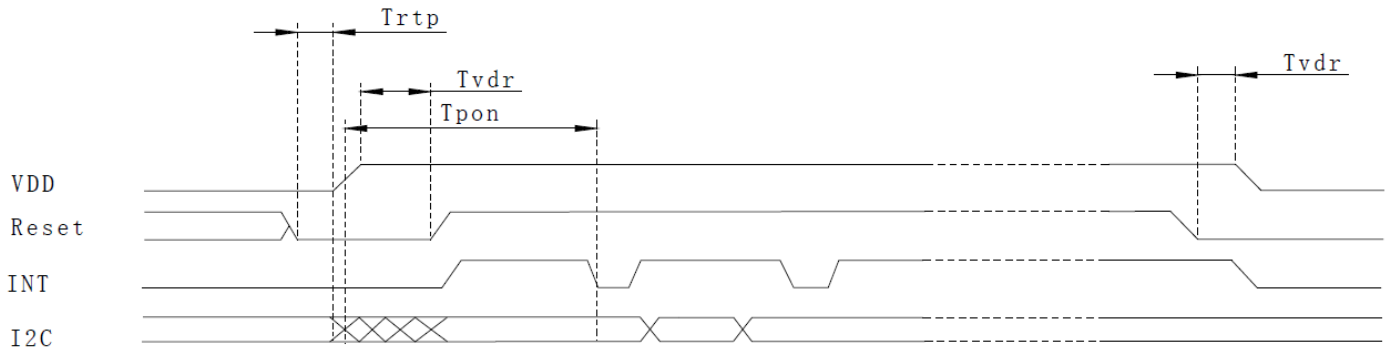
# Timing Characteristics: Capacitive Touch Panel

## Data Transfer Format

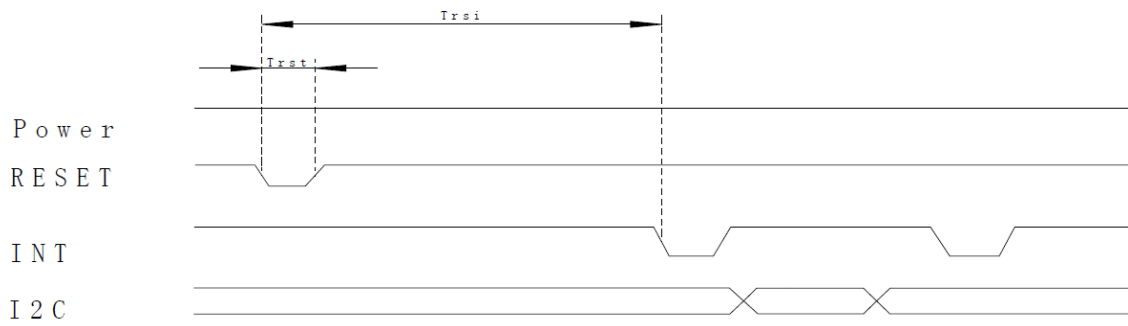


Parameter	Min	Max	Unit
SCL Frequency	0	400	KHz
Bus free time between a STOP and START Condition	1.3	-	μs
Hold Time (repeated) START Condition	0.6	-	μs
Data Setup Time	100	-	ns
Setup Time for a repeated START Condition	0.6	-	μs
Setup Time for STOP Condition	0.6	-	μs

## Power ON Sequence



## Reset Sequence



Parameter	Description	Min	Max	Unit
$T_{ris}$	Rise time from $0.1 \cdot V_{DD}$ to $0.9 \cdot V_{DD}$	-	5	ms
$T_{pdt}$	Time for voltage supply below $0.3 \cdot V_{DD}$	5	-	ms
$T_{rtp}$	Time to hold reset low Before Applying Power	100	-	$\mu s$
$T_{pon}$	Time of starting to report point after powering on	-	200	ms
$T_{vdr}$	Reset time after $V_{DD}$ power on	1	-	ms
$T_{rsi}$	Time of starting to report point after Reset	-	200	ms
$T_{rst}$	Reset Time	1	-	ms

### 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.	+60°C , 240 hrs.	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-20°C , 240 hrs.	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+50°C, 120 hrs.	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	0°C , 120 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 , 85% RH , 120 hrs.	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	0°C, 30min->25°C, 5min -> 50°C, 30min 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-55Hz , 1.5mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes	3
Static electricity test	Endurance test applying electric static discharge.	Air: V <sub>s</sub> =8KV, Contact: V <sub>s</sub> =4KV 10 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 and Terms & Conditions

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