

**Product Specification**

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# NHD-7.0-1024600AF-LSXP-CTP

## IPS TFT Liquid Crystal Display

<b>NHD-</b>	Newhaven Display
<b>7.0-</b>	7.0" Diagonal
<b>1024600-</b>	1024x600 Pixels
<b>AF-</b>	Model
<b>L-</b>	LVDS Interface
<b>S-</b>	High Brightness, White LED Backlight
<b>X-</b>	TFT
<b>P-</b>	IPS, Wide Temperature
<b>CTP-</b>	Capacitive Touch Panel

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## Additional Resources

- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** [https://www.newhavendisplay.com/knowledge\\_center.html](https://www.newhavendisplay.com/knowledge_center.html)
- **Quality Center:** [https://www.newhavendisplay.com/quality\\_center.html](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	04/22/2019	Initial Release	PK
1	06/18/2019	CTP Firmware ID & Backlight Characteristics Updated	SB
2	07/27/2020	Included Horizontal & Vertical Timing Charts	AS
3	04/27/2021	Updated the Electrical and Optical Characteristics	JT
4	08/24/2021	Updated Mechanical Drawing	ZP
5	11/22/2021	FT5426 CTP IC Version & Mechanical Drawing Update	ZP
6	03/07/2022	Mechanical Drawing Updated	ZP
7	10/31/2022	Updated CTP Electrical Characteristics, Material Characteristics, Firmware ID and Mechanical Drawing, CTP Revision upgraded to Rev4A	JT
8	02/07/2023	Mechanical Drawing Format Updated	KL
9	10/26/2023	Updated Optical Characteristics, Supply Current for LCD/Backlight Current(TFT) and Supply Voltage (CTP)	KL

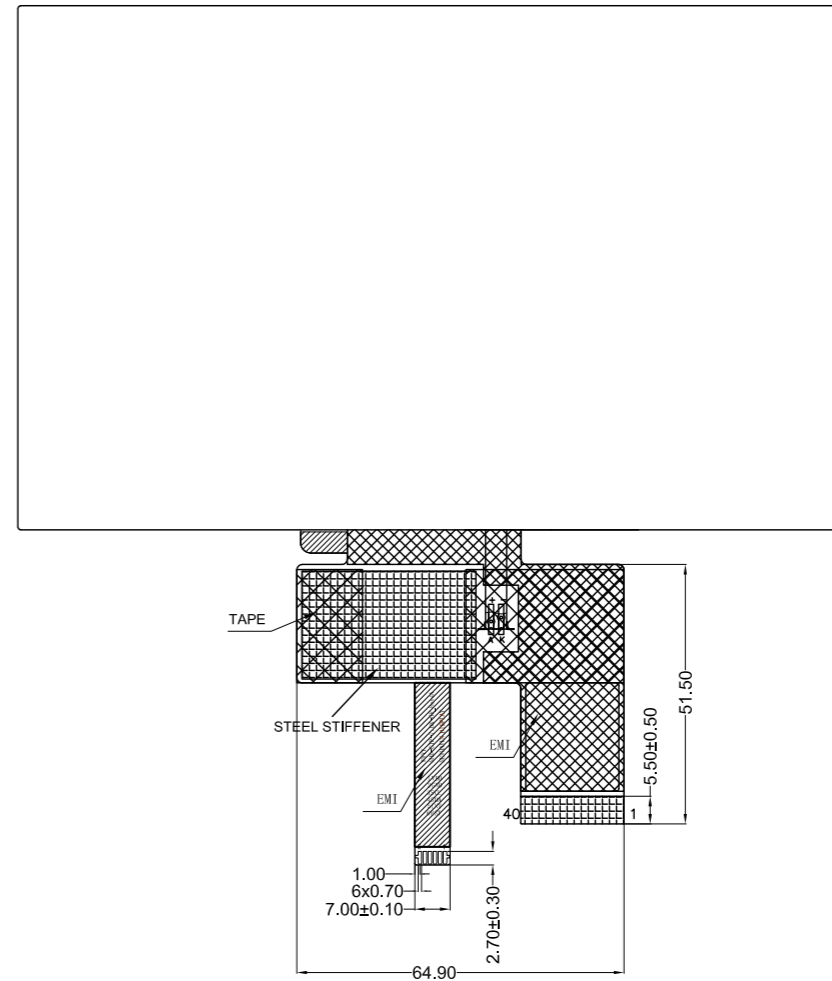
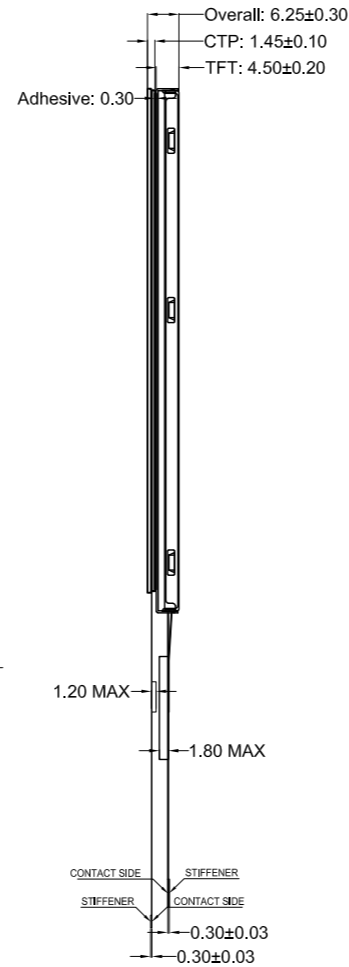
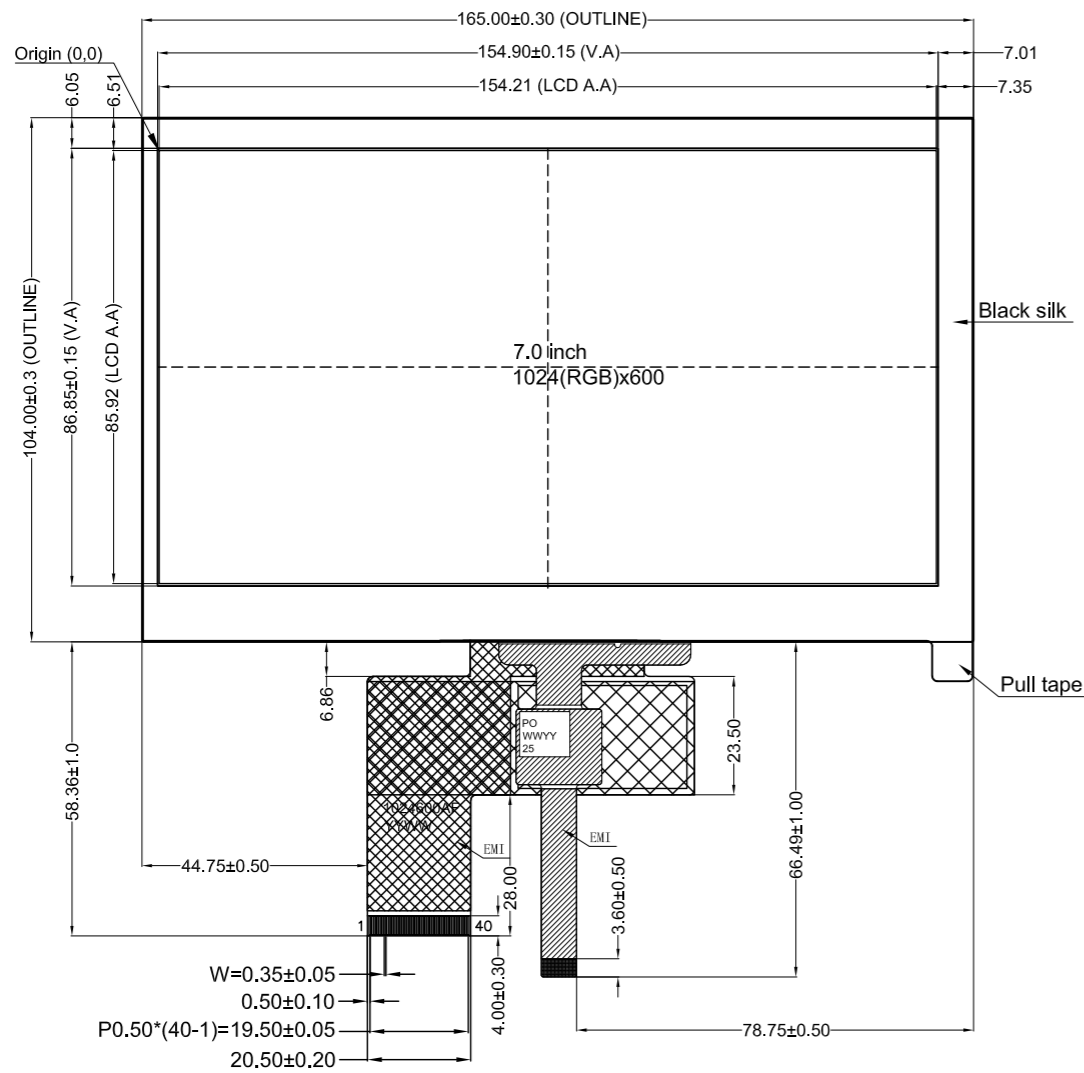
# Mechanical Drawing

Newhaven Display

NHD-7.0-1024600AF-LSXP-CTP

Date Code

Part Label (type/format may vary)

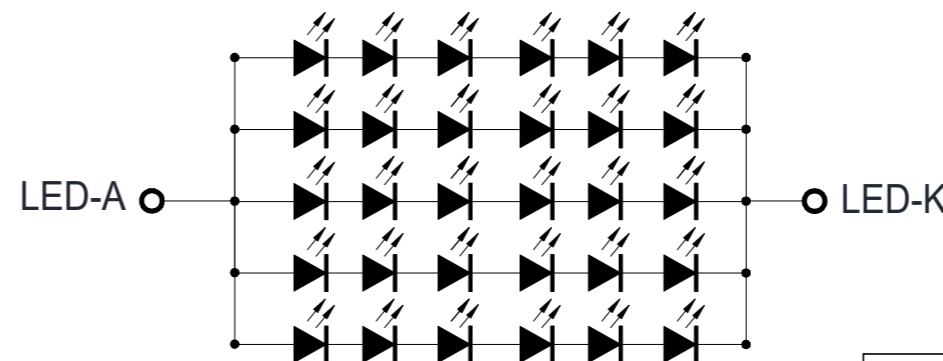


TFT

PIN	SYMBOL	PIN	SYMBOL
1	NC	21	Rin3+
2	VDD	22	GND
3	VDD	23	NC
4	NC	24	NC
5	/RES	25	GND
6	/STBYB	26	NC
7	GND	27	BIST
8	Rin0-	28	INSEL
9	Rin0+	29	NC
10	GND	30	GND
11	Rin1-	31	NC
12	Rin1+	32	NC
13	GND	33	SHLR
14	Rin2-	34	UPDN
15	Rin2+	35	NC
16	GND	36	LED-K
17	CLKIN-	37	LED-K
18	CLKIN+	38	NC
19	GND	39	LED-A
20	Rin3-	40	LED-A

CTP

PIN	SYMBOL
1	VDD
2	GND
3	SCL
4	SDA
5	/INT
6	/RESET



Product Description: 7.0" 1024x600 IPS TFT w/ Capacitive Touch

1. Driver IC: HX8282 TFT, FT5426-003 CTP
2. Interface: LVDS TFT, I<sup>2</sup>C CTP
3. Power Requirement: 3.3V TFT, 19.2V/150mA Backlight, 3.3V CTP
4. Optical Features: Normally Black, Transmissive, 935cd/m<sup>2</sup>
5. Recommended FFC Connector:  
TFT: 40pin 0.5mm pitch; Ex. Molex 54104-4031  
CTP: 6pin 1.0mm pitch; Ex. Molex 52271-0679
6. Key Features: EMI Shielded FPC, 10-Point Multitouch

<b>Standard Tolerance:</b> (Unless otherwise specified)  Linear: ±0.3mm		
	Drawing/Part Number: <b>NHD-7.0-1024600AF-LSXP-CTP</b>	Revision: -
<b>Unless otherwise specified:</b> • Dimensions are in Millimeters • Third Angle Projection	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 02/07/2023	Approved Date: 02/07/2023
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

### TFT Display:

Pin No.	Symbol	External Connection	Function Description
1	NC	-	No connection
2-3	V <sub>DD</sub>	Power Supply	Supply voltage for LCD (+3.3V)
4	NC	-	No connection
5	/RES	MPU	Active LOW Reset signal (normally pull high)
6	/STBYB	MPU	Active LOW Standby signal (normally pull high)
7	GND	Power Supply	Power Ground
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 - 24	NC	-	No connection
25	GND	Power Supply	Ground
26	NC	-	No Connection
27	BIST	MPU	Built in Self-Test. BIST = H: Self-Test Enabled. BIST = L: Normal Operation (Default)
28	INSEL	MPU	Data Input Format. NSEL = L 8-Bit LVDS Input (Default). INSEL = H 6-Bit LVDS Input
29	NC	-	No connection
30	GND	Power Supply	Power Ground
31-32	NC	-	No connection
33	SHLR	MPU	Gate Driver Left/Right Scan Settings. SHLR = H: Normal Scan (Default), SHLR = L: Reverse Scan
34	UPDN	MPU	Gate Driver Up/Down Scan Setting. UPDN = H: Reverse Scan. UPDN = L: Normal Scan (Default)
35	NC	-	No Connection
36-37	LED-K	Power Supply	Backlight Cathode (Ground)
38	NC	-	No connection
39-40	LED-A	Power Supply	Backlight Anode (150mA @ 19.2V)

**Recommended LCD connector:** 40-pin 0.5mm pitch FFC. Molex P/N: 54104-4031 (top contact)

### Capacitive Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	VDD	Power Supply	Supply voltage for operation
2	GND	Power Supply	Ground
3	SCL	MPU	Serial Clock input signal
4	SDA	MPU	Serial Data input signal
5	/INT	MPU	Interrupt signal from touch panel to host
6	/RESET	MPU	Active LOW Reset signal.

**Recommended CTP connector:** 6-pin 1.0mm pitch FFC. Molex P/N: 52271-0679 (bottom contact)



## 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 for LCD	V <sub>DD</sub>	-	3.0	3.3	3.6	V
Supply Current for LCD	I <sub>DD</sub>	V <sub>DD</sub> = 3.3V	58	87	131	mA
LVDS Differential input high Threshold voltage	R <sub>xVTH</sub>	R <sub>xVCM</sub> = 1.2V	-	-	+100	mV
LVDS Differential input low Threshold voltage	R <sub>xVTL</sub>		-100	-	-	mV
LVDS Differential input common mode voltage	R <sub>xVCM</sub>	-	VID /2	-	2.4-  VID /2	V
LVDS Differential voltage	VID	-	200	-	600	mV
Backlight Supply Current	I <sub>LED</sub>	-	125	150	180	mA
Backlight Supply Voltage	V <sub>LED</sub>	I <sub>LED</sub> = 150 mA	18	19.2	20.4	V
Backlight Lifetime*	-	T <sub>OP</sub> = 25° C	20,000	-	-	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>	-	2.7	3.3	3.6	V
Supply Current – Operating	I <sub>DD</sub>	-	-	15	23	mA
“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>	-	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	$\phi Y+$	Cr $\geq$ 10	-	85	-	$^{\circ}$
	Bottom	$\phi Y-$		-	85	-	$^{\circ}$
	Left	$\theta X-$		-	85	-	$^{\circ}$
	Right	$\theta X+$		-	85	-	$^{\circ}$
Contrast Ratio		Cr	-	600	800	-	-
Luminance		Lv	-	680	935	1275	cd/m <sup>2</sup>
Response Time		T <sub>R</sub> + T <sub>F</sub>	T <sub>OP</sub> = 25°C	-	30	40	ms
Chromaticity	Red	X <sub>R</sub>	-	0.552	0.592	0.632	-
		Y <sub>R</sub>	-	0.305	0.345	0.385	-
	Green	X <sub>G</sub>	-	0.277	0.317	0.357	-
		Y <sub>G</sub>	-	0.515	0.555	0.595	-
	Blue	X <sub>B</sub>	-	0.101	0.141	0.181	-
		Y <sub>B</sub>	-	0.069	0.109	0.149	-
	White	X <sub>w</sub>	-	0.26	0.30	0.34	-
		Y <sub>w</sub>	-	0.27	0.31	0.35	-

## Driver/Controller Information

### TFT Display:

Built-in HX8282 Source driver: <https://support.newhavendisplay.com/hc/en-us/articles/4414530429079-HX8282-A01>

Built-in HX8696 Gate driver: <https://support.newhavendisplay.com/hc/en-us/articles/4414548297367-HX8696-A>

### Capacitive Touch Panel:

Built-in FT5426-003 Controller: <https://support.newhavendisplay.com/hc/en-us/articles/4414392845079-FT5x26>



## Capacitive Touch Panel Registers

Register No.	Access	Register Name	Bits	Value	Description
01h	RO	Gesture ID	[7:0]	1Ch	Swipe Up
				14h	Swipe Down
				10h	Swipe Left
				18h	Swipe Right
				48h	Zoom In
				49h	Zoom Out
				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



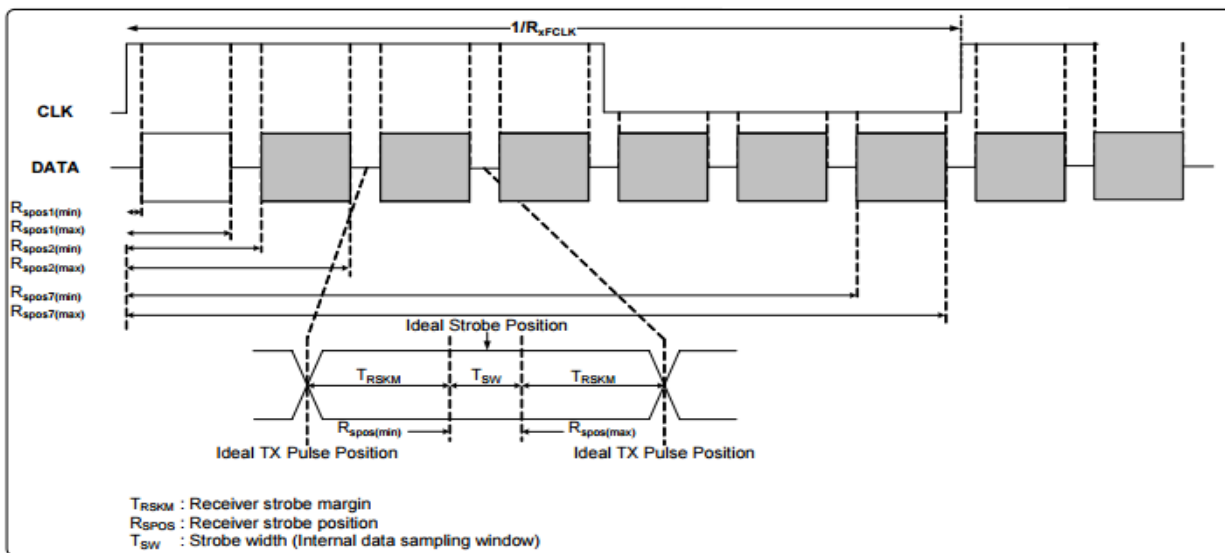
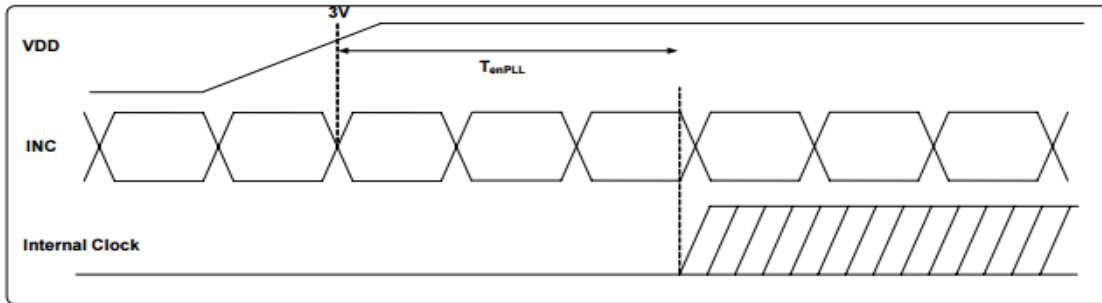
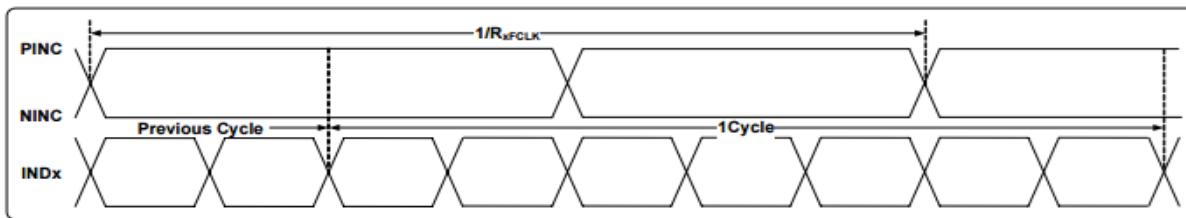
Register No.	Access	Register Name	Bits	Value	Description
1Bh	RO	TOUCH5_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
1Ch	RO	TOUCH5_XL	[7:0]	00 - FFh	Lower 8 bits of X touch coordinate
1Dh	RO	TOUCH5_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
1Eh	RO	TOUCH5_YL	[7:0]	00 - FFh	Lower 8 bits of Y touch 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
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: 25h
A8h	RO	ID_G_VENODRID	[7:0]	00-FFh	CTPM Vendor's Chip ID Default: 79h

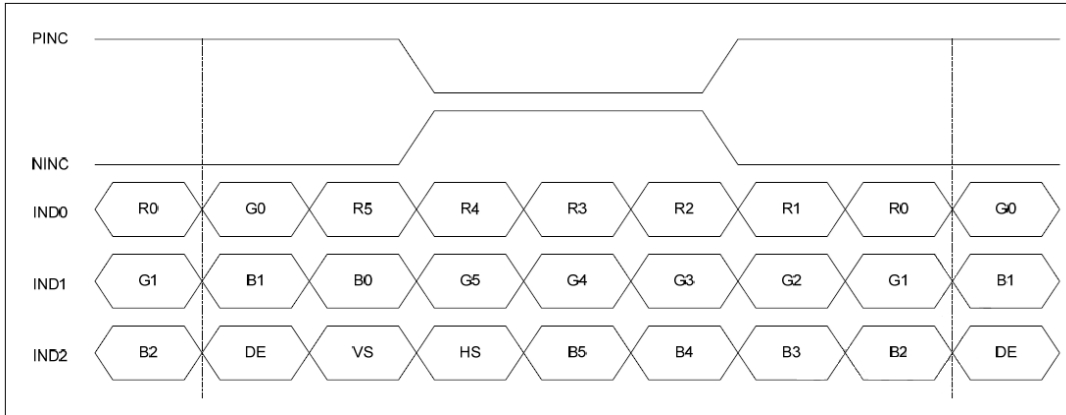
## Timing Characteristics – TFT Display

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	-

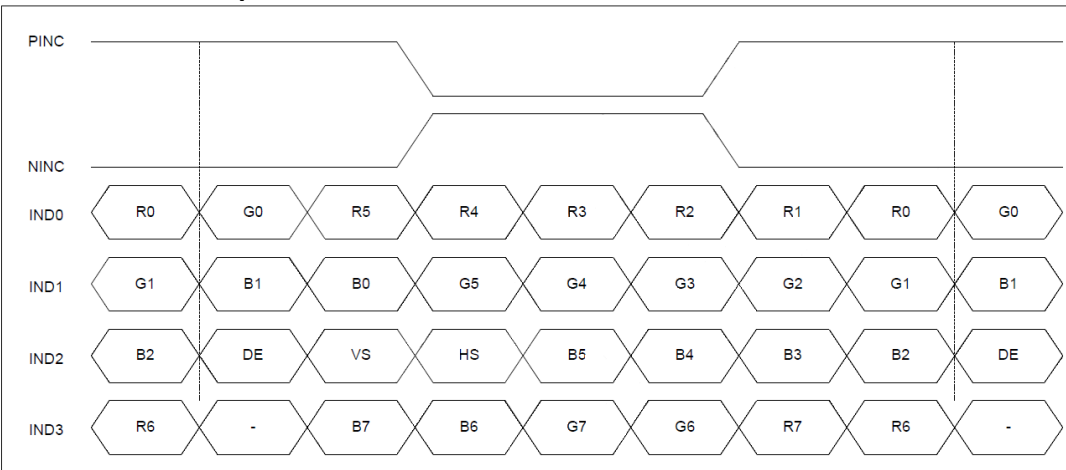
Parameter	Symbol	Spec			Unit	Condition
		Min.	Typ.	Max.		
Modulation Frequency	SSC <sub>MF</sub>	23	-	93	KHz	-
Modulation Rate	SSC <sub>MR</sub>	-	-	±3	%	LVDS Clock = 71 MHz



### 6-bit LVDS data input format:



### 8-Bit LVDS Data Input Format:

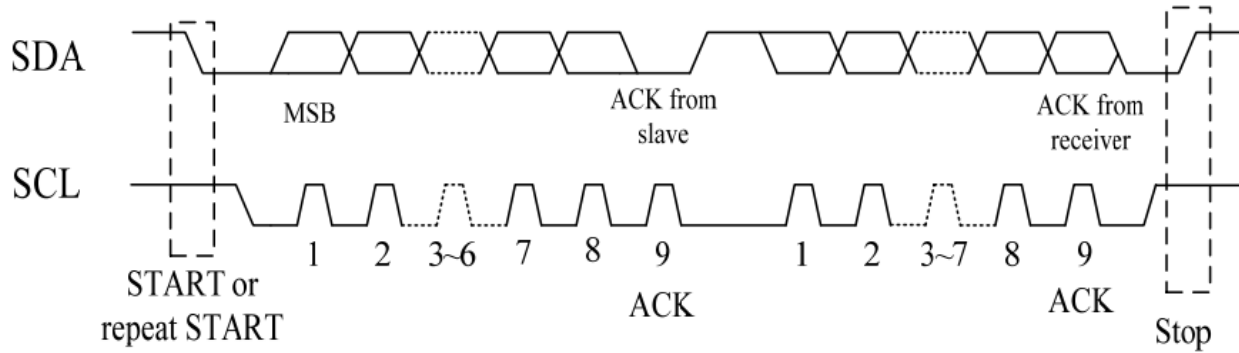


### Horizontal & Vertical Timing (1024x600)

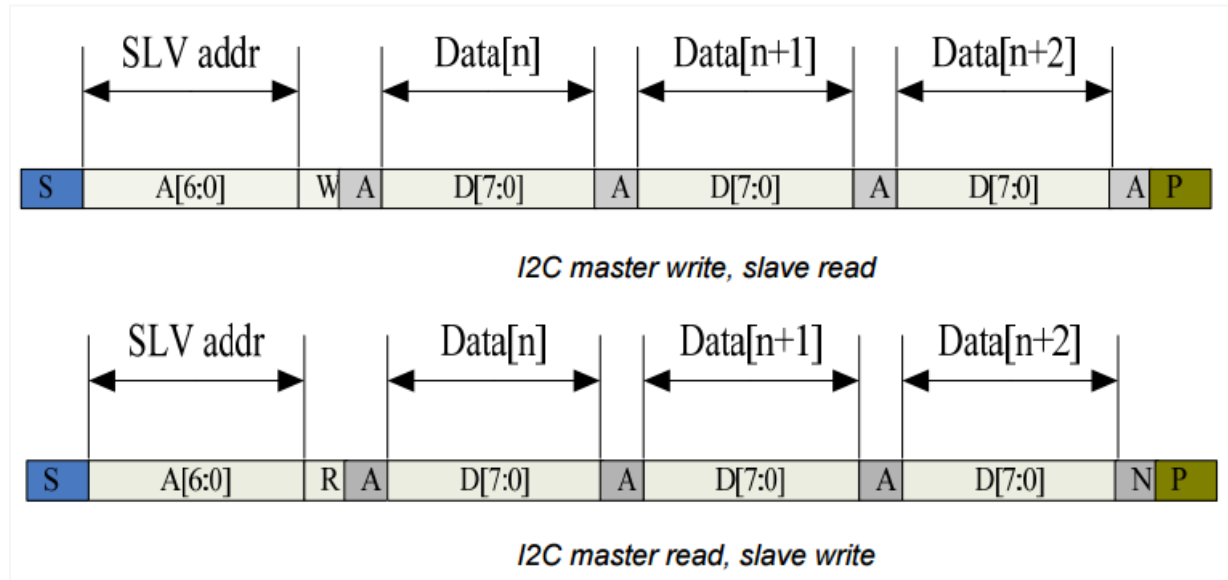
Item	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
DCLK Frequency	F <sub>CLK</sub>	44.9	51.2	63	MHz
HSYNC	Horizontal Display Area	T <sub>HD</sub>			DCLK
	HSD Period	T <sub>H</sub>			DCLK
	HSD Pulse Width	T <sub>HPW</sub>			DCLK
	HSD Back Porch	T <sub>HBP</sub>			DCLK
	HSD Front Porch	T <sub>HFP</sub>			DCLK
VSYNC	Vertical Display Area	T <sub>VD</sub>			T <sub>H</sub>
	VSD Period	T <sub>V</sub>			T <sub>H</sub>
	VSD Pulse Width	T <sub>VPW</sub>			T <sub>H</sub>
	VSD Back Porch	T <sub>VBP</sub>			T <sub>H</sub>
	VSD Front Porch	T <sub>VFP</sub>			T <sub>H</sub>

## Timing Characteristics – Capacitive Touch Panel

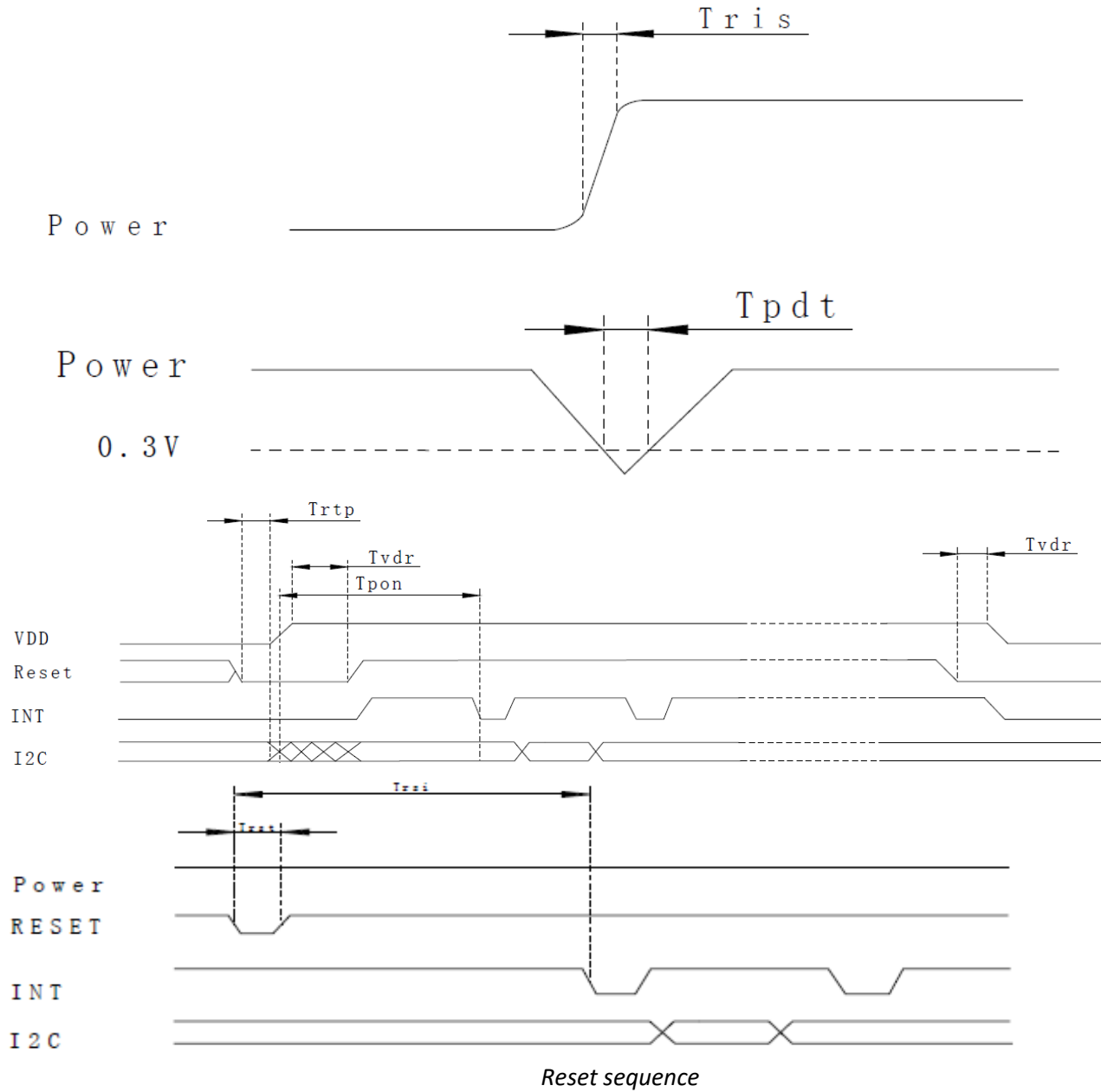
### Data Transfer Format



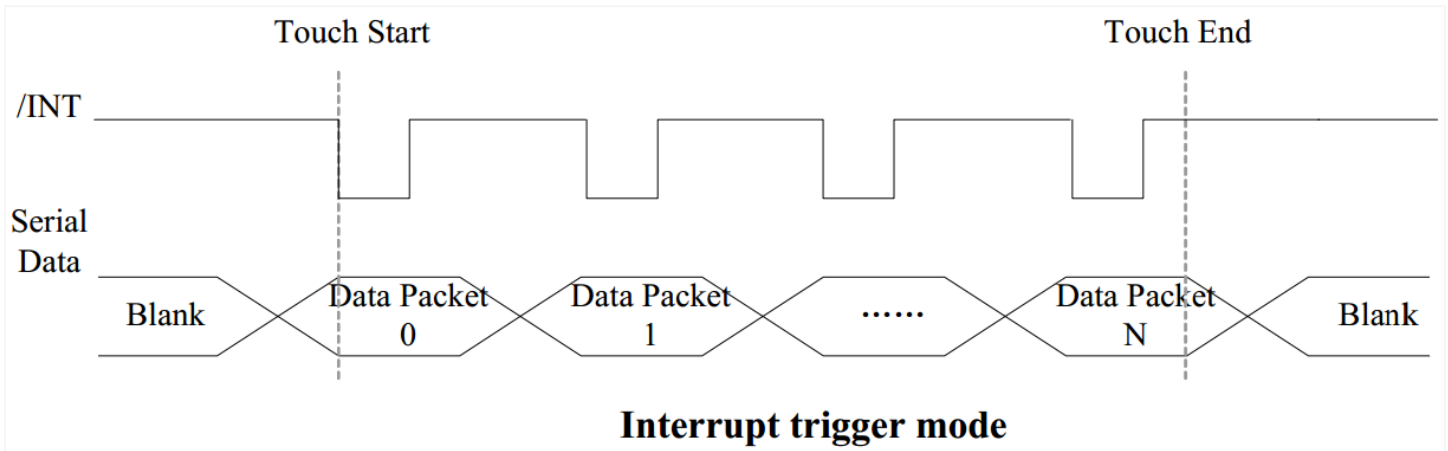
Parameter	Min	Max	Unit
SCL Frequency	0	400	KHz
Bus free time between a STOP & START condition	1.3	-	$\mu$ s
Hold time Repeated START condition	0.6	-	$\mu$ s
Data Setup Time	100	-	ns
Setup time for a repeated START condition	0.6	-	$\mu$ s
Setup time for a STOP condition	0.6	-	$\mu$ s



### 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



### 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, 240 hrs.	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°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.	+70°C, 120 hrs.	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°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, 90% 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.	-30°C, 30min->25°C, 10min -> 80°C, 30min 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	Frequency : 250 r/min Amplitude : 1 inch Time: 45min	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.