

# NHD-3.5-320240MF-ATXL#-CTP-1

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

NHD-	Newhaven Display
3.5-	3.5" Diagonal
320240-	320xRGBx240 Pixels
MF-	Model
A-	Built-in Driver / No Controller
T-	White LED Backlight
X-	TFT
L-	12:00 Optimal View, Wide Temperature
#-	<b>RoHS Compliant</b>
CTP-1	Capacitive Touch Panel with Controller

### Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

[www.newhavendisplay.com](http://www.newhavendisplay.com)

[nhtech@newhavendisplay.com](mailto:nhtech@newhavendisplay.com)

[nhsales@newhavendisplay.com](mailto:nhsales@newhavendisplay.com)

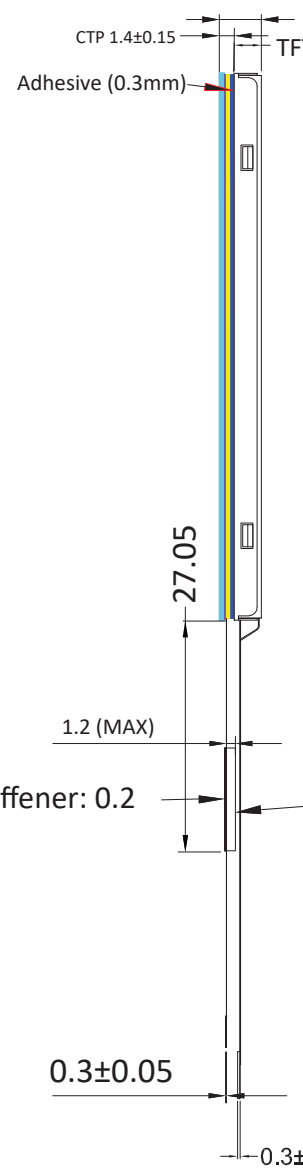
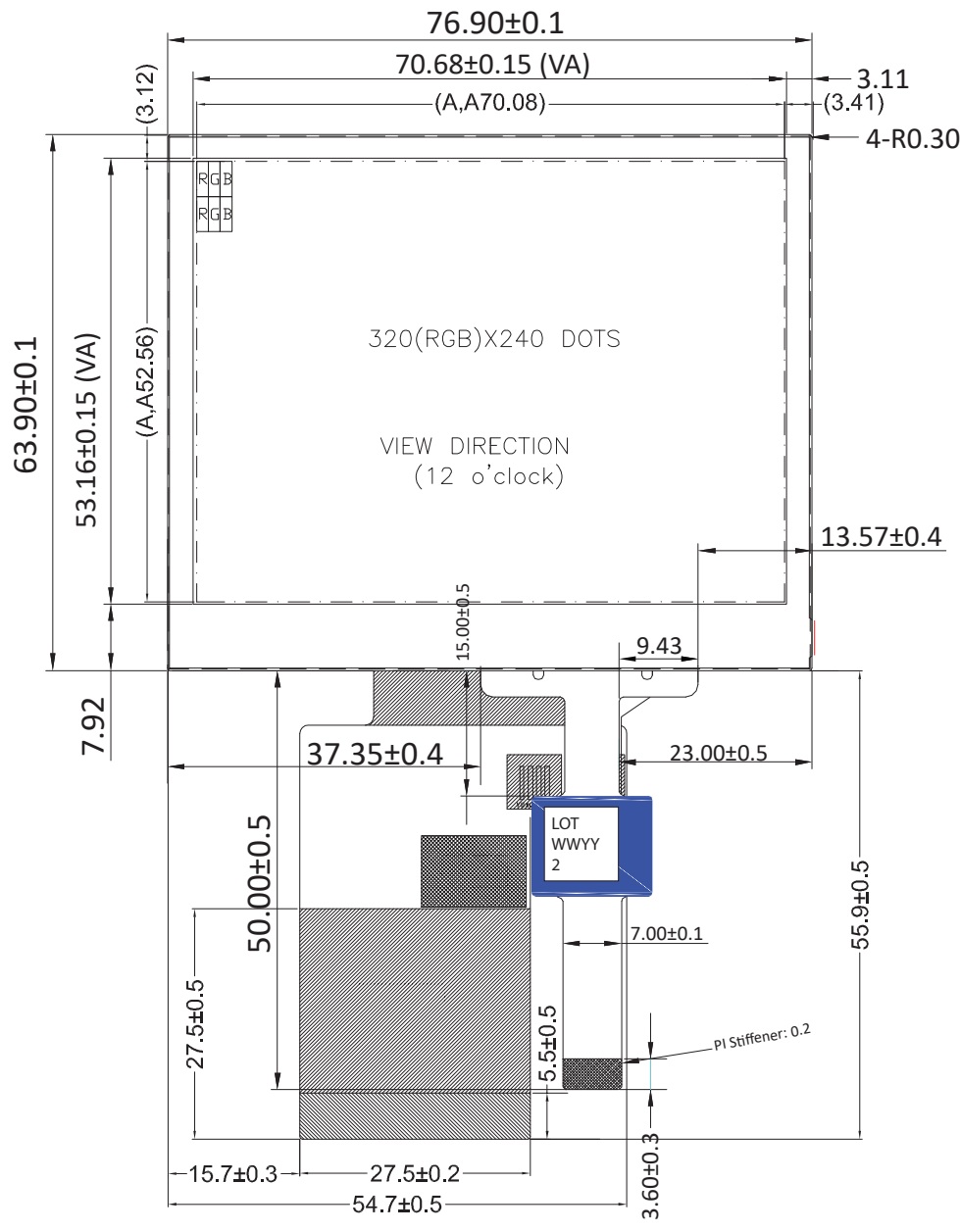
## Document Revision History

Revision	Date	Description	Changed by
0	2/1/2012	Initial Release	SB
1	12/11/2012	Timing characteristics updated	AK
2	4/25/2014	Optical characteristics updated	ML
3	5/30/2014	Driver information updated	AK
4	4/1/2015	CTP mechanical dimensions updated	AK
5	12/03/15	Luminance Updated, Backlight Lifetime Added, Datasheet Reformat	SB
6	7/5/16	Chromaticity Added	SB
7	12/8/16	V <sub>DD</sub> , I <sub>DD</sub> , and Chromaticity Updated	SB
8	7/20/18	CTP Adhesive Increased from 0.18 to 0.3mm, & Backlight Characteristics Updated	SB
9	3/14/19	CTP Driver & Panel Updated	SB
10	5/2/19	CTP Timing Note Added	SB
11	1/16/20	V <sub>LED</sub> and Mechanical Drawing Updated	SB
12	6/30/20	Revised Note on Manual Register Configuration	AS
13	7/31/20	Driver IC Part Number to NV3035GTC, Timing Charts & Quality Information	AS

## Functions and Features

- 320xRGBx240 resolution
- LED backlight
- 3.3V power supply
- 24-bit Parallel digital RGB interface (6.4MHz)
- Capacitive Touch Panel with controller
  - 10-Point multi-touch input
  - Gesture input
    - Zoom In/Out
    - Swipe Up/Down/Left/Right

A  
B  
C  
D  
E  
F



NOTES:

- |                               |                               |
|-------------------------------|-------------------------------|
| 1. Display Size:              | 3.5 TFT                       |
| 2. Optimal Viewing Direction: | 12:00                         |
| 3. Display Mode:              | Transmissive / Normally White |
| 4. Driver IC:                 | NV3035GTC                     |
| 5. Power Supply Voltage:      | 3.3V                          |
| 6. Backlight:                 | White LED/ 19.2 V (Typ)/ 18mA |
| 7. Brightness:                | 330 cd/m <sup>2</sup> (Typ)   |
| 8. Touch Panel:               | Capactive Touch               |

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## Pin Description

### TFT:

Pin No.	Symbol	External Connection	Function Description
1-2	LED_K	Power Supply	Backlight Cathode (Ground)
3-4	LED_A	Power Supply	Backlight Anode (18mA @ 19.2V)
5-7	NC	-	No Connect
8	RSTB	MPU	Active LOW Reset signal
9	SPENB	MPU	Active LOW Serial Chip Select signal
10	SPCK	MPU	Serial Clock signal
11	SPDA	MPU	Serial Data signal
12-19	B0-B7	MPU	Blue Data signals
20-27	G0-G7	MPU	Green Data signals
28-35	R0-R7	MPU	Red Data signals
36	HSD	MPU	Horizontal (Line) Sync signal
37	VSD	MPU	Vertical (Frame) Sync signal
38	CLKIN	MPU	Dot Clock signal
39-40	NC	-	No Connect
41-42	V <sub>DD</sub>	Power Supply	Supply Voltage for LCD and logic (3.3V)
43-51	NC	-	No Connect
52	DEN	-	Data Enable signal (No Connect)
53-54	GND	Power Supply	Ground

**Recommended connector:** 54pin, 0.5mm pitch, FFC connector. Molex P/N 51296-5494

### Capacitive Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	V <sub>DD</sub>	Power Supply	Supply voltage for Logic (3.0V)
2	V <sub>SS</sub>	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:** 6pin, 1.0mm pitch, FFC connector. 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	5	10	20	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>	-	V <sub>SS</sub>	-	0.2*V <sub>DD</sub>	V
"H" Level output	V <sub>OH</sub>	-	V <sub>DD</sub> -0.4	-	V <sub>DD</sub>	V
"L" Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	V <sub>SS</sub> +0.4	V
Backlight Supply Current	I <sub>LED</sub>	-	-	18	20	mA
Backlight Supply Voltage	V <sub>LED</sub>	I <sub>LED</sub> = 18 mA	16.8	19.2	20.4	V
Backlight Lifetime*	-	I <sub>LED</sub> = 18 mA 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>	-	2.8	3.3	3.6	V
Supply Current – Operating	I <sub>DD</sub>	V <sub>DD</sub> = 3.3V	-	6.0	-	mA
Supply Current – Hibernate	I <sub>DD</sub>		-	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>	-	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	-	60	-	°	
	Bottom		-	40	-	°	
	Left		-	60	-	°	
	Right		-	60	-	°	
Contrast Ratio	CR	-	200	350	-	-	
Luminance	L <sub>V</sub>	I <sub>LED</sub> = 18mA	265	330	-	cd/m <sup>2</sup>	
Response Time	Rise	T <sub>OP</sub> =25°C	-	25	40	ms	
	Fall		T <sub>F</sub>	-	25	40	ms
Chromaticity	Red	X <sub>R</sub>	-	0.556	0.606	0.656	-
		Y <sub>R</sub>	-	0.302	0.352	0.402	-
	Green	X <sub>G</sub>	-	0.268	0.318	0.368	-
		Y <sub>G</sub>	-	0.541	0.591	0.641	-
	Blue	X <sub>B</sub>	-	0.093	0.143	0.193	-
		Y <sub>B</sub>	-	0.052	0.102	0.152	-
White	X <sub>W</sub>	-	0.230	0.280	0.330	-	
	Y <sub>W</sub>	-	0.256	0.306	0.356	-	

## Capacitive Touch Panel Material Characteristics:

Property	Requirement	Unit
IC	FT5426	-
ITO Glass thickness	0.55	mm
Surface Hardness	≥6	H
Light transmission	83% ± 5%	-
Operating Humidity	20~90	RH
Storage Humidity	20~90	RH

## Driver/Controller Information

### TFT:

Built-in NV3035GTC driver. No controller.

Please download specification at

[https://www.newhavendisplay.com/resources\\_dataFiles/datasheets/LCDs/NV3035GTC.pdf](https://www.newhavendisplay.com/resources_dataFiles/datasheets/LCDs/NV3035GTC.pdf)

**NOTE:** Control registers accessible via the display's 3-wire SPI interface are used to set optimal functionality of the driver IC and TFT panel during manufacturing of the display. These control registers are not intended for use during normal operation of the display. Changing these register values may result in undesired visual artifacts and improper functionality of the display.

### Capacitive Touch Panel:

Built-in FocalTech FT5426 controller.

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

## CTP 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



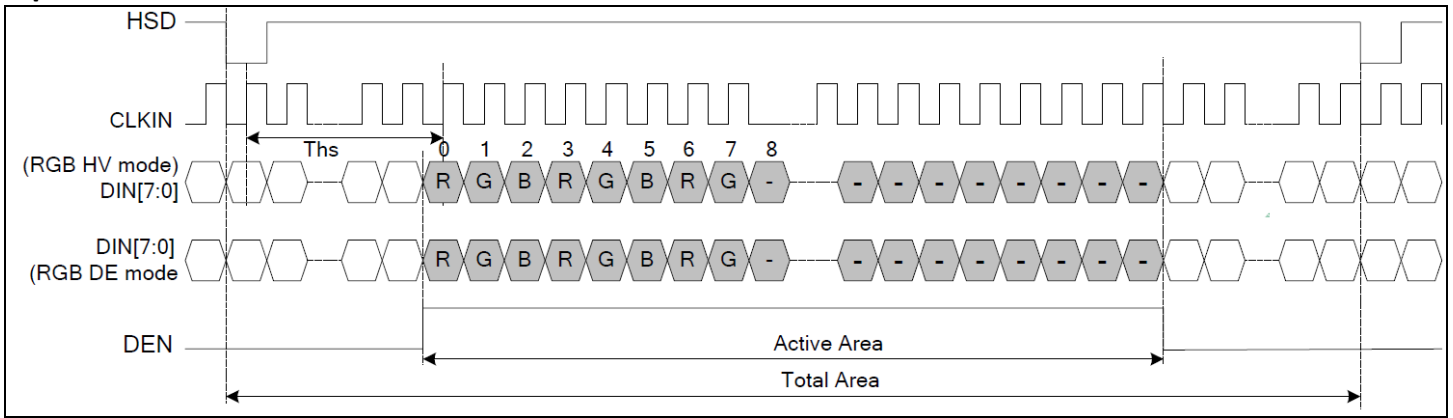
Register No.	Access	Register Name	Bits	Value	Description
3Dh	RO	TOUCH10_Weight	[7:0]	00-FFh	Touch Weight
3Eh	RO	TOUCH10_Misc	[3:0]	00-0Fh	Touch Area
80h	RW	ID_G_MC_THGROUP	[7:0]	00-FFh	Mutual-Capacitive touch Threshold / 4 Default: 4Bh
81h	RW	ID_G_MC_THPEAK	[7:0]	00-FFh	Mutual-Capacitive Peak Threshold / 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

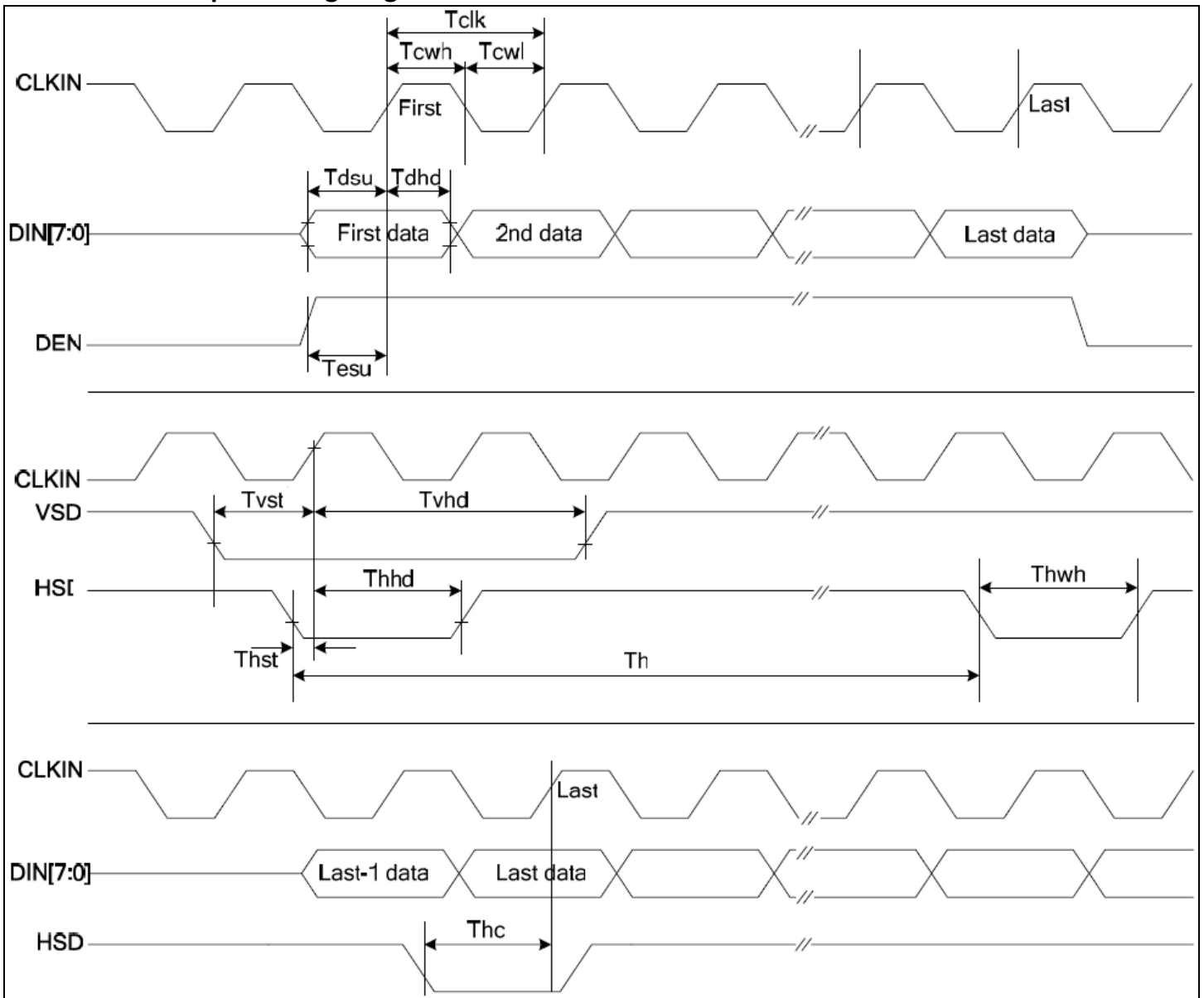
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
<b>System Operation Timing</b>						
VDD Power Source Slew Time	TPOR			1000	us	From 0V to 90% VDD
RSTB active pulse Width	TRSTB	40			us	VDD = 3.3V
<b>Input Output Timing</b>						
CLKIN clock time	Tclk	35.7		-	ns	Please refer to timing table (P25)
HSD to CLKIN	Thc	-	-	1	CLKIN	
HSD width	Thwh	1	-	-	CLKIN	
VSD width	Tvwh	1	-	-	Th	
HSD period time	Th	60	63.56	67	us	
VSD setup time	Tvst	8	-	-	ns	
VSD hold time	Tvhd	10	-	-	ns	
HSD setup time	Thst	8	-	-	ns	
HSD hold time	Thhd	10	-	-	ns	
Data set-up time	Tdsu	8	-	-	ns	DIN[23:0] to CLKIN
Data hold time	Tdhd	10	-	-	ns	DIN[23:0] to CLKIN
DEN setup time	Tesd	12	-	-	ns	DEN to CLKIN
Time that VSD to 1 <sup>st</sup> line data input	Tvs	2	13	127	Th	@C1R601/8bit RGB HV mode Control by HDLY[6:0] setting Tvs = HDLY[6:0]
Time that CCIR_V to 1 <sup>st</sup> line data input	Tvs	12	20	28	Th	@CCIR656 NTSC mode Control by HDLY[6:0] setting Tvs = HDLY[6:0]
Time that CCIR_V to 1 <sup>st</sup> line data input	Tvs	17	25	33	Th	@CCIR656 PAL mode Control by HDLY[6:0] setting Tvs = HDLY[6:0]
Time that VSD to 1 <sup>st</sup> line data input	Tvs	2	13	127	Th	@24bit RGB HV mode Control by HDLY[6:0] setting Tvs = HDLY[6:0]
Source output stable time 1	Tst	-	25	30	us	96% final, CL=30pF, RL=2KΩ
Gate output stable time	Tgst	-	500	1000	ns	96% final, CL=40pF
VCOMOUT output stable time	Tcst	-	4	8	us	96% final, CL=33nF, RL=100Ω
<b>3-wire serial communication AC timing</b>						
Serial Clock	Tspck	320	-	-	ns	
SPCK pulse duty	Tscdut	40	50	60	%	Tckh/Tspck
Serial data setup time	Tisu	120	-	-	ns	
Serial data hold time	Tihd	120	-	-	ns	
Serial clock high/low	Tssw	120	-	-	ns	
Chip select distinguish	Tcd	1	-	-	us	
SPENA to VSD	Tcv	1	-	-	us	
SPENB input setup time	Teck	150	-	-	Ns	
SPENB input hold time	Tcke	150	-	-	ns	

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLKIN frequency	Fclk	6.1	6.4	8.0	MHz	VDD=3.0~3.6V
CLKIN cycle time	Tclk	125	156	164	ns	
CLKIN pulse duty	Tcwh	40	50	60	%	Tclk
Time that HSD to 1 <sup>st</sup> data input (NTSC)	Ths	40	70	255	CLKIN	DDLY=70,Offset=0(fixed)

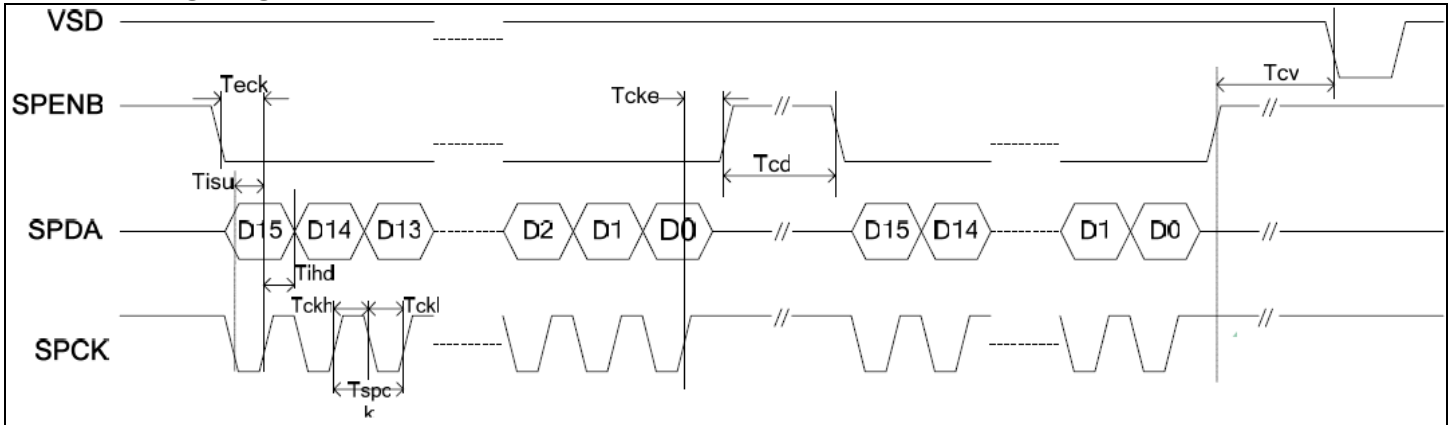
## Input Data Format



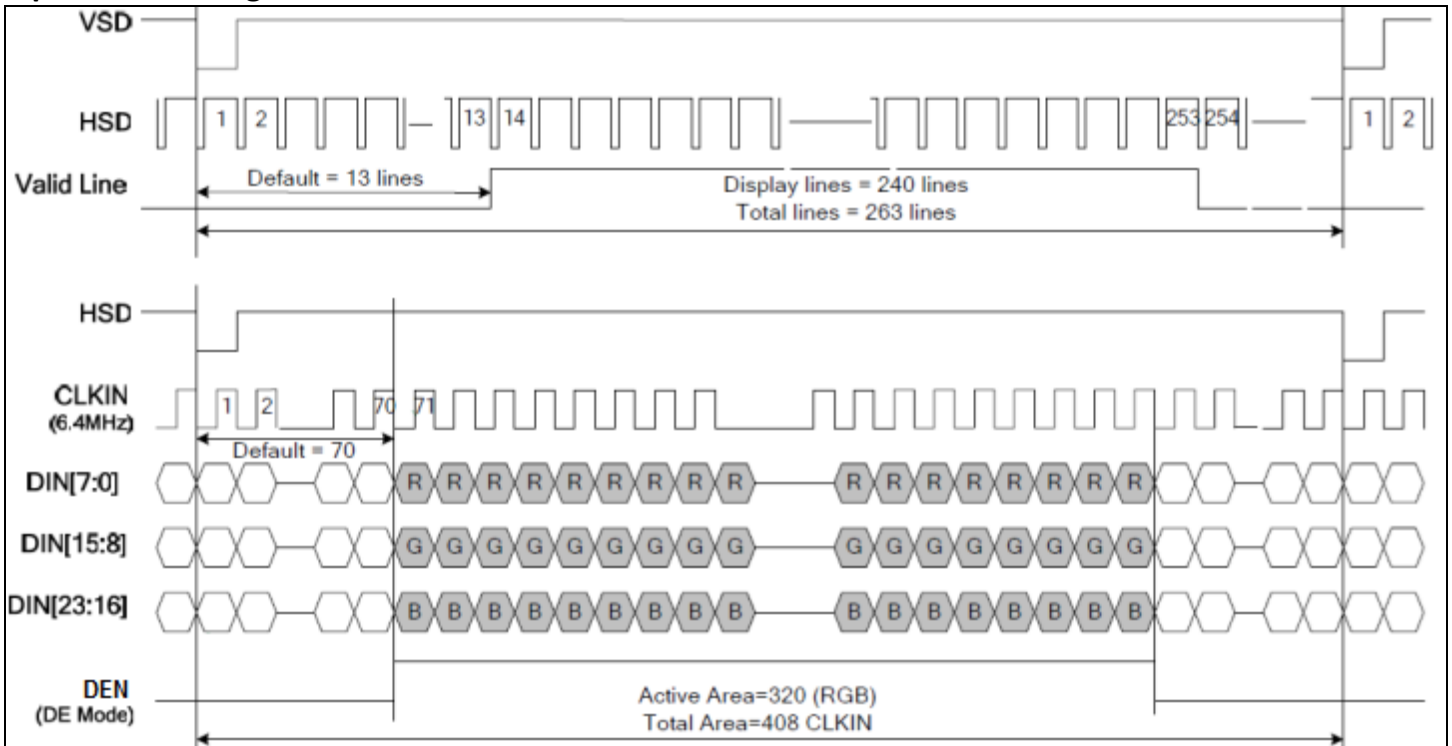
## Clock and Data Input Timing Diagram



### 3-wire Timing Diagram

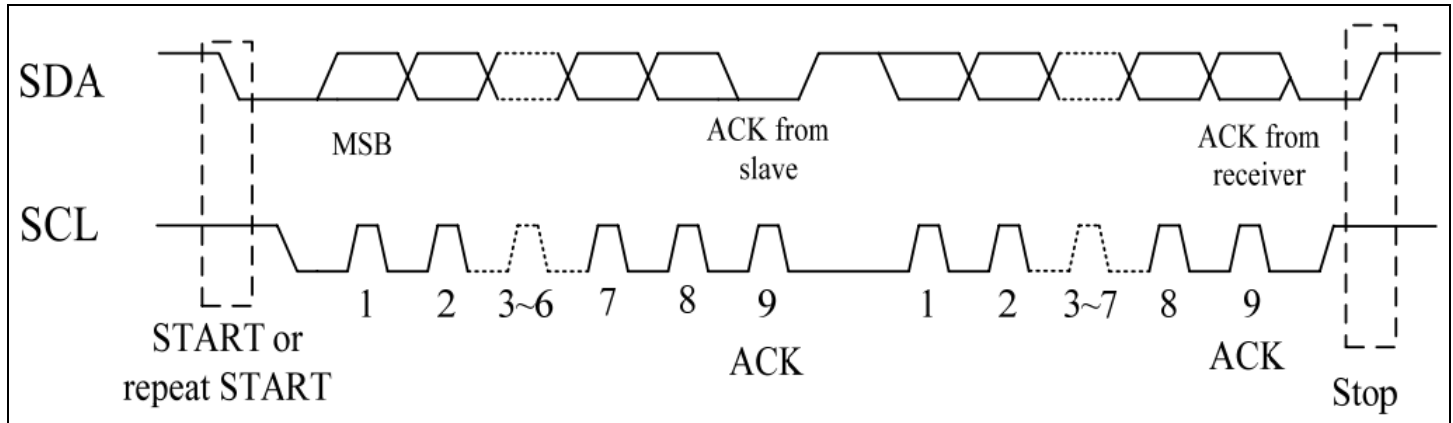


### Input Data Timing

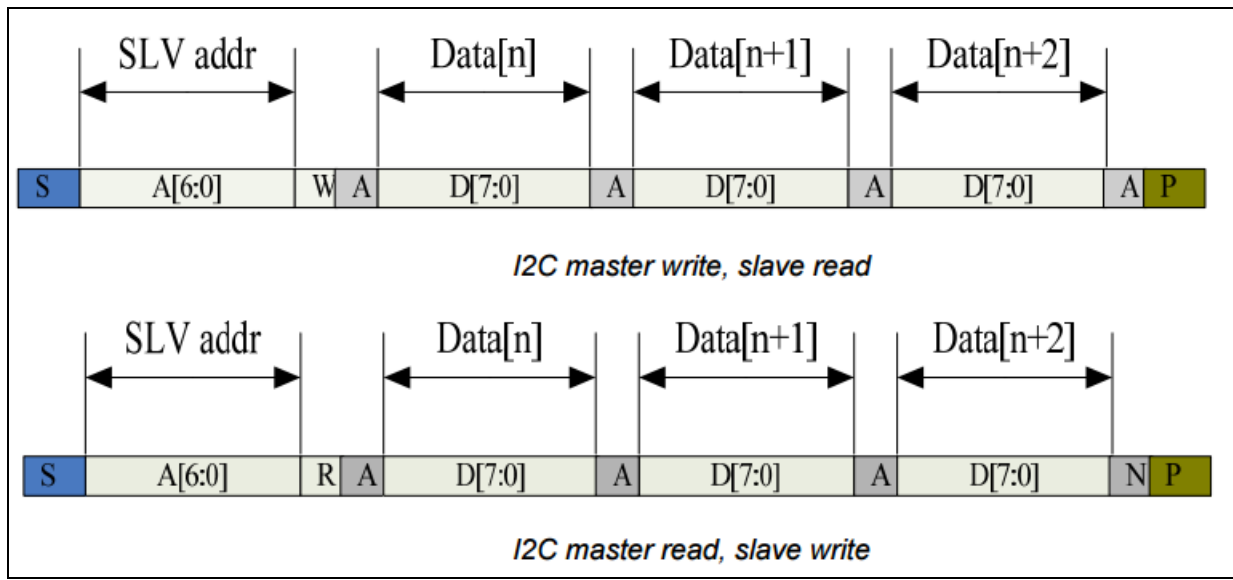


# Timing Characteristics – Capacitive Touch Panel

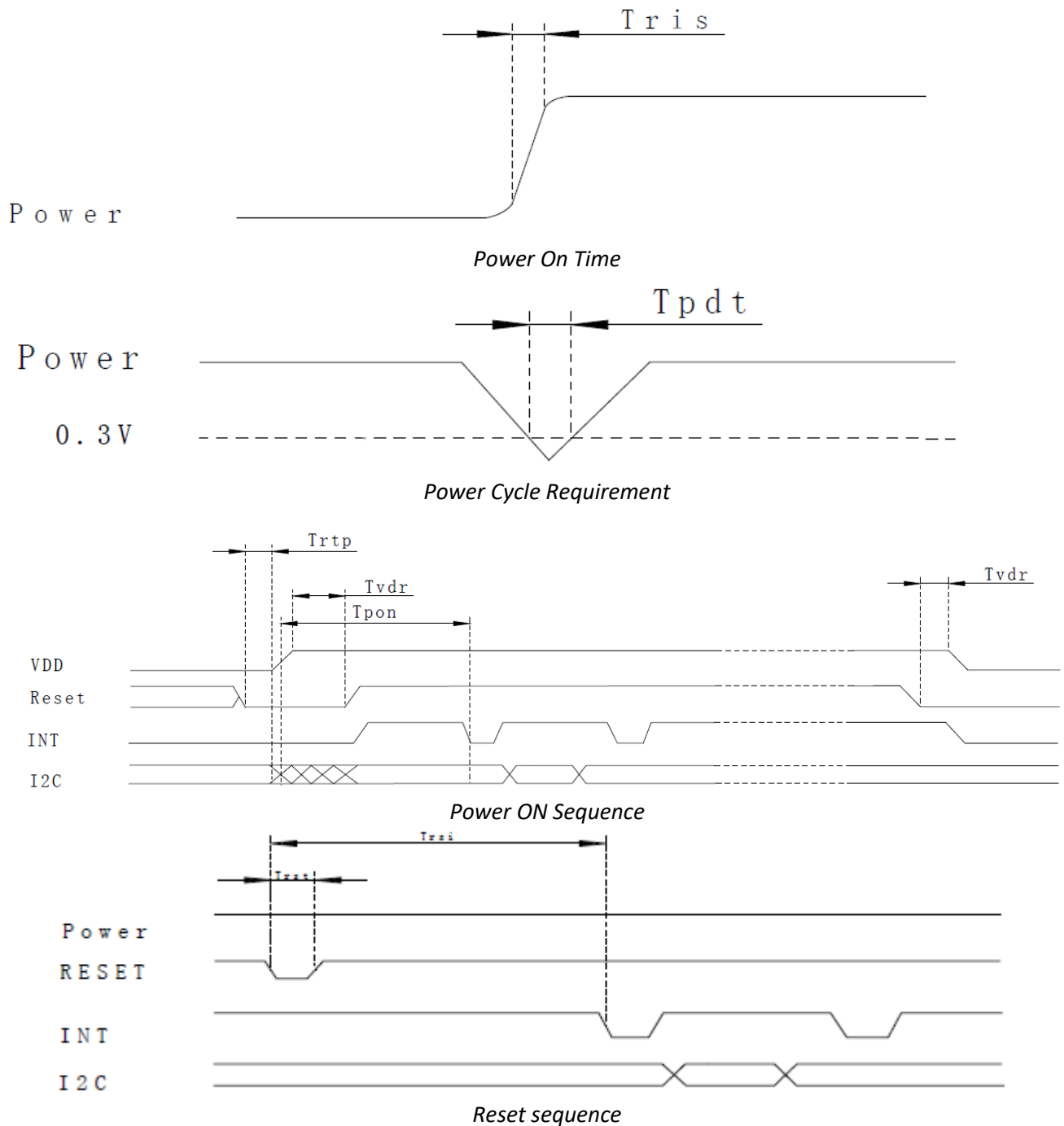
## Data Transfer Format



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

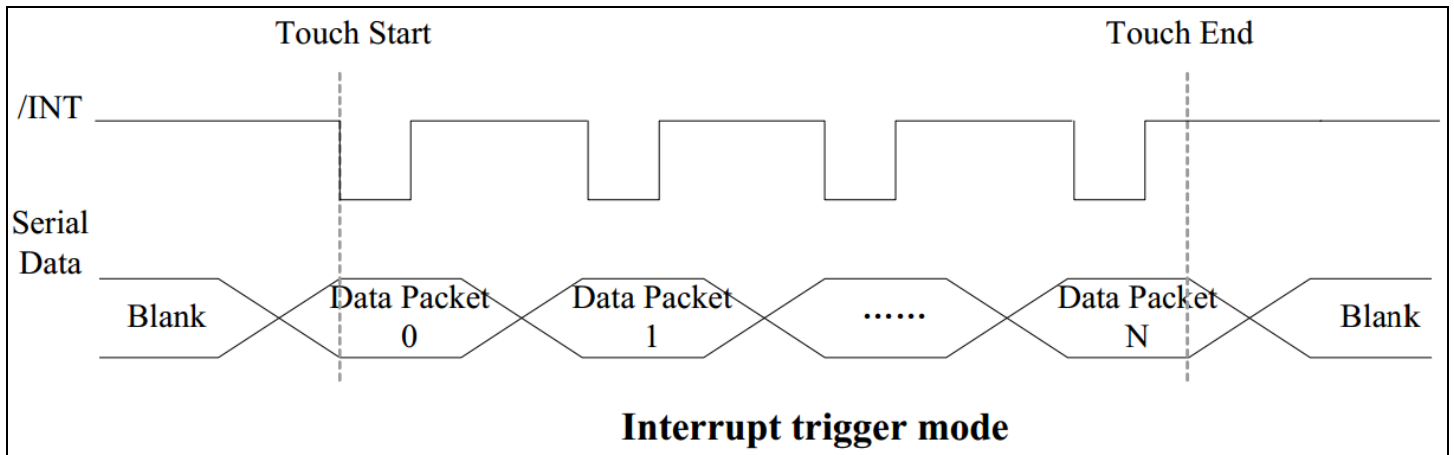


## Power ON/Reset Sequence



Parameter	Description	Min	Max	Unit
$T_{ris}$	Rise time from 0.1V <sub>DD</sub> to 0.9V <sub>DD</sub>	-	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 <sub>DD</sub>	1	-	ms
$T_{rsi}$	Time to start reporting after reset	-	200	ms
$T_{rst}^*$	Reset Time	1	-	ms

\*If Reset is tied to V<sub>CC</sub> 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 , 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C , 96hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 96hrs	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 , 96hrs	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 , 5G Acceleration 60 sec in each of 3 directions (X,Y,Z) For 30 minutes	3
Static electricity test	Endurance test applying electric static discharge.	Air: ±8kV 150pF/330Ω, 5 Times Contact: ±4kV 150pF/330Ω, 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 and Terms & Conditions

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