

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 view, Wide Temp
#-	RoHS Compliant
CTP-1	Capacitive Touch Panel with controller

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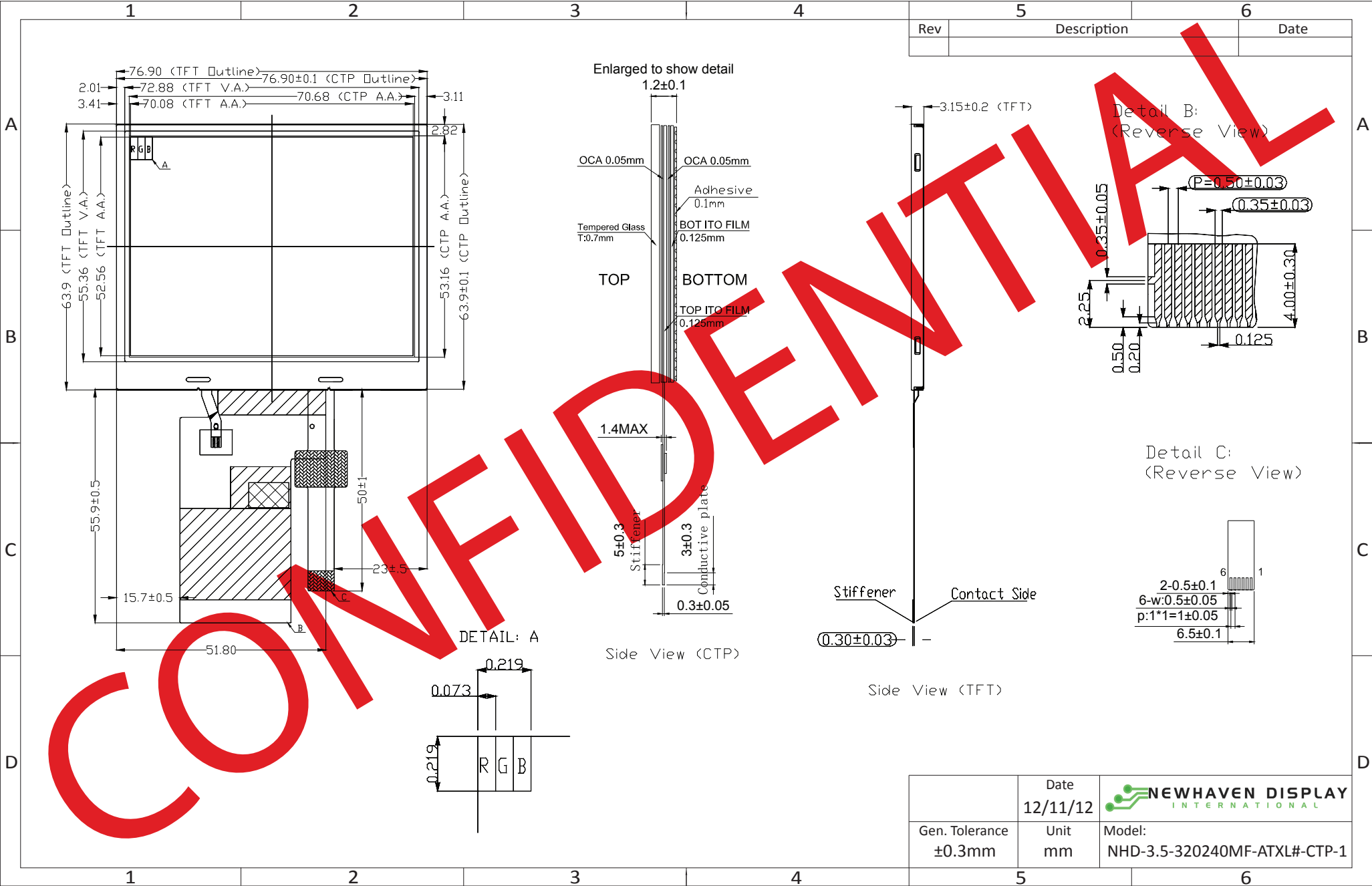
Document Revision History

Revision	Date	Description	Changed by
0	2/1/2012	Initial Release	SB
1	12/11/2012	Timing characteristics updated	AK

Functions and Features

- 320xRGBx240 resolution
- LED backlight
- 3.3V power supply
- 24-bit Parallel digital RGB interface (6.4MHz)
- Capacitive Touch Panel with controller

Mechanical Drawing



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Pin Description

LCD:

Pin No.	Symbol	External Connection	Function Description
1	LED-	Power Supply	Ground for backlight
2	LED-	Power Supply	Ground for backlight
3	LED+	Power Supply	Power for backlight (18mA @ 19.2V)
4	LED+	Power Supply	Power for backlight (18mA @ 19.2V)
5	NC	-	No Connect
6	NC	-	No Connect
7	NC	-	No Connect
8	/RST	MPU	Active LOW Reset
9	/CS	MPU	Active LOW Serial Chip Select
10	SCL	MPU	Serial Clock
11	SDA	MPU	Serial Data
12-19	B0-B7	MPU	Blue Data
20-27	G0-G7	MPU	Green Data
28-35	R0-R7	MPU	Red Data
36	HSYNC	MPU	Horizontal (Line) Sync
37	VSNC	MPU	Vertical (Frame) Sync
38	DCLK	MPU	Dot Clock
39	NC	-	No Connect
40	NC	-	No Connect
41	VDD	Power Supply	Power for LCD and logic (3.3V)
42	VDD	Power Supply	Power for LCD and logic (3.3V)
43	NC	-	No Connect
44	NC	-	No Connect
45	NC	-	No Connect
46	NC	-	No Connect
47	NC	-	No Connect
48	NC	-	No Connect
49	NC	-	No Connect
50	NC	-	No Connect
51	NC	-	No Connect
52	DE	-	Data Enable (No Connect)
53	VSS	Power Supply	Ground
54	VSS	Power Supply	Ground

Recommended LCD connector: 0.5mm pitch, 54 conductor – Molex 51296-5494

Backlight connector: on LCD connector

Mates with: ---

Capacitive Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	VDD	Power Supply	Supply voltage for Logic (3.0V)
2	VSS	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	/WAKE	MPU	External interrupt signal from host (0: Disable /INT, 1: Enable /INT)

Recommended LCD connector: 1.0mm pitch, 6 conductor – Molex 52271-0679

Electrical Characteristics

TFT:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-20	-	+70	°C
Storage Temperature Range	Tst	Absolute Max	-30	-	+80	°C
Supply Voltage	VDD		3.0	3.3	3.6	V
Supply Current	IDD	VDD=3.3V	-	25	-	mA
“H” Level input	Vih		0.8*VDD	-	VDD	V
“L” Level input	Vil		VSS	-	0.2*VDD	V
“H” Level output	Voh		VDD-0.4	-	VDD	V
“L” Level output	Vol		VSS	-	VSS+0.4	V
Backlight Supply Voltage	Vled		18.0	19.2	20.4	V
Backlight Supply Current	Iled	Vled=19.2V	-	18	20	mA

Capacitive Touch Panel:

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	Top	Absolute Max	-20	-	+70	°C
Storage Temperature Range	Tst	Absolute Max	-30	-	+80	°C
Supply Voltage	VDD		2.8	3.0	3.3	V
Supply Current – Operating	IDD	VDD=2.8V	-	6.0	-	mA
Supply Current – Hibernate	IDD	VDD=2.8V	-	0.03	-	mA
“H” Level input	Vih		0.7*VDD	-	VDD	V
“L” Level input	Vil		VSS	-	0.3*VDD	V
“H” Level output	Voh		0.7*VDD	-	VDD	V
“L” Level output	Vol		VSS	-	0.3*VDD	V

Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing Angle – Top		Cr ≥ 10	-	60	-	°
Viewing Angle – Bottom			-	40	-	°
Viewing Angle – Left			-	60	-	°
Viewing Angle – Right			-	60	-	°
Contrast Ratio	Cr		200	350	-	
Response Time (rise)	Tr		-	10	-	ms
Response Time (fall)	Tf		-	15	-	ms

Capacitive Touch Panel Material Characteristics:

Property	Requirement	Unit
IC	FT5306DE3	-
Glass Thickness	0.7	mm
Top Film Thickness	0.125	mm
Surface Hardness	6(750)	H(g)
Light Transmission	82%	-
Operating Humidity	45~85	RH
Storage Humidity	5~95	RH

Driver/Controller Information

TFT:

Built-in NT39016D driver. No controller.

Please download specification at http://www.newhavendisplay.com/app_notes/NT39016D.pdf

Note: To achieve optimum VCOM and VGL settings, the SPI interface may be used to set the following registers:

R0Eh = 6Bh

R0Fh = 24h

Capacitive Touch Panel:

Built-in FocalTech FT5x06 Capacitive Touch Controller.

Please download specification at http://www.newhavendisplay.com/app_notes/FT5x06.pdf

Timing Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
System Operation Timing						
VDD power source slew time	T _{POR}			1000	us	From 0V to 90% VDD
RSTB active pulse width	T _{RSTB}	40			us	VDD = 3.3V
Input Output Timing						
CLKIN clock time	Tclk	33.3/125	-	-	ns	Please refer to timing table(p.32)
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 st line data input	Tvs	2	13	127	Th	@CCIR601 / 8bit RGB HV mode Control by HDLY[6:0] setting Tvs = HDLY[6:0]
Time that CCIR_V to 1 st 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 st 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 st line	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=2K
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=100ohm

3-wire serial communication AC timing						
Serial clock	Tspck	320	-	-	ns	
SPCK pulse duty		40	50	60	%	Tckh / Tspck
Serial data setup time	Tisu	120	-	-	ns	
Serial data hold time	Tihd	120	-	-	ns	
Serial clock high/low	Tckh/l	120	-	-	ns	
Chip select distinguish	Tcd	1	-	-	us	
SPENB to VSD	Tcv	1	-	-	us	
SPENB input setup time	Teck	150	-	-	ns	
SPENB input hold time	Tcke	150	-	-	ns	

CCIR601 Mode A/B *

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLKIN frequency	Fclk	-	24.54 /27	30	MHz	VDD = 3.0 ~3.6V
CLKIN cycle time	Tclk	-	40/37		ns	
CLKIN pulse duty	Tcwh	40	50	60	%	Tclk
Time from HSD to 1'st data input (PAL)	Ths	128	264	-	CLKIN	DDLY = 136, Offset = 128 (fixed)
Time from HSD to 1'st data input (NTSC)	Ths	128	244	-	CLKIN	DDLY = 116, Offset = 128 (fixed)

CCIR656 Mode A/B *

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLKIN frequency	Fclk	-	27	30	MHz	VDD = 3.0 ~3.6V
CLKIN cycle time	Tclk	-	37		ns	
CLKIN pulse duty	Tcwh	40	50	60	%	Tclk
Time from EAV to 1'st data input (PAL)	Ths	128	288		CLKIN	DDLY = 152, Offset = 128 (fixed)
Time from EAV to 1'st data input (NTSC)	Ths	128	276		CLKIN	DDLY = 140, Offset = 128 (fixed)

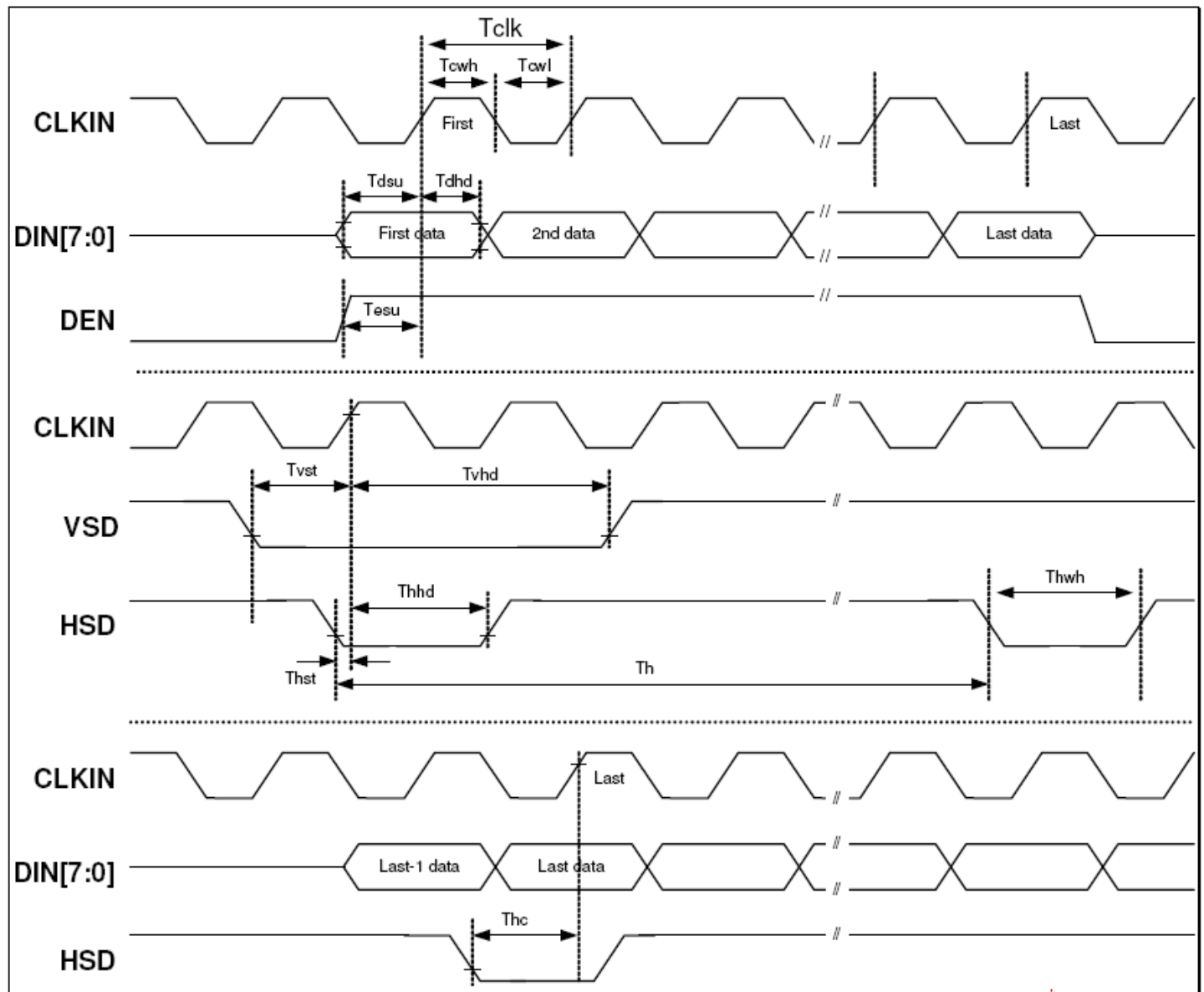
8 Bit RGB 960 CH Mode

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLKIN frequency	Fclk	-	27	30	MHz	VDD = 3.0 ~3.6V
CLKIN cycle time	Tclk	-	37		ns	
CLKIN pulse duty	Tcwh	40	50	60	%	Tclk
Time that HSD to 1'st data input(NTSC)	Ths	35	70	255	CLKIN	DDLY = 70, Offset = 0 (fixed)

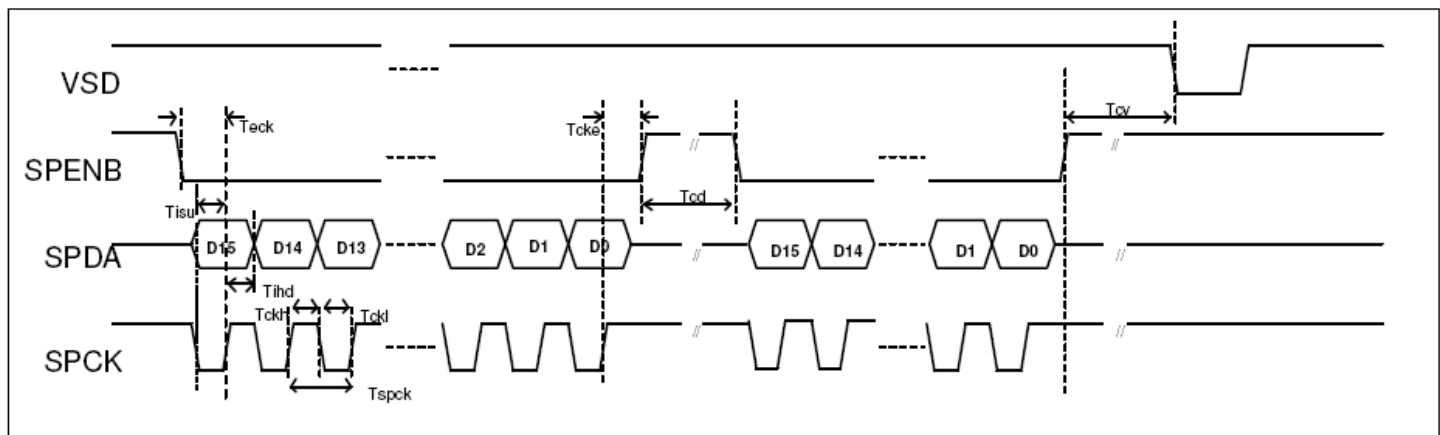
24 Bit RGB Mode (@ SEL[3:0] = 1100 or 1101)

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'st data input(NTSC)	Ths	40	70	255	CLKIN	DDLY =70, Offset = 0 (fixed)

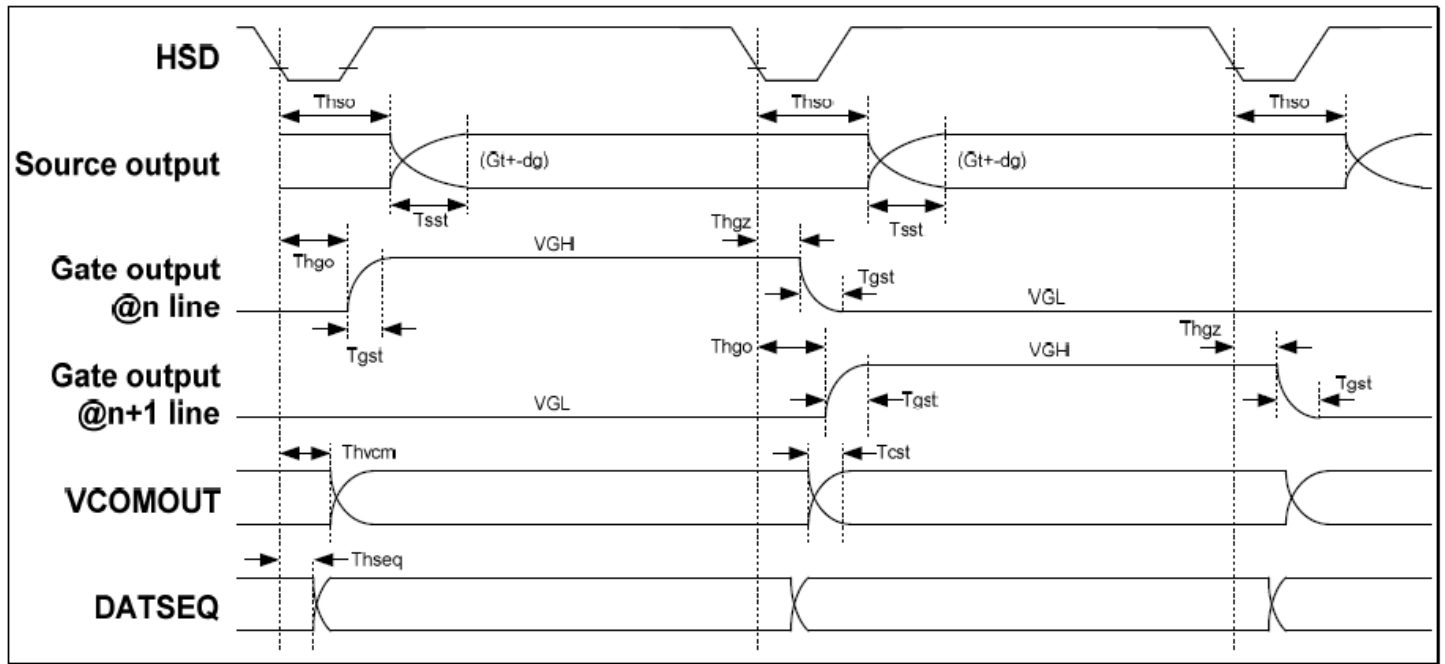
Clock and Data Input Timing Diagram



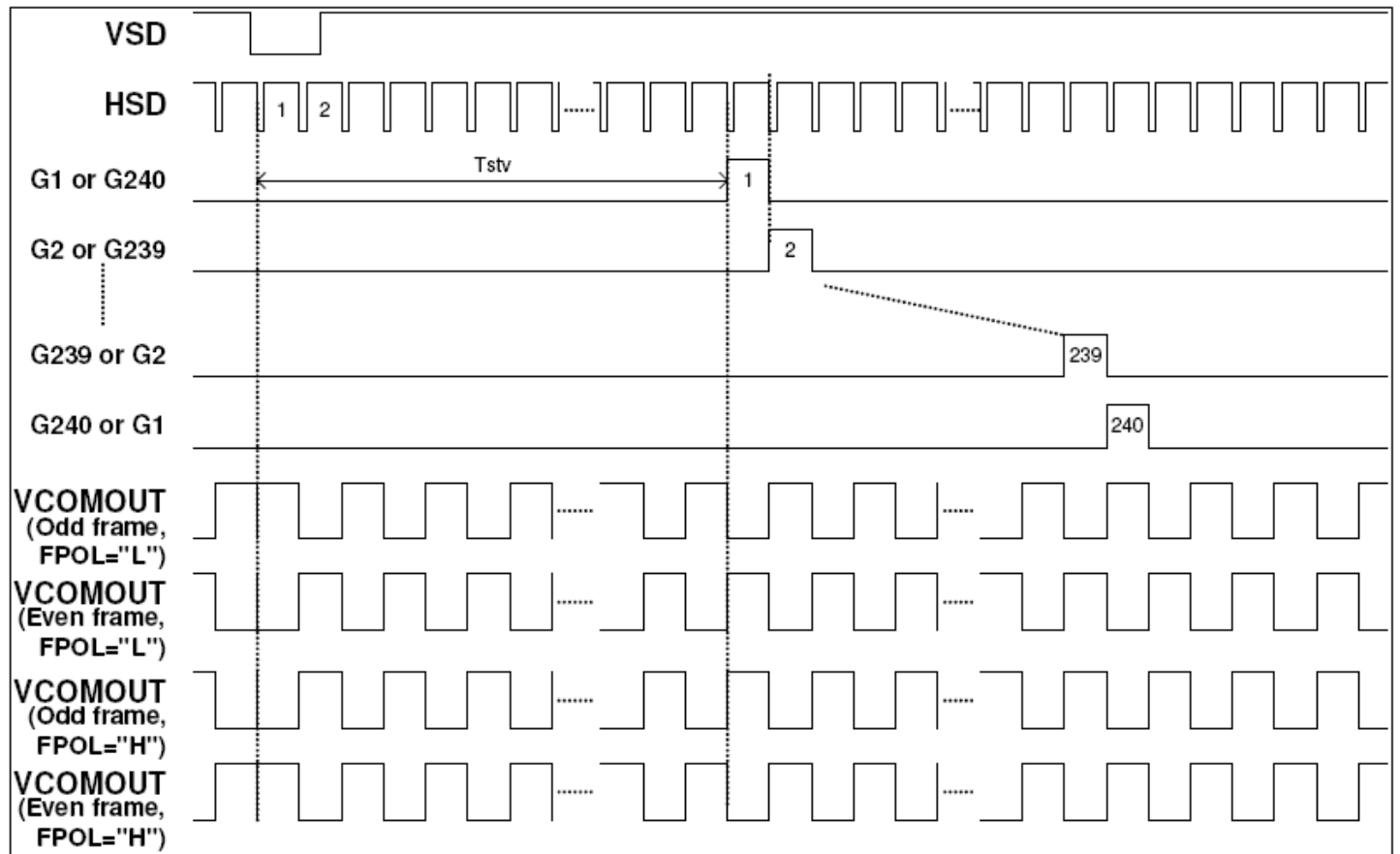
3-Wire Timing Diagram



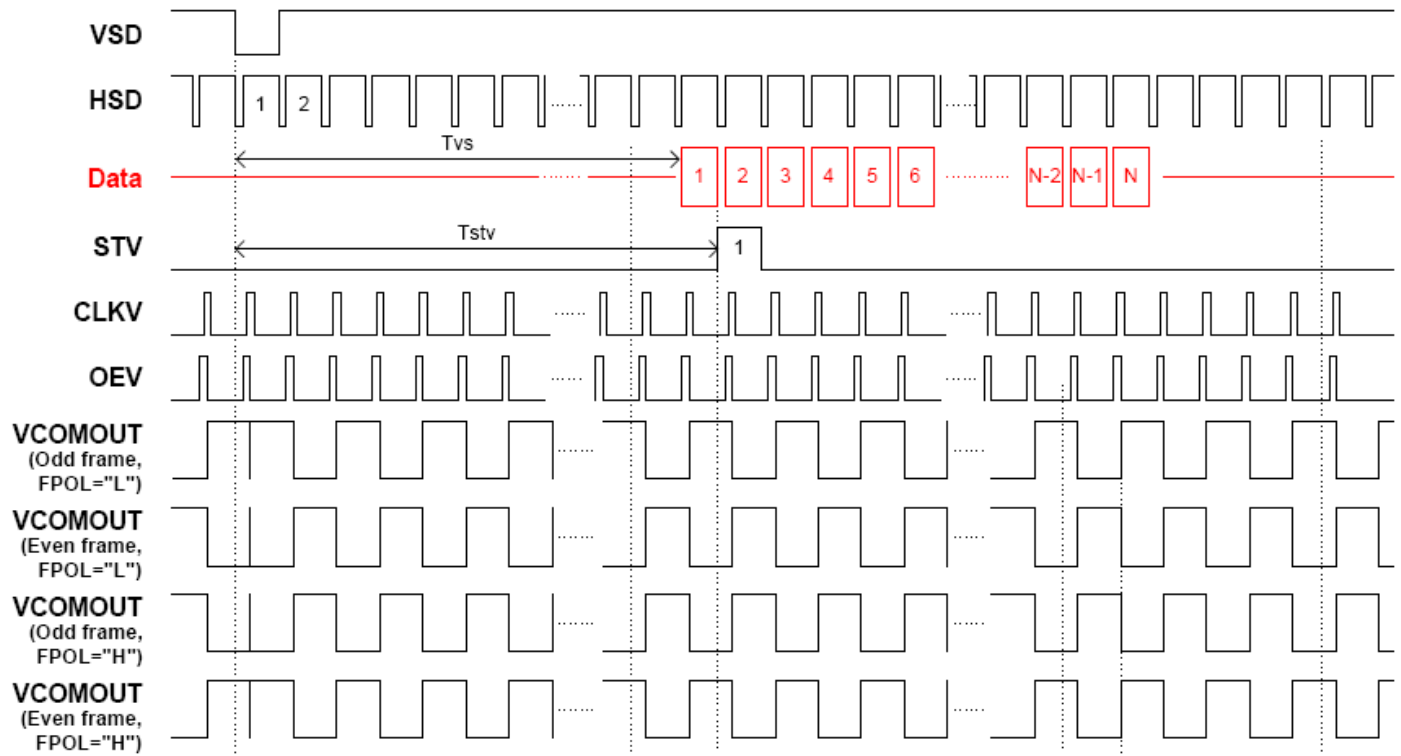
Source Driver Output Timing Diagram



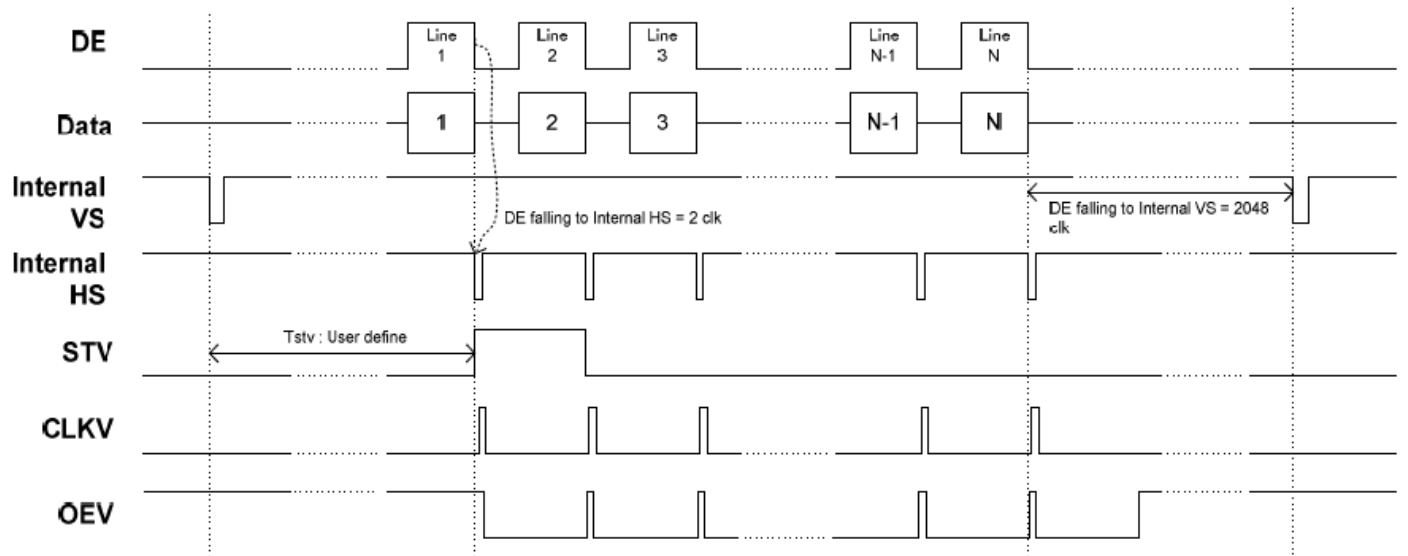
Gate Driver Output Timing Diagram



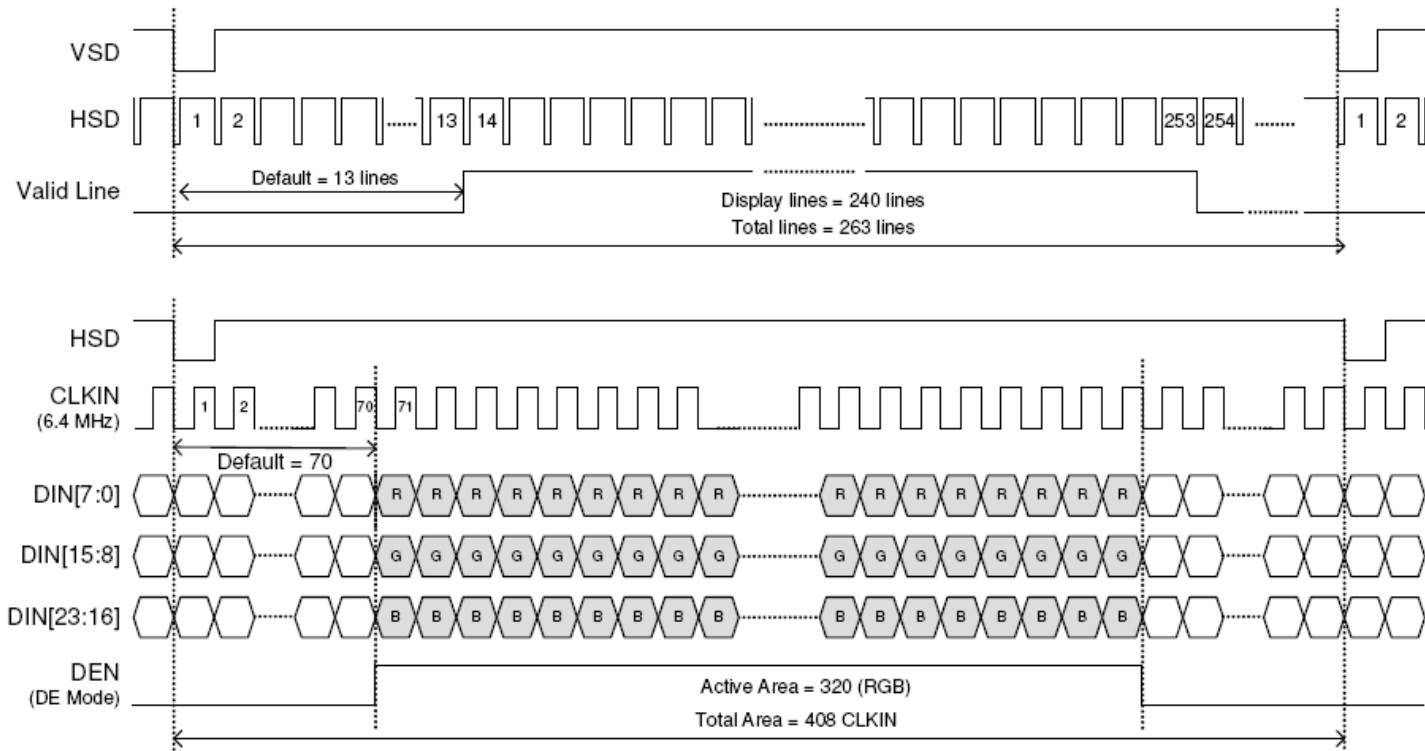
Vertical Timing Diagram (HV Mode)



Vertical Timing Diagram (DE Mode)



Input Data Timing (24 bit RGB mode for 960 x 240 @ SEL[3:0] = 1100b)



Capacitive Touch Panel Registers

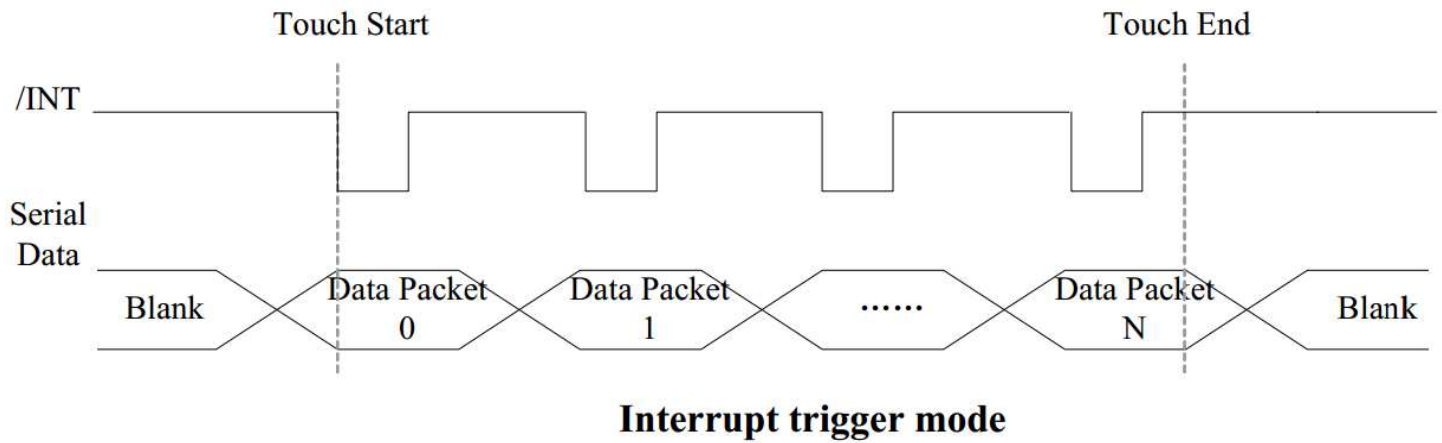
Address	Name	B7	B6	B5	B4	B3	B2	B1	B0	Access	
00h	DEVICE_MODE	Device Mode [2..0]									R/W
01h	GEST_ID	Gesture ID [7..0]								R	
02h	TD_STATUS							Touch Points [3..0]		R	
03h	TOUCH1_XH	Event Flag					1st Touch X Position MSB [11..8]			R	
04h	TOUCH1_XL	1st Touch X Position LSB [7..0]								R	
05h	TOUCH1_YH	Touch ID [3..0]				1st Touch Y Position MSB [11..8]				R	
06h	TOUCH1_YL	1st Touch Y Position LSB [7..0]								R	
07h										R	
08h										R	
09h	TOUCH2_XH	Event Flag					2nd Touch X Position MSB [11..8]			R	
0Ah	TOUCH2_XL	2nd Touch X Position LSB [7..0]								R	
0Bh	TOUCH2_YH	Touch ID [3..0]				2nd Touch Y Position MSB [11..8]				R	
0Ch	TOUCH2_YL	2nd Touch Y Position LSB [7..0]								R	
0Dh										R	
0Eh										R	
0Fh	TOUCH3_XH	Event Flag					3rd Touch X Position MSB [11..8]			R	
10h	TOUCH3_XL	3rd Touch X Position LSB [7..0]								R	
11h	TOUCH3_YH	Touch ID [3..0]				3rd Touch Y Position MSB [11..8]				R	
12h	TOUCH3_YL	3rd Touch Y Position LSB [7..0]								R	
13h										R	
14h										R	
15h	TOUCH4_XH	Event Flag					4th Touch X Position MSB [11..8]			R	
16h	TOUCH4_XL	4th Touch X Position LSB [7..0]								R	
17h	TOUCH4_YH	Touch ID [3..0]				4th Touch Y Position MSB [11..8]				R	
18h	TOUCH4_YL	4th Touch Y Position LSB [7..0]								R	
19h										R	
1Ah										R	
1Bh	TOUCH5_XH	Event Flag					5th Touch X Position MSB [11..8]			R	
1Ch	TOUCH5_XL	5th Touch X Position LSB [7..0]								R	
1Dh	TOUCH5_YH	Touch ID [3..0]				5th Touch Y Position MSB [11..8]				R	
1Eh	TOUCH5_YL	5th Touch Y Position LSB [7..0]								R	
1Fh										R	

Address	Name	B7	B6	B5	B4	B3	B2	B1	B0	Access
80h	ID_G_THGROUP	valid touching detect threshold								R/W
81h	ID_G_THPEAK	valid touching peak detect threshold								R/W
82h	ID_G_THCAL	the threshold when calculating the focus of touching								R/W
83h	ID_G_THWATER	the threshold when there is surface water								R/W
84h	ID_G_TEMP	the threshold of temperature compensation								R/W
85h	ID_G_THDIFF	the threshold whether the coordinate is different from original								R/W
86h	ID_G_CTRL					Power Control Mode [1..0]				R/W
87h	ID_G_TIME_ENTER_MONITOR	the timer for entering monitor status								R/W
88h	ID_G_PERIODACTIVE					Period Active [3..0]				R/W
89h	ID_G_PERIODMONITOR	the timer of entering idle when in monitor status								R/W
A0h	ID_G_AUTO_CLB_MODE	auto calibration mode								R/W
A1h	ID_G_LIB_VERSION_H	Firmware Library Version H byte								R
A2h	ID_G_LIB_VERSION_L	Firmware Library Version L byte								R
A3h	ID_G_CIPHER	Chip vendor ID								R
A4h	ID_G_MODE	the interrupt status to host								R
A5h	ID_G_PMODE	Power Consume Mode								
A6h	ID_G_FIRMID	Firmware ID								R
A7h	ID_G_STATE	Running State								
A8h	ID_G_FT5201ID	CTPM Vendor ID								R
A9h	ID_G_ERR	Error Code								R
AAh	ID_G_CLB	Configure TP module during calibration in Test Mode								R/W
FEh	LOG_MSG_CNT	The log MSG count								R
FFh	LOG_CUR_CHA	Current character of log message								R

NOTE: Registers 80h – AFh have been configured for optimum settings and do not need to be modified.

Register No	Register Name	Bits	Value	Description
00h	Device Mode	[2:0]	000b	Normal Operating Mode
			100b	Test Mode - read raw data (reserved)
			001b	System Information Mode (reserved)
01h	Gesture ID	[7:0]	48h	Zoom In
			49h	Zoom Out
			00h	No Gesture
02h	Touch Points	[3:0]	000b	0 touch points detected
			001b	1 touch point detected
			010b	2 touch points detected
			011b	3 touch points detected
			100b	4 touch points detected
			101b	5 touch points detected
03h	Touch 1 Event Flag	[7:6]	00b	Put Down
			01b	Put Up
			10b	Contact
			11b	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	Put Down
			01b	Put Up
			10b	Contact
			11b	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
08h	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	Put Down
			01b	Put Up
			10b	Contact
			11b	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	Put Down
			01b	Put Up
			10b	Contact
			11b	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]	55h	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]	05h	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



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(0x70);           //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.	+70°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.	+60°C , 240hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 240hrs	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.	+60°C , 90% RH , 160hrs	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 100 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-55Hz , 15mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes	3
Static electricity test	Endurance test applying electric static discharge.	VS=4KV, RS=330kΩ, CS=150pF Five 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

Warranty Information and Terms & Conditions

http://www.newhavendisplay.com/index.php?main_page=terms