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# NHD-3.5-320240MF-ATXL#-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
#-1	<b>RoHS Compliant</b>

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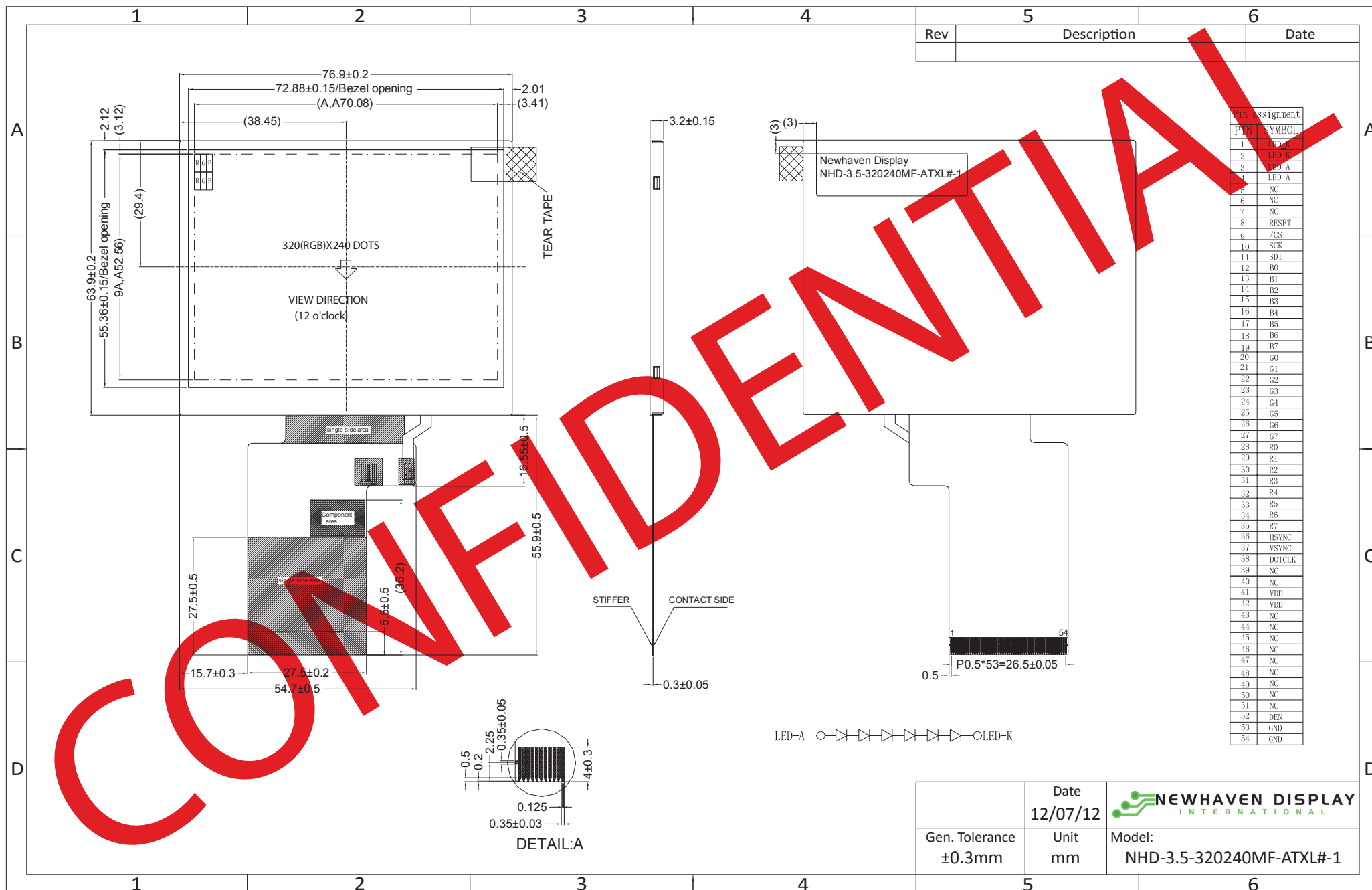
## Document Revision History

Revision	Date	Description	Changed by
0	7/8/2009	Initial Release	CL
1	7/29/2009	MECHANICAL DRAWING UPDATE	CL
2	1/25/2011	Viewing angle updated	AK
3	3/31/2011	Pin description / Note section updated	AK
4	4/8/2011	Contrast removed from electrical characteristics	BE
5	12/10/2012	Timing characteristics updated	AK

## Functions and Features

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

# Mechanical Drawing



The drawing contained herein is the exclusive property of Newhaven Display International, Inc. and shall not be copied, reproduced, and/or disclosed in any format without permission.

## Pin Description

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	VSYNC	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:** ---



## Electrical Characteristics

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
Digital 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

## 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

## Driver Information

Built-in NT39016D driver. No controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/NT39016D.pdf](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:

ROEh = 6Bh

ROFh = 24h

## Timing Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
<b>System Operation Timing</b>						
VDD power source slew time	T <sub>POR</sub>			1000	us	From 0V to 90% VDD
RSTB active pulse width	T <sub>RSTB</sub>	40			us	VDD = 3.3V
<b>Input Output Timing</b>						
CLKIN clock time	T <sub>clk</sub>	33.3/125	-	-	ns	Please refer to timing table(p.32)
HSD to CLKIN	T <sub>hc</sub>	-	-	1	CLKIN	
HSD width	T <sub>wh</sub>	1	-	-	CLKIN	
VSD width	T <sub>vwh</sub>	1	-	-	Th	
HSD period time	T <sub>h</sub>	60	63.56	67	us	
VSD setup time	T <sub>vst</sub>	8	-	-	ns	
VSD hold time	T <sub>vhd</sub>	10	-	-	ns	
HSD setup time	T <sub>hst</sub>	8	-	-	ns	
HSD hold time	T <sub>hhd</sub>	10	-	-	ns	
Data set-up time	T <sub>dsu</sub>	8	-	-	ns	DIN[23:0] to CLKIN
Data hold time	T <sub>dhd</sub>	10	-	-	ns	DIN[23:0] to CLKIN
DEN setup time	T <sub>esd</sub>	12	-	-	ns	DEN to CLKIN
Time that VSD to 1 <sup>st</sup> line data input	T <sub>vs</sub>	2	13	127	Th	@CCIR601 / 8bit RGB HV mode Control by HDLY[6:0] setting T <sub>vs</sub> = HDLY[6:0]
Time that CCIR_V to 1 <sup>st</sup> line data input	T <sub>vs</sub>	12	20	28	Th	@CCIR656 NTSC mode Control by HDLY[6:0] setting T <sub>vs</sub> = HDLY[6:0]
Time that CCIR_V to 1 <sup>st</sup> line data input	T <sub>vs</sub>	17	25	33	Th	@CCIR656 PAL mode Control by HDLY[6:0] setting T <sub>vs</sub> = HDLY[6:0]
Time that VSD to 1 <sup>st</sup> line	T <sub>vs</sub>	2	13	127	Th	@24bit RGB HV mode Control by HDLY[6:0] setting T <sub>vs</sub> = HDLY[6:0]
Source output stable time 1	T <sub>st</sub>	-	25	30	us	96% final, CL=30pF, RL=2K
Gate output stable time	T <sub>gst</sub>	-	500	1000	ns	96% final, CL=40pF
VCOMOUT output stable time	T <sub>cst</sub>	-	4	8	us	96% final, CL=33nF, RL=100ohm

<b>3-wire serial communication AC timing</b>						
Serial clock	T <sub>spck</sub>	320	-	-	ns	
SPCK pulse duty		40	50	60	%	T <sub>ckh</sub> / T <sub>spck</sub>
Serial data setup time	T <sub>isu</sub>	120	-	-	ns	
Serial data hold time	T <sub>ihd</sub>	120	-	-	ns	
Serial clock high/low	T <sub>ckh/l</sub>	120	-	-	ns	
Chip select distinguish	T <sub>cd</sub>	1	-	-	us	
SPENB to VSD	T <sub>cv</sub>	1	-	-	us	
SPENB input setup time	T <sub>eck</sub>	150	-	-	ns	
SPENB input hold time	T <sub>cke</sub>	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

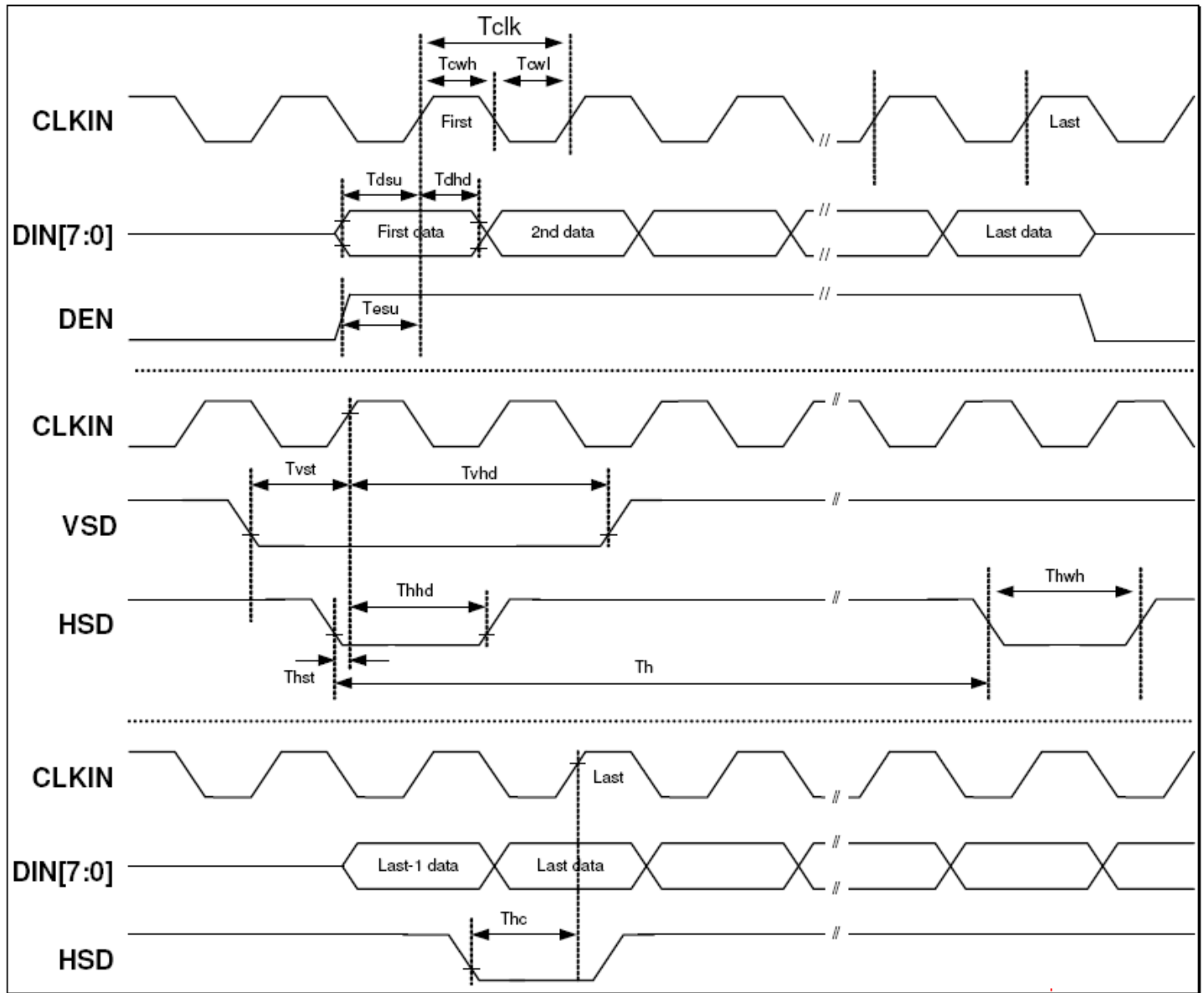
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLKIN frequency	Fclk	-	27	30	MHz	VDD = 3.0 ~3.6V
CLKIN cycle time	Tclk	-	37		ns	
CLKIN pulse duty	Tcwh	40	50	60	%	Tclk
Time that HSD to 1'st data input(NTSC)	Ths	35	70	255	CLKIN	DDLY = 70, Offset = 0 (fixed)

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

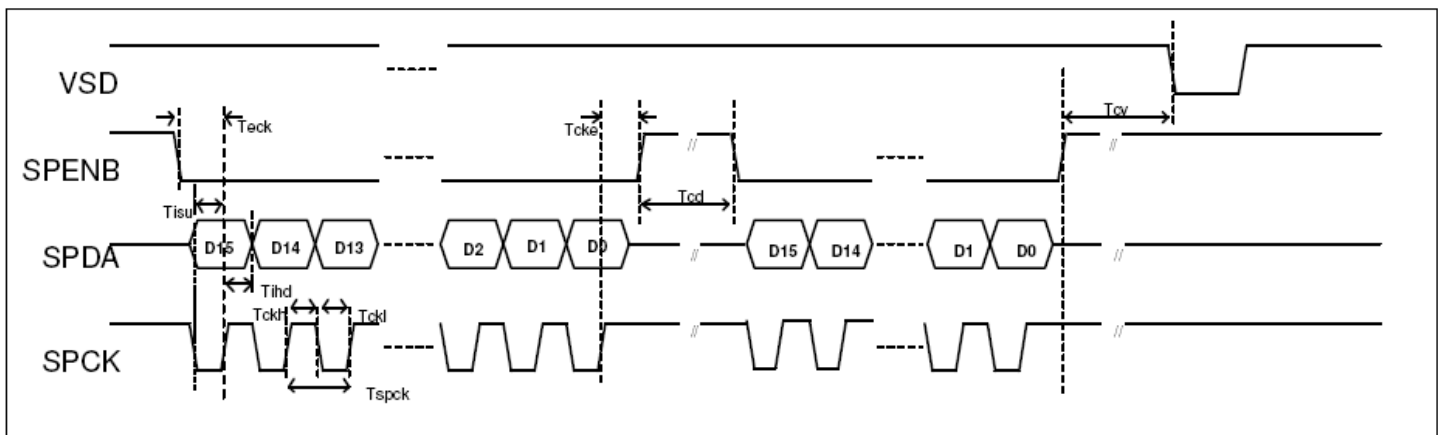
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLKIN frequency	Fclk	6.1	6.4	8.0	MHz	VDD = 3.0 ~3.6V
CLKIN cycle time	Tclk	125	156	164	ns	
CLKIN pulse duty	Tcwh	40	50	60	%	Tclk
Time that HSD to 1'st data input(NTSC)	Ths	40	70	255	CLKIN	DDLY =70, Offset = 0 (fixed)



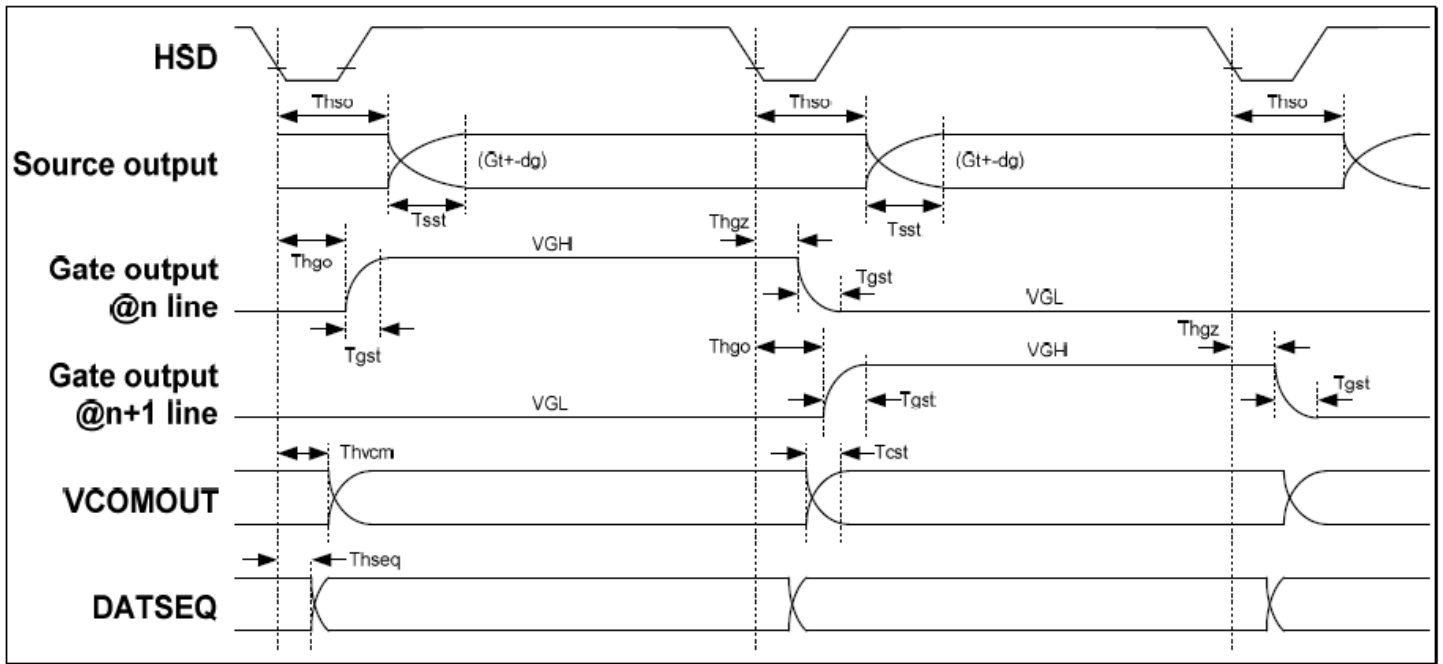
## Clock and Data Input Timing Diagram



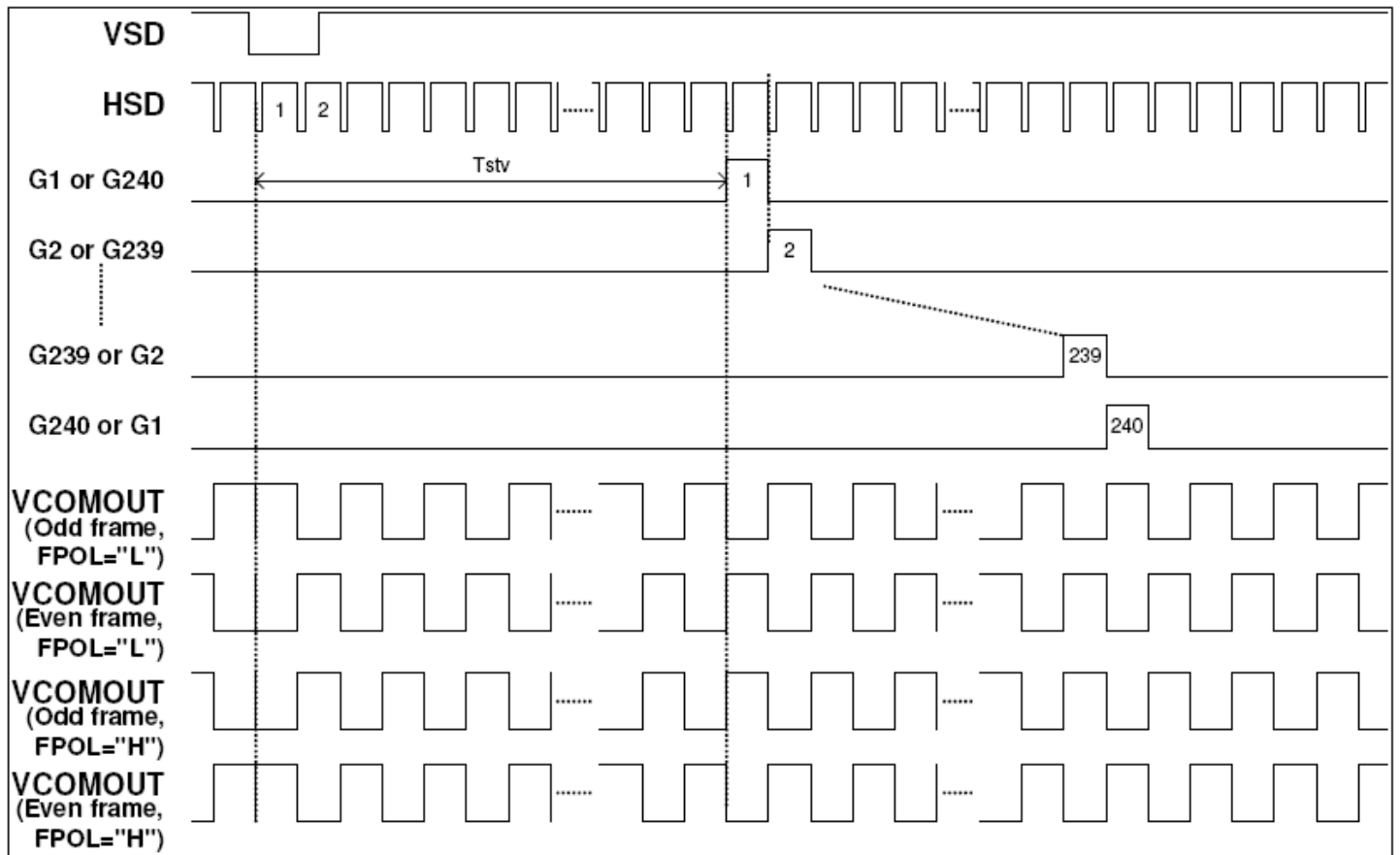
## 3-Wire Timing Diagram



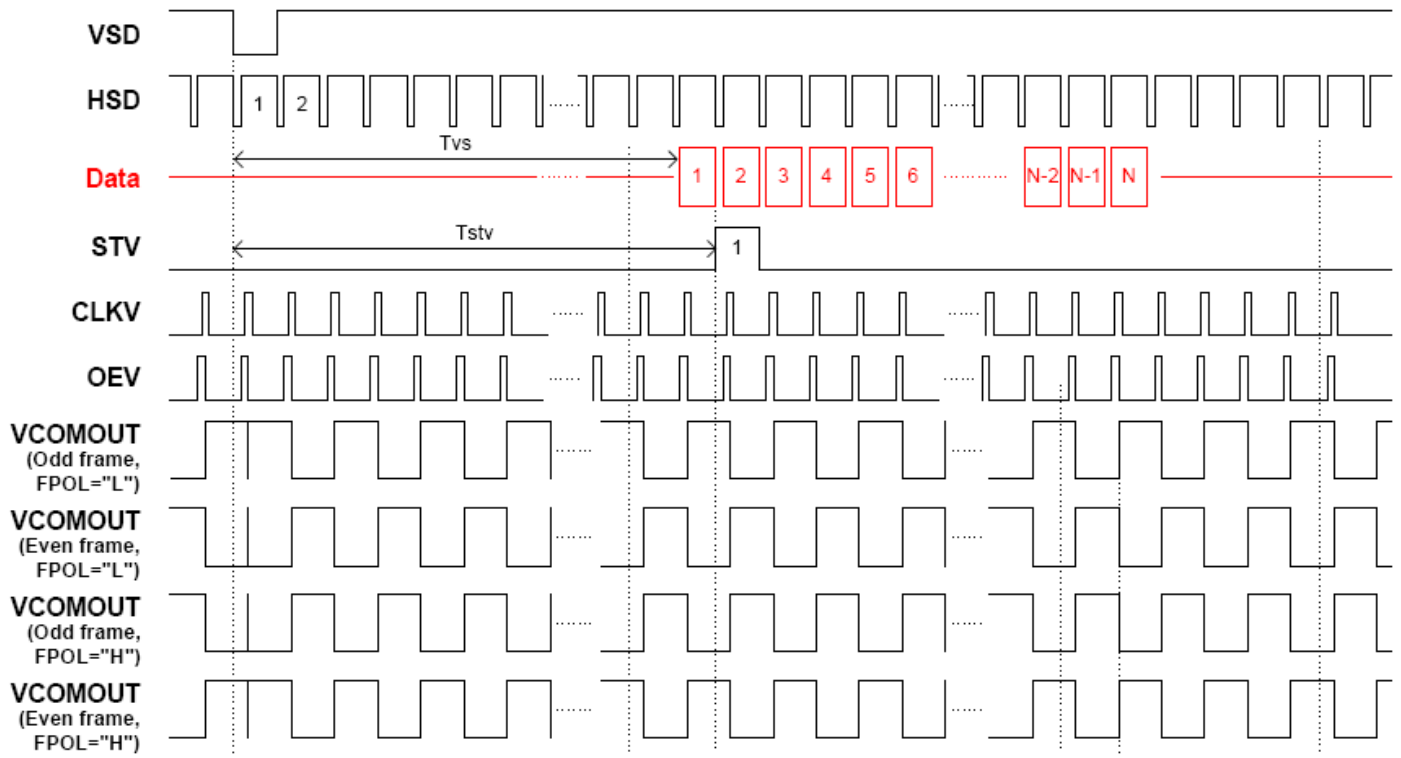
## Source Driver Output Timing Diagram



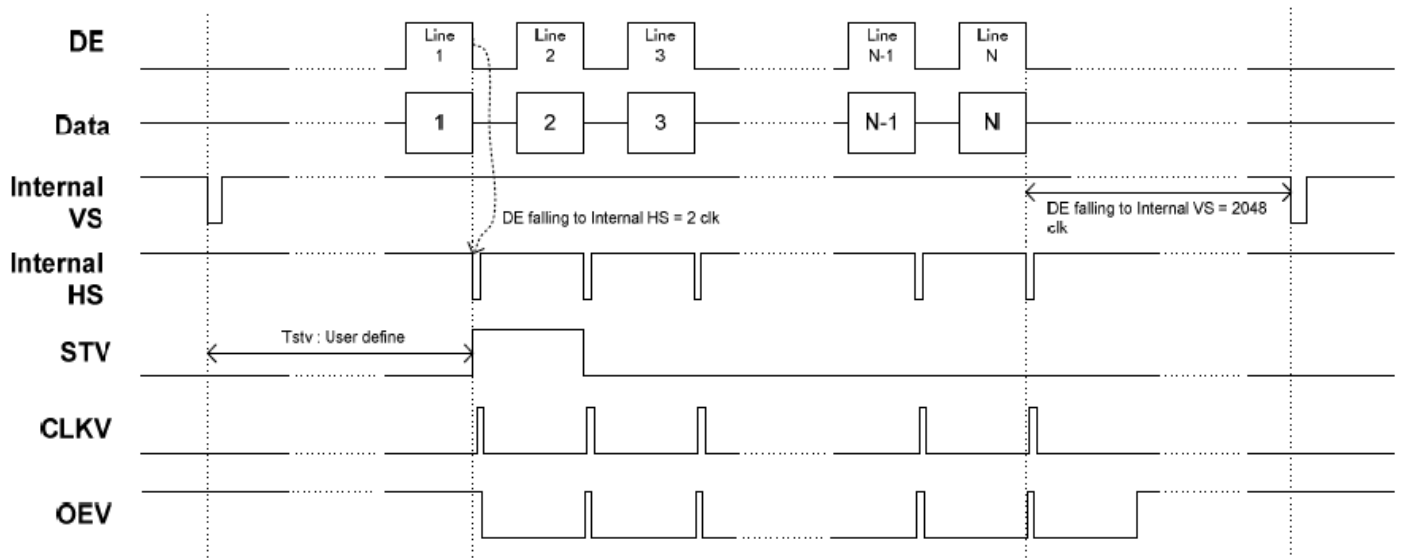
## Gate Driver Output Timing Diagram



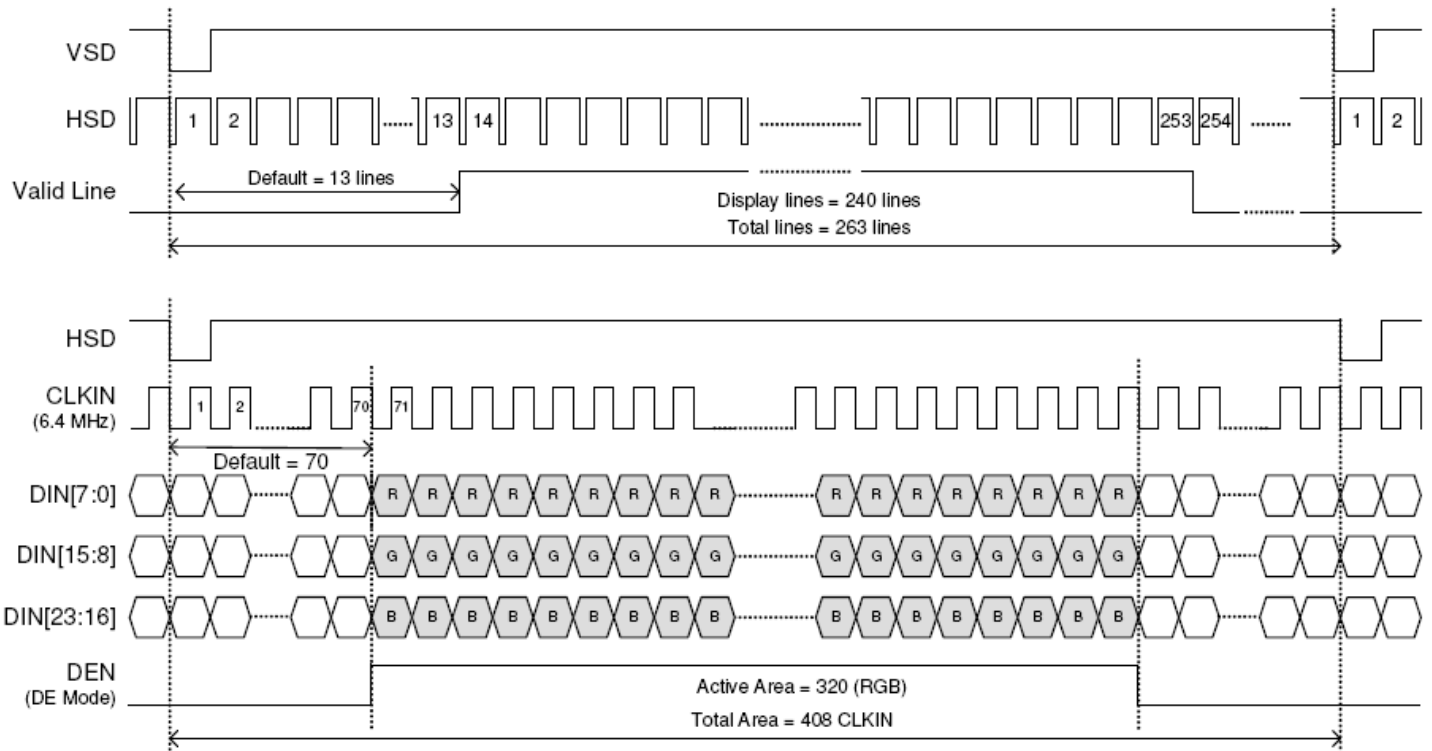
## Vertical Timing Diagram (HV Mode)



## Vertical Timing Diagram (DE Mode)



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



## 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](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)