

# NHD-3.5-320240MF-ATXL#-T-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>                |
| T-1     | 4-wire Resistive Touch Panel         |

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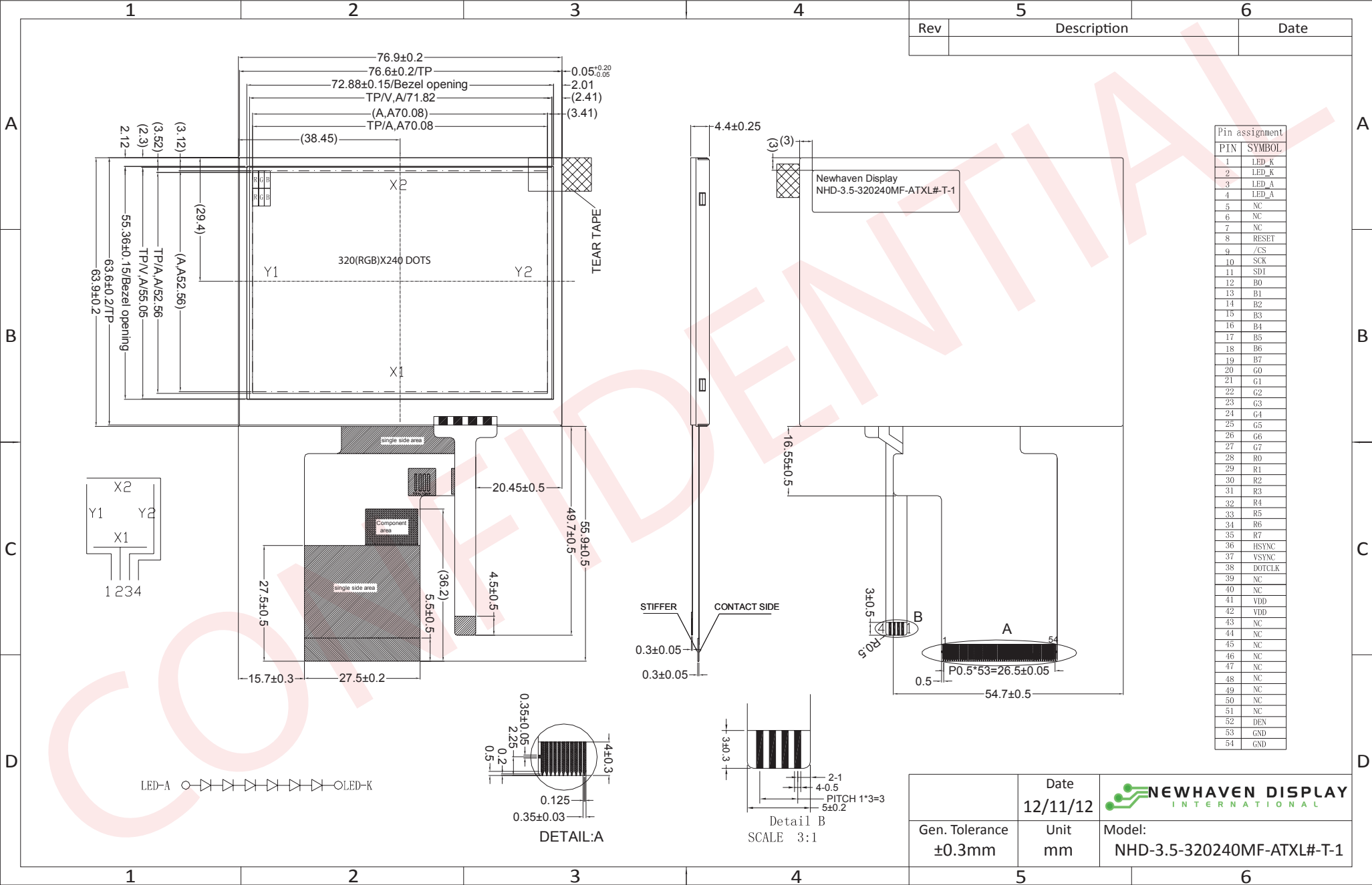
## Document Revision History

| Revision | Date       | Description                                         | Changed by |
|----------|------------|-----------------------------------------------------|------------|
| 0        | 7/8/2009   | Initial Release                                     | CL         |
| 1        | 7/29/2009  | MECHANICAL DRAWING UPDATE                           | CL         |
| 2        | 5/27/2010  | Touch Panel Characteristics Updated                 | BE         |
| 3        | 1/25/2011  | Viewing angle updated                               | AK         |
| 4        | 1/26/2011  | Mechanical Drawing updated                          | AK         |
| 5        | 3/31/2011  | Pin description / Note updated                      | AK         |
| 6        | 4/8/2011   | Contrast removed from electrical characteristics    | BE         |
| 7        | 11/29/2011 | Electrical characteristics updated                  | AK         |
| 8        | 12/11/2012 | Timing characteristics & Mechanical drawing updated | AK         |
| 9        | 4/25/2014  | Optical characteristics updated                     | ML         |
| 10       | 5/30/2014  | Driver information updated                          | AK         |

## Functions and Features

- 320xRGBx240 resolution
- LED backlight
- 24-bit Digital RGB interface (6.4MHz)
- 3.3V power supply
- With 4-Wire resistive Touch Panel

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

### LCD:

| Pin No. | Symbol | External Connection | Function Description                    |
|---------|--------|---------------------|-----------------------------------------|
| 1       | LED_K  | Power Supply        | Backlight Cathode (Ground)              |
| 2       | LED_K  | Power Supply        | Backlight Cathode (Ground)              |
| 3       | LED_A  | Power Supply        | Backlight Anode (18mA @ 19.2V)          |
| 4       | LED_A  | Power Supply        | Backlight Anode (18mA @ 19.2V)          |
| 5       | NC     | -                   | No Connect                              |
| 6       | NC     | -                   | No Connect                              |
| 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      | NC     | -                   | No Connect                              |
| 40      | NC     | -                   | No Connect                              |
| 41      | VDD    | Power Supply        | Supply Voltage for LCD and logic (3.3V) |
| 42      | VDD    | Power Supply        | Supply Voltage 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      | DEN    | -                   | Data Enable signal (No Connect)         |
| 53      | GND    | Power Supply        | Ground                                  |
| 54      | GND    | Power Supply        | Ground                                  |

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

### Resistive Touch Panel:

| Pin No. | Symbol | External Connection | Function Description |
|---------|--------|---------------------|----------------------|
| 1       | Y1     | Touch Controller    | Left                 |
| 2       | X1     | Touch Controller    | Down                 |
| 3       | Y2     | Touch Controller    | Right                |
| 4       | X2     | Touch Controller    | Up                   |

**Recommended connector:** 4pin, 1.0mm pitch, FFC connector. Molex P/N 52207-0485

## 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   | 40      | 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   | -    | 40   | -    | °                 |
| Viewing Angle – Bottom |        |           | -    | 60   | -    | °                 |
| Viewing Angle – Left   |        |           | -    | 60   | -    | °                 |
| Viewing Angle – Right  |        |           | -    | 60   | -    | °                 |
| Contrast Ratio         | Cr     |           | 200  | 350  | -    |                   |
| Luminance              | Lv     |           | 250  | 320  | -    | cd/m <sup>2</sup> |
| Response Time (rise)   | Tr     |           | -    | 25   | 40   | ms                |
| Response Time (fall)   | Tf     |           | -    | 25   | 40   | ms                |

Viewing angles based on 6:00 grayscale inversion

## Touch Panel Characteristics

| Item                        | Symbol | Condition | Min.      | Typ. | Max. | Unit       |
|-----------------------------|--------|-----------|-----------|------|------|------------|
| Linearity                   |        |           | -         | -    | 1.5  | %          |
| Circuit Resistance – X-Axis |        |           | 200       | -    | 900  | Ω          |
| Circuit Resistance – Y-Axis |        |           | 200       | -    | 900  | Ω          |
| Insulation Resistance       |        |           | 20        | -    | -    | MΩ         |
| Operating Voltage           |        |           | -         | -    | 5    | V          |
| Chattering                  |        |           | -         | -    | 10   | Ms         |
| Transmittance               |        |           | 75        | -    | -    | %          |
| Activation Force            |        |           | 70        | -    | 120  | g          |
| Pen Writing Durability      |        |           | 100,000   | -    | -    | Characters |
| Pitting Durability          |        |           | 1,000,000 | -    | -    | Touches    |
| Surface Hardness            |        |           | 3         | -    | -    | H          |
| Haze                        |        |           | -         | 7    | -    | %          |

## Driver Information

Built-in NV3035C driver. No controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/NV3035C.pdf](http://www.newhavendisplay.com/app_notes/NV3035C.pdf)

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

ROEh = 6Bh

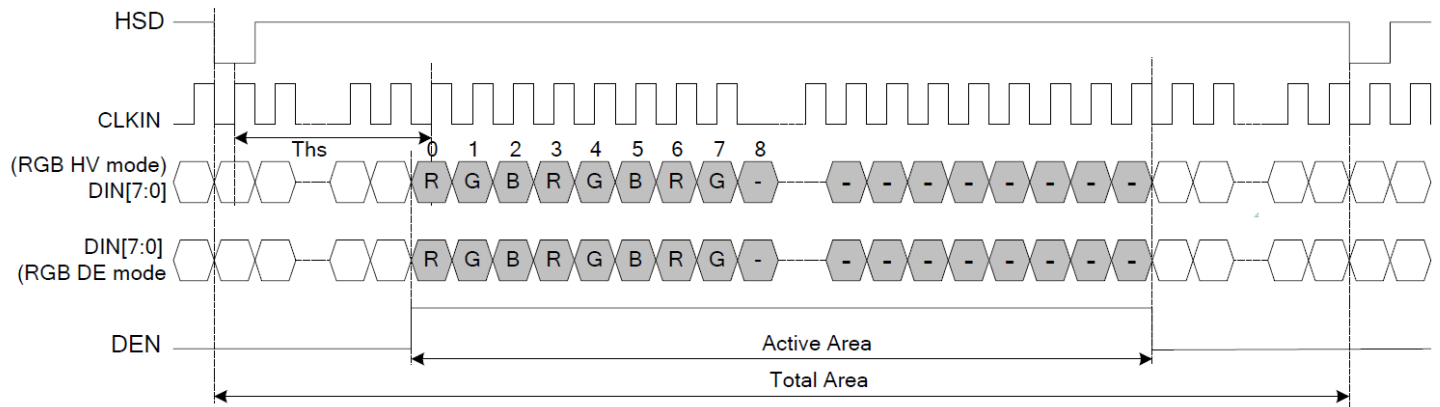
ROFh = 24h

## Timing Characteristics

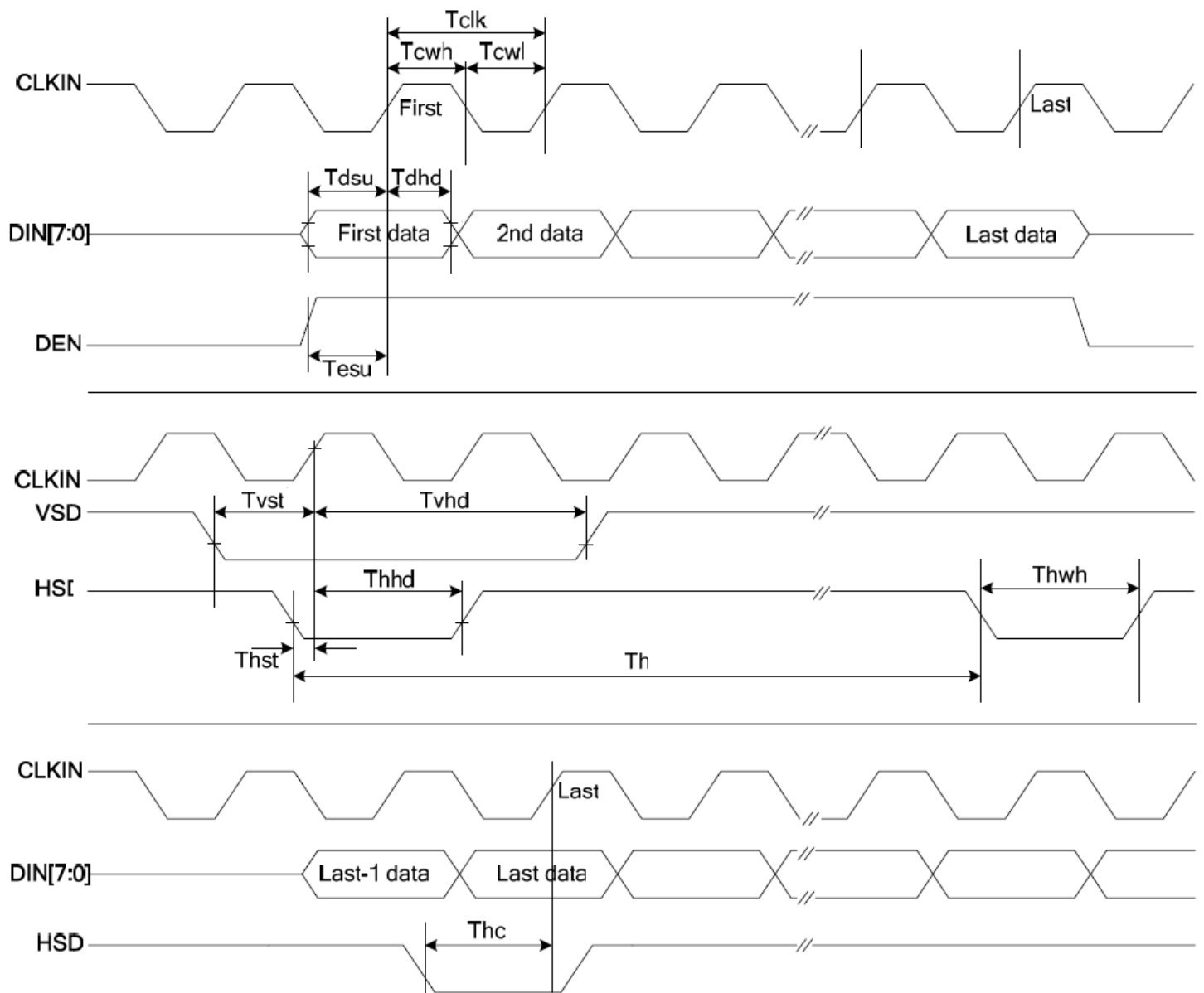
| Parameter                                           | Symbol            | Min. | Typ.  | Max. | Unit  | Conditions                                                          |
|-----------------------------------------------------|-------------------|------|-------|------|-------|---------------------------------------------------------------------|
| <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                                    | 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              | 12   | -     | -    | ns    |                                                                     |
| VSD hold time                                       | Tvhd              | 12   | -     | -    | ns    |                                                                     |
| HSD setup time                                      | Thst              | 12   | -     | -    | ns    |                                                                     |
| HSD hold time                                       | Thhd              | 12   | -     | -    | ns    |                                                                     |
| Data set-up time                                    | Tdsu              | 12   | -     | -    | ns    | DIN[23:0] to CLKIN                                                  |
| Data hold time                                      | Tdhd              | 12   | -     | -    | 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    | @CIR601/8bit 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=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                                       |
| <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                                        | Tev               | 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) |

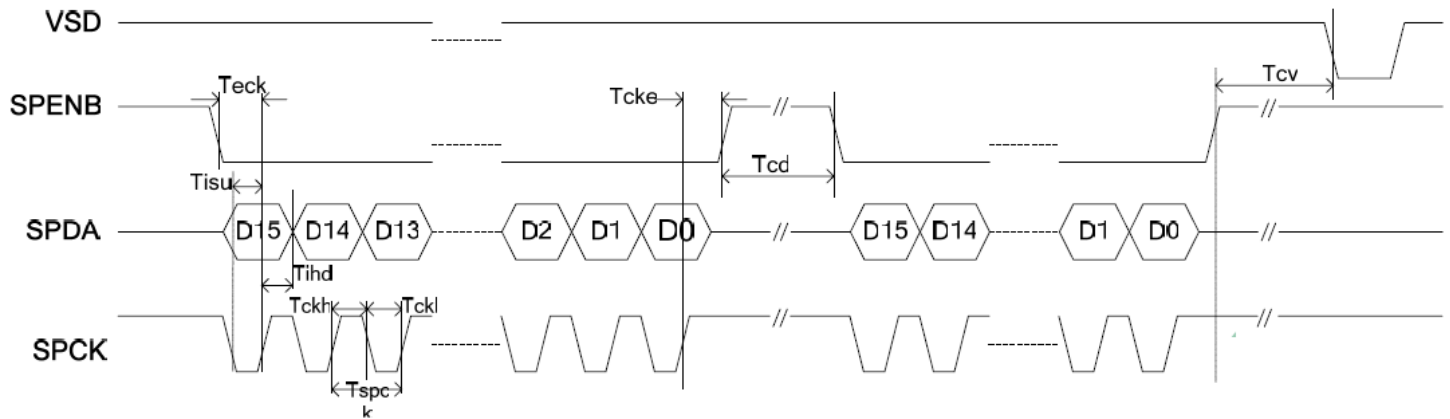
## Input Data Format



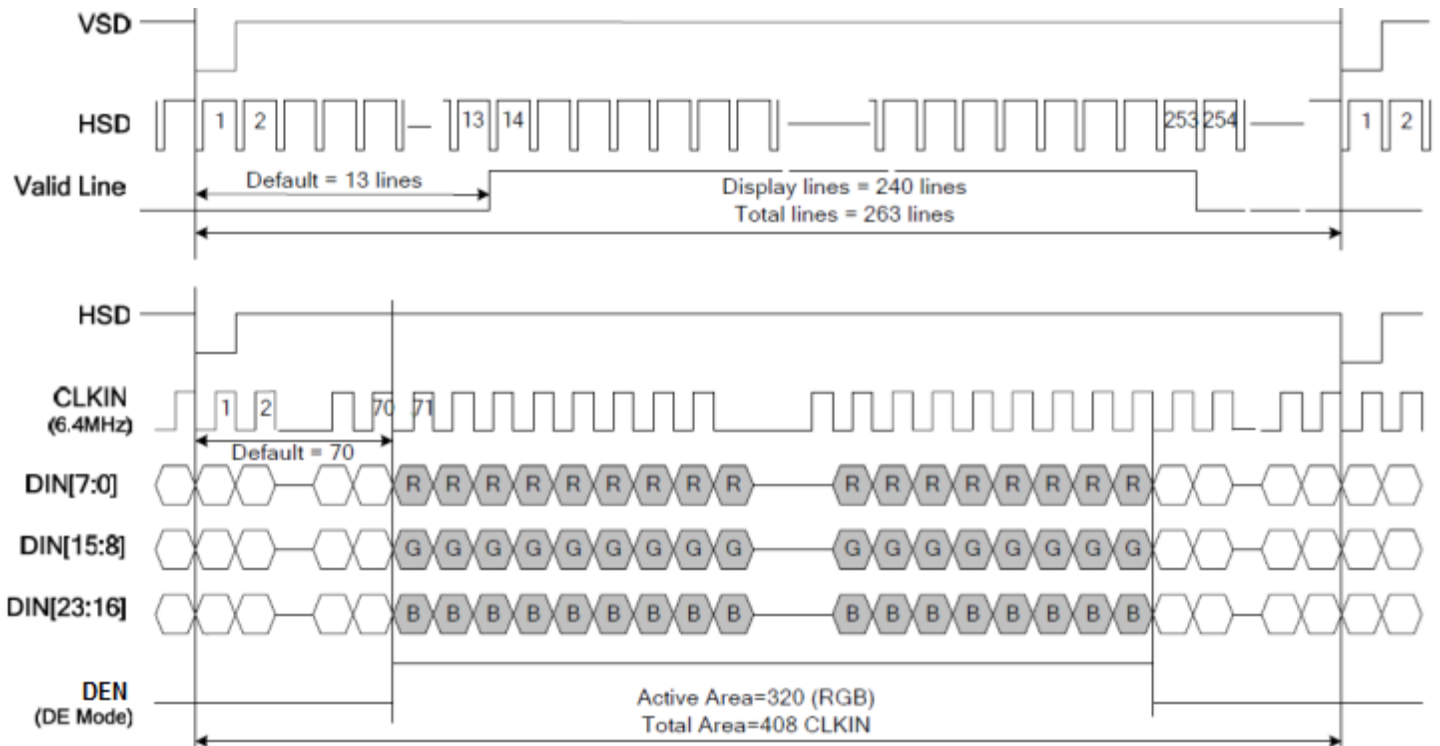
## Clock and Data Input Timing Diagram



### 3-wire Timing Diagram



### Input Data Timing



## 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.                                                            | -20°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.                     | -10°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. | +50°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.                  | -20°C,30min -> 25°C,5min -> 70°C,30min = 1 cycle<br>100 cycles                      |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.                                                           | 10-55Hz , 15mm amplitude.<br>60 sec in each of 3 directions X,Y,Z<br>For 15 minutes | 3    |
| Static electricity test               | Endurance test applying electric static discharge.                                                                              | VS=4KV, RS=330kΩ, CS=150pF<br>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)