

# NHD-3.5-320240MF-ASXN#

## 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 |
| S-      | Sunlight Readable               |
| X-      | TFT                             |
| N-      | TN, Wide Temperature            |
| #       | <b>RoHS Compliant</b>           |

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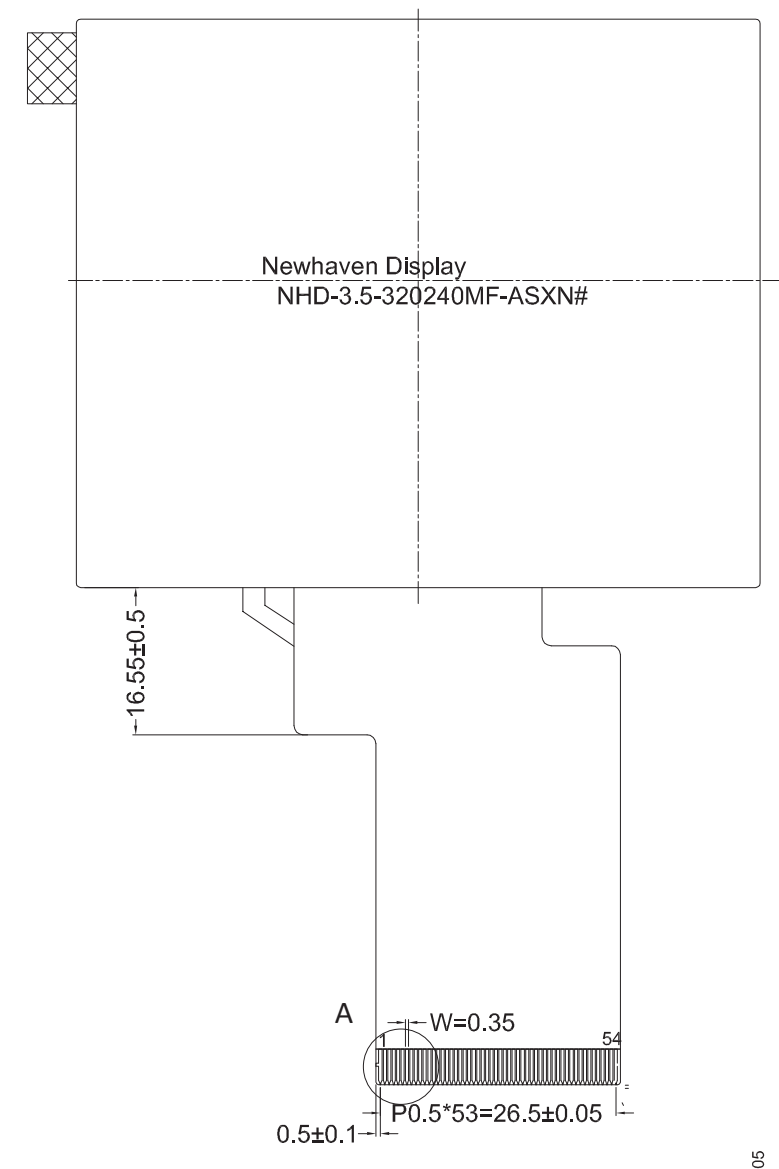
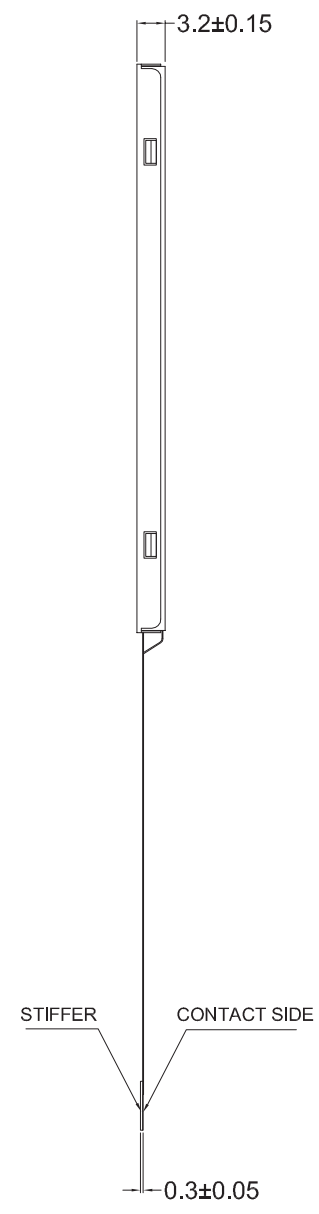
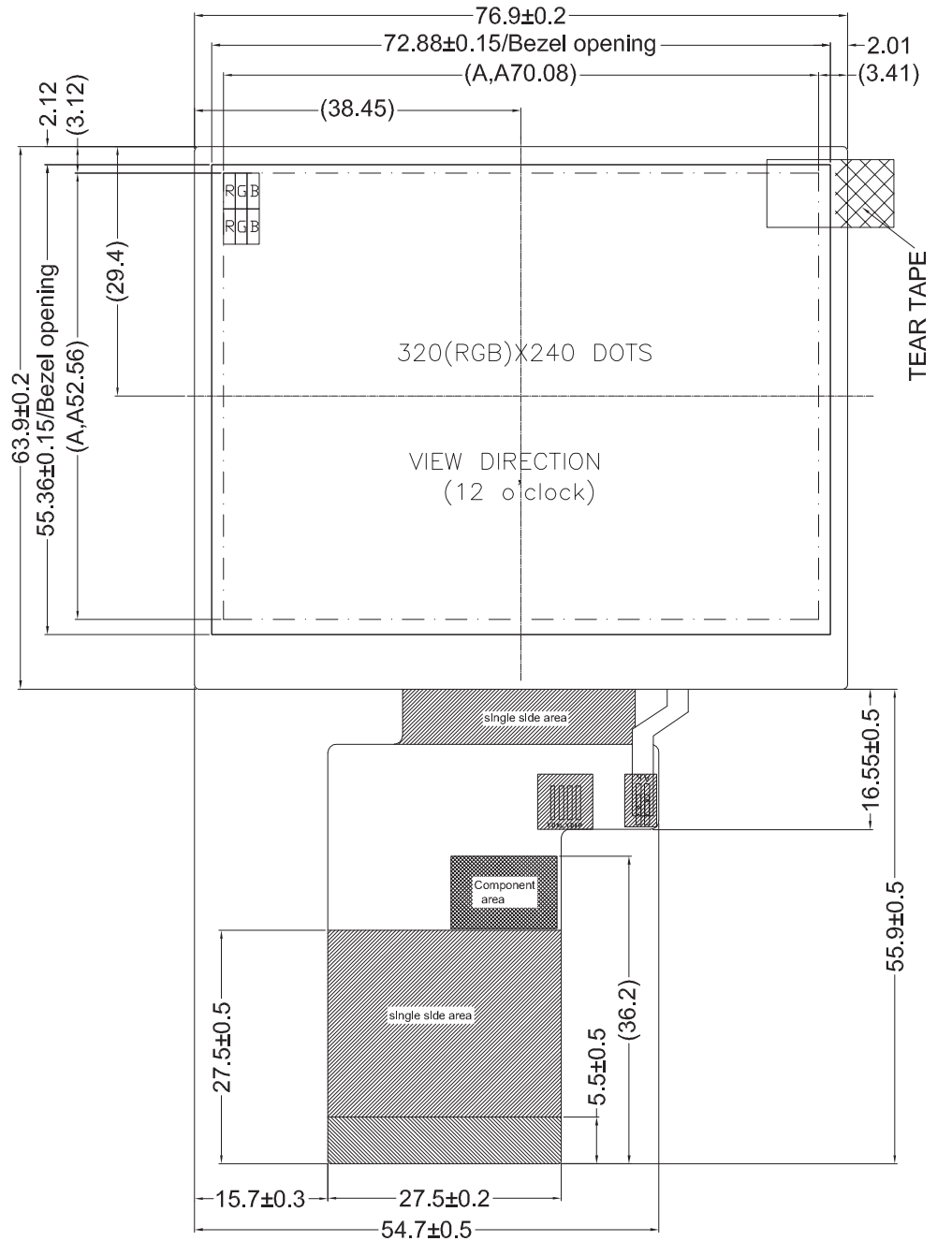
## Document Revision History

| Revision | Date    | Description                                   | Changed by |
|----------|---------|---|------------|
| 0        | 4/29/16 | Initial Release                               | SB         |
| 1        | 6/30/16 | Added Chromaticity                            | SB         |
| 2        | 9/22/16 | Backlight & Supply Current Updated            | SB         |
| 3        | 6/19/19 | Backlight Characteristics Updated             | SB         |
| 4        | 6/30/20 | Revised Note on Manual Register Configuration | AS         |

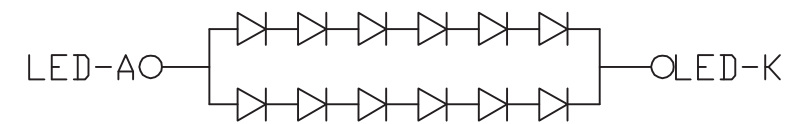
## Functions and Features

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

| SYMBOL | REVISION | DATE |
|--------|----------|------|
|        |          |      |
|        |          |      |



| Pin No. | Symbol |
|---------|--------|
| 1       | LED_K  |
| 2       | LED_K  |
| 3       | LED_A  |
| 4       | LED_A  |
| 5       | NC     |
| 6       | NC     |
| 7       | NC     |
| 8       | RSTB   |
| 9       | SPENB  |
| 10      | SPCK   |
| 11      | SPDA   |
| 12-19   | B0-B7  |
| 20-27   | G0-G7  |
| 28-35   | R0-R7  |
| 36      | HSD    |
| 37      | VSD    |
| 38      | CLKIN  |
| 39      | NC     |
| 40      | NC     |
| 41      | VDD    |
| 42      | VDD    |
| 43      | NC     |
| 44      | NC     |
| 45      | NC     |
| 46      | NC     |
| 47      | NC     |
| 48      | NC     |
| 49      | NC     |
| 50      | NC     |
| 51      | NC     |
| 52      | DEN    |
| 53      | GND    |
| 54      | GND    |



- NOTES:**
- |                    |  |
|--------------------|--|
| 1. Display Size:   | 3.5 TFT                                    |
| 2. Optimal View:   | 12 O'CLOCK                                 |
| 3. Display Mode:   | Transmissive / Normally White / Anti-Glare |
| 4. Driver IC:      | NV3035C                                    |
| 5. Supply Voltage: | 3.3V                                       |
| 6. Backlight:      | White LED/ 19.2 V (Typ)/ 40mA              |
| 7. Brightness:     | 1000cd/m <sup>2</sup> (Typ)                |

STANDARD TOLERANCE: (UNLESS OTHERWISE SPECIFIED)

LINEAR: ±0.3mm

UNLESS OTHERWISE SPECIFIED: - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION

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**NEWHAVEN DISPLAY INTERNATIONAL**

DRAWING/PART NUMBER: NHD-3.5-320240MF-ASXN#

REVISION: 1.0

SIZE: A3

SCALE: NS

SHEET 1 OF 1

DRAWN BY: S. Baxi

APPROVED BY: S. Baxi

DRAWN DATE: 6/19/19

APPROVED DATE: 6/19/19

## Pin Description

| 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 (40mA @ 19.2V)          |
| 4       | LED_A  | Power Supply        | Backlight Anode (40mA @ 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

## Electrical Characteristics

| 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   |
| Digital 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     | 15                    | 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> | V <sub>LED</sub> =19.2V  | 30                    | 40     | 50                    | mA   |
| Backlight Supply Voltage    | V <sub>LED</sub> | I <sub>LED</sub> = 40 mA | 17.4                  | 19.2   | 19.8                  | V    |
| Backlight Lifetime*         | -                | 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

## 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> = 40 mA | 800   | 1000  | -     | cd/m <sup>2</sup> |   |
| Response Time*         | Rise           | T <sub>OP</sub> = 25°C   | -     | 25    | 40    | ms                |   |
|                        | Fall           |                          | -     | 25    | 40    | ms                |   |
| Chromaticity           | Red            | X <sub>R</sub>           | -     | 0.547 | 0.597 | 0.647             | - |
|                        |                | Y <sub>R</sub>           | -     | 0.283 | 0.333 | 0.383             | - |
|                        | Green          | X <sub>G</sub>           | -     | 0.274 | 0.324 | 0.374             | - |
|                        |                | Y <sub>G</sub>           | -     | 0.574 | 0.624 | 0.674             | - |
|                        | Blue           | X <sub>B</sub>           | -     | 0.096 | 0.146 | 0.196             | - |
|                        |                | Y <sub>B</sub>           | -     | 0.072 | 0.122 | 0.172             | - |
| White                  | X <sub>W</sub> | -                        | 0.247 | 0.297 | 0.347 | -                 |   |
|                        | Y <sub>W</sub> | -                        | 0.315 | 0.365 | 0.415 | -                 |   |

## 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)

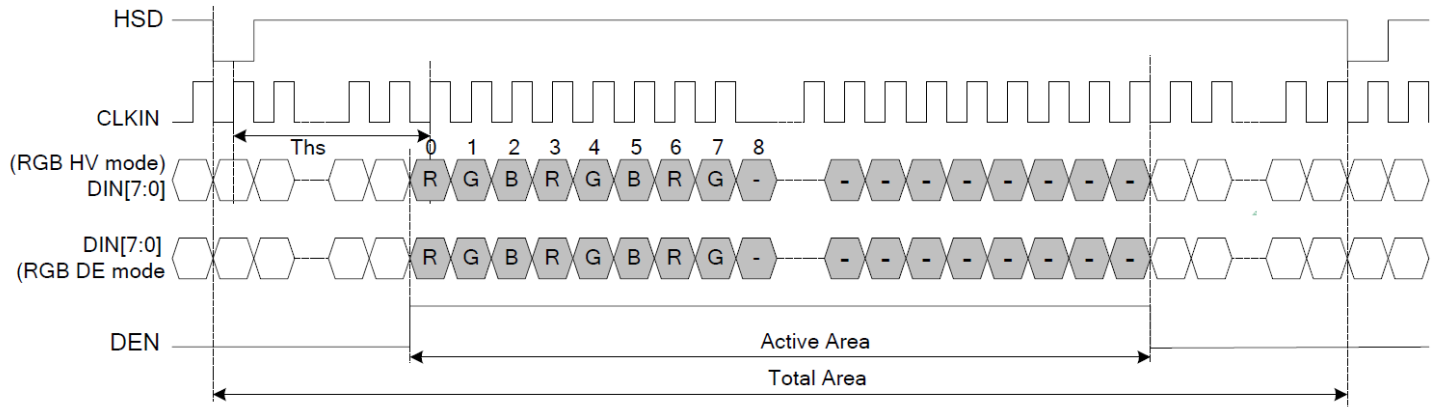
**NOTE:** Control registers accessible via the display's 3-wire SPI interface are used to set optimal functionality of the driver IC and TFT panel during manufacturing of the display. These control registers are not intended for use during normal operation of the display. Changing these register values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

## Timing Characteristics

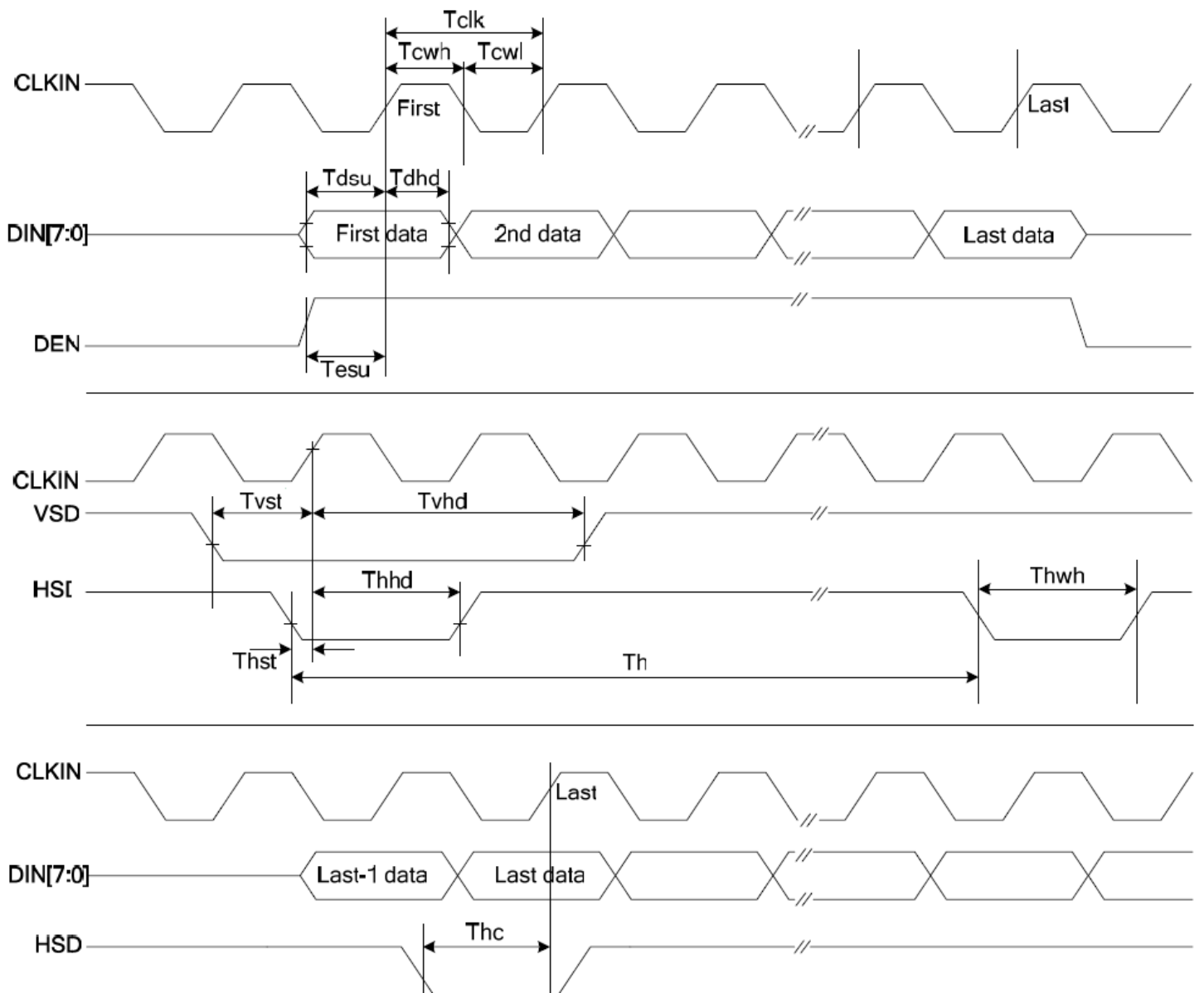
| Parameter   | Symbol             | Min. | Typ.  | Max. | Unit  | Conditions   |
|---|--------------------|------|-------|------|-------|--|
| <b>System Operation Timing</b>                      |                    |      |       |      |       |  |
| VDD power source slew time                          | 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  | T <sub>hc</sub>    | -    | -     | 1    | CLKIN |  |
| HSD width   | T <sub>hwh</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>   | 12   | -     | -    | ns    |  |
| VSD hold time                                       | T <sub>vhd</sub>   | 12   | -     | -    | ns    |  |
| HSD setup time                                      | T <sub>hst</sub>   | 12   | -     | -    | ns    |  |
| HSD hold time                                       | T <sub>hhd</sub>   | 12   | -     | -    | ns    |  |
| Data set-up time                                    | T <sub>dsu</sub>   | 12   | -     | -    | ns    | DIN[23:0] to CLKIN   |
| Data hold time                                      | T <sub>dhd</sub>   | 12   | -     | -    | 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    | @CIR601/8bit 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 data input    | 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>est</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                                     | T <sub>scdut</sub> | 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>ssw</sub>   | 120  | -     | -    | ns    |  |
| Chip select distinguish                             | T <sub>cd</sub>    | 1    | -     | -    | us    |  |
| SPENA to VSD  | T <sub>ev</sub>    | 1    | -     | -    | us    |  |
| SPENB input setup time                              | T <sub>eck</sub>   | 150  | -     | -    | Ns    |  |
| SPENB input hold time                               | T <sub>cke</sub>   | 150  | -     | -    | ns    |  |

| Parameter   | Symbol           | Min. | Typ. | Max. | Unit  | Conditions                           |
|---|------------------|------|------|------|-------|--------------------------------------|
| CLKIN frequency                                   | F <sub>clk</sub> | 6.1  | 6.4  | 8.0  | MHz   | VDD=3.0~3.6V                         |
| CLKIN cycle time                                  | T <sub>clk</sub> | 125  | 156  | 164  | ns    |                                      |
| CLKIN pulse duty                                  | T <sub>cwh</sub> | 40   | 50   | 60   | %     | T <sub>clk</sub>                     |
| Time that HSD to 1 <sup>st</sup> data input(NTSC) | T <sub>hs</sub>  | 40   | 70   | 255  | CLKIN | DDL <sub>Y</sub> =70,Offset=0(fixed) |

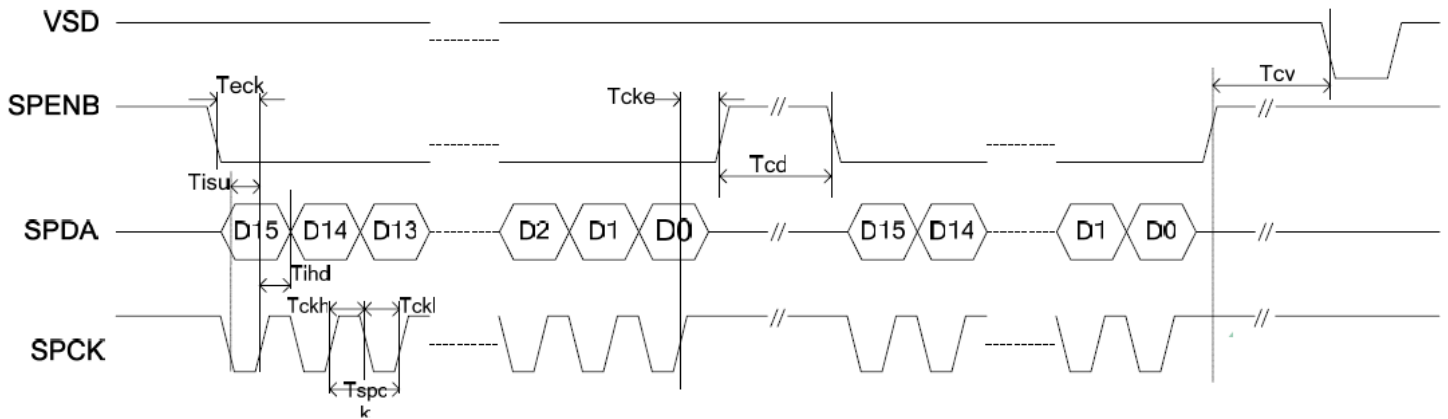
## Input Data Format



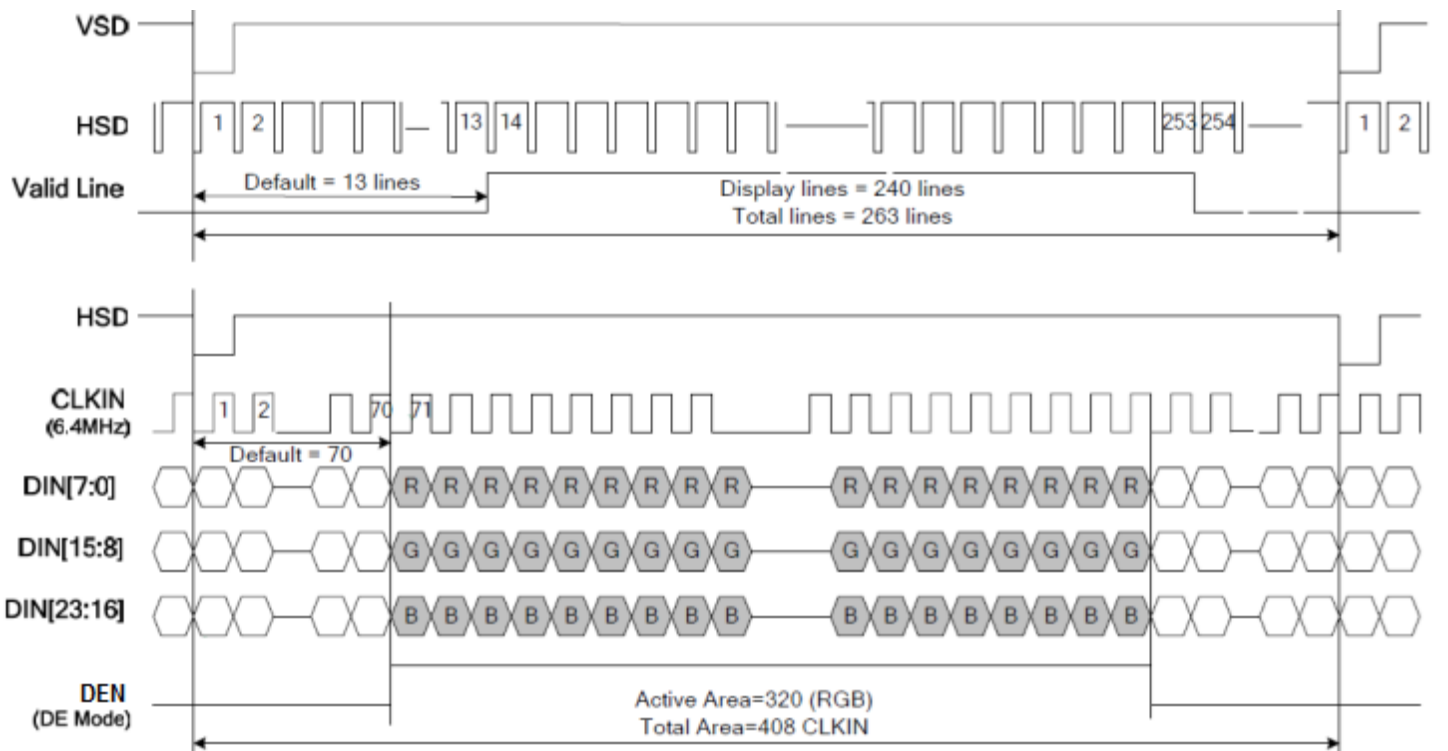
## Clock and Data Input Timing Diagram



### 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.  | -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<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)

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