DATA MODUL

# SPECIFICATION

HannStar

## HSD028G3N3-90000C-PX

2.8" - QVGA - RGB

Version: 1.0
Date: 21.12.2023

Note: This specification is subject to change without prior notice

TO : DATA MODUL

Date : Dec.21.2023

# HannStar Product Information

(Preliminary)

## 2.8” Color TFT-LCD Module

Model: **HSD028G3N3-90000C-PX**

Note: (1) The information contained herein is tentative and may be changed without prior notices.

(2) Please contact HannStar Display Corp. before designing your product based on this module specification.

(3) The information contained herein is presented merely to indicate the characteristics and performance of our products. No responsibility is assumed by HannStar for any intellectual property claims or other problems that may result from application based on the module described herein.

# Record of Revisions

| Rev. | Date | Sub-Model | Description of change |
|---|---|---|---|
| 1.0 | Dec.21.2023 | 90000C-PX | Preliminary Product Information was first released. |

# Contents

# 1.0 GENERAL DESCRIPTION

## 1.1 Introduction

HannStar Display model HSD028G3N3-90000C-PX is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit and a back- light system. This TFT LCD has a 2.8 (3:4) inch diagonally measured active display area with 240x320 (240 horizontal by 320 vertical pixel) resolution.

## 1.2 Features

- 2.8 inch configuration
- 262K color by 6 bits R.G.B.
- ROHS / Halogen Free Compliance

## 1.3 General information

| Item | | Specification | Unit |
|---|---|---|---|
| Outline Dimension(LCM) | | 50.20(H) x 69.20(V) x 2.75(D) | mm |
| Display area | | 43.20 (H) x57.60 (V) | mm |
| Number of Pixel | | 240 RGB (H) x 320 (V) | pixels |
| Pixel pitch | | 0.180 (H) x 0.180 (V) | mm |
| Pixel arrangement | | RGB Vertical Stripe | -- |
| Display mode | | Normally Black | -- |
| Display Interface | | SPI+RGB | -- |
| NTSC | | 70 (Typ.) | % |
| Surface treatment | | HC | -- |
| Weight | | 18(Typ.) | g |
| Power Consumption | Logic System (White Pattern) | 0.0392 (typ.) | W |
| | B/L System | 0.48 (typ.) | W |

## 2.0 ABSOLUTE MAXIMUM RATINGS

### 2.1 Electrical Absolute Rating

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Analog Supply voltage | VCC | -0.3 | 3.6 | V | GND=0 |
| Digital supply voltage | IOVCC | -0.3 | 3.6 | V | GND=0 |
| Logic Input voltage | Vin | -0.3 | IOVCC+0.3 | V | GND=0 |

Note (1):

Permanent damage may occur to the LCD module if beyond this specification.

Functional operation should be restricted to the conditions described under normal operating conditions.

Note (2):

Ta =25±2℃

### 2.2 Environment Absolute Rating

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Operating Temperature | $T_{opa}$ | -20 | 70 | ℃ | (3),(4) |
| Storage Temperature | $T_{stg}$ | -30 | 80 | ℃ | (3),(4) |

Note (3):

If Ta below 50ºC, the maximal humidity is 90%RH, if Ta over 50ºC, absolute humidity should be less than 60%RH.

Note (4):

The response time will be extremely slow when the operating temperature is around -10℃, and the back ground will become darker at high temperature operating.

## 3.0 OPTICAL CHARACTERISTICS

### 3.1 Optical specification

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast | | CR | Θ=0 Normal viewing angle | 640 | 800 | -- | -- | (1)(2) |
| Response time | | Tr+Tf | | -- | 30 | 40 | msec | (1)(3) |
| White luminance (Center) | | $Y_L$ | | -- | 650 | -- | $cd/m^2$ | (1)(4) |
| Color Gamut | | S(%) | | -- | 70 | -- | % | |
| Color chromaticity (CIE1931) | White | $W_x$ | | 0.278 | 0.308 | 0.338 | | (1)(4) |
| | | $W_y$ | | 0.300 | 0.330 | 0.360 | | |
| | Red | $R_x$ | | -- | -- | -- | | |
| | | $R_y$ | | -- | -- | -- | | |
| | Green | $G_x$ | | -- | -- | -- | | |
| | | $G_y$ | | -- | -- | -- | | |
| | Blue | $B_x$ | | -- | -- | -- | | |
| | | $B_y$ | | -- | -- | -- | | |
| Viewing angle | Hor. | $Θ_L$ | CR>10 | -- | 80 | -- | | |
| | | $Θ_R$ | | -- | 80 | -- | | |
| | Ver. | $Θ_U$ | | -- | 80 | -- | | |
| | | $Θ_D$ | | -- | 80 | -- | | |
| Brightness Uniformity | | $B_{UNI}$ | Θ=0 | 75 | 80 | -- | | (5) |
| Optima View Direction | | ALL | | | | | | |

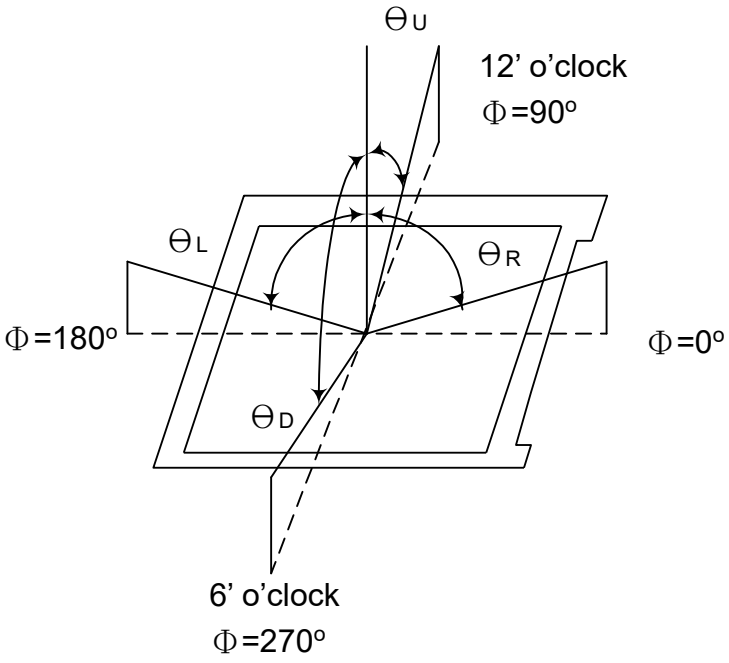
### 3.2 Measuring Condition

- Measuring surrounding：dark room
- Ambient temperature：25±2°C
- 15min. warm-up time.

### 3.3 Measuring Equipment

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-7 for other optical characteristics.
- Measuring spot size: 20 ~ 21 mm

**Note (1)** Definition of Viewing Angle:

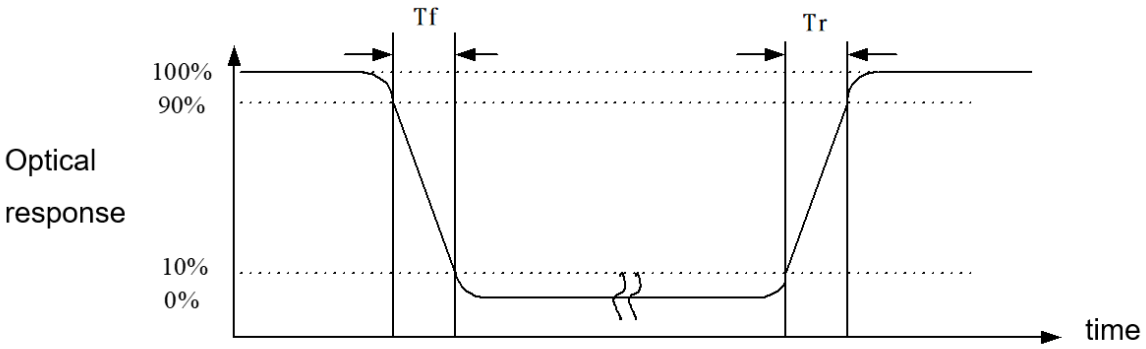



**Note (2)** Definition of Contrast Ratio (CR) :

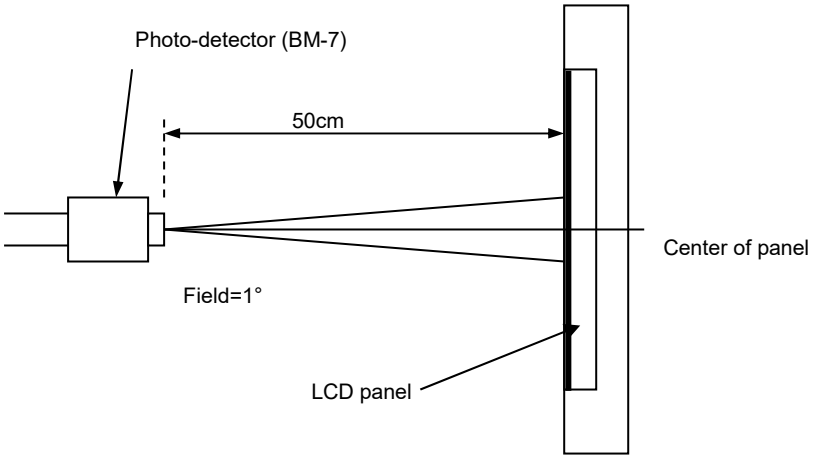
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

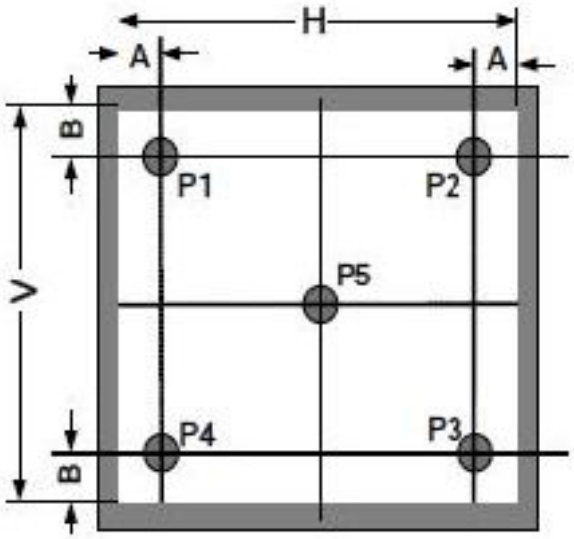
**Note (3)** Definition of Response Time : Sum of Tr and Tf




**Note (4)** Definition of optical measurement setup



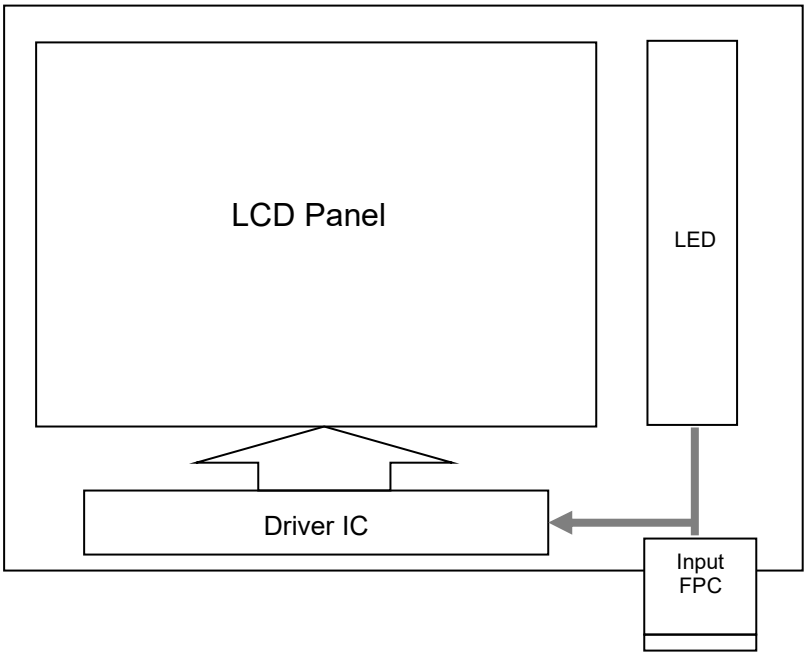
**Note (5)** Definition of brightness uniformity



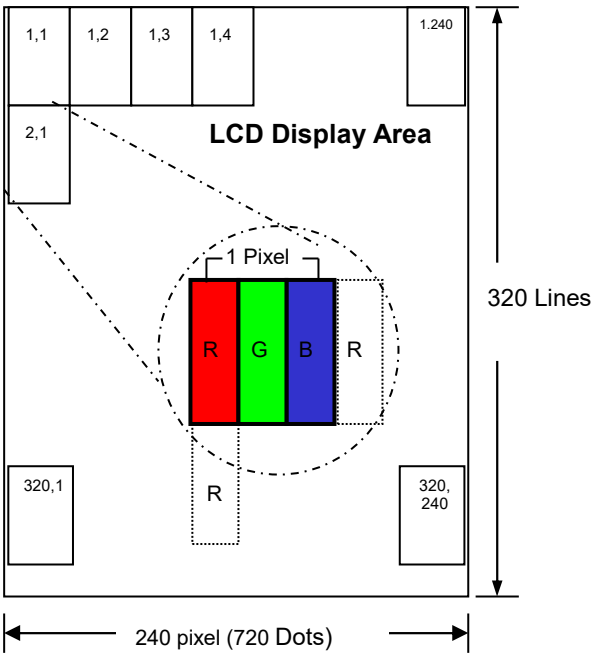

$$\text{Luminance uniformity} = \frac{\text{(Min Luminance of 5 points)}}{\text{(Max Luminance of 5 points)}} \times 100\%$$

# 4.0 BLOCK DIAGRAM

## 4.1 TFT LCD Module




## 4.2 Pixel Format



## 5.0 INTERFACE PIN CONNECTION

### 5.1 LCM Pin Assignment

The recommended connector：FH12-50S-0.5SH manufactured by HIROSE

| NO. | Symbol | Description |
|---|---|---|
| 1 | LEDK | LED Cathode. |
| 2 | LEDA1 | LED Anode. |
| 3 | LEDA2 | LED Anode. |
| 4 | LEDA3 | LED Anode. |
| 5 | LEDA4 | LED Anode. |
| 6 | IM0 | Select the SPI+RGB interface mode;Note1 |
| 7 | IM3 | |
| 8 | IM2 | |
| 9 | IM1 | |
| 10 | RESET | Reset signal pin |
| 11 | VSYNC | Frame Synchronous Signal for RGB interface operation |
| 12 | HSYNC | Line Synchronous Signal for RGB interface operation |
| 13 | DOTCLK | Dot-clock signal for RGB interface operation |
| 14 | DE | Data enable signal for RGB interface operation |
| 15-32 | DB17-DB0 | Data Bus.Note2 |
| 33 | SDO | Serial output signal |
| 34 | SDI | Serial input/output signal |
| 35 | RD | Not connect |
| 36 | D/CX | Data or command select |
| 37 | SCL | Serial clock signal |
| 38 | CS | Chip select |
| 39 | TE | Tearing effect output pin to synchronize MPU to frame writing |
| 40-41 | IOVCC | Power supply |
| 42 | VCC | Power supply |
| 43 | GND | Ground |
| 44 | XR(NC) | Not connect |
| 45 | YD(NC) | Not connect |
| 46 | XL(NC) | Not connect |
| 47 | YU(NC) | Not connect |
| 48 | GND | Ground |
| 49 | GND | Ground |
| 50 | GND | Ground |

Note1:

| IM3 | IM2 | IM1 | IM0 | Interface Mode | DB Pin use | |
|---|---|---|---|---|---|---|
| | | | | | D/C | GRAM |
| 0 | 1 | 0 | 1 | 3 wire-9bit mode I | SDI:in/out | |
| 0 | 1 | 1 | 0 | 4 wire-8bit mode I | SDI:in/out | |
| 1 | 1 | 0 | 1 | 3 wire-9bit mode II | SDI:in | SDO:out |
| 1 | 1 | 1 | 0 | 4 wire-8bit mode II | SDI:in | SDO:out |

Note2:

When RGB 6bit Interface use DB[5:0];

When RGB 16bit Interface use DB[17:13]&DB[11:1],DB[17:13]=R[4:0],DB[11:6],G[5:0],DB[5:1] = B[4:0];

When RGB 18bit Interface use DB[17:0],DB[17:12]=R[5:0],DB[11:6],G[5:0],DB[5:0] = B[5:0];

## 6.0 ELECTRICAL CHARACTERISTICS

### 6.1 TFT LCD Module

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Analog Supply voltage | VCC | 2.5 | 2.8 | 3.3 | V | |
| Analog supply current | $I_{VCC}$ | - | 12 | 16 | mA | VCC=2.8V |
| Logic supply voltage | IOVCC | 1.65 | 2.8 | 3.3 | V | |
| Logic supply current | $I_{IOVCC}$ | - | 2 | 3.5 | mA | IOVCC =2.8V |
| Logic input voltage | VIH | 0.7*VDDIO | - | VDD | V | |
| | VIL | GND | - | 0.3*VDDIO | V | |

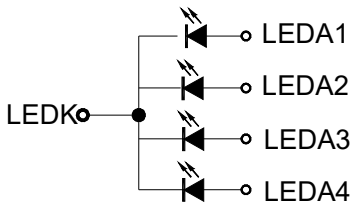
### 6.2 Backlight Unit

| Parameter | Symbol | Min | Typ | Max | Units | Condition |
|---|---|---|---|---|---|---|
| LED Current | $I_F$ | -- | 80 | -- | mA | Ta=25℃ |
| LED Voltage | $V_F$ | 5.6 | 6.0 | 6.4 | Volt | Ta=25℃ |
| LED Life-Time | N/A | 15,000 | -- | -- | Hour | Ta=25℃ Note (2) |

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃. and LED typical current. The LED lifetime could be decreased if operating $I_F$ is larger than LED typical current. The constant current driving method is suggested.

Note (3) LED light bar circuit :

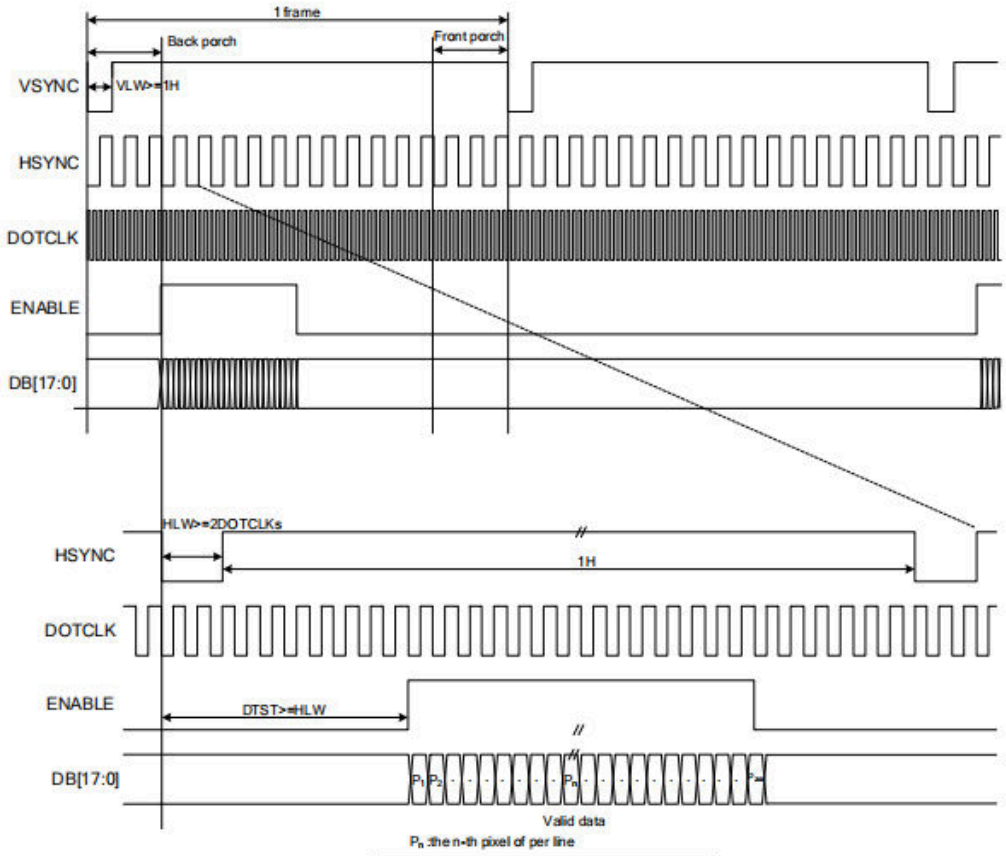



VF =6.0±0.4V;IV = 20*4mA

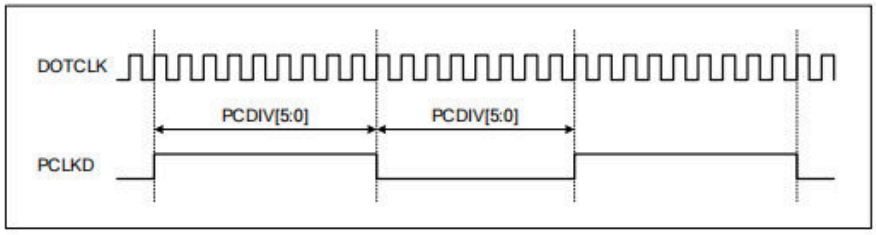
## 6.3 Interface Characteristics

### 6.3.1 AC characteristics for interface

#### 6.3.1.1 RGB 16/18-bit Interface Timing Characteristics



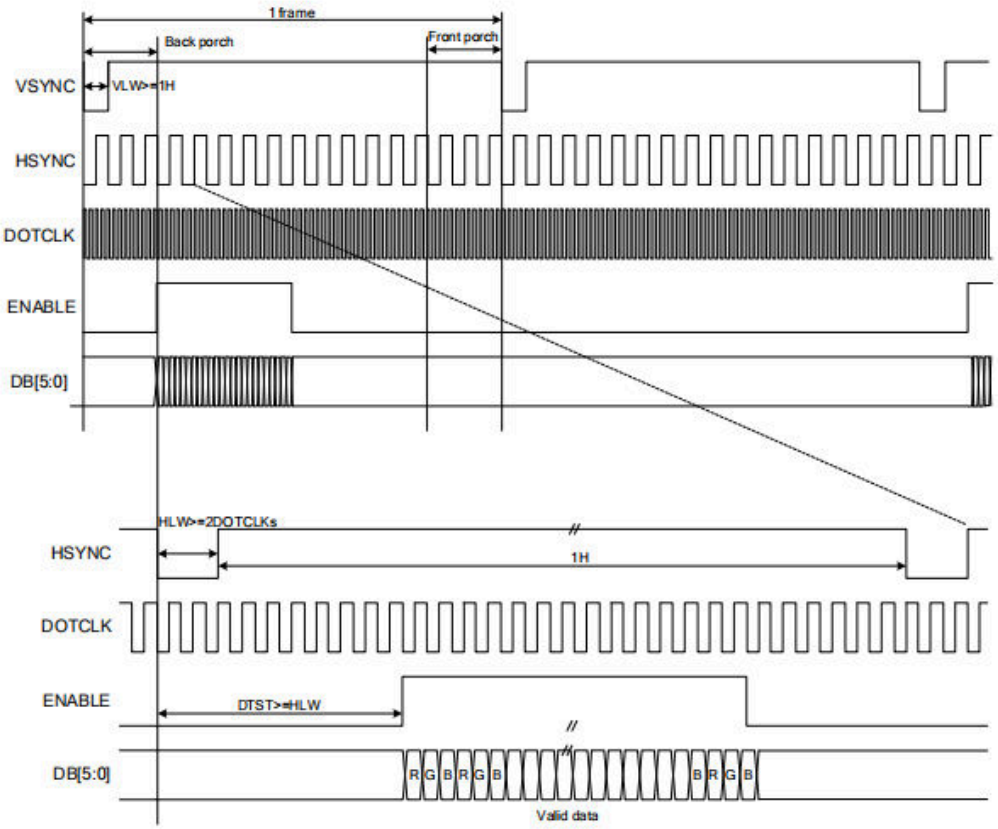

VLW : VSYNC Low Width
HLW : HSYNC Low Width
DTST : Data Transfer Startup Time



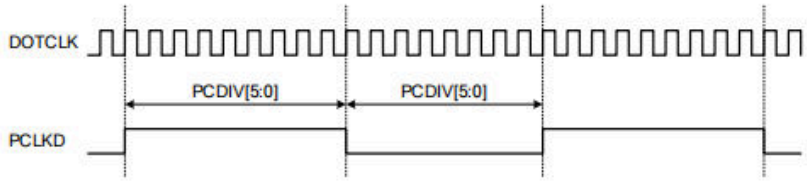

*Note 1: The ENABLE signal is not needed when RGB interface SYNC mode is selected.*

*Note 2: VSPL='0', HSPL='0', DPL='0' and EPL='1' of "Interface Mode Control (B0h)" command.*

### 6.3.1.2 RGB 6-bit Interface Timing Characteristics




VLW : VSYNC Low Width
HLW : HSYNC Low Width
DTST : Data Transfer Startup Time

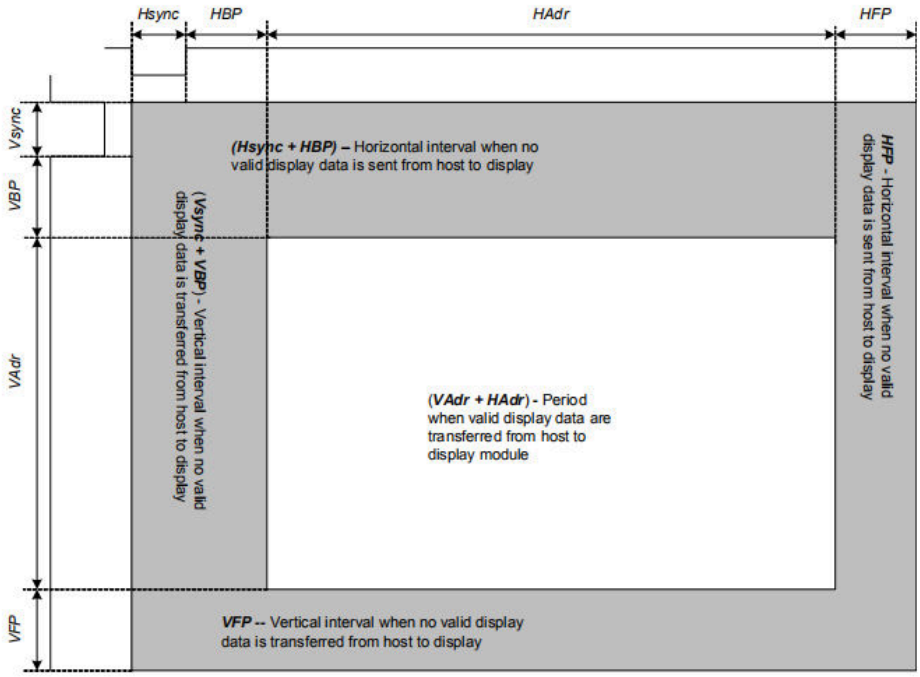



*Note 1: The ENABLE signal is not needed when RGB interface SYNC mode is selected.*

*Note 2: VSPL='0', HSPL='0', DPL='0' and EPL='1' of "Interface Mode Control (B0h)" command.*

*Note 3: In 6-bit RGB interface mode, each dot of one pixel (R, G and B) is transferred in synchronization with DOTCLK.*

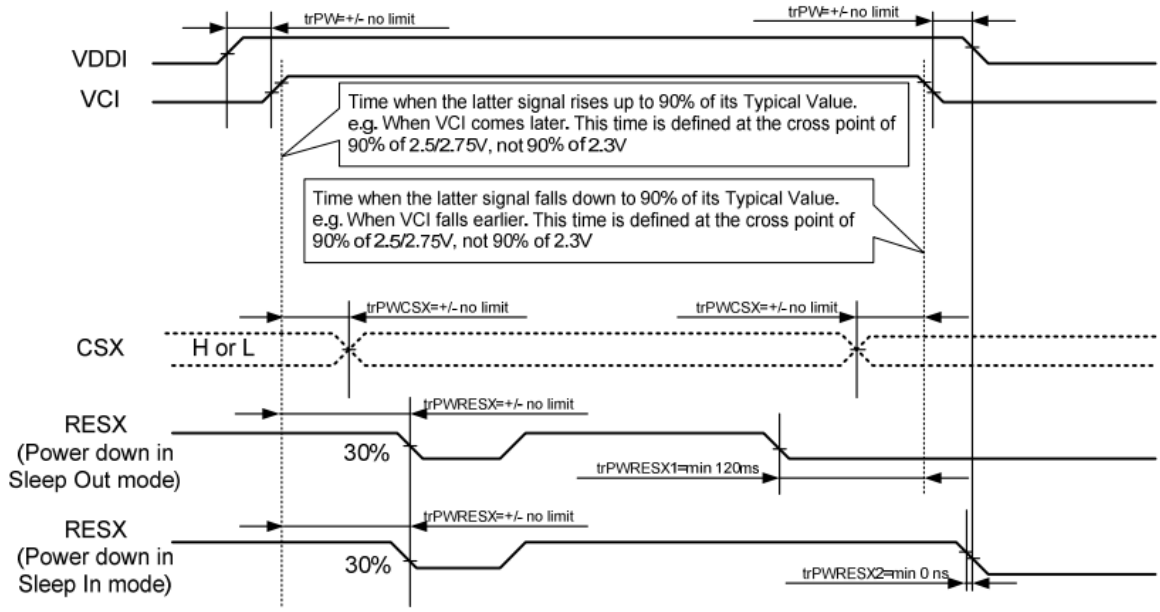
*Note 4: In 6-bit RGB interface mode, set the cycles of VSYNC, HSYNC and ENABLE to 3 multiples of DOTCLK.*




| Parameters | Symbols | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Horizontal Synchronization | Hsync | | 2 | 10 | 16 | DOTCLK |
| Horizontal Back Porch | HBP | | 2 | 20 | 24 | DOTCLK |
| Horizontal Back Porch(ByPass mode)* | HBP(BP) | | 58 | 64 | 200 | DOTCLK |
| Horizontal Address | HAdr | | - | 240 | - | DOTCLK |
| Horizontal Front Porch | HFP | | 2 | 10 | 16 | DOTCLK |
| Vertical Synchronization | Vsync | | 1 | 2 | 4 | Line |
| Vertical Back Porch | VBP | | 1 | 2 | - | Line |
| Vertical Address | VAdr | | - | 320 | - | Line |
| Vertical Front Porch | VFP | | 3 | 4 | - | Line |

### 6.4 Power Sequence

If RESX line is held High or unstable by the host during Power On, then a Hardware Reset must be applied after both VCI and VDDI have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.




trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

## 7.0 RELIABILTY TEST ITEMS

| No. | Item | Conditions | Remark |
|---|---|---|---|
| 1 | High Temperature Storage | Ta=+80±2℃, 240hrs | |
| 2 | Low Temperature Storage | Ta=-30±2℃, 240hrs | |
| 3 | High Temperature Operation | Ta=70±2℃, 240hrs | |
| 4 | Low Temperature Operation | Ta=-20±2℃, 240hrs | |
| 5 | High Temperature and High Humidity (operation) | Ta=60±2℃, 90%RH, 240Hrs | |
| 6 | Thermal Cycling Test (non operation) | -20℃(30min)→+70℃(30min),100 cycles | |

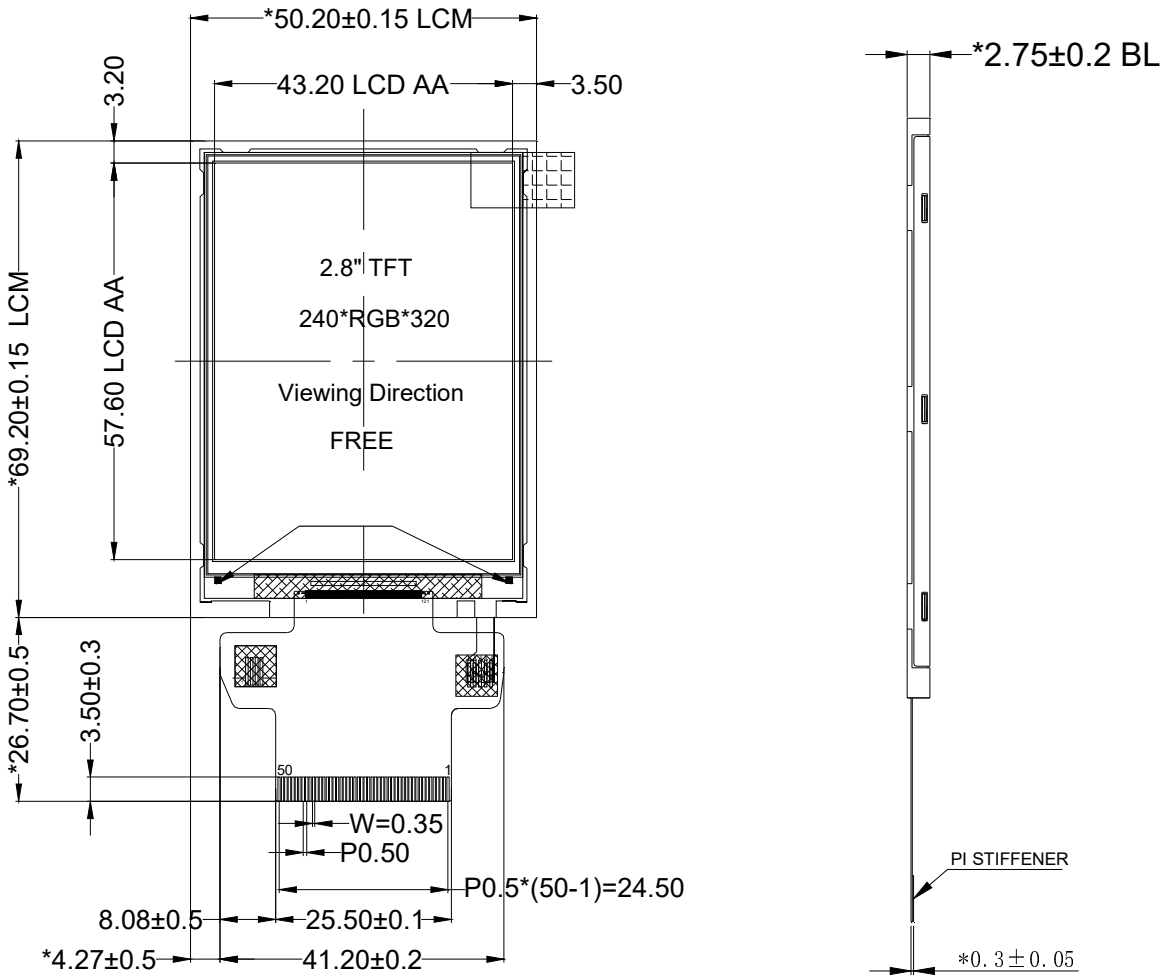
Note1: There is no display function NG issue occurred, all the cosmetic specification is judged before the reliability stress.

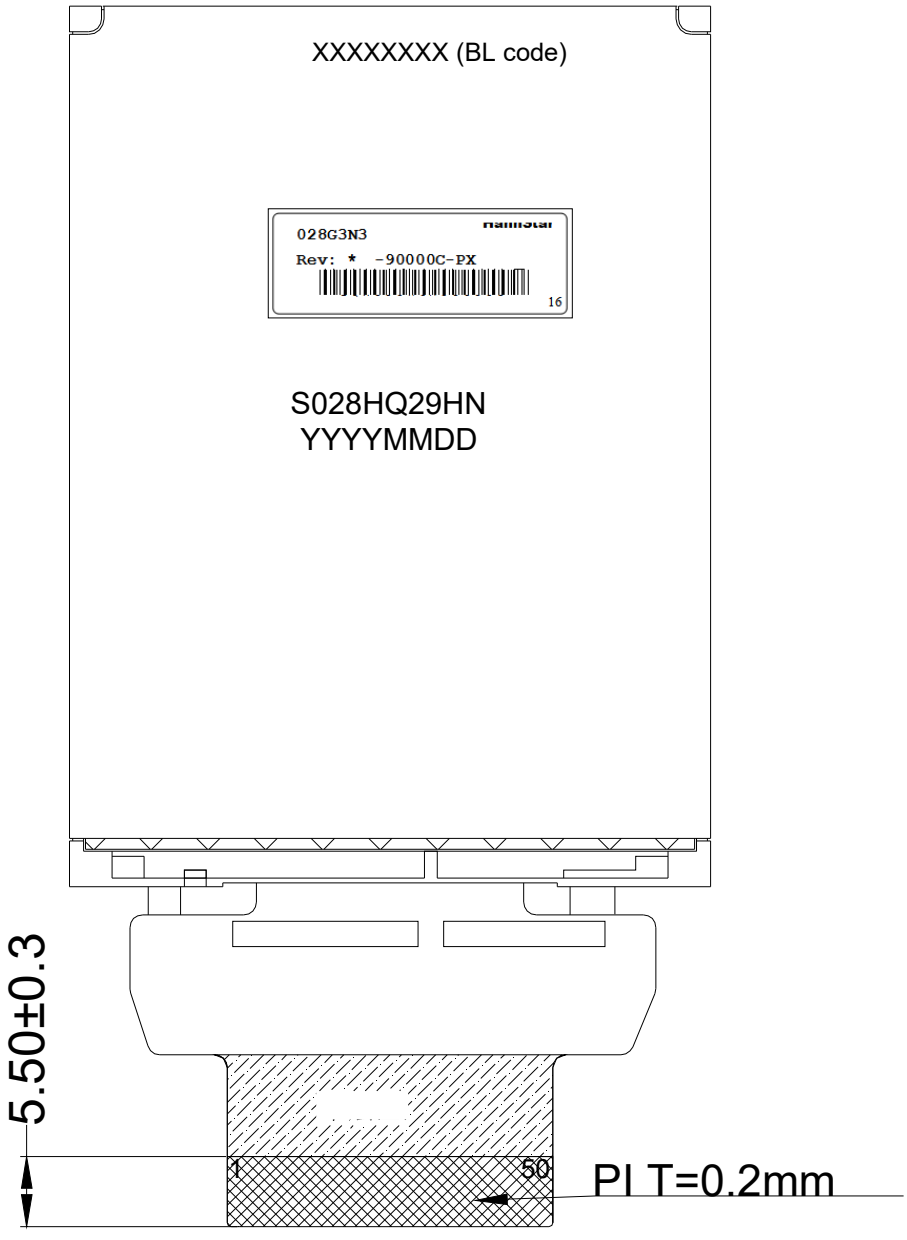
Note2: All of the function & cosmetic Judgment basis base on room temperature. (The tested module must have enough recovery time at least 2 hours at room temperature.)

Note3: The test condition definition panel's surface temperature.

## 8.0 OUTLINE DIMENSION

**Unit : mm**





## 9.0 LOT MARK

### 9.1 Lot Mark

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Code 1,2,3,4,5,6: HannStar internal flow control code.
Code 7: production location.
Code 8: production year.
Code 9: production month.
Code 10,11,12,13,14,15: serial number.

Note (1) Production Year: Code 8 is defined by the last number of the year, for example

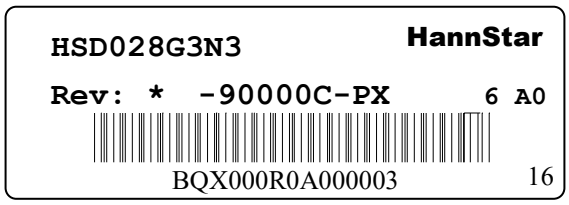
| Year | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

Note (2) Production Month

| Month | Jan. | Feb. | Mar. | Apr. | May. | Jun. | Jul. | Aug. | Sep. | Oct | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

### 9.2 Detail of Lot Mark

(1) Below label is attached on the backside of the LCD module. See Section 8.0: Outline Dimension.
(2) The detail of Lot Mark is attached as below.
(3) This is subject to change without prior notice.



# 10.0 PACKAGE SPECIFICATION

## 10.1 Packing form

TBD

## 10.2 Packing Drawing

TBD

# 11.0 GENERAL PRECAUTION

## 11.1 Use Restriction

This product is not authorized for use in life supporting systems, aircraft navigation control systems, military systems and any other application where performance failure could be life-threatening or otherwise catastrophic.

## 11.2 Disassembling or Modification

Do not disassemble or modify the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. HannStar does not warrant the module, if customers disassemble or modify the module.

## 11.3 Breakage of LCD Panel

11.3.2. If LCD panel is broken and liquid crystal spills out, do not ingest or inhale liquid crystal, and do not contact liquid crystal with skin.

11.3.3. If liquid crystal contacts mouth or eyes, rinse out with water immediately.

11.3.4. If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

11.3.5. Handle carefully with chips of glass that may cause injury, when the glass is broken.

## 11.4 Electric Shock

11.4.1. Disconnect power supply before handling LCD module.

11.4.2. Do not pull or fold the LED cable.

11.4.3. Do not touch the parts inside LCD modules and the fluorescent LED's connector or cables in order to prevent electric shock.

## 11.5 Absolute Maximum Ratings and Power Protection Circuit

11.5.1. Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature, etc., otherwise LCD module may be damaged.

11.5.2. Please do not leave LCD module in the environment of high humidity and high temperature for a long time.

11.5.3. It's recommended to employ protection circuit for power supply.

### 11.6 Operation

11.6.1 Do not touch, push or rub the polarizer with anything harder than HB pencil lead.

11.6.2 Use fingerstalls of soft gloves in order to keep clean display quality, when persons handle the LCD module for incoming inspection or assembly.

11.6.3 When the surface is dusty, please wipe gently with absorbent cotton or other soft material.

11.6.4 Wipe off saliva or water drops as soon as possible. If saliva or water drops contact with polarizer for a long time, they may causes deformation or color fading.

11.6.5 When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzine or other adequate solvent.

### 11.7 Mechanism

Please mount LCD module by using mounting holes arranged in four corners tightly.

### 11.8 Static Electricity

11.8.1 Protection film must remove very slowly from the surface of LCD module to prevent from electrostatic occurrence.

11.8.2 Because LCD module use CMOS-IC on circuit board and TFT-LCD panel, it is very weak to electrostatic discharge. Please be careful with electrostatic discharge. Persons who handle the module should be grounded through adequate methods.

### 11.9 Strong Light Exposure

The module shall not be exposed under strong light such as direct sunlight. Otherwise, display characteristics may be changed.

### 11.10 Disposal

When disposing LCD module, obey the local environmental regulations.

DATA MODUL

ALL TECHNOLOGIES. ALL COMPETENCIES. ONE SPECIALIST.

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