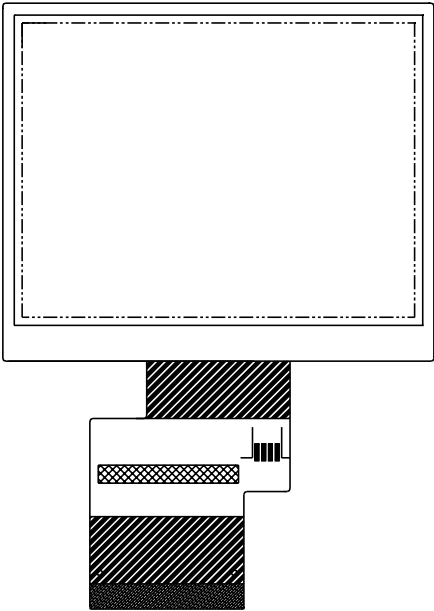




PRODUCT SPECIFICATION

**HDA350-2G**

QVGA, TFT COLOR GRAPHICS  
LCD DISPLAY MODULE



|  |               |              |           |                                |
|--|---------------|--------------|-----------|--------------------------------|
| HANTRONIX, INC.<br>10080 BUBB RD.<br>CUPERTINO, CA 95014 | Q.A.:<br>Z.W. | REV.:<br>1.0 | HDA350-2G | SHEET 1 OF 19<br>DATE: 1/18/11 |
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## 1. General Description and Features

HDA350-2G is a TM (Transmissive) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. The resolution of a 3.5" contains 320RGBx240 dots and can display up to 16.7M colors.

### 1.1 Features

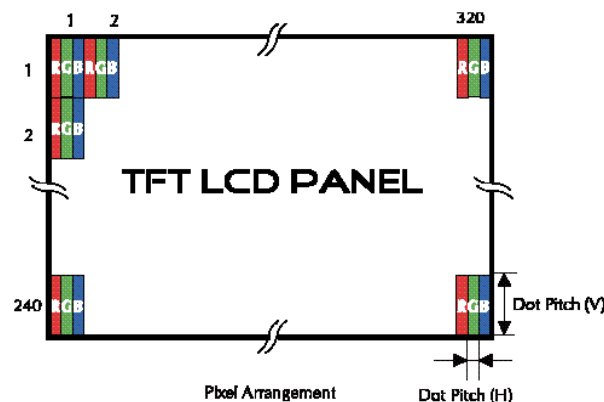
- Transmissive and back-light with six LEDs are available.
- TN (Twisted Nematic) mode.
- Programmable Frame & N-line polarity inversion.
- System & Graphic interface 3-lines SPI + 8bits color RGB.
- DEN (Data Enable Input) mode, SYNC mode
- RoHS Compliance

### 1.2 Applications

- Display terminals for DSC (Digital Still Camera), PMP (Portable Multimedia Player) application products.

### 1.3 LCD Module

| Item               | Specification                 | Unit     |
|--------------------|-------------------------------|----------|
| Screen Size        | 3.5 inches                    | Diagonal |
| Display Resolution | 320 x RGB x 240               | Dot      |
| Dot Pitch          | 0.219 (H) x 0.219 (V)         | mm       |
| Active Area        | 70.08 (H) x 52.56 (V)         | mm       |
| Outline Dimension  | 76.9 (W) x 63.9 (H) x 3.3 (D) | mm       |
| Display Mode       | Normally white/Transmissive   | --       |
| Pixel Arrangement  | RGB-Stripe                    | --       |
| Surface Treatment  | Anti-glare (AG)               | --       |
| Display Color      | 16.7 M                        | --       |
| Viewing Direction  | 6 o'clock                     | --       |
| Input Interface    | Digital 8-bits color RGB      | --       |
| Color Gamut        | NTSC 60%                      | --       |



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## 2. Mechanical Information

| Item        |                | Min. | Typ.  | Max. | Unit | Note |
|-------------|----------------|------|-------|------|------|------|
| Module Size | Horizontal (H) | --   | 76.90 | --   | mm   | --   |
|             | Vertical (V)   | --   | 63.90 | --   | mm   | (1)  |
|             | Thickness (T)  | --   | 3.30  | --   | mm   | (2)  |
| Weight      |                | --   | TBD   | --   | g    | --   |

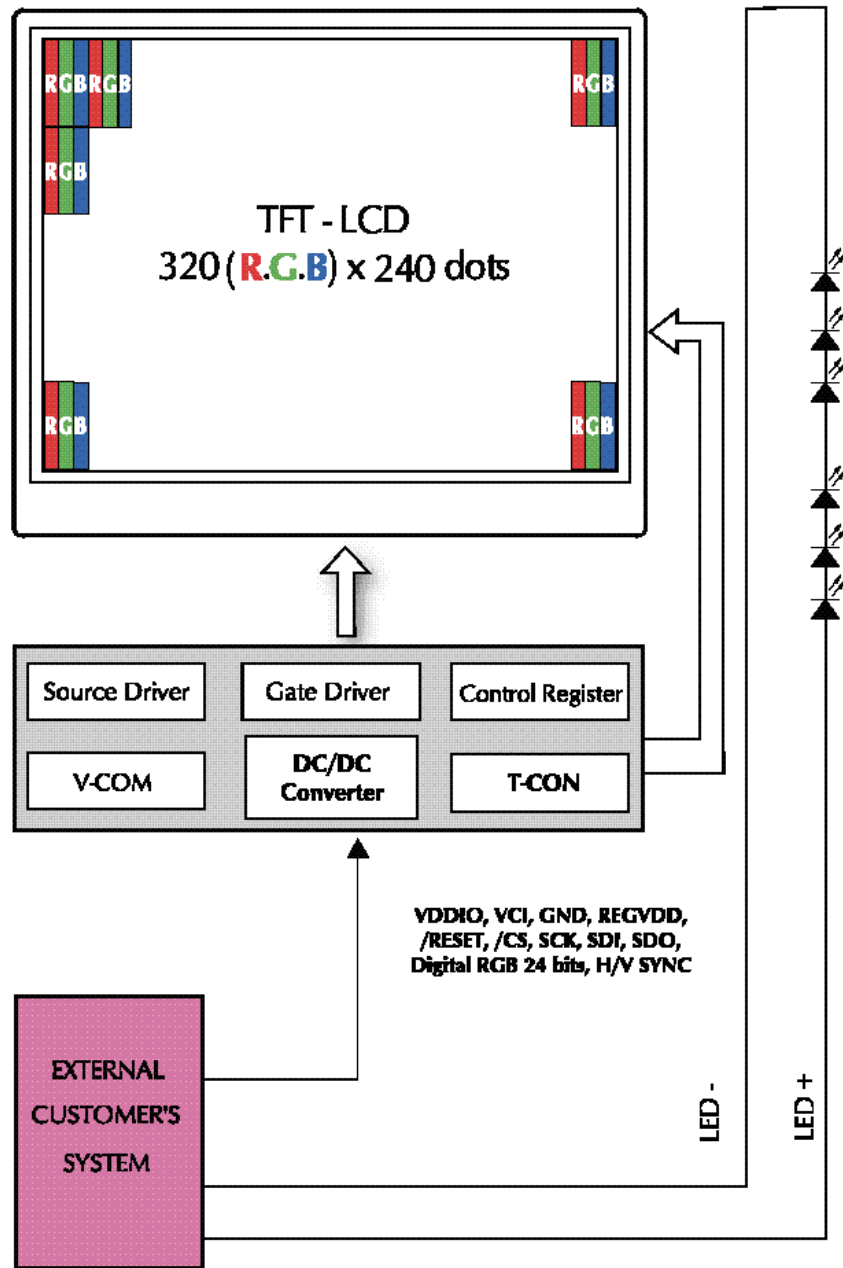
Note (1) Not include FPC.

Refer to the Outline Dimension for further information.

(2) Back-light unit are included.

#### 4. Block Diagram

##### 4.1 TFT-LCD Module with Back Light



|  |               |              |                  |                                |
|--|---------------|--------------|------------------|--------------------------------|
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## 5. Input Terminal Pin Assignment

### 5.1 Pin Assignment (LCD)

| Pin No. | Symbol | I/O | Function                        | Remark |
|---------|--------|-----|---------------------------------|--------|
| 1       | LED-   | I   | Backlight LED Ground            |        |
| 2       | LED-   | I   | Backlight LED Ground            |        |
| 3       | LED+   | I   | Backlight LED Power             |        |
| 4       | LED+   | I   | Backlight LED Power             |        |
| 5       | N/C    | --- | No Connection                   |        |
| 6       | N/C    | --  | No Connection                   |        |
| 7       | /RESET | I   | Reset Signal                    |        |
| 8       | /CS    | I   | SPI Interfaces, Chip Select pin |        |
| 9       | SCLK   | I   | SPI Interface Clock pin         |        |
| 10      | SDI    | I   | SPI Interface Data INPUT pin    |        |
| 11      | SDO    | O   | SPI Interface Data OUPUT pin    |        |
| 12      | B0     | I   | Blue Data Bit 0                 |        |
| 13      | B1     | I   | Blue Data Bit 1                 |        |
| 14      | B2     | I   | Blue Data Bit 2                 |        |
| 15      | B3     | I   | Blue Data Bit 3                 |        |
| 16      | B4     | I   | Blue Data Bit 4                 |        |
| 17      | B5     | I   | Blue Data Bit 5                 |        |
| 18      | B6     | I   | Blue Data Bit 6                 |        |
| 19      | B7     | I   | Blue Data Bit 7                 |        |
| 20      | G0     | I   | Green Data Bit0                 |        |
| 21      | G1     | I   | Green Data Bit1                 |        |
| 22      | G2     | I   | Green Data Bit2                 |        |
| 23      | G3     | I   | Green Data Bit3                 |        |
| 24      | G4     | I   | Green Data Bit4                 |        |
| 25      | G5     | I   | Green Data Bit5                 |        |
| 26      | G6     | I   | Green Data Bit6                 |        |
| 27      | G7     | I   | Green Data Bit7                 |        |
| 28      | R0     | I   | Red Data Bit0                   |        |
| 29      | R1     | I   | Red Data Bit1                   |        |
| 30      | R2     | I   | Red Data Bit2                   |        |
| 31      | R3     | I   | Red Data Bit3                   |        |
| 32      | R4     | I   | Red Data Bit4                   |        |
| 33      | R5     | I   | Red Data Bit5                   |        |

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|    |                   |    |   |  |
|----|-------------------|----|---|--|
| 34 | R6                | I  | Red Data Bit6                                   |  |
| 35 | R7                | I  | Red Data Bit7                                   |  |
| 36 | H <sub>SYNC</sub> | I  | Horizontal Sync Input                           |  |
| 37 | V <sub>SYNC</sub> | I  | Vertical Sync Input                             |  |
| 38 | D <sub>CLK</sub>  | I  | Dot Clock signal                                |  |
| 39 | V <sub>DDIO</sub> | P  | Voltage input pin for I/O logic. (2.5V to 3.6V) |  |
| 40 | V <sub>DDIO</sub> | P  | Voltage input pin for I/O logic. (2.5V to 3.6V) |  |
| 41 | V <sub>CI</sub>   | P  | Booster input voltage pin. (2.5V to 3.6V)       |  |
| 42 | V <sub>CI</sub>   | P  | Booster input voltage pin. (2.5V to 3.6V)       |  |
| 43 | REGVDD            | I  | Connect to voltage source between 2.5V to 3.6V  |  |
| 44 | N/C               | -- | No Connection                                   |  |
| 45 | N/C               | -- | No Connection                                   |  |
| 46 | N/C               | -- | No Connection                                   |  |
| 47 | N/C               | -- | No Connection                                   |  |
| 48 | N/C               | -- | No Connection                                   |  |
| 49 | N/C               | -- | No Connection                                   |  |
| 50 | N/C               | -- | No Connection                                   |  |
| 51 | N/C               | -- | No Connection                                   |  |
| 52 | DE                | I  | Data Enable Input                               |  |
| 53 | GND               | P  | Ground  |  |
| 54 | GND               | P  | Ground  |  |

## 6. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state.  
 Measuring equipment: BM-7A.

( $T_a=25\pm 2^\circ\text{C}$ ,  $V_{cc} = V_{cl}=3.3\text{V}$ ,  $I_f=40\text{mA}$ )

| Item                         | Symbol         | Condition                  | Min                                   | Type  | Max   | Unit              | Note   |       |
|------------------------------|----------------|----------------------------|---------------------------------------|-------|-------|-------------------|--------|-------|
| Brightness                   | --             |                            | 250                                   | 300   | --    | cd/m <sup>2</sup> | --     |       |
| Response time                | T <sub>R</sub> | $\theta=0^\circ$           | --                                    | 15    | 20    | ms                | Note.  |       |
|                              | T <sub>F</sub> |                            | --                                    | 35    | 50    | ms                |        |       |
| Contrast ratio               | CR             | At optimized viewing angle | 240                                   | 300   | --    | --                | Note.  |       |
| Color Chromaticity (CIE1931) | Red            | R <sub>x</sub>             | $\theta=0^\circ$ Normal Viewing Angle | 0.590 | 0.640 | 0.690             | --     | Note. |
|                              |                | R <sub>y</sub>             |                                       | 0.294 | 0.344 | 0.394             |        |       |
|                              | Green          | G <sub>x</sub>             |                                       | 0.248 | 0.298 | 0.348             | --     |       |
|                              |                | G <sub>y</sub>             |                                       | 0.532 | 0.583 | 0.633             |        |       |
|                              | Blue           | B <sub>x</sub>             |                                       | 0.090 | 0.140 | 0.190             | --     |       |
|                              |                | B <sub>y</sub>             |                                       | 0.080 | 0.130 | 0.180             |        |       |
|                              | White          | W <sub>x</sub>             |                                       | 0.262 | 0.312 | 0.362             | --     |       |
|                              |                | W <sub>y</sub>             |                                       | 0.299 | 0.349 | 0.399             |        |       |
| Viewing Angle (6H)           | Hor.           | $\theta_R$                 | CR $\geq$ 10                          | 50    | 60    | --                | Degree | Note. |
|                              |                | $\theta_L$                 |                                       | 50    | 60    | --                |        |       |
|                              | Ver.           | $\phi_H$                   |                                       | 40    | 50    | --                |        |       |
|                              |                | $\phi_L$                   |                                       | 50    | 60    | --                |        |       |

Note : Definition of Transmittance (T%)

$$T = \text{Aperture Ratio (TFT)} \times W_y \text{ (CF)}$$

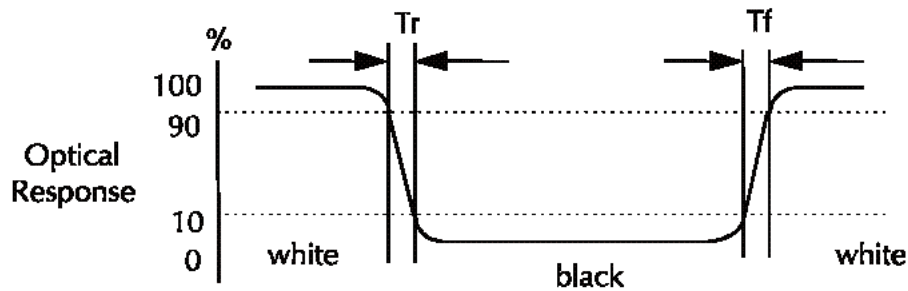
|  |       |       |           |                  |
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a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7(fast) with a viewing angle of 2° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



c. Definition of contrast ratio:

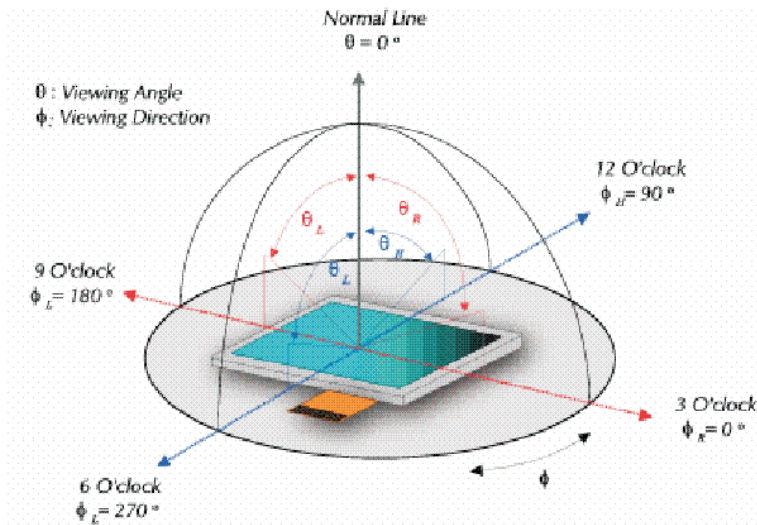
$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

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e. View Angle



f. Definition of Luminance of White: Luminance of white at the center points

|                                 |          |
|---------------------------------|----------|
| Light Source of Back-Light Unit | LED Type |
|---------------------------------|----------|

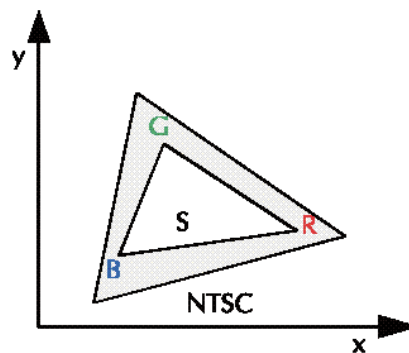
g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 9-points}}{\text{Max. luminance of white among 9-points}} \times 100$$

h. The definition of Color Gamut -Color Chromaticity CIE 1931

Color coordinate of white & red, green, blue at center point.

Color Gamut : NTSC(%) = ( RGB Triangle Area / NTSC Triangle Area ) x 100



|  |       |       |           |                  |
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## 7. Absolute Maximum Ratings

### 7.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

( $T_a=25\pm 2^\circ\text{C}$ ,  $V_{SS}=\text{GND}=0$ )

| Item   | Symbol    | Min. | Max. | Unit             | Note     |
|--|-----------|------|------|------------------|----------|
| Storage temperature                            | $T_{STG}$ | -30  | 80   | $^\circ\text{C}$ | (1)      |
| Operating temperature<br>(Ambient temperature) | $T_{OPR}$ | -20  | 70   | $^\circ\text{C}$ | (1), (2) |

Note (1) 95 % RH Max. ( $40^\circ\text{C} \geq T_a$ )

Maximum wet-bulb temperature at  $39^\circ\text{C}$  or less. ( $T_a > 40^\circ\text{C}$ ) No condensation.

Note (2) In case of below  $0^\circ$ , the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character.

### 7.2 Electrical Absolute Rating

#### 7.2.1 TFT-LCD Module

(Voltage Referenced to  $\text{GND}=\text{VSS}$ )

| Item           | Symbol | Value   |      | Unit | Condition |
|----------------|--------|---------|------|------|-----------|
|                |        | Min.    | Max. |      |           |
| Supply Voltage | VDDIO  | -0.3    | +4.0 | V    | --        |
| Supply Voltage | VCI    | VSS-0.3 | 5.0  | V    | --        |

#### 7.2.2 Back-Light Unit

( $T_a=25\pm 2^\circ\text{C}$ )

| Item    | Symbol | Min. | Max. | Unit | Note |
|---------|--------|------|------|------|------|
| Current | $I_f$  | --   | 30   | mA   | (1)  |

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

|  |       |       |           |                  |
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## 8. Electrical Characteristics

### 8.1 TFT-LCD Module (DC Characteristics)

(TA=25°C)

| Item                     | Symbol             | Condition                | Value                 |      |                       | Unit |
|--------------------------|--------------------|--------------------------|-----------------------|------|-----------------------|------|
|                          |                    |                          | Min.                  | Typ. | Max.                  |      |
| Logic Power Supply       | V <sub>DDIO</sub>  |                          | 2.5                   | 3.3  | 3.6                   | V    |
| Boost Power Supply       | V <sub>CI</sub>    |                          | 2.5                   | 3.3  | 3.6                   | V    |
| Logic High Input voltage | V <sub>IH</sub>    |                          | 0.8 V <sub>DDIO</sub> | -    | V <sub>DDIO</sub>     | V    |
| Logic Low Input voltage  | V <sub>IL</sub>    |                          | 0                     | -    | 0.2 V <sub>DDIO</sub> |      |
| Logic Power current      | I <sub>VDDIO</sub> | V <sub>DDIO</sub> = 3.3V | -                     | 0.5  | -                     | mA   |
| Boost Power current      | I <sub>VCI</sub>   |                          | -                     | 7    | -                     | mA   |

### 8.2 Backlight Unit

The back-light system is an edge-lighting type with **six** white LEDs (Light Emitting Diode).

(Ta=25±2°C)

| Item                | Symbol           | Value   |        |      | Unit | Condition |
|---------------------|------------------|---------|--------|------|------|-----------|
|                     |                  | Min.    | Typ.   | Max. |      |           |
| Power Consumption   | P <sub>LED</sub> | -       | (408)  | -    | mW   | (2)       |
| Forward voltage     | V <sub>f</sub>   | -       | (19.8) | -    |      | (1)       |
| LED Current         | I <sub>f</sub>   | -       | 20     | -    | mA   |           |
| LED Life Time(25°C) | -                | (20000) | -      | -    | hr   | (3)       |

Note (1) Six LEDs serial type.

(2) Where I<sub>f</sub> = 20mA, V<sub>f</sub> = P<sub>LED</sub> / I<sub>f</sub>

(3) The environmental conducted under ambient air flow ,at Ta=25±2°C,60%RH±5%

|  |       |       |           |                  |
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**9. Basic Display Color and Gray Scale**

|             | Color & Gray Scale | Data Signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------|--------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|             |                    | R7          | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             | Red                | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             | Green              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             | Blue               | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |
|             | Cyan               | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |
|             | Magenta            | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |
|             | Yellow             | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|             | White              | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |
| Red         | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | Red(1)             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | Red(2)             | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |    |
|             | Red(127)           | 0           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |
|             | Red(254)           | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | Red(255)           | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
| Green       | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | Green(1)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | Green(2)           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |    |
|             | Green(127)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |    |
|             | Green(254)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | Green(255)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
| Blue        | Black              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|             | Blue(1)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |    |    |
|             | Blue(2)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |    |    |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |    |
|             | Blue(127)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |
|             | :                  | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |    |    |
|             | Blue(254)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  |    |    |
|             | Blue(255)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |    |    |

0 : Low level voltage, 1 :High level voltage

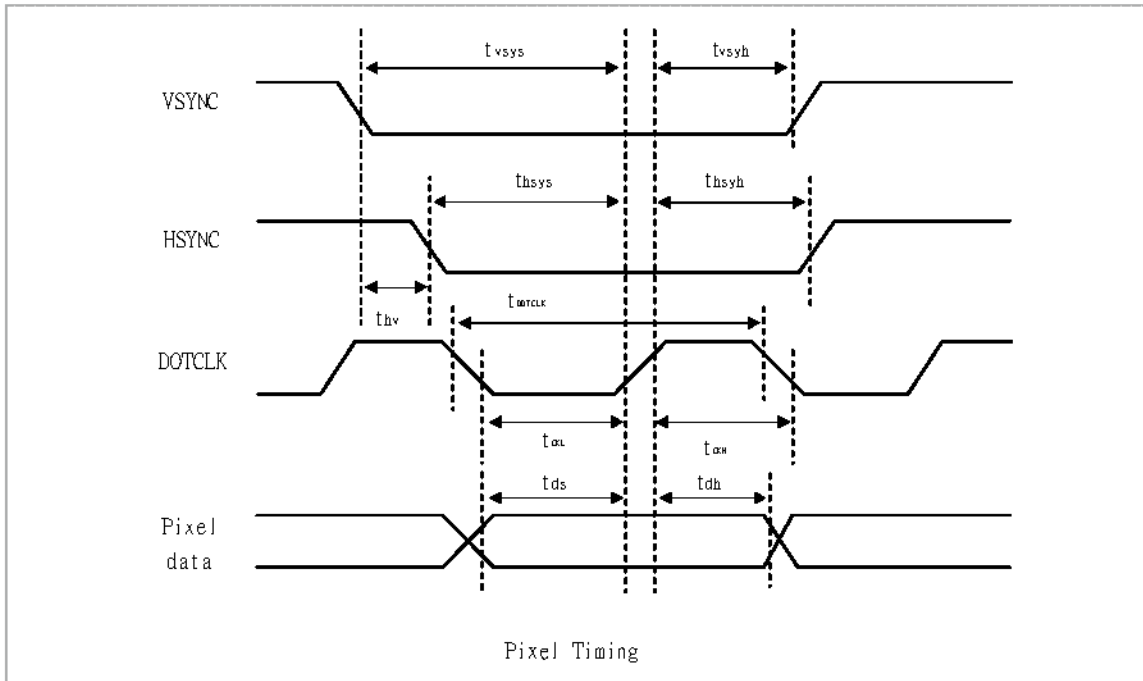
Each basic color can be displayed in 256 gray scales from 8 bit data signals. With the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

## 10. AC Timing

### 10.1 AC Characteristics (Pixel Timing)

| (Unless otherwise specified, Voltage Referenced to VSS, VDDIO = 2.8V, TA = 25°C ) |         |      |      |      |         |
|---|---------|------|------|------|---------|
| Item  | Symbol  | Min. | Typ. | Max. | Unit    |
| DOTCLK Frequency  | fDOTCLK | -    | 6.5  | 10   | MHz     |
| DOTCLK Period   | tDOTCLK | 100  | 154  | -    | ns      |
| Vertical Sync Setup Time  | tvsys   | 20   | -    | -    | ns      |
| Vertical Sync Hold Time   | tvsyh   | 20   | -    | -    | ns      |
| Horizontal Sync Setup Time  | thsys   | 20   | -    | -    | ns      |
| Horizontal Sync Hold Time   | thsyh   | 20   | -    | -    | ns      |
| Phase difference of Sync Signal Falling Edge                                      | thv     | 1    | -    | 240  | tDOTCLK |
| DOTCLK Low Period   | tCKL    | 50   | -    | -    | ns      |
| DOTCLK High Period  | tCKH    | 50   | -    | -    | ns      |
| Data Setup Time   | tds     | 12   | -    | -    | ns      |
| Data hold Time  | tdh     | 12   | -    | -    | ns      |
| Reset pulse width   | tRES    | 10   | -    | -    | us      |

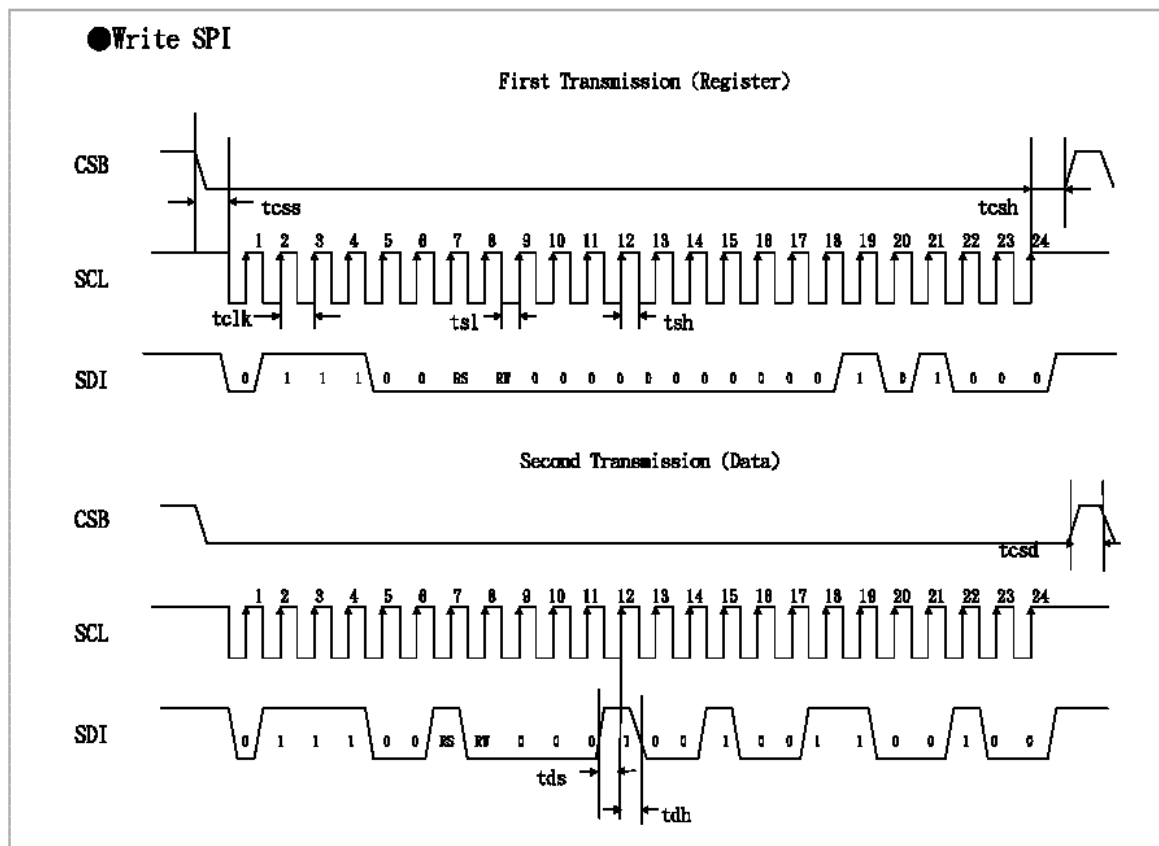
Note: External clock source must be provided to DOTCLK pin of HX8238-A. The driver will not operate if absent of the clocking signal.



## 10.2 SPI Timing Characteristics

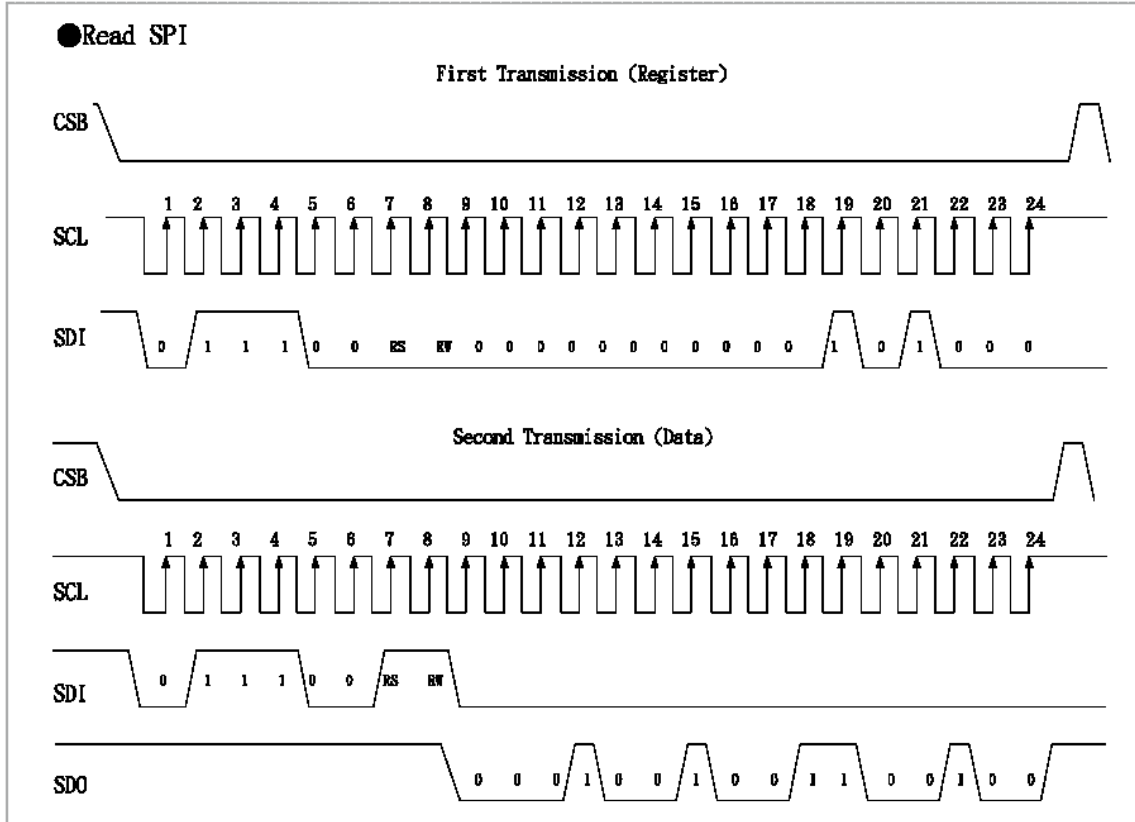
| Item                        | Symbol | Min. | Typ. | Max. | Unit |
|-----------------------------|--------|------|------|------|------|
| Serial Clock Frequency      | fclk   | -    | -    | 20   | MHz  |
| Serial Clock Cycle Time     | tclk   | 50   | -    | -    | ns   |
| Clock Low Width             | tsl    | 25   | -    | -    | ns   |
| Clock High Width            | tsh    | 25   | -    | -    | ns   |
| Chip Select Setup Time      | tcss   | 0    | -    | -    | ns   |
| Chip Select Hold Time       | tcsh   | 10   | -    | -    | ns   |
| Chip Select High Delay Time | tcsd   | 20   | -    | -    | ns   |
| Data Setup Time             | tds    | 5    | -    | -    | ns   |
| Data Hold Time              | tdh    | 10   | -    | -    | ns   |

## 10.3 Write SPI interface Timing Diagram



Note: The example writes "0x1264h" to register R28h.  
 SPID connected to VSS.

### 10.4 Read SPI interface Timing Diagram



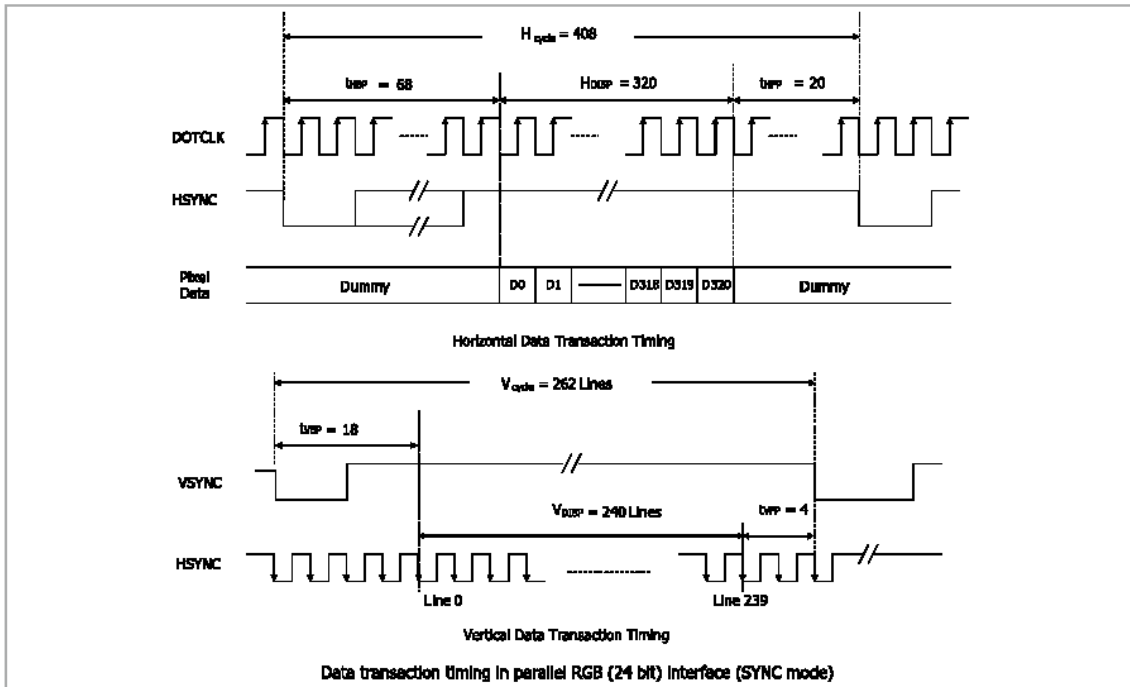
Note: The example Read "0x1264h" from register R28h.

10.5 AC Characteristics

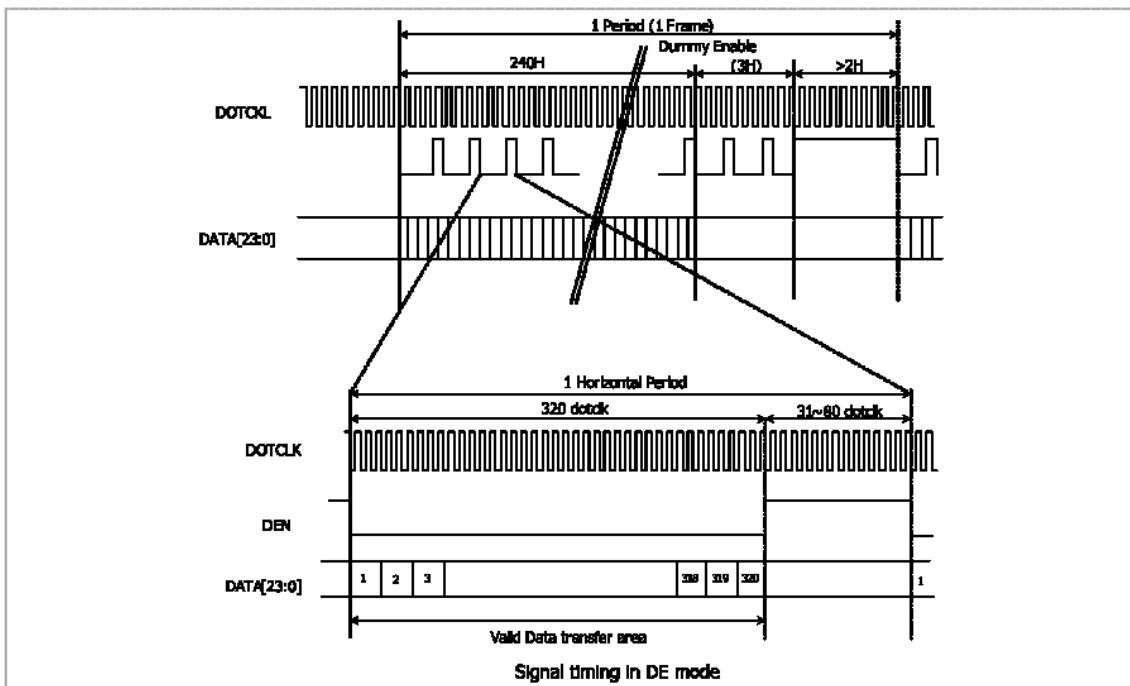
| Item                         | Symbol      | Min.   | Typ. | Max.        | Unit    |       |
|------------------------------|-------------|--------|------|-------------|---------|-------|
| DOTCLK Frequency             | fDOTCLK     | -      | 6.5  | 10          | MHz     |       |
| DOTCLK Period                | tDOTCLK     | 100    | 154  | -           | ns      |       |
| Horizontal Frequency (Line)  | fH          | -      | 14.9 | 22.35       | KHz     |       |
| Vertical Frequency (Refresh) | fV          | -      | 60   | 90          | Hz      |       |
| Horizontal Back Porch        | tHBP        | -      | 68   | -           | tDOTCLK |       |
| Horizontal Front Porch       | tHFP        | -      | 20   | -           | tDOTCLK |       |
| Horizontal Data Start Point  | tHBP        | -      | 68   | -           | tDOTCLK |       |
| Horizontal Blanking Period   | tHBP + tHFP | -      | 88   | -           | tDOTCLK |       |
| Horizontal Display Area      | HDISP       | -      | 320  | -           | tDOTCLK |       |
| Horizontal Cycle             | Hcycle      | -      | 408  | 450         | tDOTCLK |       |
| Vertical Back Porch          | tVBP        | -      | 18   | -           | Lines   |       |
| Vertical Front Porch         | tVFP        | -      | 4    | -           | Lines   |       |
| Vertical Data Start Point    | tVBP        | -      | 18   | -           | Lines   |       |
| Vertical Blanking Period     | tVBP + tVFP | -      | 22   | -           | Lines   |       |
| Vertical Display Area        | NTSC        | VDISP  | -    | 240         | -       | Lines |
|                              | PAL         |        |      | 280(PALM=0) |         |       |
|                              |             |        |      | 288(PALM=1) |         |       |
| Vertical Cycle               | NTSC        | Vcycle | -    | 262         | 350     | Lines |
|                              | PAL         |        |      | 313         |         |       |



### 10.6 Timing in Parallel RGB (24 bit SYNC Mode)



### 10.7 Timing in Parallel RGB (24 bit DE Mode)



## 11 Reliability Condition for LCD

### 11.1 Main LCD Reliability Test

#### 11.1.1 Reliability Test Condition

| No. | Panel | Item                               | Condition  | Test time | Note |
|-----|-------|------------------------------------|--|-----------|------|
| 1   | √     | High temp. operating               | 70°C   | 240 Hrs   | --   |
| 2   | √     | Low temp. operating                | -20°C  | 240 Hrs   | --   |
| 3   | √     | High temp. storage                 | 80°C   | 240 Hrs   | --   |
| 4   | √     | Low temp. storage                  | -30°C  | 240 Hrs   | --   |
| 5   | √     | High Temp / High Humidity Storage  | T = 60°C /85%. For (But no condensation dew)   | 240 Hrs   | --   |
| 6   | √     | High Temp/ High Humidity Operating | T = 40°C /85% For (But no condensation dew)  | 240 Hrs   | --   |
| 7   | √     | Thermal Shock (Non-Operation)      | -10 ← → 60°C, 50 cycle<br>30min 30min  | 1 Hrs     | --   |
| 8   | √     | Vibration (Non-Operation)          | Frequency:10 ~ 55Hz,<br>mp:1.5mm<br>Sweep Time : 11min<br>Test Time : 2hrs for each direction of X,Y,Z | --        | --   |
| 9   | √     | Shock (Non-Operation)              | Acceleration : 100G,<br>Period : 6ms<br>Directions of X,Y,Z<br>Cycles: Twice                           | --        | --   |

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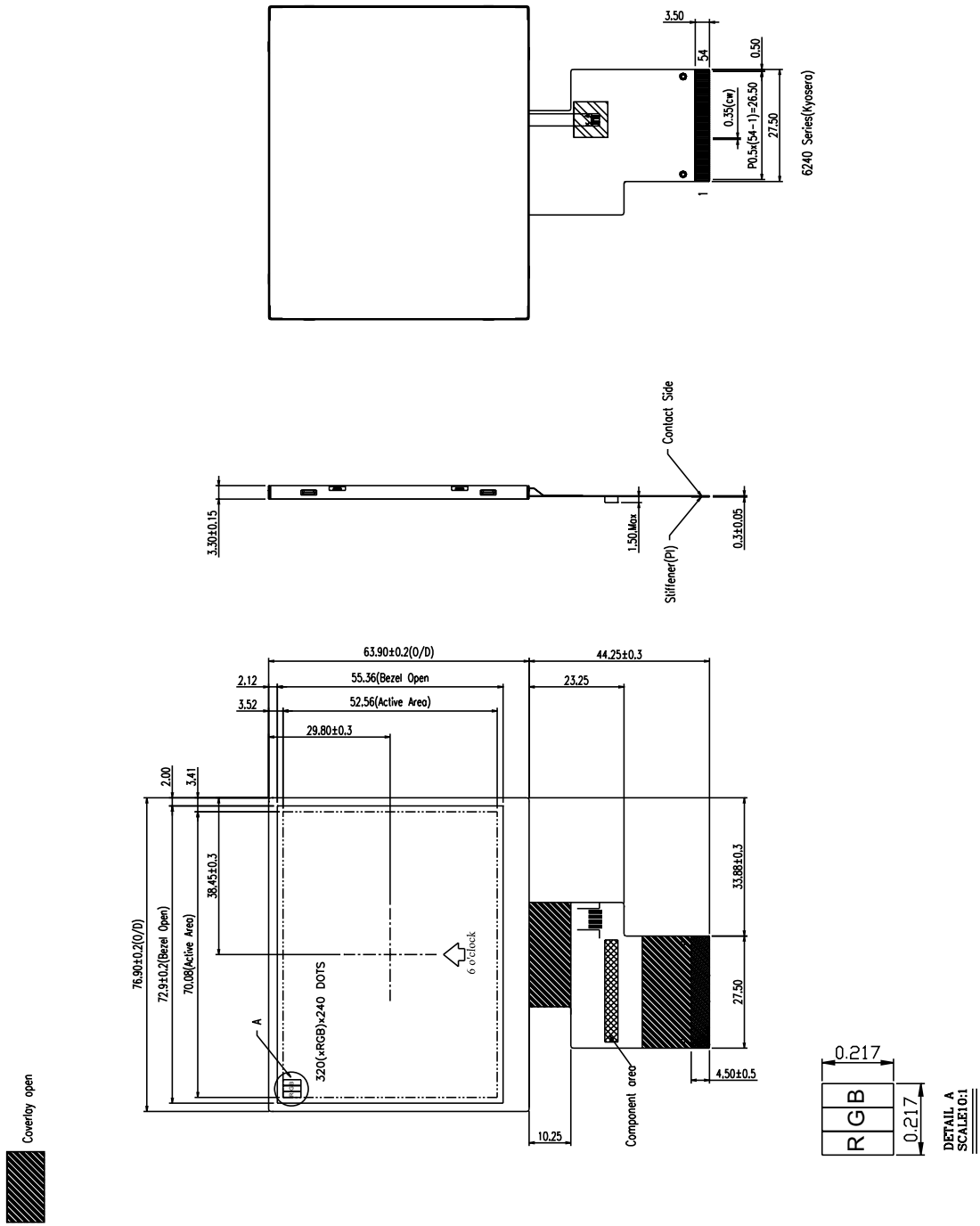
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### 3. Dimensional Outlines



| PIN ASSIGNMENT |               |
|----------------|---------------|
| 1.             | LED-          |
| 2.             | LED-          |
| 3.             | LED+          |
| 4.             | LED+          |
| 5.             | NC            |
| 6.             | NC            |
| 7.             | /RESET        |
| 8.             | /CS           |
| 9.             | SCK           |
| 10.            | SDI           |
| 11.            | SDO           |
| 12.            | BO            |
| 13.            | B1            |
| 14.            | B2            |
| 15.            | B3            |
| 16.            | B4            |
| 17.            | B5            |
| 18.            | GND           |
| 19.            | GND           |
| 20.            | G0            |
| 21.            | G1            |
| 22.            | G2            |
| 23.            | G3            |
| 24.            | G4            |
| 25.            | G5            |
| 26.            | GND           |
| 27.            | GND           |
| 28.            | R0            |
| 29.            | R1            |
| 30.            | R2            |
| 31.            | R3            |
| 32.            | R4            |
| 33.            | R5            |
| 34.            | GND           |
| 35.            | GND           |
| 36.            | HSTNC         |
| 37.            | VSTNC         |
| 38.            | DCLK          |
| 39.            | VDDD          |
| 40.            | VDDD          |
| 41.            | VDDIO         |
| 42.            | VDDIO         |
| 43.            | NC            |
| 44.            | NC            |
| 45.            | NC(YU:TOP)    |
| 46.            | NC(XR:RIGHT)  |
| 47.            | NC(YD:BOTTOM) |
| 48.            | NC(XL:LEFT)   |
| 49.            | NC            |
| 50.            | NC            |
| 51.            | NC            |
| 52.            | DE            |
| 53.            | GND           |
| 54.            | GND           |

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DETAIL A  
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