

Specification For Approval

Preliminary Specification

Final Specification

| | |
|-----------------|--------------------------|
| Customer | |
| Model | 3.5" qVGA TFT-LCD |
| Supplier | |

| Approved by | | Proposed by | |
|--------------------|------------------|--------------------|------------------|
| APPROVED BY | SIGNATURE | APPROVED BY | SIGNATURE |
| _____ | _____ | _____ | _____ |
| DESIGNED BY | SIGNATURE | DESIGNED BY | SIGNATURE |
| _____ | _____ | _____ | _____ |

VER.0.1

Sep. 04 . 2006

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1. General Description

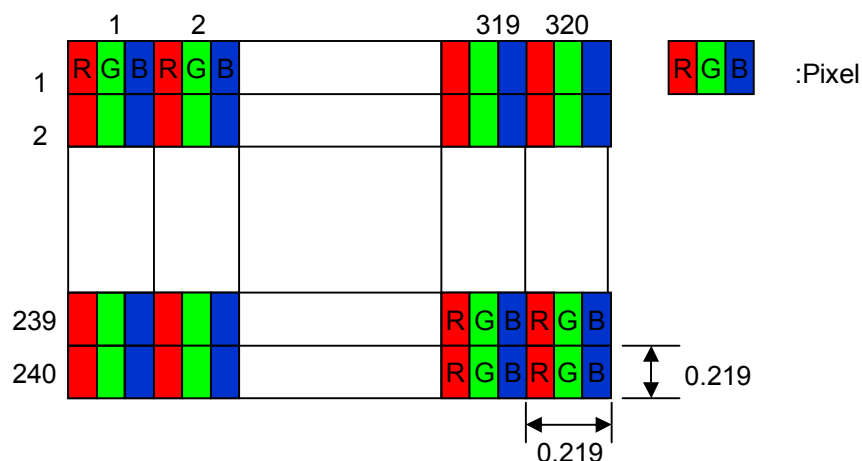
This main Module has a 3.5 inch diagonally measured active display area with 320X240 resolution
 Each pixel is divided into Red, Green and Blue sub-pixels and dots which are arranged in vertical stripes.
 Main LCD color is determined with 16.7M Color signal for each pixel.

The **IM350RBN1A** has been designed to apply the interface method that enables low power, high speed, and high contrast.

2. General Features

| Item | Main display | Remark |
|--------------------|--|--------|
| Display Mode | Normally White, Transmissive LCD | |
| Viewing Direction | 6 o'clock (In optimum contrast direction) good viewing direction is 12'oclock) | |
| Driving Method | A-Si TFT Active Matrix | |
| Input Signals | Digital 8bit RGB/24bit interface | |
| Outside Dimensions | 81.1mm(W) X 66.23mm(H) X 4.85mm(D) | |
| Active area | 70.08mm(H) x 52.56mm(V) | |
| Number of Pixels | 320×RGB×240 Pixels | 1) |
| Pixel Pitch | 0.219mm(H) X 0.219mm(W) | 1) |
| Pixel Arrangement | RGB stripes | 1) |
| Driver IC | HX8218C01(Source) / HX8655A(Gate) | himax |

Note 1) Main Display



3. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause operation or damage to the unit

| Parameter | Symbol | Value | | Unit | Notes |
|--------------------------------|------------------|-------|------|------|------------|
| | | Min. | Max. | | |
| LC Operating Voltage *1) | V _{Op} | 3.0 | 3.6 | V | @ 25± 5 °C |
| Gate On Voltage | VGH | 12 | 16 | V | 14 (Typ) |
| Gate Off Voltage | VGL | -10 | -6 | V | -8 (Typ) |
| Operating Temperature | T _{Op} | -20 | 70 | °C | |
| Storage Temperature | T _{STG} | -30 | 80 | °C | |
| Operating Ambient Humidity *2) | H _{Op} | 10 | 90 | %RH | *3) |
| Storage Humidity *2) | Hstg | 10 | 90 | %RH | *4) |

Note :

* 1) Liquid Crystal driving voltage.

Due to the characteristics of LC Material, this voltage vary with environmental temperature.

* 2) Non-condensation.

* 3) Temp. ≤ 60°C , 90% RH MAX.

* 4) Temp. > 60°C , Absolute humidity shall be less than 90% RH at 60°C

4. Electrical Specification 1)

4.1 Main Window Display (TFT LCD)

[Ta=25°C]

| Properties | | Sym. | Min | Typ. | Max | Unit | Note |
|------------------------------|------|----------------|-----|------|-----|------|------|
| Power Supply Voltage | | Vcc | 3.0 | 3.3 | 3.6 | V | |
| Supply Voltage | | Vdd | 4.8 | 5.0 | 5.2 | V | |
| Gate On Voltage | | Vgh | 12 | 14 | 16 | V | |
| Gate Off Voltage | | Vgl | -10 | -8 | -6 | V | |
| Operation frequency | | Fcpy | 60 | 75 | 90 | Hz | |
| Back-light Power Consumption | | Pbl | - | 400 | - | mW | 3) |
| Power Consumption | Full | Pfull | - | 65 | - | mW | 3) |
| Back-light Current | | I _B | - | 20 | - | mA | 4) |

Note :

- 1) The recommended operating conditions refers to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be within the absolute maximum ratings.
Accordingly, please make sure that the module is used within this range.
And these current values are measured under the condition that all device are stopped, each component is stable and Logic signal is input.
- 2) All the unused input terminals have to be connected to Vdd or Vss. Please select appropriate one which meet the function required by unused terminal.

3) Power Consumption

- (1) VDD=5.1V,
- (2) check pattern = Black pattern. Vcc=3.1V, Frame=60Hz
- (3) Where IB=20mA, VB=PBL/IB.
- (4) 6 LEDs serial type.



<Check Pattern>

5. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 500mm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

5.1 Main (TFT LCD)

Ta = 25 (Ambient Temperature)

| Spec | Parameter | Symbol | Condition | Values | | | Unit | Notes | |
|-----------------------|---------------------------|--------------------|--------------------|--------|-------|-------|-------------------|--------|-------|
| | | | | Min | Typ | Max | | | |
| With Backlight LED ON | Contrast Ratio | C/R | $\theta = 0^\circ$ | 200 | 300 | - | | FIG.1 | |
| | Luminance | BP | $\theta = 0^\circ$ | - | 350 | - | cd/m ² | FIG.2 | |
| | Luminance Uniformity | ΔL | $\theta = 0^\circ$ | 80 | - | - | % | FIG.2 | |
| | Response Time | Tr+Tf | $\theta = 0^\circ$ | - | 30 | 45 | ms | FIG.3 | |
| | Viewing Angle | $\Phi = 180^\circ$ | CR>10 | | - | 43 | - | Degree | FIG.4 |
| | | $\Phi = 0^\circ$ | | | - | 43 | - | Degree | |
| | | $\Phi = 90^\circ$ | | | - | 45 | - | Degree | |
| | | $\Phi = 270^\circ$ | | | - | 25 | - | Degree | |
| | CIE Color Coordinate 1931 | Wx | $\theta = 0^\circ$ | | 0.264 | 0.314 | 0.364 | | FIG.1 |
| | | Wy | | | 0.286 | 0.336 | 0.386 | | |
| | | Rx | $\theta = 0^\circ$ | | 0.518 | 0.568 | 0.618 | | |
| | | Ry | | | 0.322 | 0.372 | 0.422 | | |
| | | Gx | $\theta = 0^\circ$ | | 0.313 | 0.363 | 0.413 | | |
| | | Gy | | | 0.507 | 0.557 | 0.607 | | |
| | | Bx | $\theta = 0^\circ$ | | 0.109 | 0.159 | .209 | | |
| By | | 0.088 | | | 0.138 | 0.188 | | | |
| Flicker | | $\theta = 0^\circ$ | | - | - | 7 | % | FIG.5 | |
| Color Gamut | | $\theta = 0^\circ$ | | - | 39 | - | % | | |

◆ **Measurement System**

Notes :

1. Contrast Ratio(CR) is defined mathematically as :

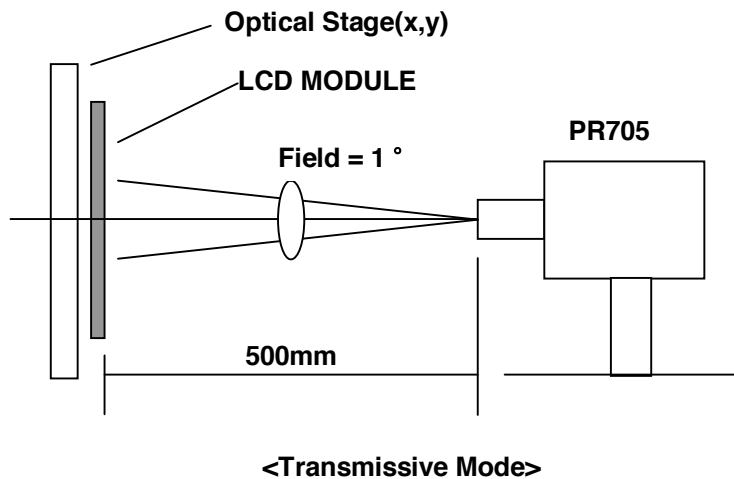
$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center point across the LCD surface 500mm from the surface with all pixels displaying white. For more information see FIG 1.

3. Response time is the time required for the display to transition from white to black (Rising Time, Tr) and from black to white (Falling Time, Tf). For additional information see FIG 3.

4. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

FIG. 1. Optical Characteristic Measurement Equipment and Method



- Measurement System (Test Procedure) With backlight turned on
- Measuring Instrument: PR705 made by PHOTO RESEARCH
- Measuring Field : 1°
- Environment: Inside a darkroom

FIG. 2. Measurement Points for Luminance

► Luminance Uniformity

Using FIG.1 Measurement System with the backlight turned on, the luminance uniformity should be obtained from the next expression, when white raster (white : gradation level L63) is displayed: (* LED Current = 20mA)

$$\text{Luminance Uniformity} = L_{\min} / L_{\max} \times 100 (\%)$$

, L_{\min} = Minimum luminance point

L_{\max} = Maximum luminance point

► Luminance

Use FIG.1(Test Procedure) under Measurement System with the backlight turned on to measure the luminance when white raster (white: Gradation level L63) is displayed.

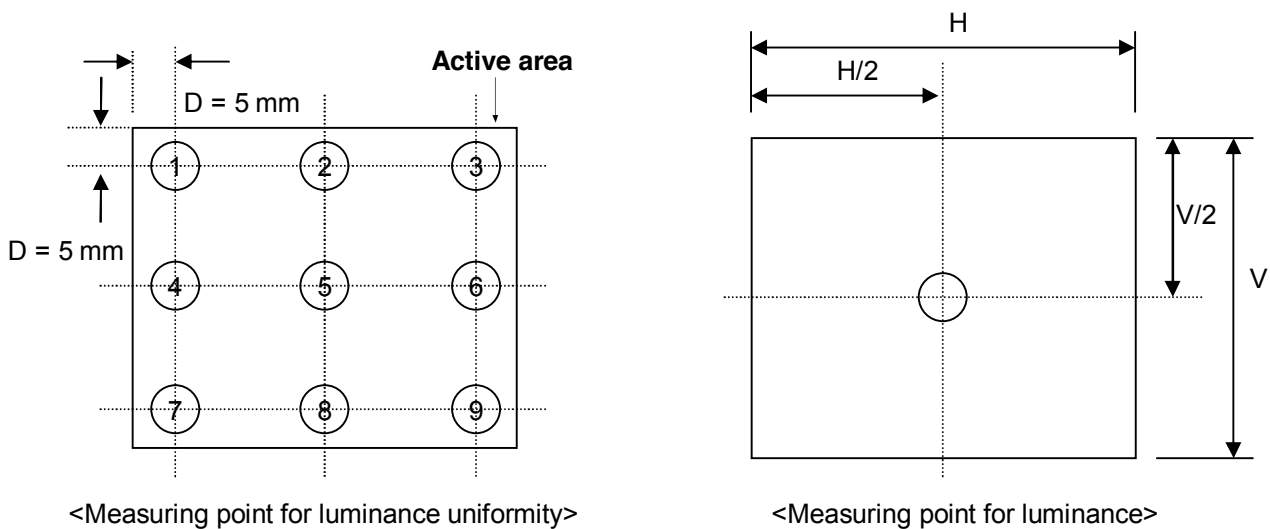


FIG. 3. The definition of Response Time

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

Response Time = Rising Time (T_r) + Falling Time (T_f)
 , Rising Time(T_r) : Full White 90% Full White 10% Transmittance.
 Falling Time(T_f) : Full White 10% Full White 90% Transmittance.

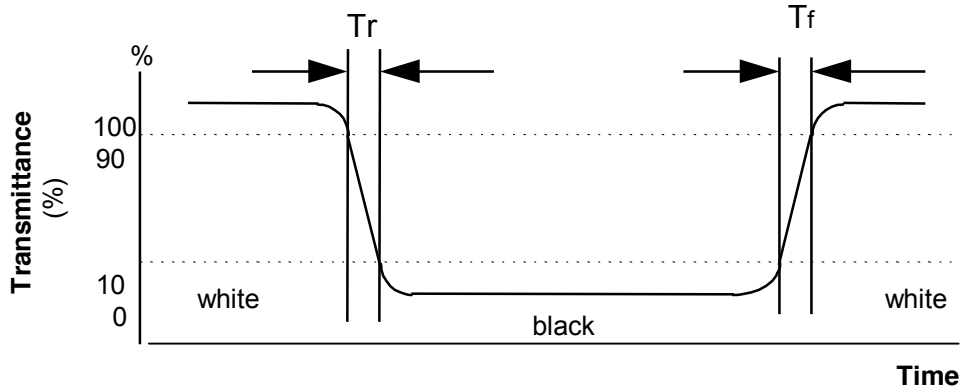


FIG. 4. The definition of Viewing Angle

Use Fig. 1 (Test Procedure) under Measurement System to measure the contrast from the measuring direction specified by the conditions as the following figure.
 The definition of viewing angle range is that the contrast ratio is higher than CR 10. ($CR > 10$)

<dimension of viewing angle range>

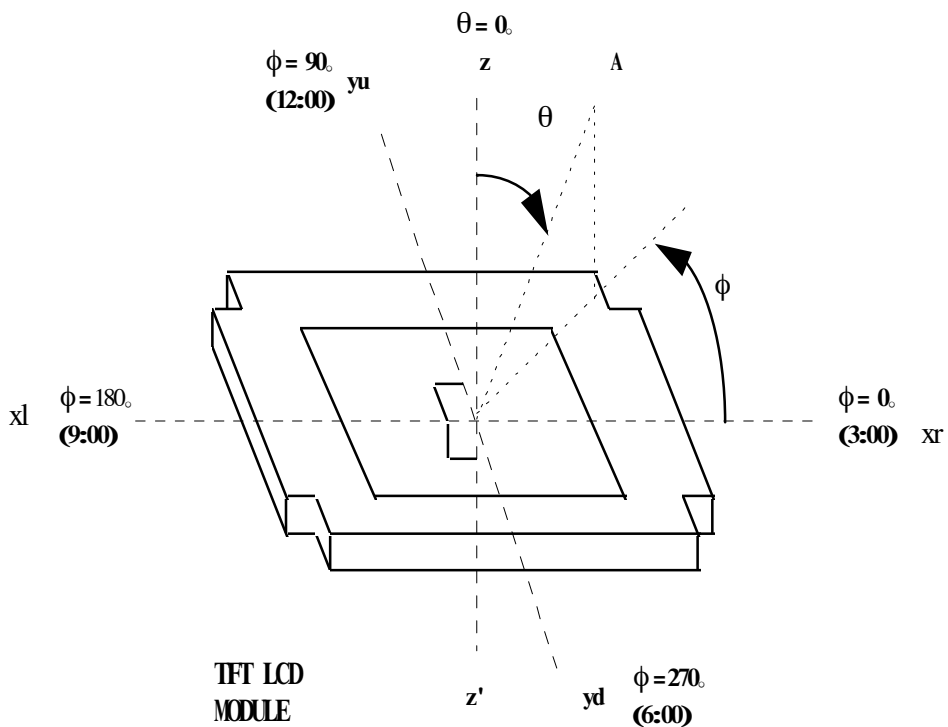
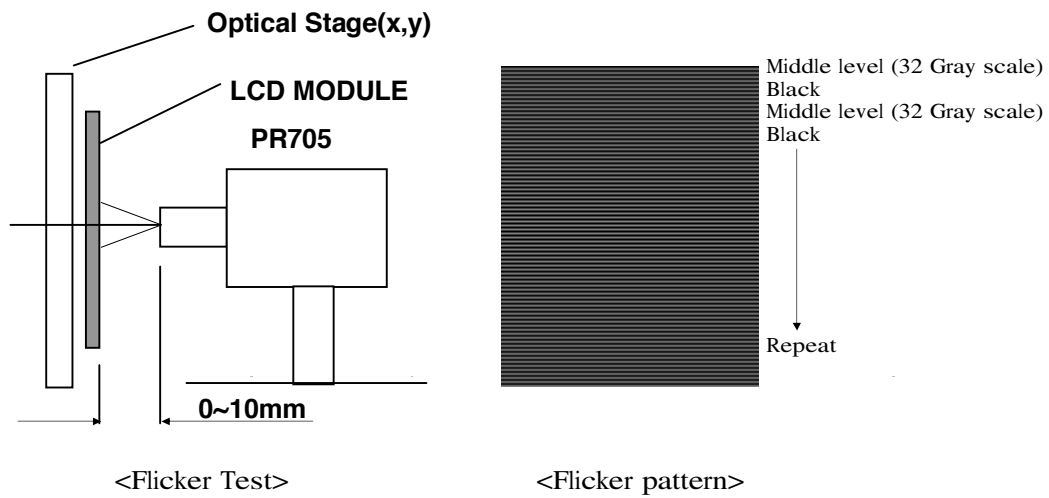


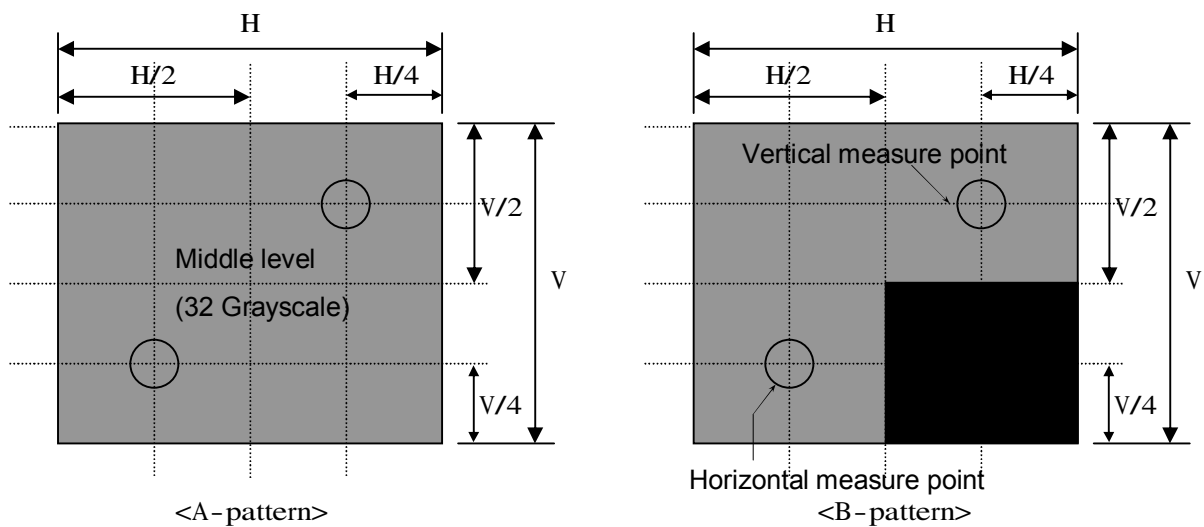
Fig. 5. Measuring Method for Flicker Level



- Measurement System (Test Procedure) With backlight turned on
- Measuring Instrument : PR705 made by PHOTO RESEARCH
- Measuring Field : 1°
- Environment: Inside a darkroom
- Display a flicker pattern (see below) and measure flicker level (%) with flicker checker.
- Distance from the flicker pattern to the checker is 0~10mm.

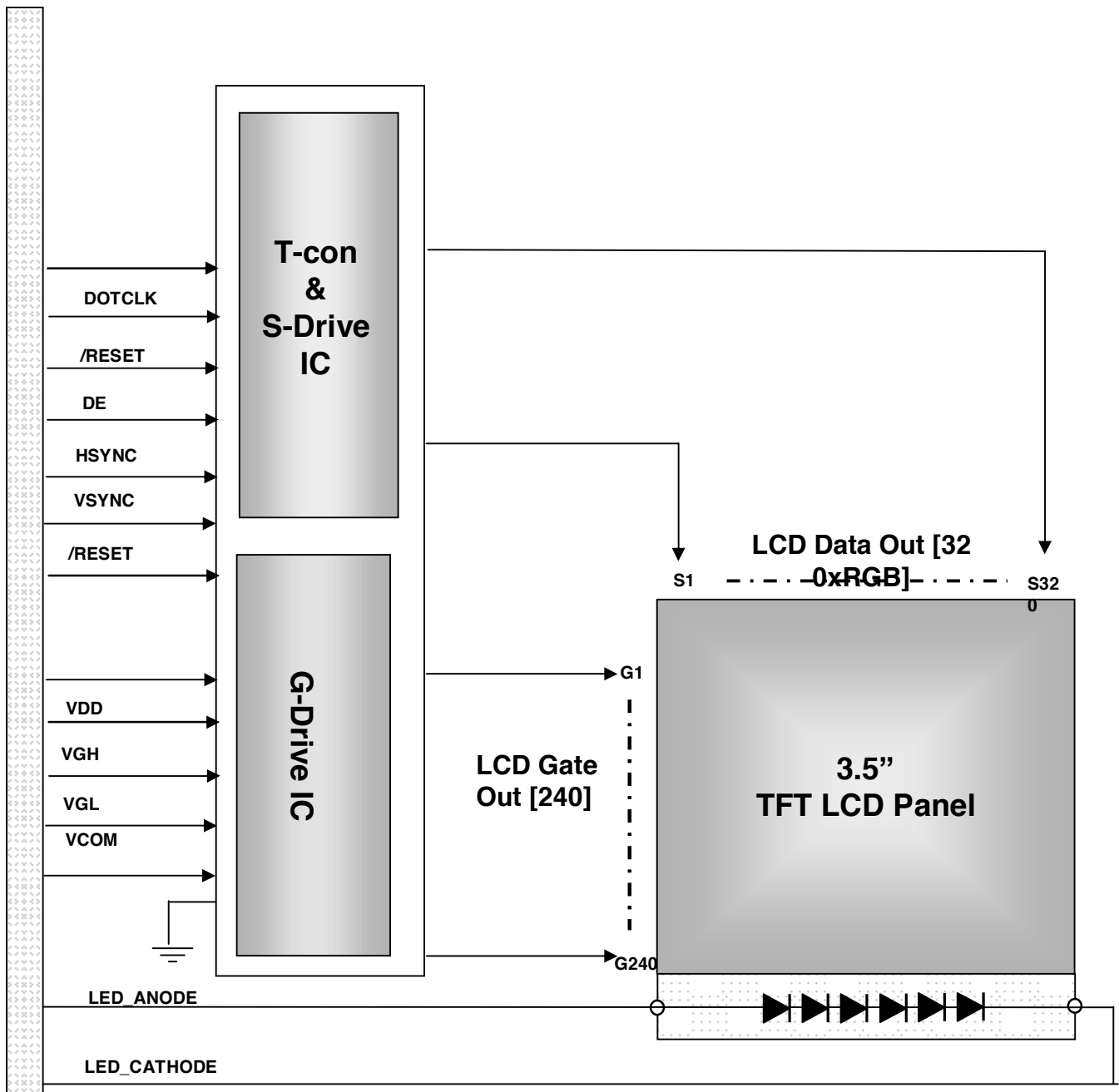
Fig. 6. Measuring Method for Crosstalk

$$\text{Crosstalk}(\%) = \frac{|\text{Luminance(A-pattern)} - \text{Luminance(B-pattern)}|}{\text{Luminance(A-pattern)}} \times 100$$



Crosstalk means irregularity of luminance in the background when window pattern (white against black background) is displayed.

6. Block Diagram



7. Pin Description

7.1. Input signal and power : pin description (Kyocera 04-6240-045-003-800)

| Pin No. | Symbol | Description | Pin No. | Symbol | Description |
|---------|-------------|--|---------|--------|--------------------------------------|
| 1 | LED_Cathode | LED_CATHODE | 24 | D16 | Display Data (R) D0: LSB, D7: MSB |
| 2 | | | 25 | D17 | |
| 3 | LED_Anode | LED_ANODE | 26 | D0 | |
| 4 | | | 27 | D1 | |
| 5 | GND | Ground | 28 | D2 | |
| 6 | /RESET | Reset | 29 | D3 | |
| 7 | /CS | NC | 30 | D4 | |
| 8 | SCK | NC | 31 | D5 | |
| 9 | SDI | NC | 32 | D6 | |
| 10 | D20 | Display Data (B) D20: LSB, D27: MSB | 33 | D7 | |
| 11 | D21 | | 34 | HSYNC | Horizontal Sync. Signal |
| 12 | D22 | | 35 | VSYNC | Vertical Sync. Signal |
| 13 | D23 | | 36 | DOTCLK | Data Clock |
| 14 | D24 | | 37 | VDD | Analog voltage(5V) |
| 15 | D25 | | 38 | VCC | Digital Voltage(3.3V) |
| 16 | D26 | | 39 | T_Y+ | Touch Panel Y+ |
| 17 | D27 | | 40 | T_Y- | Touch Panel Y- |
| 18 | D10 | Display Data (G) D10: LSB, D17: MSB | 41 | T_X+ | Touch Panel X+ |
| 19 | D11 | | 42 | T_X- | Touch Panel X- |
| 20 | D12 | | 43 | DE | Input Data Enable |
| 21 | D13 | | 44 | GND | Ground |
| 22 | D14 | | 45 | | |
| 23 | D15 | | | | |

7.2. Relation Between Input Signal and Color

| COLOR | DISPLAY | DATA SIGNAL | | | | | | | | | | | | | | | | GARY SCALE LEVEL | | |
|---------------------|---------|-------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|------------------|------|---------|
| | | RED | | | | | | GREEN | | | | | | BLUE | | | | | | |
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | 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 | - |
| | BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | CYAN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | RED | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | MAGENTA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | YELLOW | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 | - |
| GARY SCALE OF RED | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R0 |
| | DARK | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R1 |
| | . | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R2 |
| | . | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | R3~R252 |
| | . | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | . | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R253 |
| | LIGHT | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R254 |
| RED | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R255 | |
| GARY SCALE OF GREEN | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G0 |
| | DARK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G1 |
| | . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G2 | |
| | . | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | G3~G252 |
| | . | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | . | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G253 |
| | LIGHT | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G254 | |
| GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G255 | |
| GARY SCALE OF BLUE | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B0 |
| | DARK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | B1 |
| | . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | B2 |
| | . | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | B3~B252 |
| | . | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | B253 |
| | LIGHT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | B254 |
| BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | B255 | |

Note) Gray definition

Rn : RED Gray, Gn : GREEN Gray, Bn : BLUE Gray (n = Gray Level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

8. Register Values

8.1 Command Description

8.1.1 SPI Resister Description

- Register R0:

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---------|----------|-------|-------|-------|-------|-------|-------|-------|
| Name | reserved | STHD1 | STHD0 | STHP4 | STHP3 | STHP2 | STHP1 | STHP0 |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

STHD [1:0]: adjust start pulse position by dot.

| STHD1 | STHD0 | STH position adjust by dot |
|-------|-------|----------------------------|
| 1 | 1 | -1 |
| 1 | 0 | -2 |
| 0 | 0 | 0 |
| 0 | 1 | +1 |

STHP [4:0]: adjust start pulse position by pixel

| STHP4 | STHP3 | STHP2 | STHP1 | STHP0 | STH position adjust by pixel |
|-------|-------|-------|-------|-------|------------------------------|
| 1 | 1 | 1 | 1 | 1 | -1 |
| 1 | 1 | 1 | 1 | 0 | -2 |
| 1 | 1 | 1 | 0 | 1 | -3 |
| 1 | 1 | 1 | 0 | 0 | -4 |
| 1 | 1 | 0 | 1 | 1 | -5 |
| 1 | 1 | 0 | 1 | 0 | -6 |
| 1 | 1 | 0 | 0 | 1 | -7 |
| 1 | 1 | 0 | 0 | 0 | -8 |
| 1 | 0 | 1 | 1 | 1 | -9 |
| 1 | 0 | 1 | 1 | 0 | -10 |
| 1 | 0 | 1 | 0 | 1 | -11 |
| 1 | 0 | 1 | 0 | 0 | -12 |
| 1 | 0 | 0 | 1 | 1 | -13 |
| 1 | 0 | 0 | 1 | 0 | -14 |
| 1 | 0 | 0 | 0 | 1 | -15 |
| 1 | 0 | 0 | 0 | 0 | -16 |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | +1 |
| 0 | 0 | 0 | 1 | 0 | +2 |
| 0 | 0 | 0 | 1 | 1 | +3 |
| 0 | 0 | 1 | 0 | 0 | +4 |
| 0 | 0 | 1 | 0 | 1 | +5 |
| 0 | 0 | 1 | 1 | 0 | +6 |
| 0 | 0 | 1 | 1 | 1 | +7 |
| 0 | 1 | 0 | 0 | 0 | +8 |
| 0 | 1 | 0 | 0 | 1 | +9 |
| 0 | 1 | 0 | 1 | 0 | +10 |
| 0 | 1 | 0 | 1 | 1 | +11 |
| 0 | 1 | 1 | 0 | 0 | +12 |
| 0 | 1 | 1 | 0 | 1 | +13 |
| 0 | 1 | 1 | 1 | 0 | +14 |
| 0 | 1 | 1 | 1 | 1 | +15 |

● Register R1:

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---------|-------|-------|-------|-------|----------|----------|----------|----------|
| Name | STVP3 | STVP2 | STVP1 | STVP0 | reserved | reserved | reserved | reserved |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

STVP [3:0]: adjust first line position by line

| STVP3 | STVP2 | STVP1 | STVP0 | STV position adjust by line |
|-------|-------|-------|-------|-----------------------------|
| 1 | 1 | 1 | 1 | -1 |
| 1 | 1 | 1 | 0 | -2 |
| 1 | 1 | 0 | 1 | -3 |
| 1 | 1 | 0 | 0 | -4 |
| 1 | 0 | 1 | 1 | -5 |
| 1 | 0 | 1 | 0 | -6 |
| 1 | 0 | 0 | 1 | -7 |
| 1 | 0 | 0 | 0 | -8 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | +1 |
| 0 | 0 | 1 | 0 | +2 |
| 0 | 0 | 1 | 1 | +3 |
| 0 | 1 | 0 | 0 | +4 |
| 0 | 1 | 0 | 1 | +5 |
| 0 | 1 | 1 | 0 | +6 |
| 0 | 1 | 1 | 1 | +7 |

● Register R2:

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---------|----------|----------|----------|----------|--------|--------|--------|---------|
| Name | reserved | reserved | reserved | reserved | VS_POL | HS_POL | NPC_IN | NPC_SET |
| Default | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |

VS_POL: VS polarity setting.

VS_POL=L, negative polarity.

VS_POL=H, positive polarity.

HS_POL: HS polarity setting.

HS_POL=L, negative polarity.

HS_POL=H, positive polarity.

NPC_IN: define the NTSC/PAL mode by SPI.

NPC_IN=L, PAL.

NPC_IN=H, NTSC.

NPC_SET: set the NTSC/PAL auto detection or define by NPC_IN.

NPC_SET=L, auto detection.

NPC_SET=H, define by NPC_IN.

8. 2 Power on/off sequence

To prevent the device damage from latch up, the power on/off sequence shown below must be followed

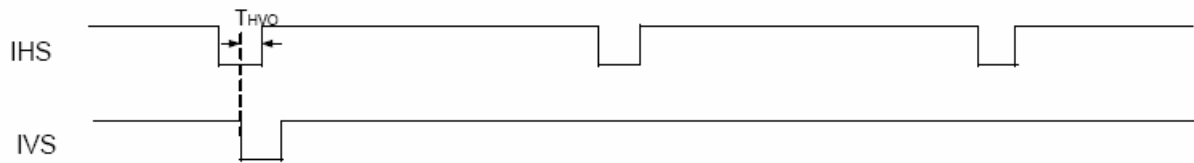
Power ON : VCC VDD V1 ~V8

Power OFF : V1 ~ V8 VDD VCC

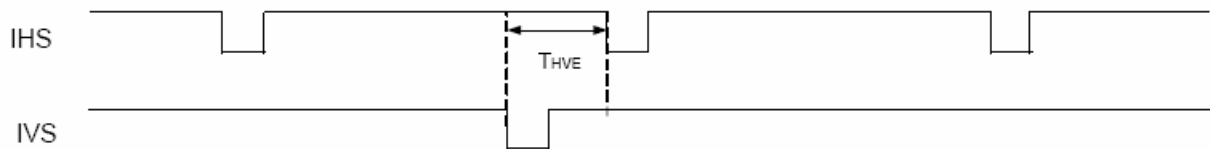
8. 3 Digital RGB Timing Waveform

8.3.1 HIS and IVS Timing

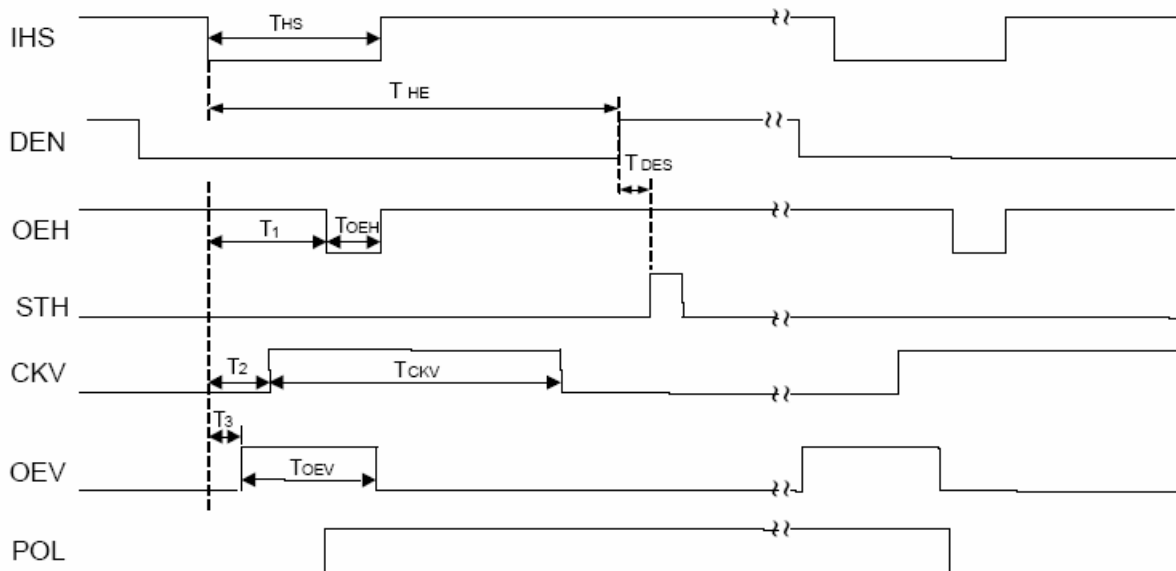
- Odd field



- Even field

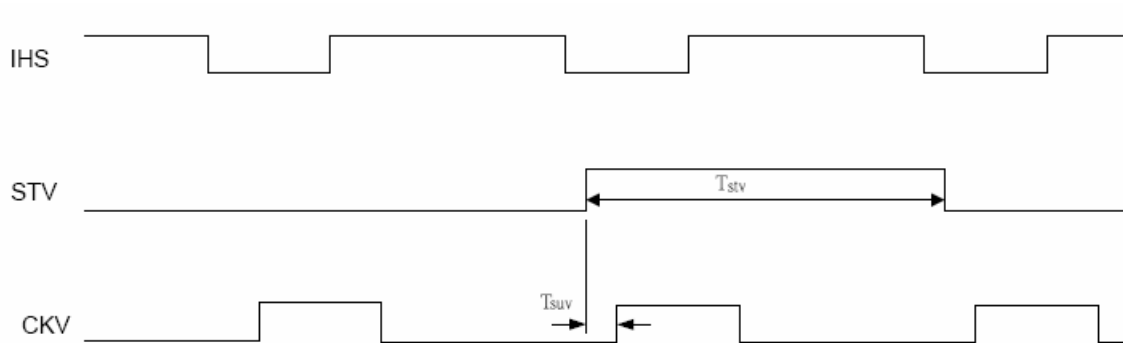


8.3.2 HIS and Horizontal control timing waveform

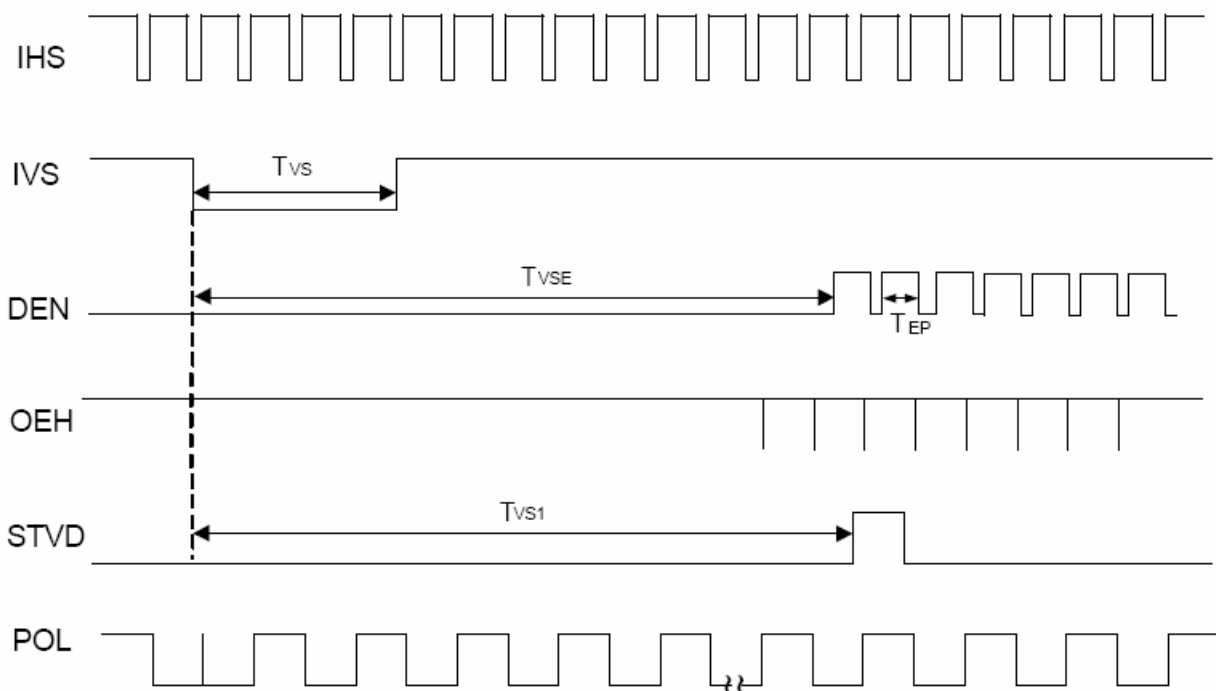


Note : (1) HIS=Hsync, IVS=Vsync

8.3.3 HIS and Vertical shift clock timing waveform

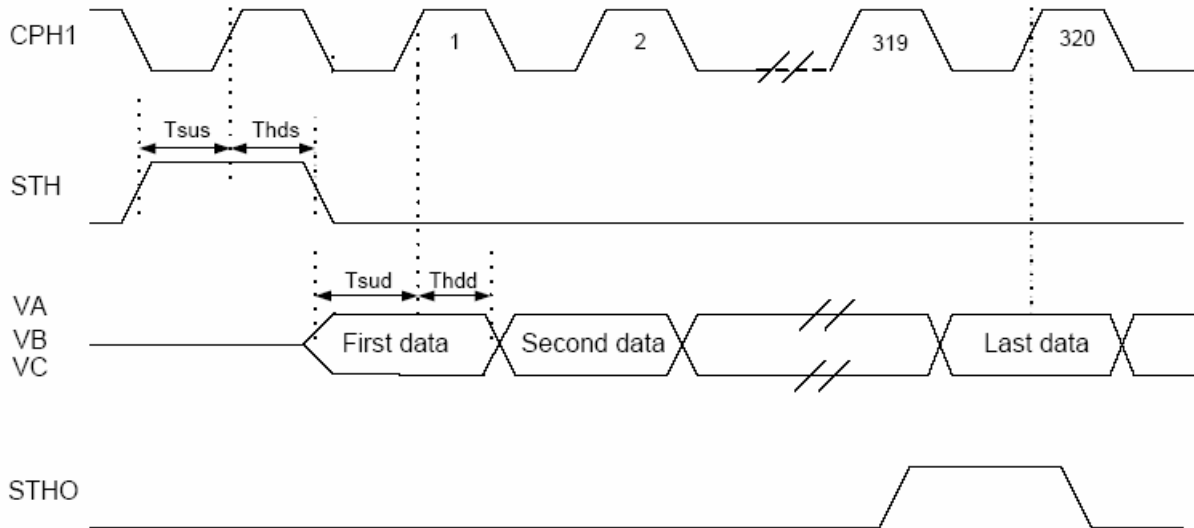


8.3.4 HIS and Vertical control timing waveform

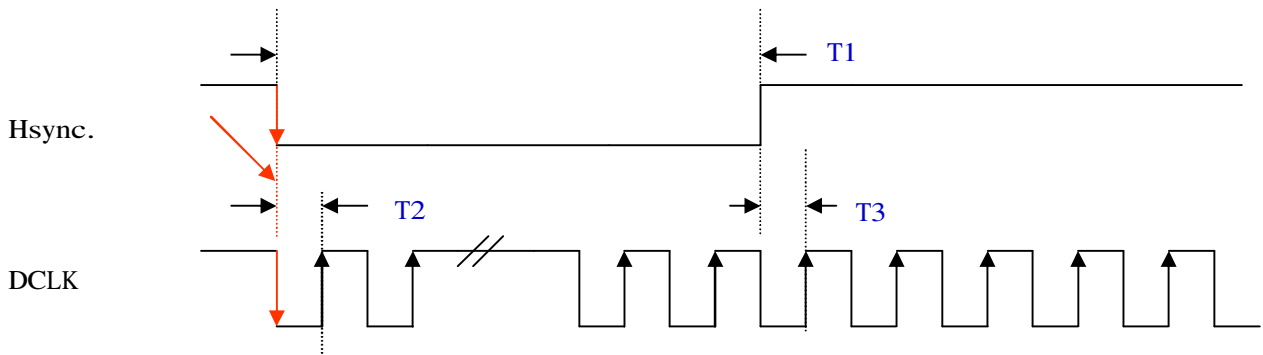


8.4 Source Driver Timing Chart

8.4.1 Clock and Start Pulse timing waveform



8.4.2 Control Signal and RGB Data timing waveform



T1 : Min. 5 DCLK ~ Max. 30 DCLK

T2 : Set-up Time Min. 12ns

T3 : Hold Time Min. 12ns

** Must be synchronized between Hsync. Falling edge and Dot Clock falling edge.

9. AC Characteristics

9.1 Input Signal characteristics

Digital Parallel RGB Interface (960 x 240 resolution)

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit | |
|--|-----------|-----------|-------|------|-----------|-------|
| CLK period | T_{OSC} | - | 156 | - | ns | |
| Data setup time | T_{SU} | 12 | - | - | ns | |
| Data hold time | T_{HD} | 12 | - | - | ns | |
| IHS period | T_H | - | 408 | - | T_{OSC} | |
| IHS pulse width | T_{HS} | 5 | 30 | - | T_{OSC} | |
| IHS rising time | T_{Cr} | - | - | 700 | ns | |
| IHS falling time | T_{Cf} | - | - | 300 | ns | |
| IVS pulse width | T_{VS} | 1 | 3 | 5 | T_H | |
| IVS rising time | T_{Vr} | - | - | 700 | ns | |
| IVS falling time | T_{Vf} | - | - | 1.5 | μs | |
| IVS falling to IHS rising time for odd field | T_{HVO} | 1 | - | - | T_{OSC} | |
| IVS falling to IHS falling time for even field | T_{HVE} | 1 | - | - | T_{OSC} | |
| IVS-DEN time | NTSC | T_{VSE} | - | 18 | - | T_H |
| | PAL | T_{VSE} | - | 26 | - | T_H |
| IHS-DEN time | T_{HE} | 36 | 68 | 88 | T_{OSC} | |
| DEN pulse width | T_{EP} | - | 320 | - | T_{OSC} | |
| DEN-STH time | T_{DES} | - | 1 | - | T_{OSC} | |
| IVS period | NTSC | - | 262.5 | - | T_H | |
| | PAL | - | 312.5 | - | T_H | |

Note:

(1)When SYNC mode is used, 1st data start from 68th CLK after IHS falling.

9.2 Hardware reset timing

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit. |
|------------------------|-----------|------|------|------|---------|
| RESETB low pulse width | T_{RSB} | 10 | - | - | μs |

9.3 Output signal characteristics for digital input signal

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit. |
|--------------------------|-----------|-----------|------|------|---------|
| Rising time | T_r | - | - | 10 | ns |
| Falling time | T_f | - | - | 10 | ns |
| Internal STH setup time | T_{SUS} | 12 | - | - | ns |
| Internal STH hold time | T_{HDS} | 12 | - | - | ns |
| Internal data setup time | T_{SID} | 60 | - | - | ns |
| Internal data hold time | T_{HDD} | 40 | - | - | ns |
| OEH pulse width | T_{OEH} | - | 1248 | - | ns |
| OEV pulse width | T_{OEV} | - | 4992 | - | ns |
| CKV pulse width | T_{CKV} | - | 3744 | - | ns |
| IHS-OEH time | T_1 | - | 4368 | - | ns |
| IHS-CKV time | T_2 | - | 2496 | - | ns |
| IHS-OEV time | T_3 | - | 624 | - | ns |
| STV setup time | T_{SUV} | - | 1872 | - | ns |
| STV pulse width | T_{STV} | - | 1 | - | T_H |
| IVS-STV time | NTSC | T_{VS1} | - | 19 | T_H |
| | PAL | T_{VS1} | - | 27 | T_H |
| OEH-STV time | T_{OES} | - | 2 | - | T_H |
| Output settling time | T_{ST} | - | 12 | 20 | μs |

10. SPI Timing Characteristics

| PARAMETER | Symbol | Min. | Typ. | Max. | Unit. |
|--------------------------|-----------|------|------|------|----------|
| SPCK period | T_{CK} | 60 | - | - | ns |
| SPCK high width | T_{CKH} | 30 | - | - | ns |
| SPCK low width | T_{CKL} | 30 | - | - | ns |
| Data setup time | T_{SU1} | 12 | - | - | ns |
| Data hold time | T_{HD1} | 12 | - | - | ns |
| SPENA to SPCK setup time | T_{CS} | 20 | - | - | ns |
| SPENA to SPDA hold time | T_{CE} | 20 | - | - | ns |
| SPENA high pulse width | T_{CD} | 50 | - | - | ns |
| SPDA output latency | T_{CR} | - | 1/2 | - | T_{CK} |

● SPI read timing

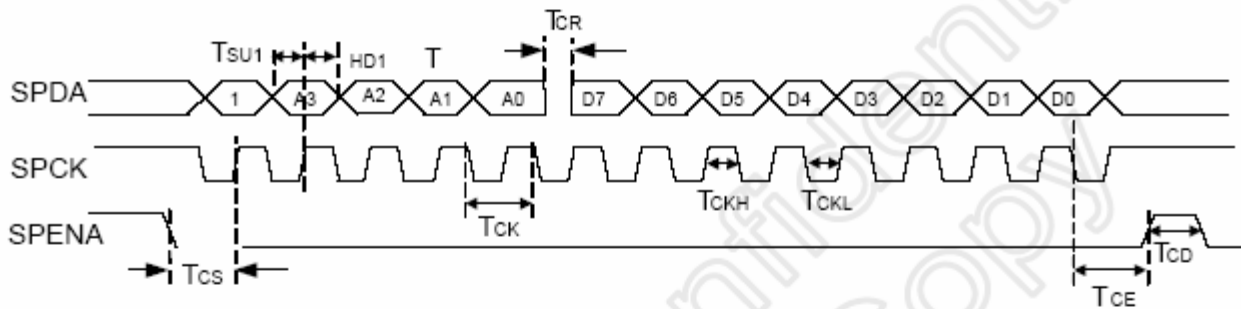


Figure 9. 2 SPI Read Timing

● SPI write timing

