

# Product Specifications

|                    |                      |
|--------------------|----------------------|
| <b>Customer</b>    |                      |
| <b>Description</b> | 3.45" TFT LCD Module |
| <b>Model Name</b>  | LQ035NC111           |
| <b>Date</b>        | 2007/11/26           |
| <b>Doc. No.</b>    |                      |
| <b>Revision</b>    | 04                   |

|                                                                                                                                     |  |
|-------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Customer Approval</b>                                                                                                            |  |
|                                                                                                                                     |  |
| <b>Date</b>                                                                                                                         |  |
| The above signature represents that the product specifications, testing regulation, and warranty in the specifications are accepted |  |

| Engineering |            |          |            |
|-------------|------------|----------|------------|
| Check       | Date       | Prepared | Date       |
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## RECORD OF REVISIONS

[illegible]

## 1. SUMMARY

This technical specification applies to 3.45" color TFT-LCD panel. The 3.45" color TFT-LCD panel is designed for GPS, camcorder, digital camera application and other electronic products which require high quality flat panel displays.  
This module follows RoHS.

## 2. FEATURES

High Resolution: 230,400 Dots (320 RGB x 240). LQ035NC111 is a transmissive type color active matrix liquid crystal display (LCD) which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, driver ICs, FPC and a backlight unit.

## 3. GENERAL SPECIFICATIONS

| Parameter            | Specifications                                   | Unit      |
|----------------------|--------------------------------------------------|-----------|
| Screen size          | 3.45(Diagonal)                                   | inch      |
| Display Format       | 320 RGB x 240                                    | Dot       |
| Active area          | 70.08(H) x 52.56(V)                              | mm        |
| Dot size             | 73x 219                                          | um        |
| Pixel Configuration  | RGB-Stripe                                       |           |
| Outline dimension    | 76.9(W) x 63.9(H) x 3.3(D)                       | mm        |
| Display Mode         | Normally white/Transmissive                      |           |
| Display Garmut       | NTSC 60%                                         |           |
| Input Interface      | Digital 24-bit RGB/SERIAL<br>RGB/CCIR656/CCIR601 |           |
| Weight               | (40)                                             | g         |
| View Angle direction | 6 o'clock                                        |           |
| Temperature Range    | Operation                                        | -20~70 °C |
|                      | Storage                                          | -30~80 °C |

## 4. ABSOLUTE MAXIMUM RATINGS

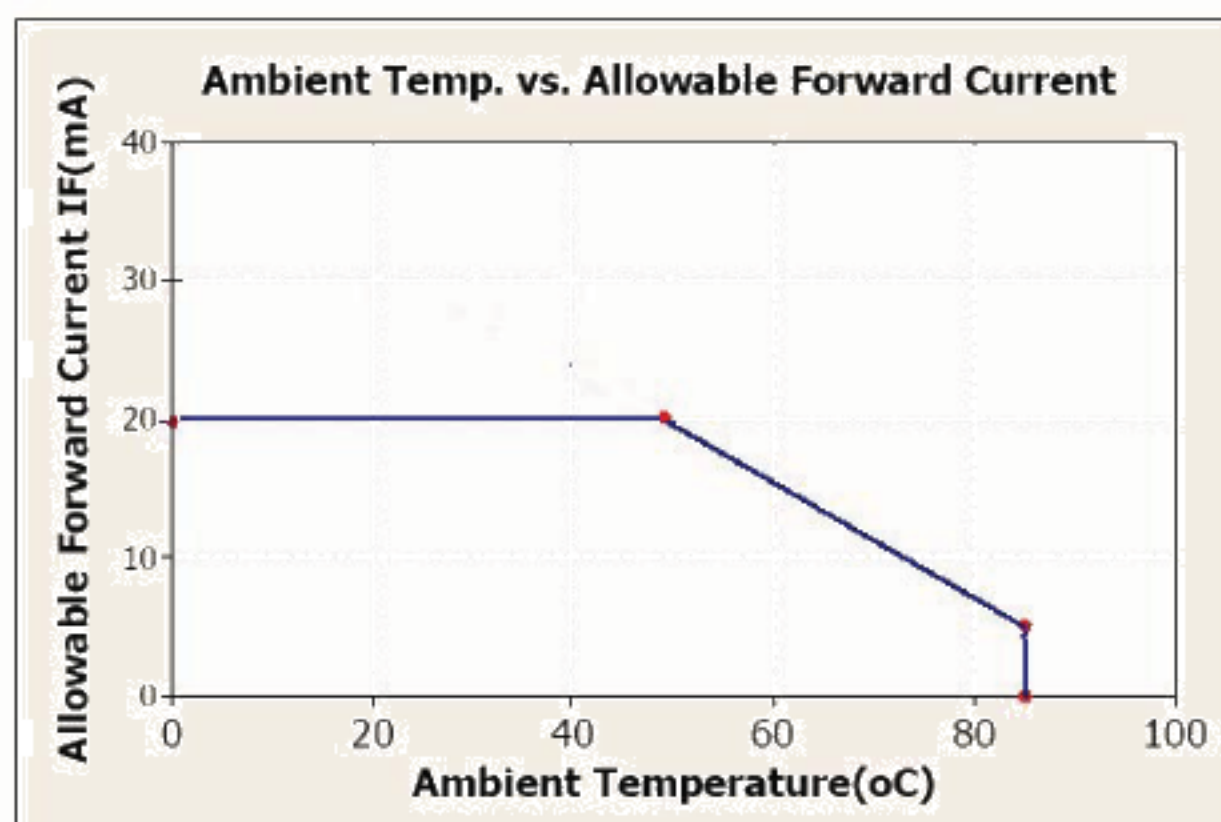
| Item                 | Symbol    | Condition | Min. | Max.    | Unit | Remark |
|----------------------|-----------|-----------|------|---------|------|--------|
| Power Voltage        | DVDD,AVDD | GND=0     | -0.3 | 5.0     | V    |        |
| Input Signal Voltage | $V_{in}$  | GND=0     | -0.3 | VDD+0.3 | V    | NOTE   |
| Logic Output Voltage | $V_{OUT}$ | GND=0     | -0.3 | VDD+0.3 | V    | NOTE   |

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

1. Temp.  $\leq 60^{\circ}\text{C}$ , 90% RH MAX.

Temp.  $> 60^{\circ}\text{C}$ , Absolute humidity shall be less than 90% RH at  $60^{\circ}\text{C}$

2.



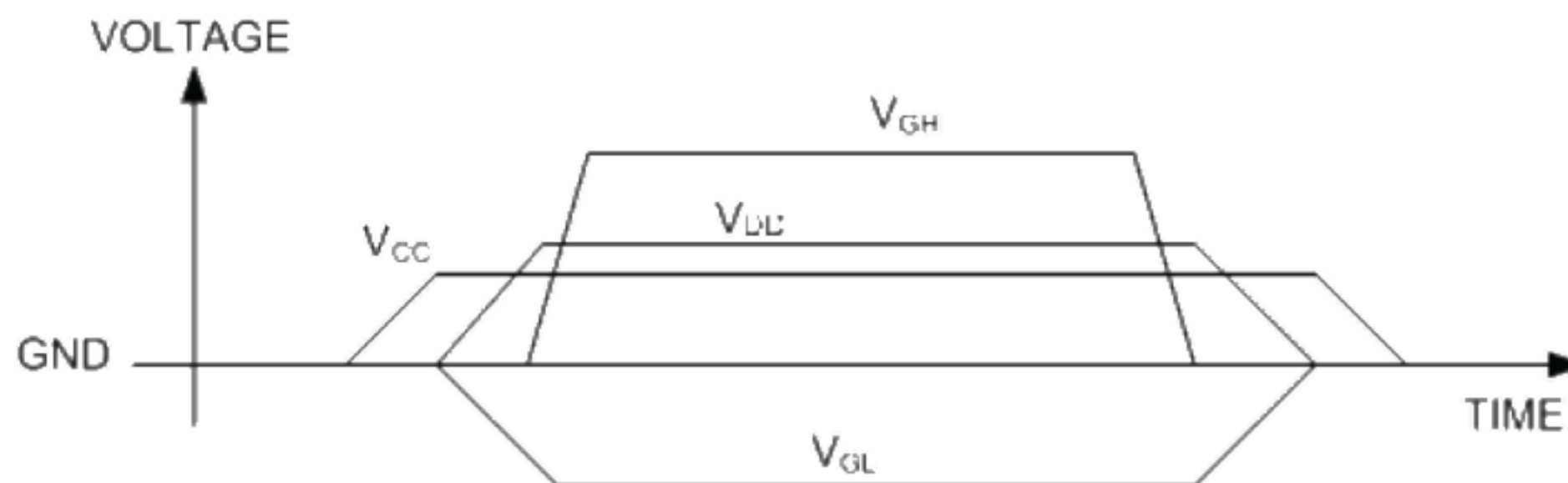
## 5. ELECTRICAL CHARACTERISTICS

### 5.1. Operating conditions:

| Parameter                 | Symbol | Rating |      |      | Unit | Condition |
|---------------------------|--------|--------|------|------|------|-----------|
|                           |        | Min.   | Typ. | Max. |      |           |
| Power Voltage             | VCC    | 3.0    | 3.3  | 3.6  | V    |           |
| Digital Operation Current | Icc    |        | 8.6  |      | mA   |           |
| Gate On Power             | VGH    | 14     | 15   | 18   | V    |           |
| Gate Off Power            | VGL    | -11    | -10  | -8   | V    |           |
| Vcom High Voltage         | VcomH  |        | 3.7  |      | V    | Note1     |
| Vcom low Voltage          | VcomL  |        | -1.6 |      | V    | Note1     |
| Vcom level max            | VcomA  |        |      | 6    | V    |           |

Note1. VcomH& VcomL : Adjust the color with gamma data. Vp-p should be higher then 4V.(Option 5V)

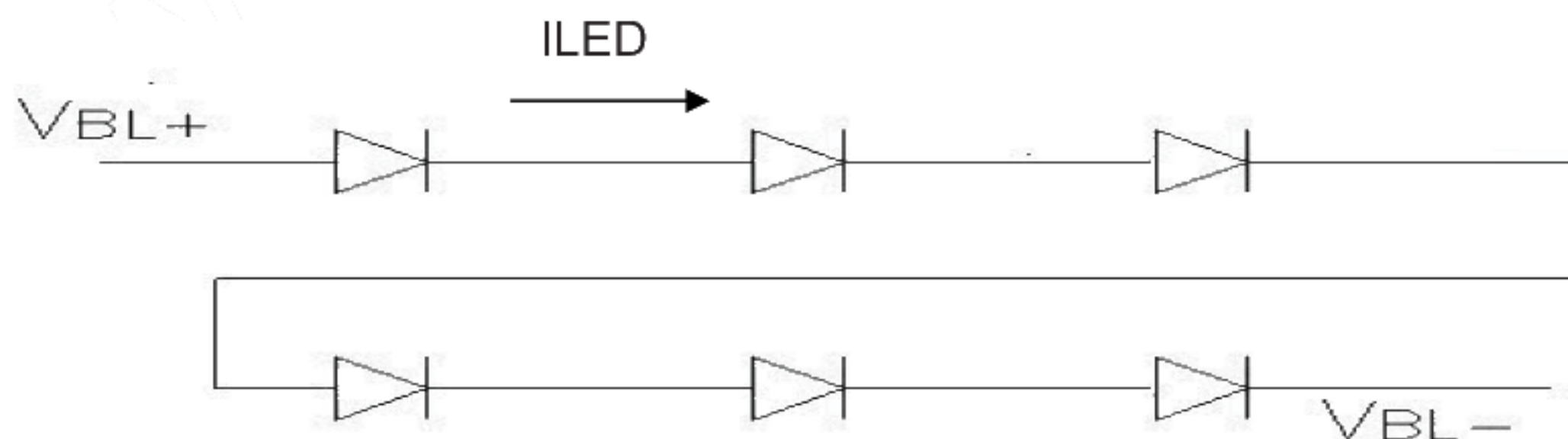
Note: Please power on following the sequence VCC → VDD



### 5.2 LED driving conditions

| Parameter         | Symbol | Min. | Typ.      | Max. | Unit | Remark   |
|-------------------|--------|------|-----------|------|------|----------|
| LED current       |        | -    | 20        | -    | mA   |          |
| Power Consumption |        | -    | 400       | 420  | mW   |          |
| LED voltage       | VBL+   | 18.6 | 19.8      | 21   | V    | Note 1   |
| LED Life Time     | -      |      | (50,000)- | -    | Hr   | Note 2,3 |

Note 1 : There are 1 Groups LED



Note 2 : Ta = 25°C

Note 3 : Brightness to be decreased to 50% of the initial value

## 6. DC CHARACTERISTICS

| Parameter                | Symbol   | Rating  |      |         | Unit | Condition |
|--------------------------|----------|---------|------|---------|------|-----------|
|                          |          | Min.    | Typ. | Max.    |      |           |
| Low level input voltage  | $V_{IL}$ | 0       | -    | 0.3 VCC | V    |           |
| High level input voltage | $V_{IH}$ | 0.7 VCC | -    | VCC     | V    |           |

## 7. AC CHARACTERISTICS

### Digital Parallel RGB interface

| Signal | Item           | Symbol | Min | Typ | Max | Unit |
|--------|----------------|--------|-----|-----|-----|------|
| Dclk   | Frequency      | Tosc   | -   | 156 | -   | ns   |
|        | High Time      | Tch    | -   | 78  | -   | ns   |
|        | Low Time       | Tcl    | -   | 78  | -   | ns   |
| Data   | Setup Time     | Tsu    | 12  | -   | -   | ns   |
|        | Hold Time      | Thd    | 12  | -   | -   | ns   |
| Hsync  | Period         | TH     | -   | 408 | -   | Tosc |
|        | Pulse Width    | THS    | 5   | 30  | -   | Tosc |
|        | Back-Porch     | Thb    | -   | 38  | -   | Tosc |
|        | Display Period | TEP    | -   | 320 | -   | Tosc |
|        | Hsync-den time | THE    | 36  | 68  | 88  | Tsoc |
|        | Front-Porch    | Thf    | -   | 20  | -   | Tosc |
| Vsync  | Period         | Tv     | -   | 262 | -   | TH   |
|        | Pulse Width    | Tvs    | 1   | 3   | 5   | TH   |
|        | Back-Porch     | Tvb    | -   | 15  | -   | TH   |
|        | Display Period | Tvd    | -   | 240 | -   | TH   |
|        | Front-Porch    | Tvf    | 2   | 4   | -   | TH   |

Note: 1.  $T_{hp} + T_{hb} = 68$ , the user is make up by yourself.  
2.  $T_v = T_{vs} + T_{vb} + T_{vd} + T_{vf}$ , the user is make up by yourself.  
3. When SYNC mode is used, 1<sup>st</sup> data start from 68<sup>th</sup> Dclk after Hsync falling

**Digital Serial RGB interface**

| Signal | Item           | Symbol | Min | Typ  | Max | Unit |
|--------|----------------|--------|-----|------|-----|------|
| Dclk   | Frequency      | Tosc   | -   | 52   | -   | ns   |
|        | High Time      | Tch    | -   | 78   | -   | ns   |
|        | Low Time       | Tcl    | -   | 78   | -   | ns   |
| Data   | Setup Time     | Tsu    | 12  | -    | -   | ns   |
|        | Hold Time      | Thd    | 12  | -    | -   | ns   |
| Hsync  | Period         | TH     | -   | 1224 | -   | Tosc |
|        | Pulse Width    | THS    | 5   | 90   | -   | Tosc |
|        | Back-Porch     | Thb    |     | 114  |     | Tosc |
|        | Display Period | TEP    | -   | 960  | -   | Tosc |
|        | Hsync-den time | THE    | 108 | 204  | 264 |      |
|        | Front-Porch    | Thf    | -   | 60   | -   | Tosc |
| Vsync  | Period         | Tv     | -   | 262  | -   | TH   |
|        | Pulse Width    | Tvs    | 1   | 3    | 5   | TH   |
|        | Back-Porch     | Tvb    | -   | 15   | -   | TH   |
|        | Display Period | Tvd    | -   | 240  | -   | TH   |
|        | Front-Porch    | Tvf    | 2   | 4    | -   | TH   |

Note: 1.  $T_{hp} + T_{hb} = 204$ , the user is make up by yourself.  
2.  $T_v = T_{vs} + T_{vb} + T_{vd} + T_{vf}$ , the user is make up by yourself.  
3. When SYNC mode is used, 1<sup>st</sup> data start from 204<sup>th</sup> Dclk after Hsync falling

**CCIR601/656 Interface**

| Signal | Item       | Symbol | Min | Typ | Max | Unit |
|--------|------------|--------|-----|-----|-----|------|
| Dclk   | Frequency  | Tosc   | -   | 37  | -   | ns   |
|        | High Time  | Tch    | -   | 78  | -   | ns   |
|        | Low Time   | Tcl    | -   | 78  | -   | ns   |
| Data   | Setup Time | Tsu    | 12  | -   | -   | ns   |
|        | Hold Time  | Thd    | 12  | -   | -   | ns   |

## 7.1 Waveform

- CCIR601 (HS\_POL=L in Register R2)

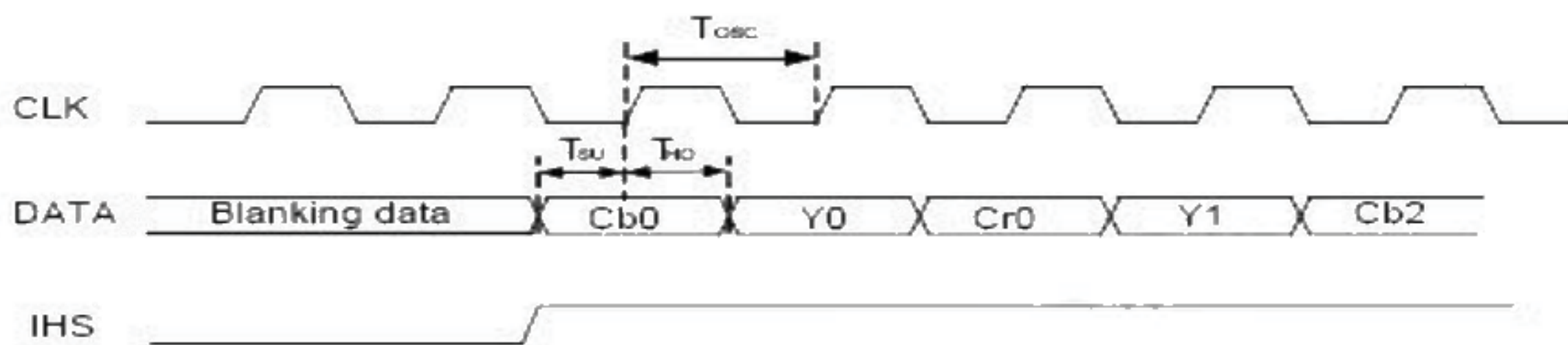


Figure1 CLK,DATA and HIS waveforms in CCIR601

- CCIR656

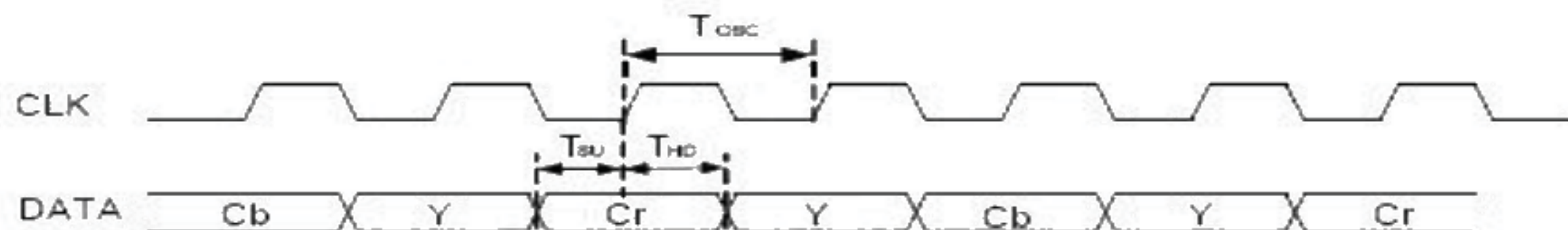


Figure2 CLK and DATA waveforms in CCIR656

- Digital Serial RGB

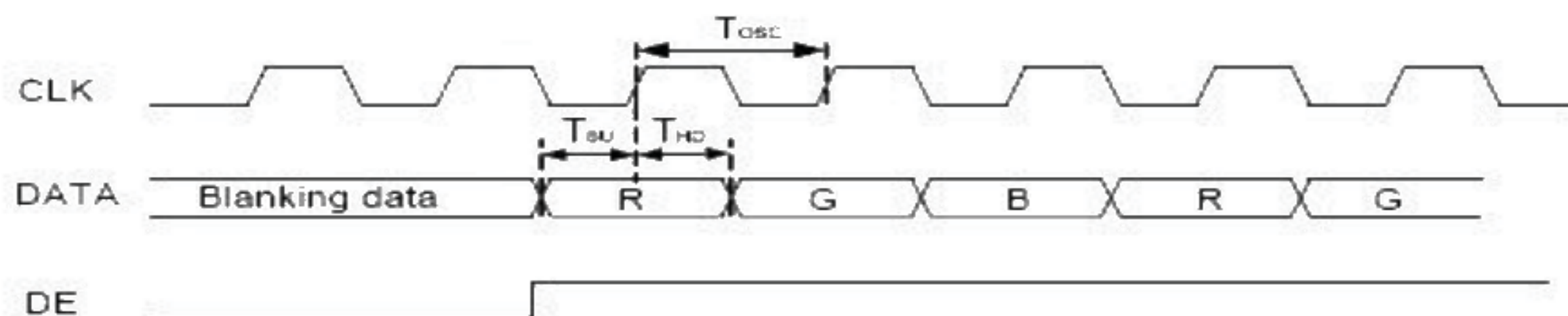


Figure3 CLK, DATA and DE waveforms in Digital Serial RGB

- Digital Parallel RGB

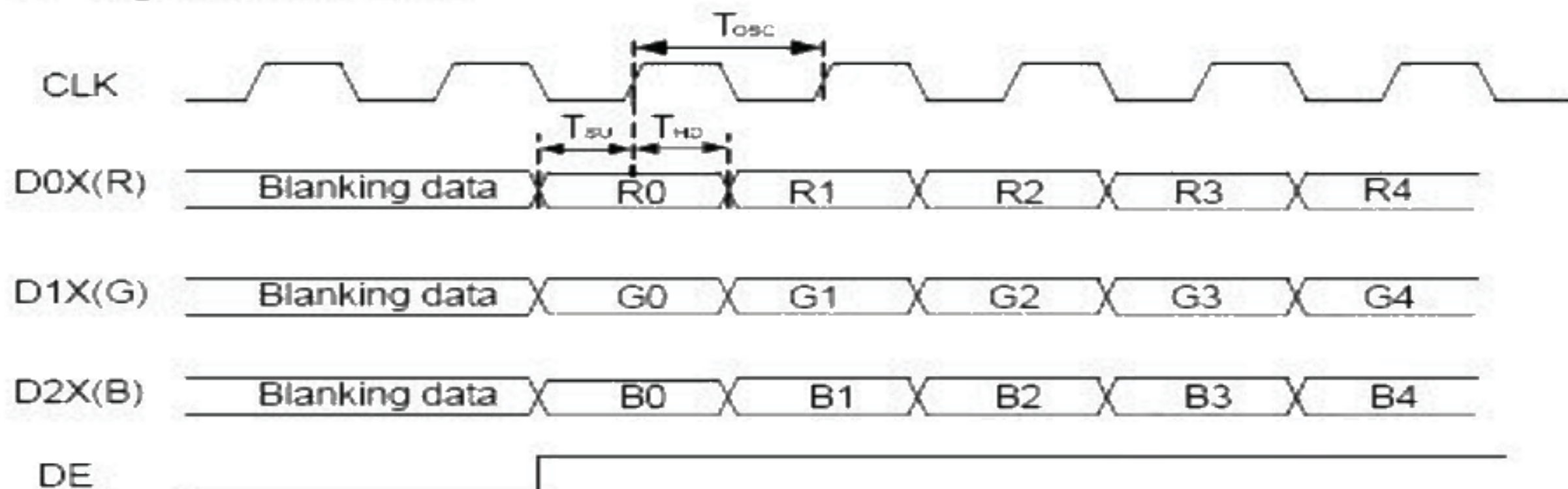


Figure4 CLK, DATA and DE waveforms in Digital Parallel RGB

### 7.1.1 Standby ON/OFF Control

LQ35HC112 has a power ON/OFF sequence control function. When STB pin is pulled L, blank data is outputted for 5-frames first, from the falling edge of the following VSYNC signal. The blank data would be gray level 255 for normally white LC.

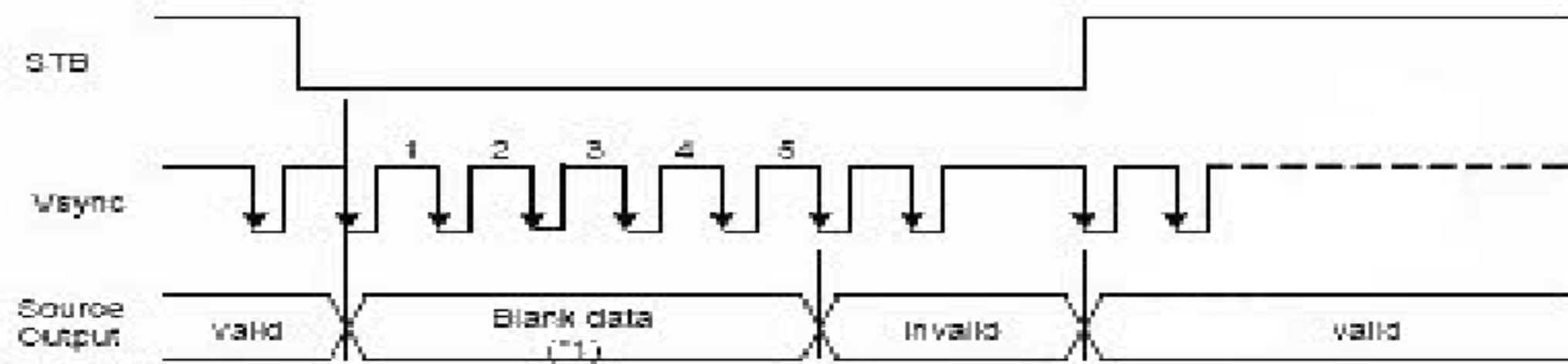


Figure5 Standby ON/OFF Control

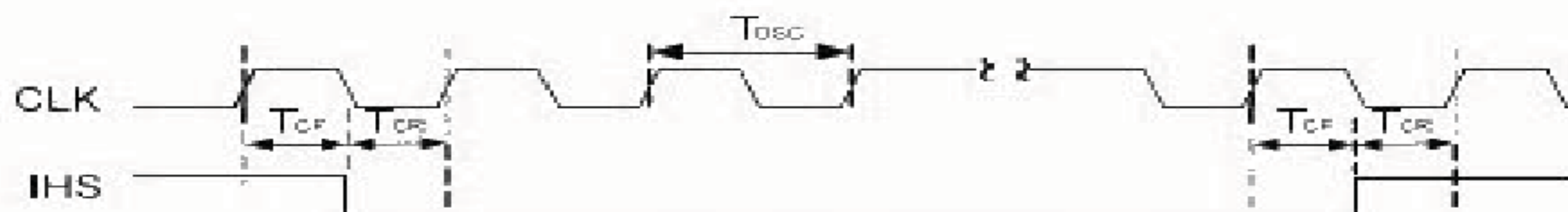


Figure6 CLK and IHS timing waveform

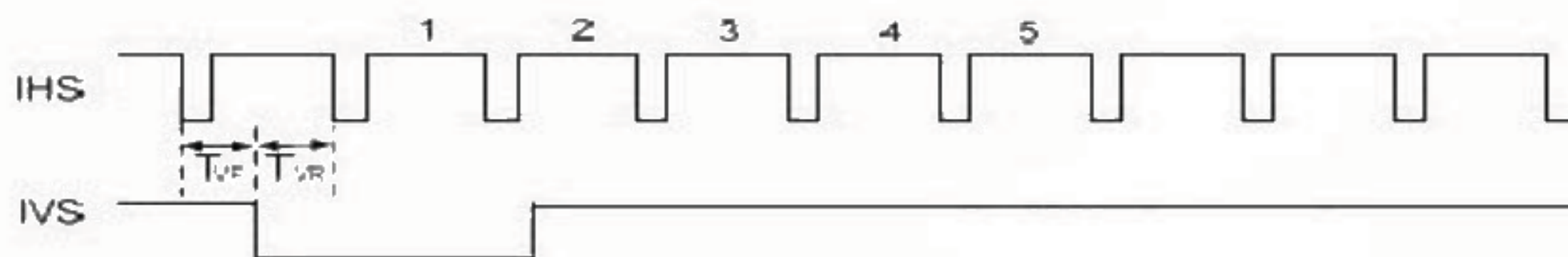
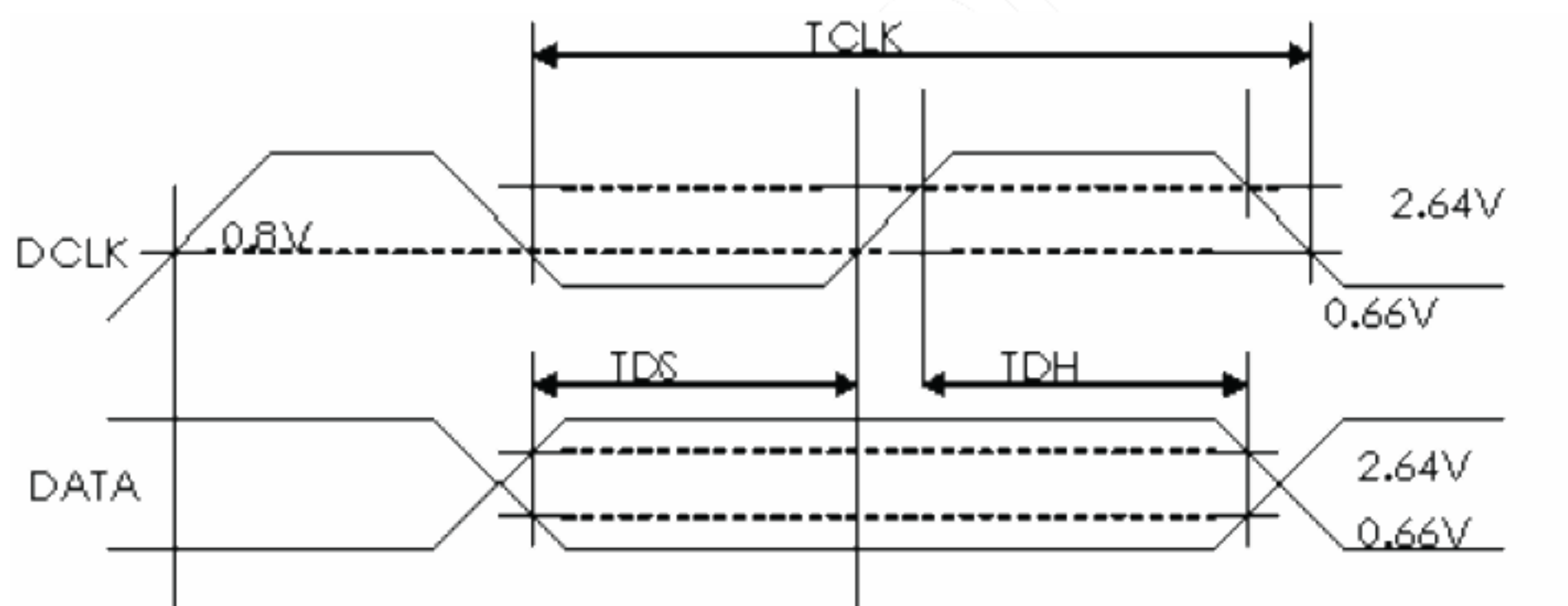
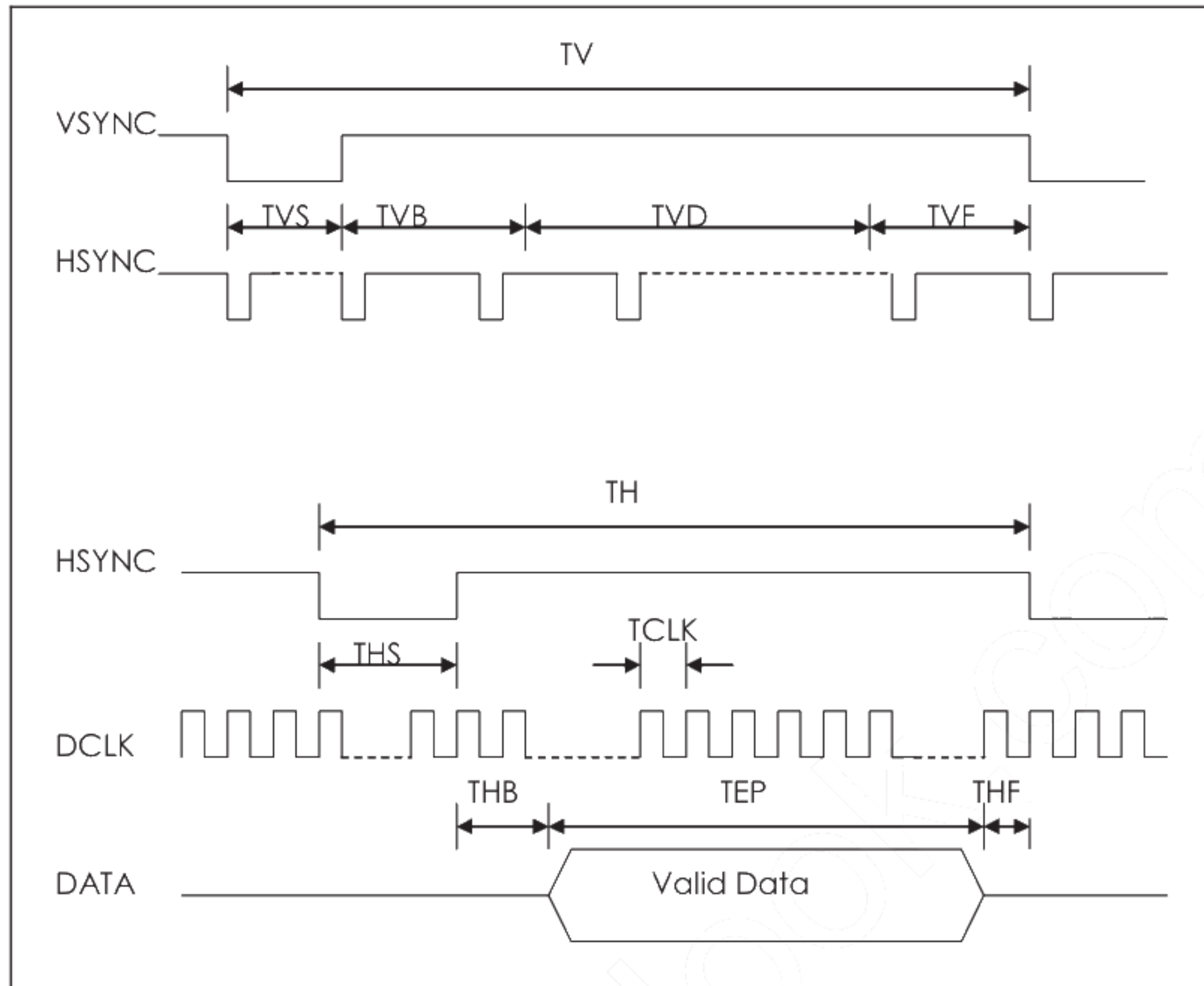
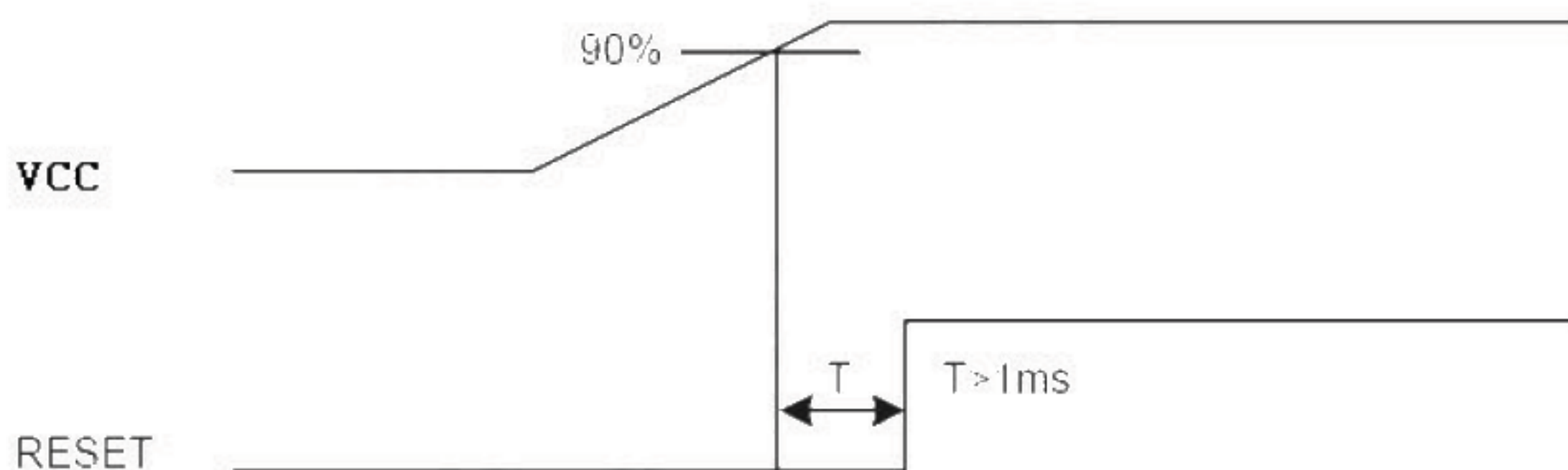


Figure7 IHS and IVS timing waveforms



## 7.2 Reset Timing Chart

The RESET input must be held at least 1ms after power is stable



Reset timing

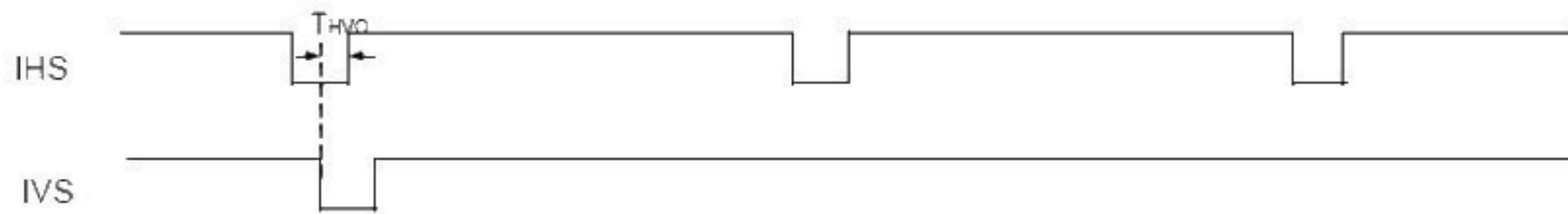
### 7.3 Digital RGB timing waveform

Hsync and Vsync timing

CCIR601 timing waveform VS\_POL=H, HS\_POL=L in Register R2)

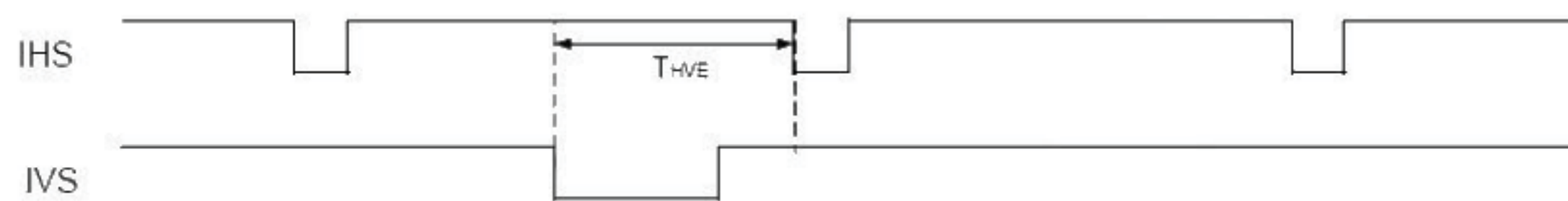
#### IHS and IVS timing

##### ● Odd field



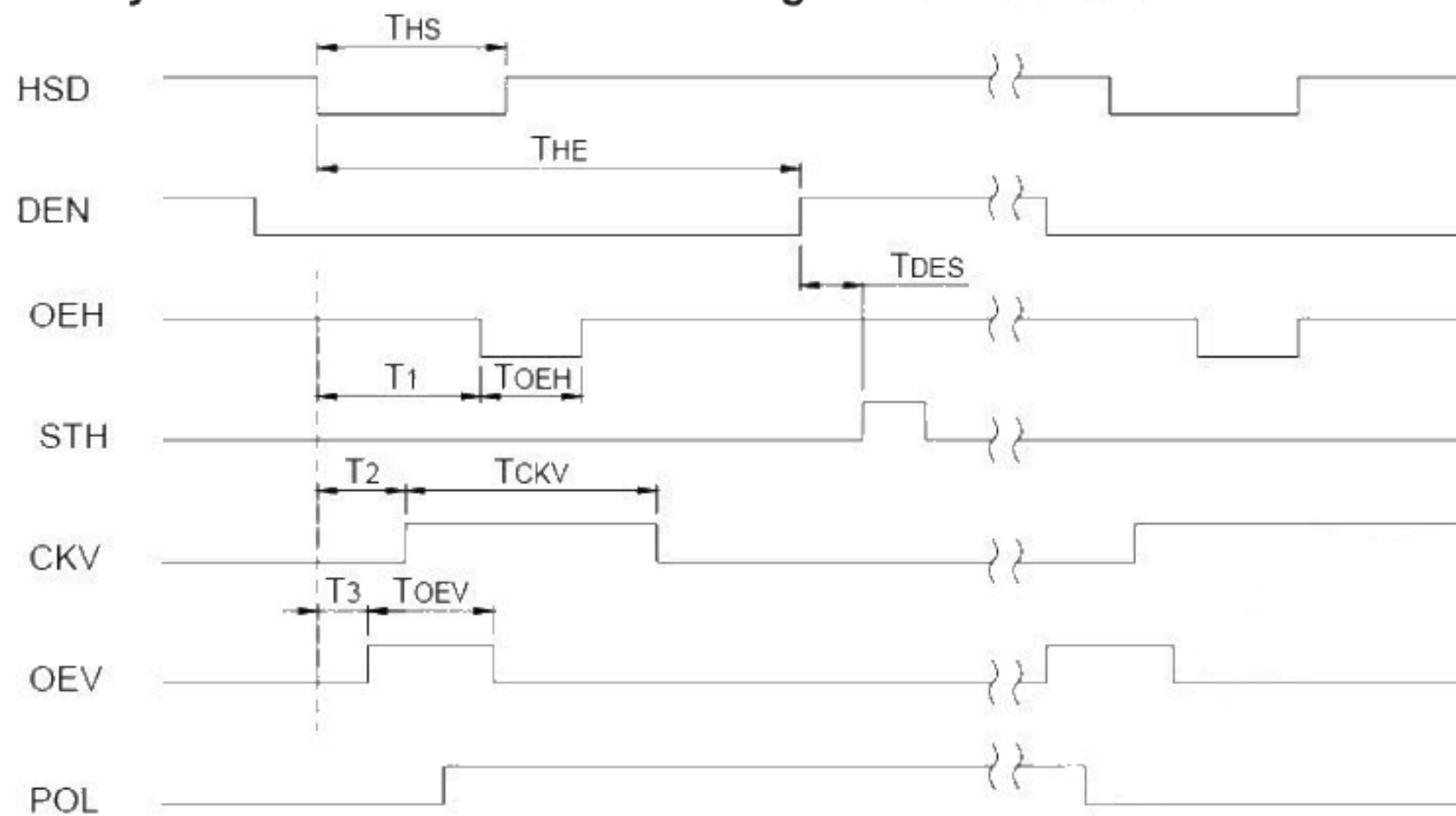
IHS and IVS waveforms in odd field

##### ● Even field

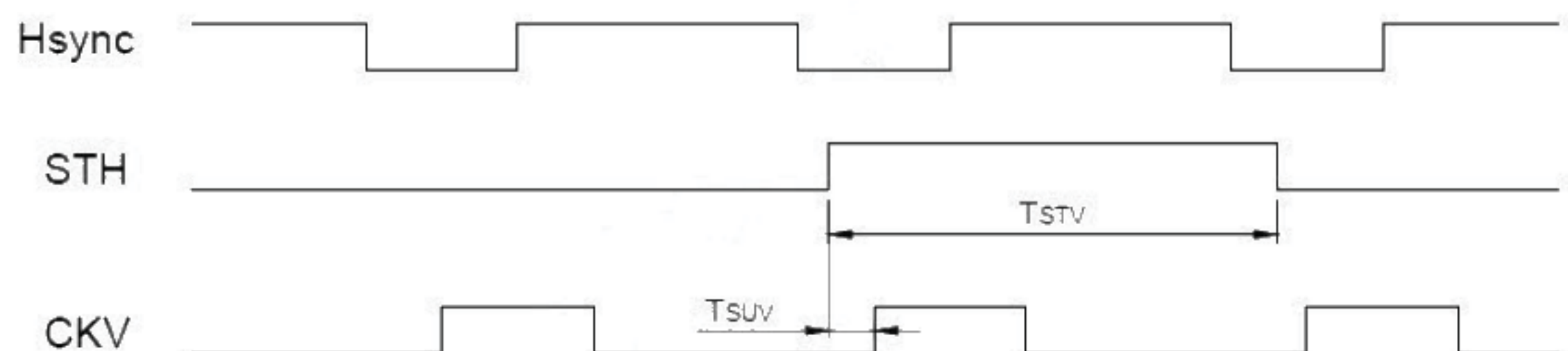


IHS and IVS waveforms in even field

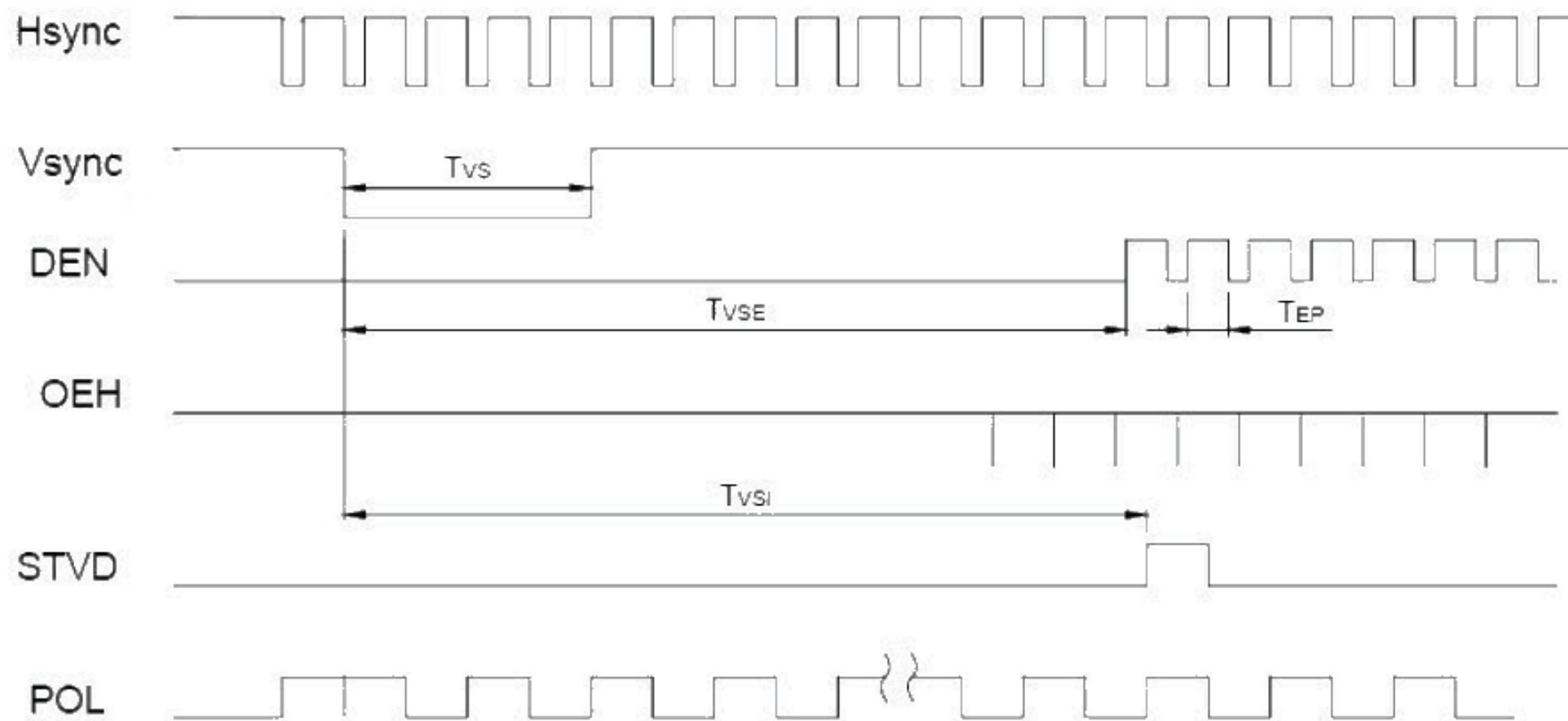
#### 7.3.1 Hsync and horizontal control timing waveform



#### 7.3.2 Hsync and vertical shift clock timing waveform

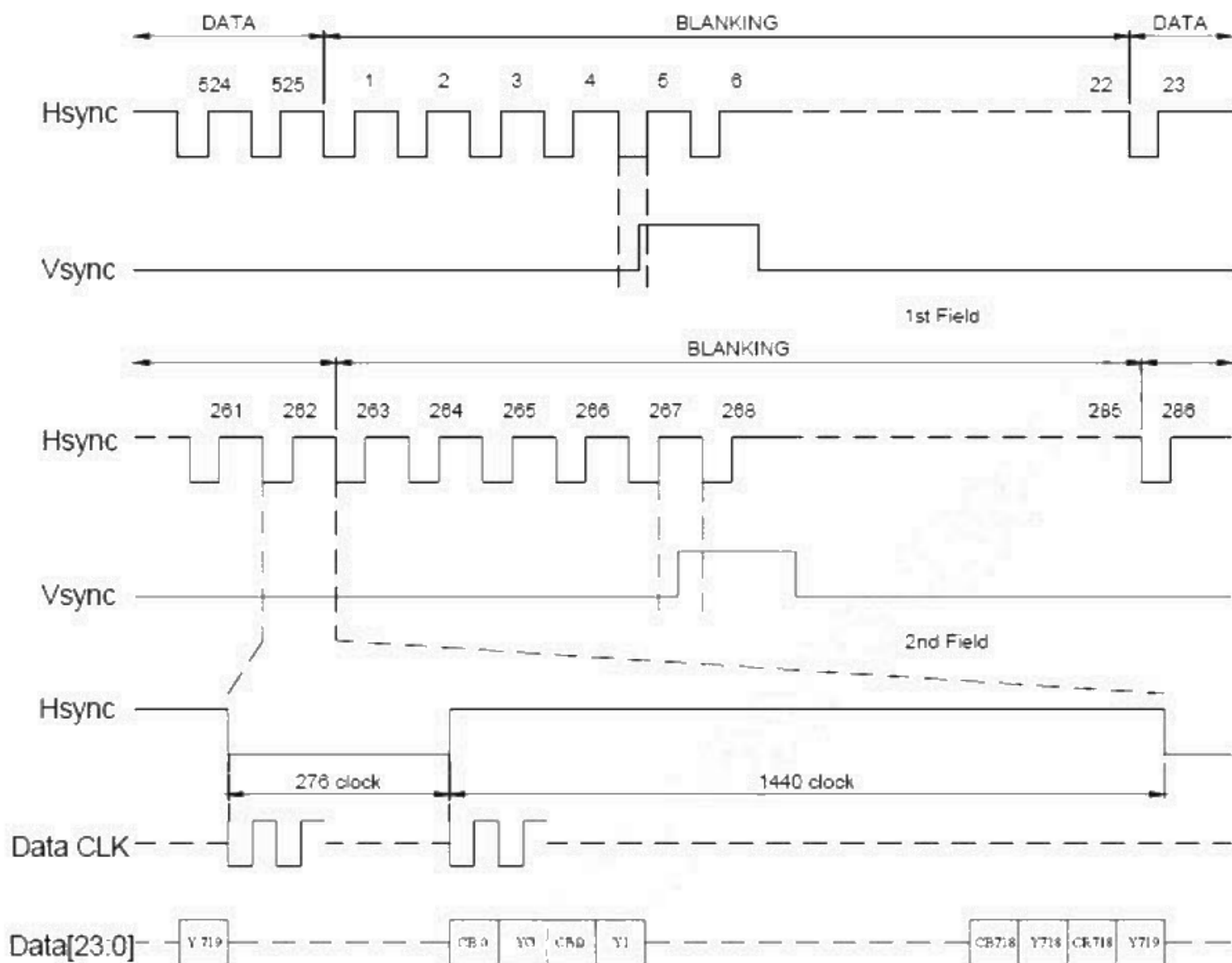


### 7.3.3 Hsync and vertical control timing waveform

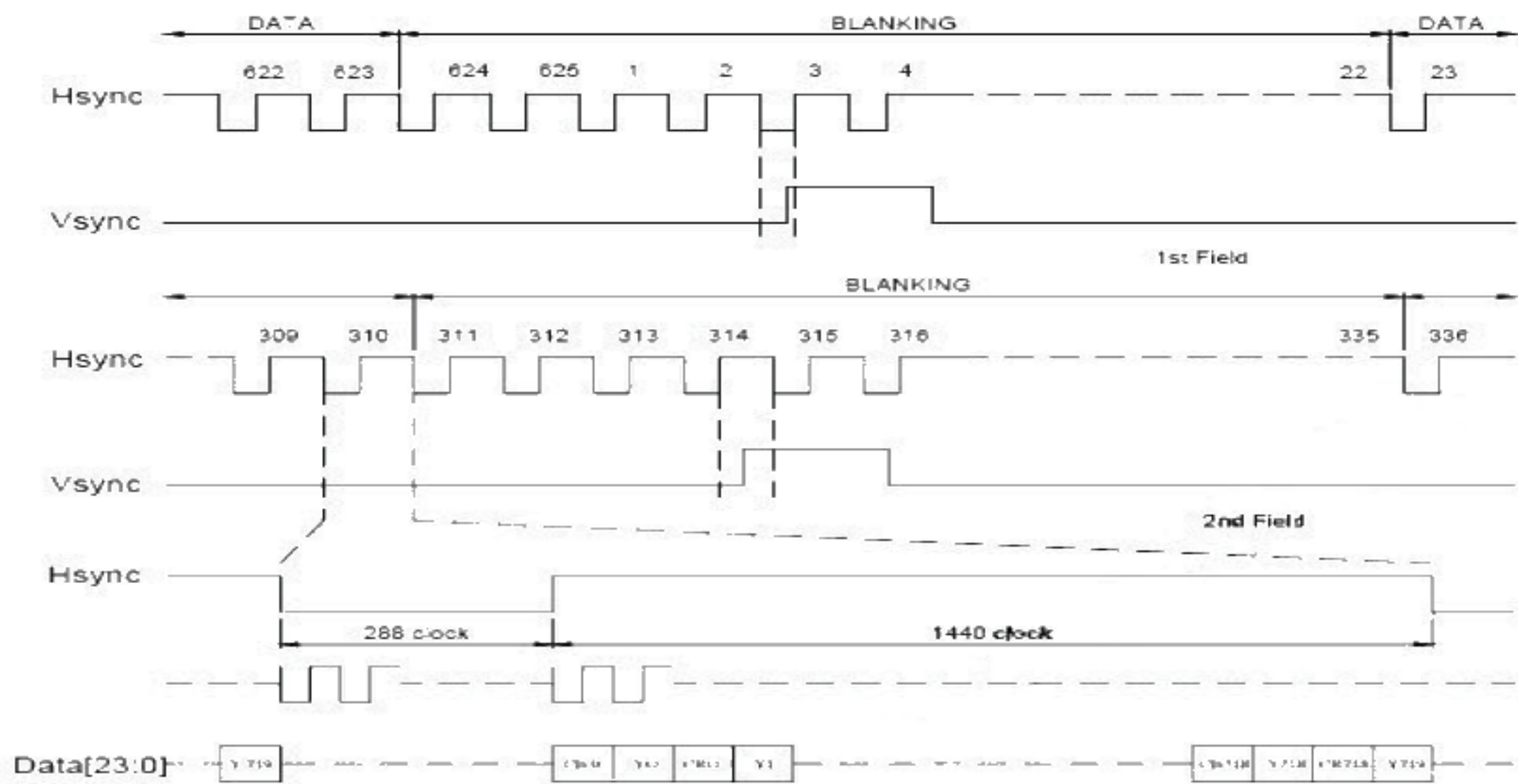


### 7.3.4 CCIR601 timing waveform

CCIR601 timing waveform (VS\_POL="H", HS\_POL="L" in Register R2)

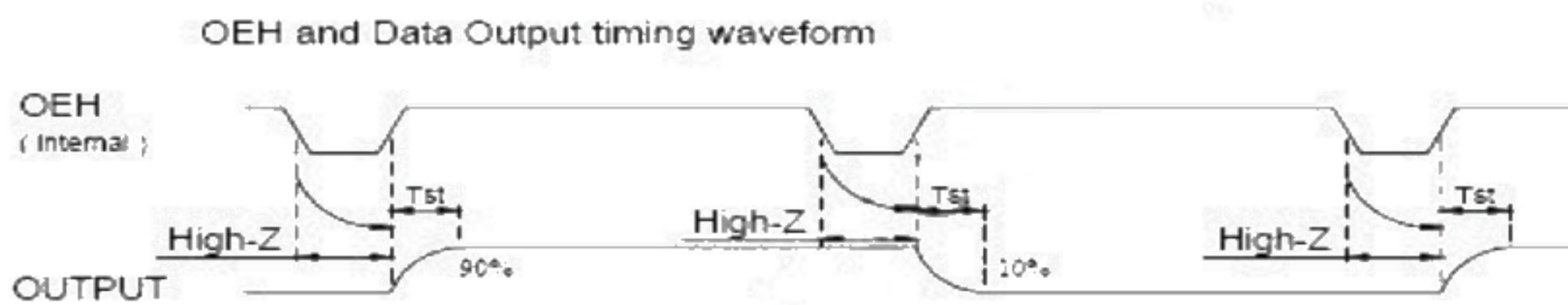
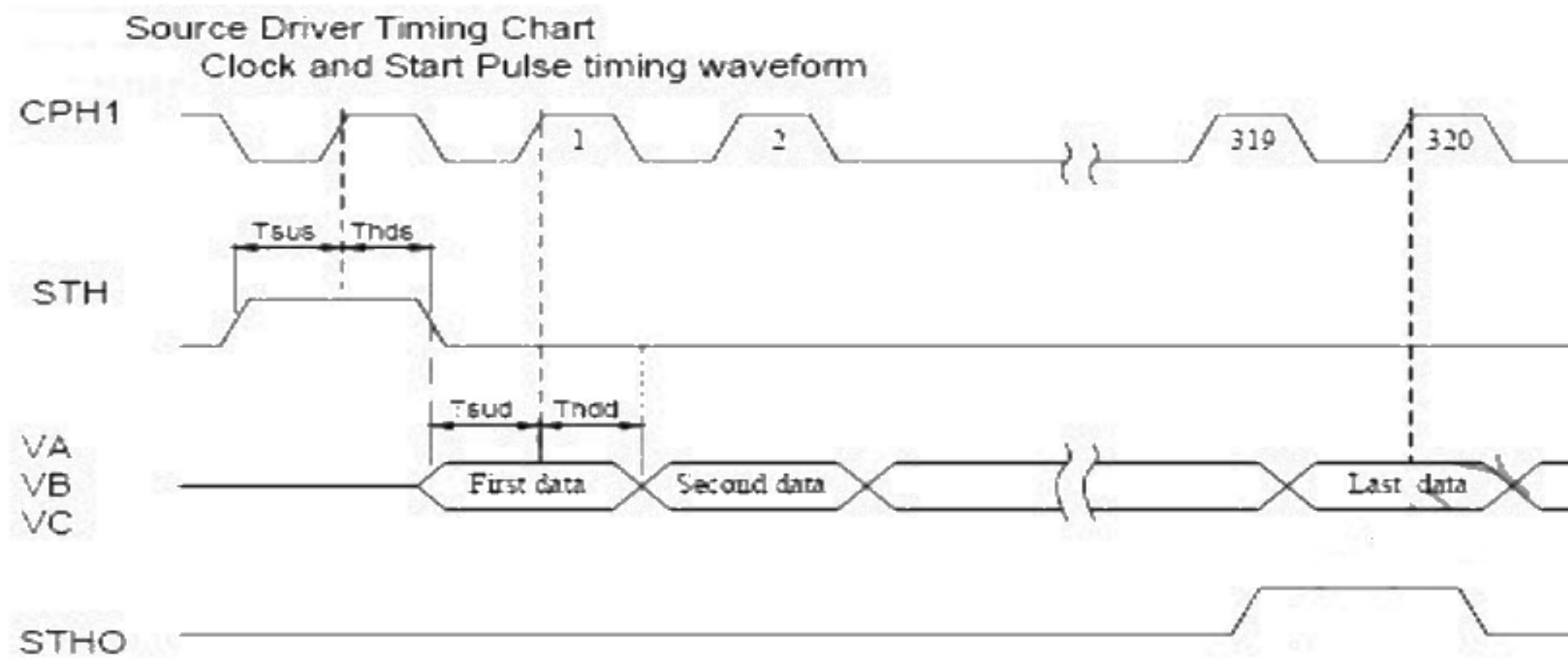


ITU-BT.601 NTSC Input Timing



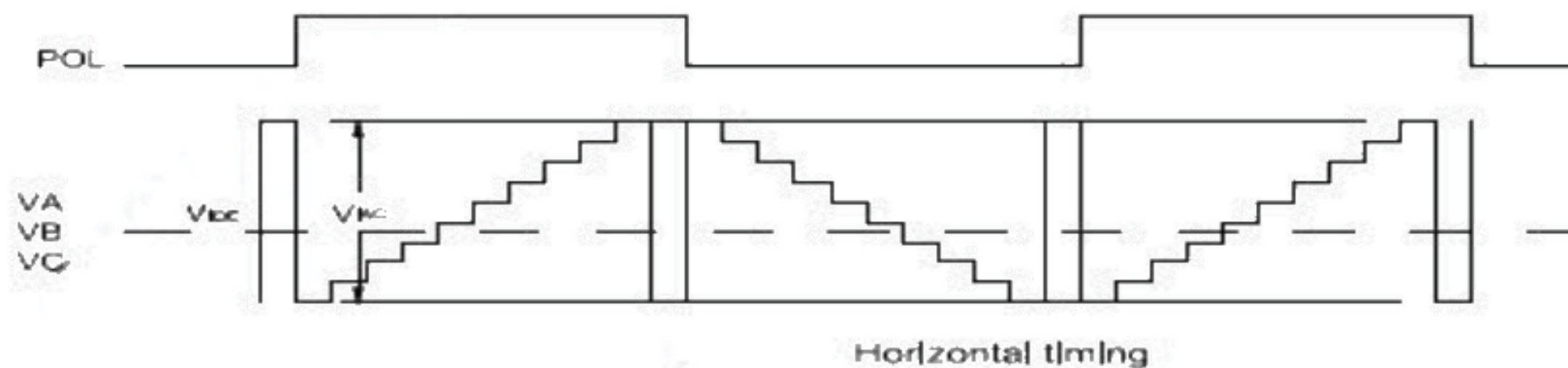
ITU-BT 601 PAL Input Timing

### 7.3.5 Source Driver Timing Chart

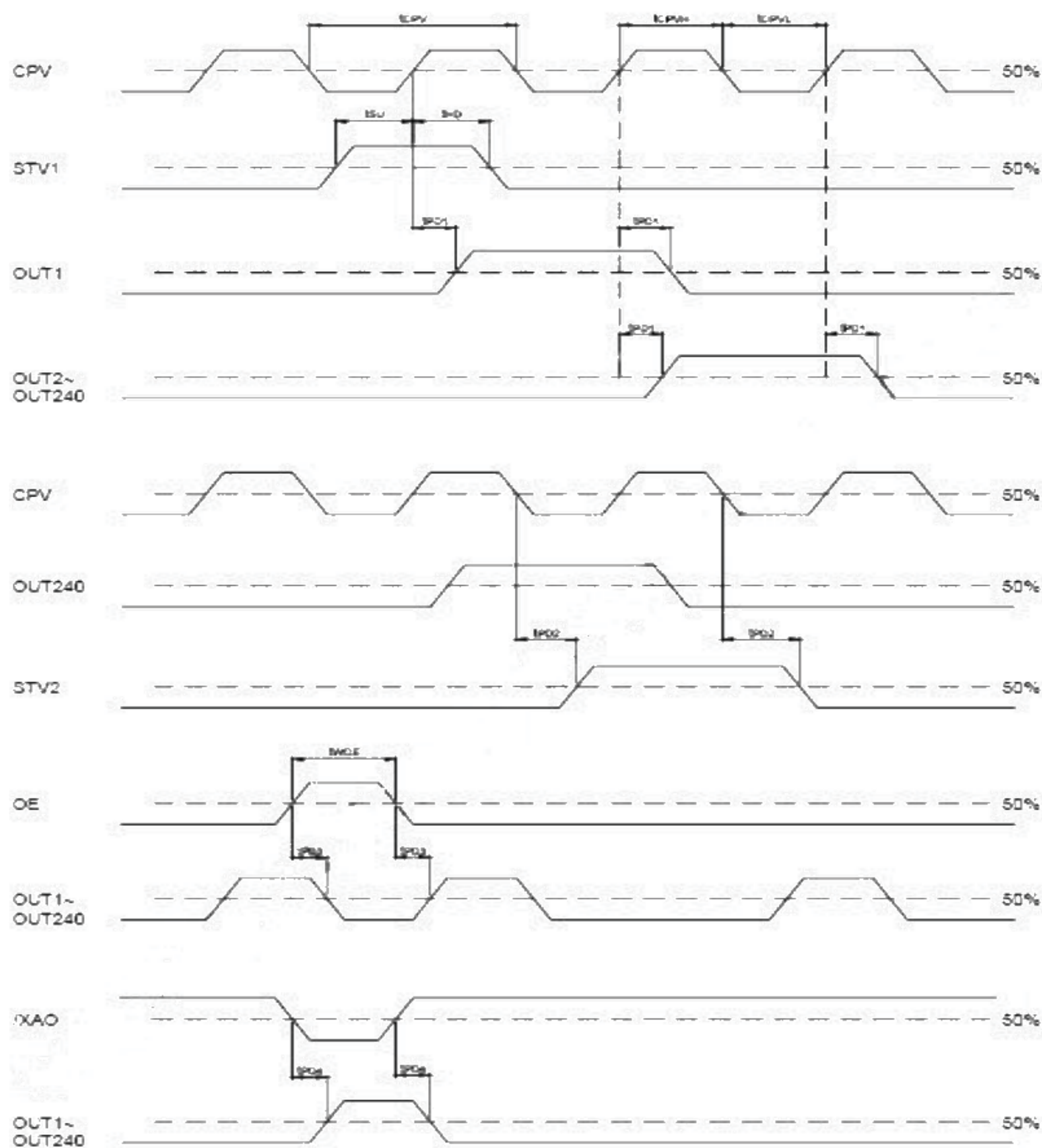


Analog video signal characteristics

| PARAMETER                           | Symbol    | Min. | Typ.  | Max. | Unit |
|-------------------------------------|-----------|------|-------|------|------|
| Video signal amplitude (VA, VB, VC) | $V_{IAC}$ | -    | 3.81  | -    | V    |
|                                     | $V_{IDC}$ | -    | 2.385 | -    | V    |



### 7.3.6 Gate Driver Timing Chart



## 8. OPTICAL CHARACTERISTIC

$T_a=25\pm2^{\circ}\text{C}$ ,  $I_{LED}=20\text{mA}$

| Item               | Symbol | Condition                             | Min.   | Typ.   | Max.   | Unit              | Remark            |
|--------------------|--------|---------------------------------------|--------|--------|--------|-------------------|-------------------|
| Response time      | Tr     | $\theta=0^{\circ}$ 、 $\Phi=0^{\circ}$ | -      | 10     |        | ms                | Note 3,5          |
|                    | Tf     |                                       | -      | 15     |        | ms                |                   |
| Contrast ratio     | CR     | At optimized viewing angle            | 300    | 400    | -      | -                 | Note 4,5          |
| Color Chromaticity | White  | $\theta=0^{\circ}$ 、 $\Phi=0$         | (0.26) | (0.31) | (0.36) |                   | Note 2,6,7        |
|                    |        |                                       | (0.28) | (0.33) | (0.38) |                   |                   |
|                    | Red    | $\theta=0^{\circ}$ 、 $\Phi=0$         |        |        |        |                   |                   |
|                    |        |                                       |        |        |        |                   |                   |
|                    | Green  | $\theta=0^{\circ}$ 、 $\Phi=0$         |        |        |        |                   |                   |
|                    |        |                                       |        |        |        |                   |                   |
|                    | Blue   | $\theta=0^{\circ}$ 、 $\Phi=0$         |        |        |        |                   |                   |
|                    |        |                                       |        |        |        |                   |                   |
| Viewing angle      | Hor.   | $\Theta_R$                            | (50)   | (60)   |        | Deg.              | Note 1            |
|                    |        | $\Theta_L$                            | (50)   | (60)   |        |                   |                   |
|                    | Ver.   | $\Phi_T$                              | (40)   | (50)   |        |                   |                   |
|                    |        | $\Phi_B$                              | (45)   | (55)   |        |                   |                   |
| Brightness         | -      | -                                     | 200    | 250    | -      | cd/m <sup>2</sup> | Center of display |

$T_a=25\pm2^{\circ}\text{C}$ ,  $I_L=20\text{mA}$

Note 1: Definition of viewing angle range

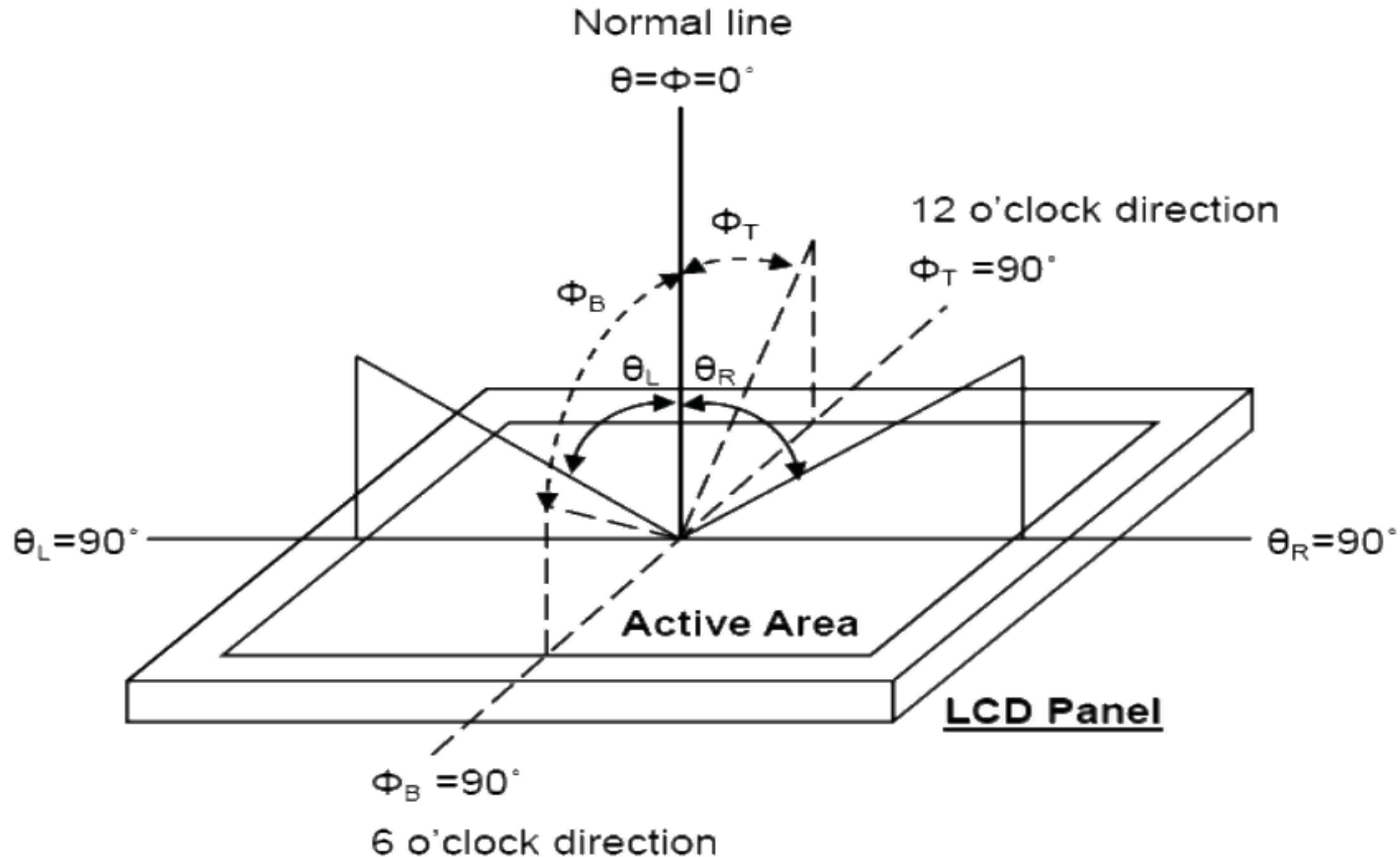


Fig. 8-1 Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

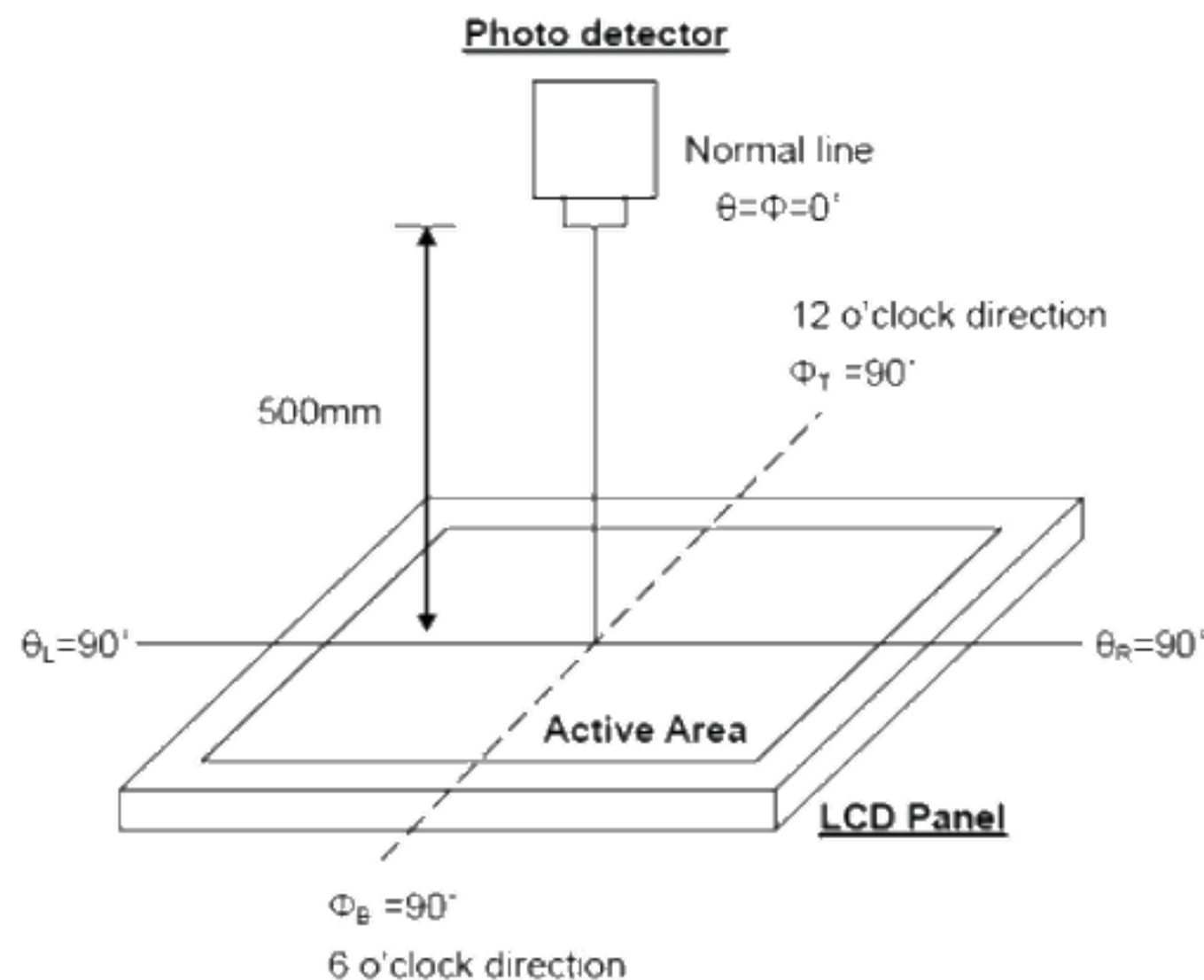


Fig. 8-2 Optical measurement system setup

Note 3: Definition of Response time:

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time,  $T_r$ , is the time between photo detector output intensity changed from 90% to 10%. And fall time,  $T_f$ , is the time between photo detector output intensity changed from 10% to 90%.

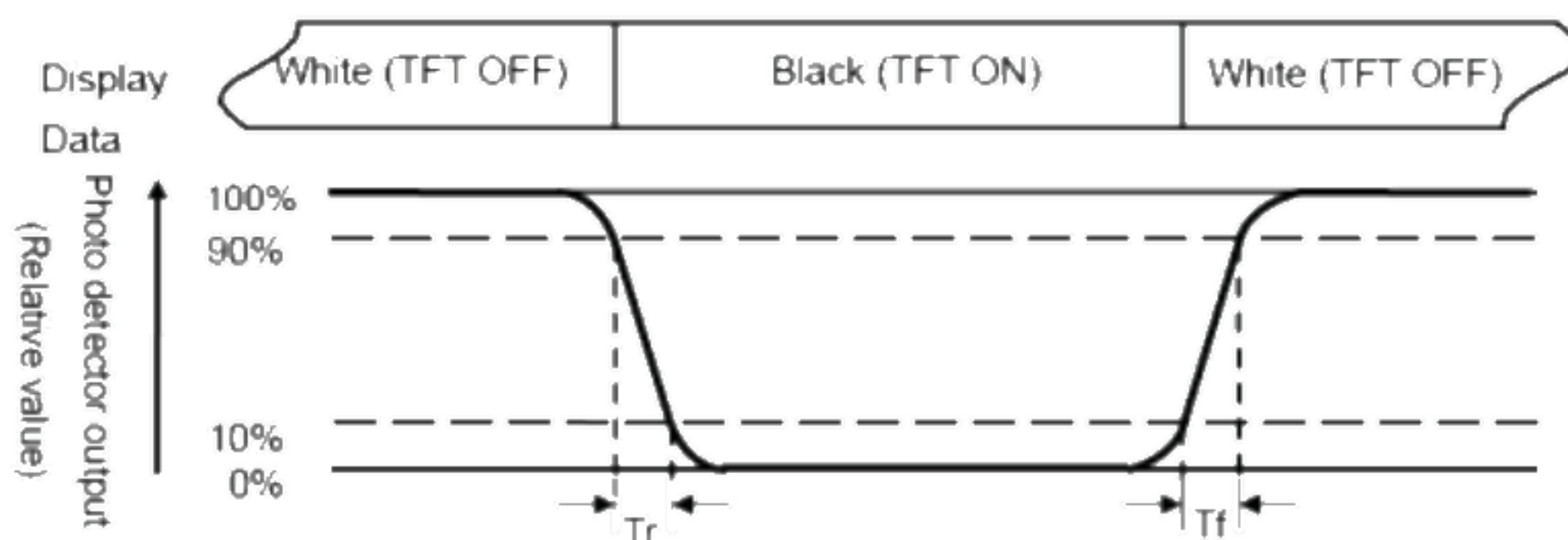


Fig. 3-3 Definition of response time

Note 4: Definition of contrast ratio:

The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: White  $V_i = V_{i50} \pm 1.5V$

Black  $V_i = V_{i50} \pm 2.0V$

“±” means that the analog input signal swings in phase with VCOM signal.

“±” means that the analog input signal swings out of phase with VCOM signal.

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 6: Definition of color chromaticity (CIE 1931)  
Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 8 : Uniformity (U) =  $\frac{\text{Brightness (min)}}{\text{Brightness (max)}} \times 100\%$

## 10. INTERFACE

### 10.1. LCM PIN Definition

| Pin | Symbol | I/O | Function                         | Remark |
|-----|--------|-----|----------------------------------|--------|
| 1   | VBL-   | I   | Backlight LED Ground             |        |
| 2   | VBL-   | I   | Backlight LED Ground             |        |
| 3   | VBL+   | I   | Backlight LED Power              |        |
| 4   | VBL+   | I   | Backlight LED Power              |        |
| 5   | Y1     | I   | Top electrode ,                  |        |
| 6   | X1     | I   | Right electrode                  |        |
| 7   | NC     |     | Not Use                          |        |
| 8   | /RESET | -   | Hardware Reset                   |        |
| 9   | SPENA  | I   | SPI Interface Data Enable Signal | Note 3 |
| 10  | SPCLK  | I   | SPI Interface Data Clock         | Note 3 |
| 11  | SPDAT  | I   | SPI Interface Data               | Note 3 |
| 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 /DX0               | Note 4 |
| 29  | R1     | I   | Red Data Bit1 /DX1               | Note 4 |
| 30  | R2     | I   | Red Data Bit2 /DX2               | Note 4 |
| 31  | R3     | I   | Red Data Bit3 /DX3               | Note 4 |
| 32  | R4     | I   | Red Data Bit4 /DX4               | Note 4 |
| 33  | R5     | I   | Red Data Bit5 /DX5               | Note 4 |
| 34  | R6     | I   | Red Data Bit6 /DX6               | Note 4 |

|    |       |   |                                         |          |
|----|-------|---|-----------------------------------------|----------|
| 35 | R7    | I | Red Data Bit7 /DX7                      | Note 4   |
| 36 | HSYNC | I | Horizontal Sync Input                   |          |
| 37 | VSNC  | I | Vertical Sync Input                     |          |
| 38 | DCLK  | I | Dot Data Clock                          |          |
| 39 | NC    |   | Not Use                                 |          |
| 40 | NC    |   | Not Use                                 |          |
| 41 | Vcc   | I | Digital Power                           |          |
| 42 | Vcc   | I | Digital Power                           |          |
| 43 | Y2    | I | Bottom electrode                        |          |
| 44 | X2    | I | Left electrode                          |          |
| 45 | NC    | - | Internal test use                       |          |
| 46 | NC    | - | Not Use                                 |          |
| 47 | NC    | - | Internal test use                       |          |
| 48 | IF2   | I | Control the input data format /floating | Note 1   |
| 49 | IF1   | I | Control the input data format           | Note 1,5 |
| 50 | IF0   | I | Control the input data format           | Note 1,5 |
| 51 | NC    |   | Not Use                                 |          |
| 52 | DE    | I | Data Enable Input                       | Note 2   |
| 53 | GND   | I | Ground                                  |          |
| 54 | GND   | I | Ground                                  |          |

Note:

1. The mode control (IF2) not use ,it can't control CCIR601 interface , If not use CCIR601 ,it can floating.
2. For digital RGB input data format, both SYNC mode and DE+SYNC mode are supported. If DE signal is fixed low, SYNC mode is used. Otherwise, DE+SYNC mode is used.Suggest used SYNC mode!!
3. usually pull high.
4. IF select serial RGB or CCIR601/656 input mode is selected,only DX0-DX7 used,and the other short to GND, Only selected serial RGB · CCIR601/656 interface,DX BUS will enable,Digital input mode DX0 is LSB and DX7 is MSB.
5. Control the input data format

IF2-0: Define the input interface mode.

| IF2 | IF1 | IF0 | Format                                                              | Operating Frequency |
|-----|-----|-----|---------------------------------------------------------------------|---------------------|
| 0   | 0   | 0   | Parallel-RGB data format<br>(only support stripe type color filter) | 6.5MHz              |
| 0   | 0   | 1   | Serial-RGB data format                                              | 19.5MHz             |
| 0   | 1   | 0   | CCIR 656 data format (640RGB)                                       | 24.54MHz            |
| 0   | 1   | 1   | CCIR 656 data format (720RGB)                                       | 27MHz               |
| 1   | 0   | 0   | YUV mode A data format (Cr-Y-Cb-Y)                                  | 24.54MHz            |
| 1   | 0   | 1   | YUV mode A data format (Cr-Y-Cb-Y)                                  | 27MHz               |
| 1   | 1   | 0   | YUV mode B data format (Cb-Y-Cr-Y)                                  | 27MHz               |
| 1   | 1   | 1   | YUV mode B data format (Cb-Y-Cr-Y)                                  | 24.54MHz            |

| Input format | DOTCLK Freq (MHz) | Display Data | Active Area (DOTCLK) |
|--------------|-------------------|--------------|----------------------|
| YUV mode     | 24.54             | 640          | 1280                 |
|              | 27                | 720          | 1440                 |

| Mode         | D[23:16] | D[15:8] | D[7:0] | IHS | IVS | DEN                                |
|--------------|----------|---------|--------|-----|-----|------------------------------------|
| ITU-R BT 656 | D[23:16] | GND     | GND    | NC  | NC  | NC                                 |
| ITU-R BT 601 | D[23:16] | GND     | GND    | IHS | IVS | NC                                 |
| 8 bit RGB    | D[23:16] | GND     | GND    | IHS | IVS | NC for HV Mode<br>DEN for DEN Mode |
| 24 bit RGB   | R[7:0]   | G[7:0]  | B[7:0] | IHS | IVS | NC for HV Mode<br>DEN for DEN Mode |

## 10.2 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   | $T_{CO}$  | 50   | -    | -    | ns       |
| SPDA output latency      | $T_{CR}$  | -    | 1/2  | -    | $T_{CK}$ |

### ● SPI read timing

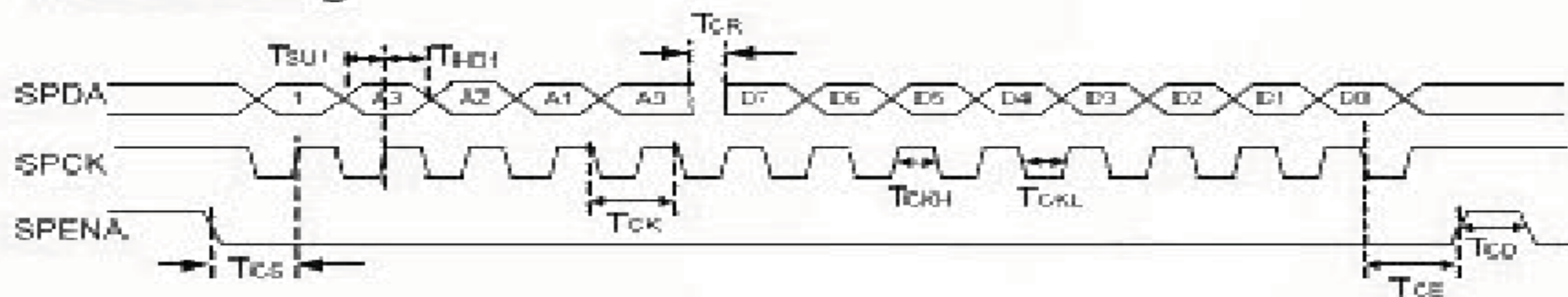


Figure8 SPI read timing

### ● SPI write timing

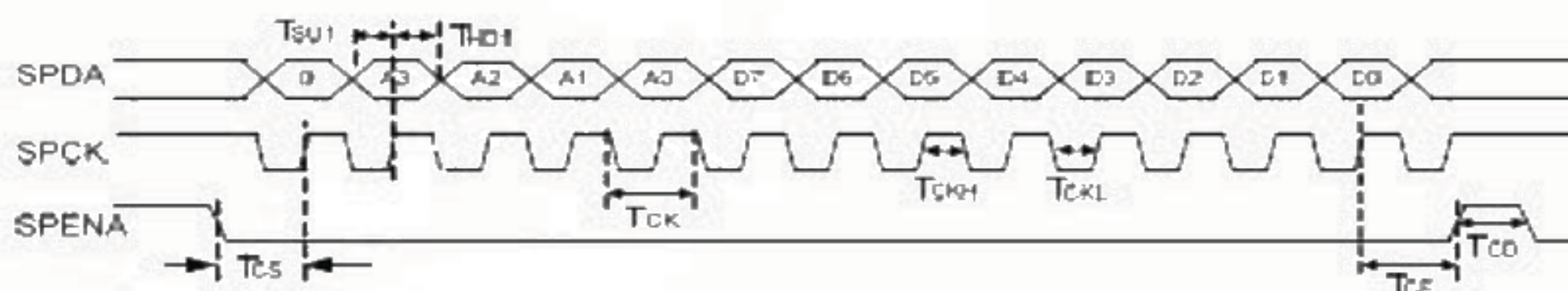


Figure9 SPI write timing

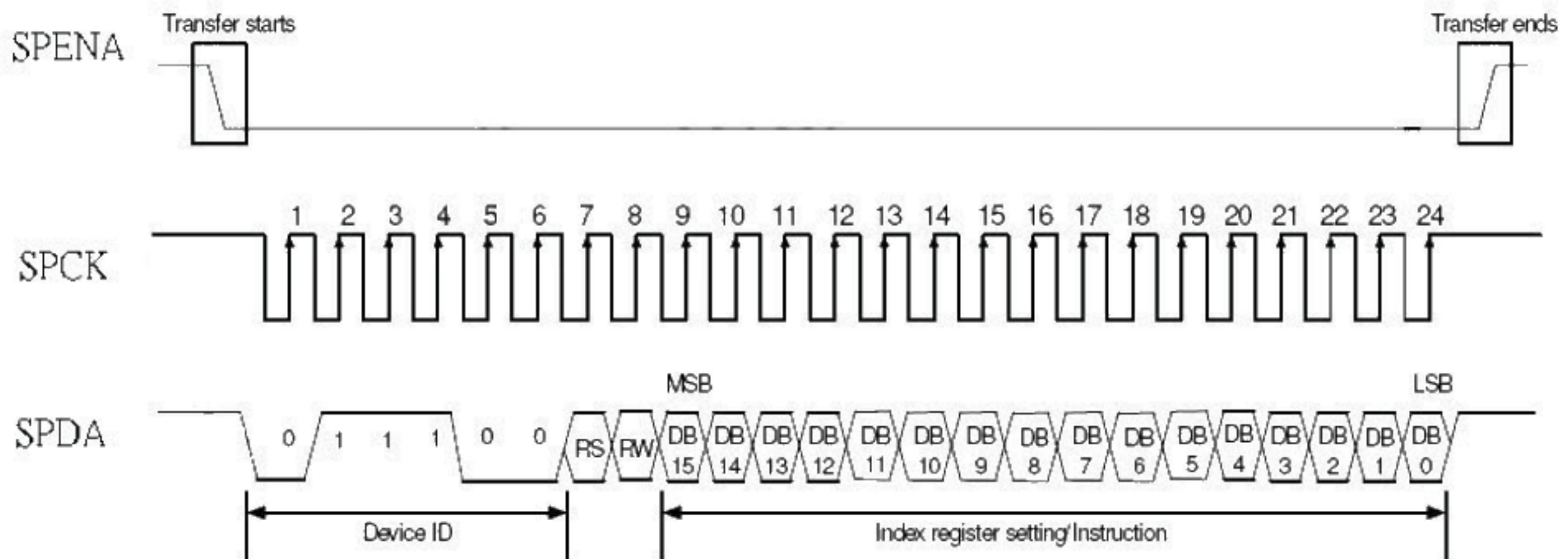


Figure10 SPI timing

### 10.3 SPI Register Description

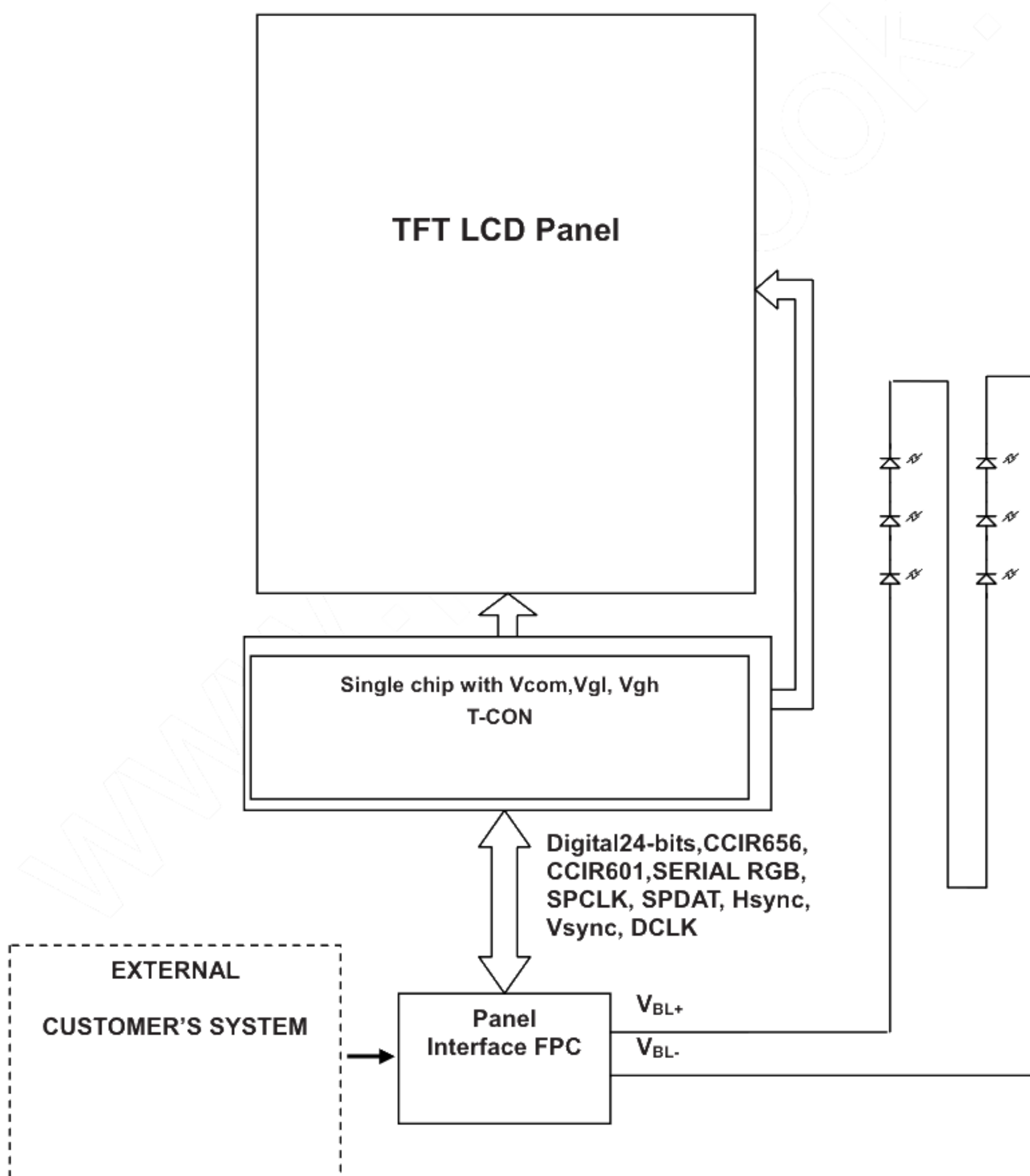
Will be showing on Application Note From Chilintech.

### 10.4 Basic Display Color and Gray Scale

| Color        |                 | Input Color Data |    |    |    |    |    |     |    |       |    |    |    |    |    |     |    |      |    |    |    |    |    |     |    |
|--------------|-----------------|------------------|----|----|----|----|----|-----|----|-------|----|----|----|----|----|-----|----|------|----|----|----|----|----|-----|----|
|              |                 | Red              |    |    |    |    |    |     |    | Green |    |    |    |    |    |     |    | Blue |    |    |    |    |    |     |    |
|              |                 | MSB              |    |    |    |    |    | LSB |    | MSB   |    |    |    |    |    | LSB |    | MSB  |    |    |    |    |    | LSB |    |
|              |                 | 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 Colors | Black           | 0                | 0  | 0  | 0  | 0  | 0  | 0   | 0  | 0     | 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  | 0   | 0  |
|              | Green(255)      | 0                | 0  | 0  | 0  | 0  | 0  | 0   | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1   | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0   | 0  |
|              | Blue(255)       | 0                | 0  | 0  | 0  | 0  | 0  | 0   | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0   | 0  | 1    | 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   | 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   | 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   | 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   | 1  |
| Red          | Red(0) Dark     | 0                | 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)          | 0                | 0  | 0  | 0  | 0  | 0  | 0   | 1  | 0     | 0  | 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  | 0   | 0  |
|              | :               | :                | :  | :  | :  | :  | :  | :   | :  | :     | :  | :  | :  | :  | :  | :   | :  | :    | :  | :  | :  | :  | :  | :   | :  |
|              | Red(253)        | 1                | 1  | 1  | 1  | 1  | 1  | 0   | 1  | 0     | 0  | 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  | 0   | 0  |
|              | Red(255) Bright | 1                | 1  | 1  | 1  | 1  | 1  | 1   | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0   | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0   | 0  |

|       |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green | Green(0) Dark    | 0 | 0 | 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 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|       | Green(2)         | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|       | :                | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
|       | Green(253)       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|       | Green(254)       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|       | Green(255)Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue  | Blue(0) Dark     | 0 | 0 | 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 | 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 | 0 | 0 |
|       | :                | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
|       | Blue(253)        | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
|       | Blue(254)        | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
|       | Blue(255) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## 11. BLOCK DIAGRAM



## 12. QUALITY ASSURANCE

| No. | Test Items                                        | Test Condition                                                                                                                              | REMARK        |
|-----|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1   | High Temperature Storage Test                     | Ta=80°C Dry 240h                                                                                                                            |               |
| 2   | Low Temperature Storage Test                      | Ta=-30°C Dry 240h                                                                                                                           |               |
| 3   | High Temperature Operation Test                   | Ta=70°C Dry 240h                                                                                                                            |               |
| 4   | Low Temperature Operation Test                    | Ta=-20°C Dry 240h                                                                                                                           |               |
| 5   | High Temperature and High Humidity Operation Test | Ta=60°C 90%RH 240h                                                                                                                          |               |
| 6   | Electro Static Discharge Test                     | Panel surface / top case.<br>Contact / Air : ±6KV / ±8KV ,<br>150pF , 330Ω                                                                  | Non-operating |
| 7   | Shock Test (non-operating)                        | Shock Level : 100G<br>Waveform : Half Sinusoidal<br>Wave<br>Shock Time : 6ms<br>Number of Shocks : 3 times for<br>each ±X, ±Y, ±Z direction |               |
| 8   | Vibration Test (non-operating)                    | Frequency range: 10Hz ~<br>550Hz<br>Stoke : 1.3mm<br>Sweep : 1.5G, 33.3~400Hz<br>Vibration : Sinusoidal Wave, 1Hrs<br>for X,YZ direction.   |               |
| 9   | Thermal Shock Test                                | -20°C (0.5h) ~ 70°C (0.5h) / 100<br>cycles                                                                                                  |               |

\*\*\*\*\* Ta= Ambient Temperature

Note:

1. The test samples have recovery time for 2 hours at room temperature before the function check. In the standard conditions, there is no display function NG issue occurred.
2. All the cosmetic specifications are judged before the reliability stress.

[illegible]



## 15 RECAUTIONS

Please pay attention to the following when you use this TFT LCD module.

### 15.1 MOUNTING PRECAUTIONS

- (1) You must mount a module using arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.  
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach a transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not describe because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.  
Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are determined to the polarizer)
- (7) When the surface becomes dusty, please wipe gently with adsorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

### 15.2 OPERATING PRECAUTIONS

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :  $V=\pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower)  
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

### 15.3 ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wristband etc. And don't touch interface pin directly.

### 15.4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

## 15.5 STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

## 15.6 HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) The protection film is attached to the polarizer with a small amount of glue. Is apt to remain on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- (3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- (4) You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.