



**RAYSTAR**

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## RFC350L-AIH-DNN

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### SPECIFICATION

CUSTOMER:

|             |  |
|-------------|--|
| APPROVED BY |  |
| PCB VERSION |  |
| DATE        |  |

FOR CUSTOMER USE ONLY

| SALES BY | APPROVED BY | CHECKED BY | PREPARED BY |
|----------|-------------|------------|-------------|
|          |             |            |             |

Release DATE:

## Revision History

| VERSION | DATE       | REVISED PAGE NO. | Note  |
|---------|------------|------------------|---|
| 0       | 2014/01/16 |                  | First issue   |
| A       | 2016/02/25 |                  | Add size & Surface.<br>Modify LED Life Time,<br>Block Diagram &<br>Static electricity test. |
| B       | 2016/08/08 |                  | Modify Reliability.<br>Remove Package<br>Specification                                      |
| C       | 2016/08/11 |                  | Modify Vibration test   |
| D       | 2016/10/17 |                  | Modify Summary  |

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## 1.Module Classification Information

|          |          |          |           |           |          |          |          |          |          |          |          |          |
|----------|----------|----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>R</b> | <b>F</b> | <b>C</b> | <b>35</b> | <b>0L</b> | <b>-</b> | <b>A</b> | <b>I</b> | <b>H</b> | <b>-</b> | <b>D</b> | <b>N</b> | <b>N</b> |
| 1        | 2        | 3        | 4         | 5         | -        | 6        | 7        | 8        | -        | 9        | 10       | 11       |

| Item | Description   |  |
|------|---|--|
| 1    | R : Raystar Optonics Inc.   |  |
| 2    | Display Type : F→TFT Type, J→ Custom TFT  |  |
| 3    | Solution: A: 128x160    B:320x234    C:320x240    D:480x234    E:480x272<br>F:800x480    G:640x480    H:1024x600    I:320x480    J:240x320<br>K:1280x800    L:240x400    M:1024x768    N:128x128    O:480x800<br>P:640x320    Q:800x600    S:480x128    T:800x320 |  |
| 4    | Display Size : 3.5" TFT   |  |
| 5    | Version Code.   |  |
| 6    | Model Type:<br>A : TFT LCD<br>E : TFT+FR+CONTROL BOARD<br>J : TFT+FR+A/D BOARD<br>N : TFT+FR+A/D BOARD+CONTROL BOARD<br>S : TFT+FR+POWER BOARD (DC TO DC)<br>1 : TFT+CONTROL BOARD  | 6 : TFT+FR<br>H : TFT+D/V BOARD<br>I : TFT+FR+D/V BOARD<br>B : TFT+POWER BD  |
| 7    | Polarizer Type,<br>Temperature range,<br>View direction   | I→Transmissive, W. T, 6:00 ; C→Transmissive, N. T, 6:00<br>L→Transmissive, W.T,12:00 ; F→Transmissive, N.T,12:00<br>Y→Transmissive,W.T, IPS TFT ;<br>A→Transmissive, N.T, IPS TFT<br>Z→Transmissive, W.T, O-TFT<br>R→Transmissive, Super W.T, O-TFT<br>N→Transmissive, Super W.T, 6:00;<br>Q→Transmissive, Super W.T, 12:00<br>V→Transmissive, Super W.T, VA TFT |
| 8    | Backlight   | W : LED, White                      H : LED, High Light White<br>F : CCFL, White   |
| 9    | Driver Method   | D: Digital    A: Analog    L : LVDS    M:MIPI  |
| 10   | Interface   | N : without control board    A : 8Bit    B : 16Bit<br>S:SPI Interface    R: RS232    U:USB    I: I2C   |
| 11   | TS  | N : Without TS    S : resistive touch panel<br>C : capacitive touch panel capacitive touch panel (G-F-F)<br>G : capacitive touch panel(G-G)  |

## 2.Summary

TFT 3.5" is a TN transmissive type color active matrix TFT liquid crystal display that use amorphous silicon TFT as switching devices. This module is composed of a TFT\_LCD module, it is usually designed for industrial application and this module follows RoHs,

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### 3.General Specifications

- Size: 3.5 inch
- Dot Matrix: 320 x RGBx240(TFT) dots
- Module dimension: 76.9(W) x 63.9(H) x 3.26(D) mm
- Active area: 70.08 x 52.56 mm
- Dot pitch: 0.073 x 0.219 mm
- LCD type: TFT, Normally White, Transmissive
- View Direction: 12 o'clock
- Gray Scale Inversion Direction: 6 o'clock
- Backlight Type: LED, Normally White
- With /Without TP: Without TP
- Surface: Anti-Glare

\*Color tone slight changed by temperature and driving voltage.

## 4.Interface

### 4.1. LCM PIN Definition

| Pin | Symbol | Function                               | Remark |
|-----|--------|--|--------|
| 1   | LED-   | Power for LED backlight cathode        |        |
| 2   | LED-   | Power for LED backlight cathode        |        |
| 3   | LED+   | Power for LED backlight anode          |        |
| 4   | LED+   | Power for LED backlight anode          |        |
| 5   | NC     | No connect                             |        |
| 6   | NC     | No connect                             |        |
| 7   | NC     | No connect                             |        |
| 8   | /RESET | Hardware reset                         |        |
| 9   | SPENA  | Chip select pin of serial interface    |        |
| 10  | SPCLK  | Clock pin of serial interface          |        |
| 11  | SPDAT  | Data input pin in serial mode          |        |
| 12  | B0     | Data bus                               |        |
| 13  | B1     | Data bus                               |        |
| 14  | B2     | Data bus                               |        |
| 15  | B3     | Data bus                               |        |
| 16  | B4     | Data bus                               |        |
| 17  | B5     | Data bus                               |        |
| 18  | B6     | Data bus                               |        |
| 19  | B7     | Data bus                               |        |
| 20  | G0     | Data bus                               |        |
| 21  | G1     | Data bus                               |        |
| 22  | G2     | Data bus                               |        |
| 23  | G3     | Data bus                               |        |
| 24  | G4     | Data bus                               |        |
| 25  | G5     | Data bus                               |        |
| 26  | G6     | Data bus                               |        |
| 27  | G7     | Data bus                               |        |
| 28  | R0     | Data bus                               |        |
| 29  | R1     | Data bus                               |        |
| 30  | R2     | Data bus                               |        |
| 31  | R3     | Data bus                               |        |
| 32  | R4     | Data bus                               |        |
| 33  | R5     | Data bus                               |        |
| 34  | R6     | Data bus                               |        |
| 35  | R7     | Data bus                               |        |
| 36  | HSYNC  | Line synchronization signal            |        |
| 37  | VSYNC  | Frame synchronization signal           |        |
| 38  | DCLK   | Dot-clock signal and oscillator source |        |
| 39  | NC     | No connect                             |        |
| 40  | NC     | No connect                             |        |
| 41  | VCC    | Power Supply                           |        |
| 42  | VCC    | Power Supply                           |        |

|           |             |  |  |
|-----------|-------------|--|--|
| <b>43</b> | <b>NC</b>   | No connect   |  |
| <b>44</b> | <b>NC</b>   | No connect   |  |
| <b>45</b> | <b>NC</b>   | No connect   |  |
| <b>46</b> | <b>NC</b>   | No connect   |  |
| <b>47</b> | <b>NC</b>   | No connect   |  |
| <b>48</b> | <b>SEL2</b> | Input pin to select input interface mode   |  |
| <b>49</b> | <b>SEL1</b> | Input pin to select input interface mode   |  |
| <b>50</b> | <b>SEL0</b> | Input pin to select input interface mode   |  |
| <b>51</b> | <b>NC</b>   | No connect   |  |
| <b>52</b> | <b>DE</b>   | Display enable pin from controller. Internal pull high<br>Connect to VCCIO or floating if not used |  |
| <b>53</b> | <b>DGND</b> | System ground pin of the IC.<br>Connect to system ground.  |  |
| <b>54</b> | <b>AVSS</b> | Grounding for analog circuit<br>-Connect to system ground  |  |



**Note:**

1. The mode control (SEL2) 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

| <b>SEL2</b> | <b>SEL1</b> | <b>SEL0</b> | <b>Format</b>   | <b>Operating Frequency</b> |
|-------------|-------------|-------------|---|----------------------------|
| 0           | 0           | 0           | Parallel-RGB data format<br>(only support stripe type color filter) | 6.5MHZ                     |
| 0           | 0           | 1           | Serial-RGB data format  | 19.5 MHZ                   |
| 0           | 1           | 0           | CCIR 656data format (640RGB)  | 24.54 MHZ                  |
| 0           | 1           | 1           | CCIR 656data format (720RGB)  | 27 MHZ                     |
| 1           | 0           | 0           | YUV mode A data format(Cr-Y-Cb-Y)                                   | 24.54 MHZ                  |
| 1           | 0           | 1           | YUV mode A data format(Cr-Y-Cb-Y)                                   | 27 MHZ                     |
| 1           | 1           | 0           | YUV mode B data format(Cr-Y-Cr-Y)                                   | 27 MHZ                     |
| 1           | 1           | 1           | YUV mode B data format(Cr-Y-Cr-Y)                                   | 24.54 MHZ                  |

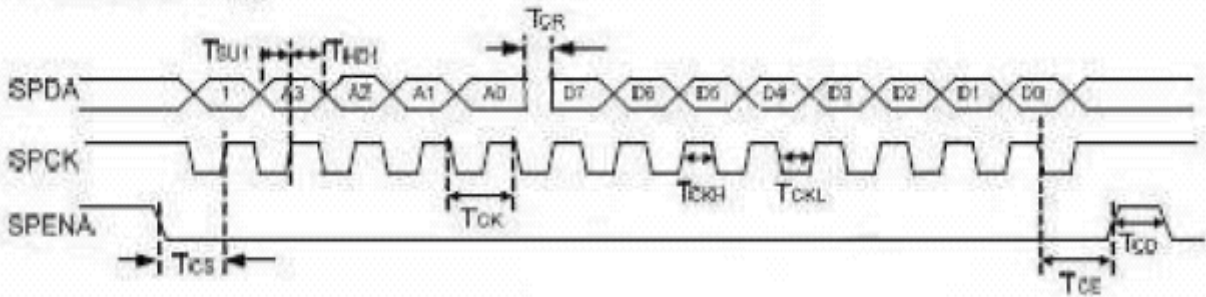
| <b>Input format</b> | <b>DOTCLK Ferg(MHz)</b> | <b>Display Data</b> | <b>Active Area (DOTCLK)</b> |
|---------------------|-------------------------|---------------------|-----------------------------|
| YUV mode            | 24.54                   | 640                 | 1280                        |
|                     | 27                      | 720                 | 1440                        |

| <b>Mode</b>  | <b>D[23:16]</b> | <b>D[15:8]</b> | <b>D[7:0]</b> | <b>IHS</b> | <b>IVS</b> | <b>DEN</b>       |
|--------------|-----------------|----------------|---------------|------------|------------|------------------|
| 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   |
|              |                 |                |               |            |            | DEN for DEN Mode |
| 24 bit RGB   | R[7:0]          | G[7:0]         | B[7:0]        | IHS        | IVS        | NC for HV Mode   |
|              |                 |                |               |            |            | DEN for DEN Mode |

## 4.2. SPI timing Characteristics

| Parameter                | Symbol | Min. | Typ. | Max. | Unit |
|--------------------------|--------|------|------|------|------|
| SPCK period              | Tcx    | 60   | -    | -    | ns   |
| SPCK high width          | Tcxh   | 30   | -    | -    | ns   |
| SPCK low width           | Tcxl   | 30   | -    | -    | ns   |
| Data setup time          | Tsu1   | 12   | -    | -    | ns   |
| Data hold time           | Thd1   | 12   | -    | -    | ns   |
| SPENA to SPCK setup time | Tcs    | 20   | -    | -    | ns   |
| SPENA to SPDA hold time  | Tce    | 20   | -    | -    | ns   |
| SPENA high pulse width   | Tcd    | 50   | -    | -    | ns   |
| SPDA output latency      | Tcs    | -    | 1/2  | -    | Tcx  |

### ● SPI read timing



### ● SPI write timing

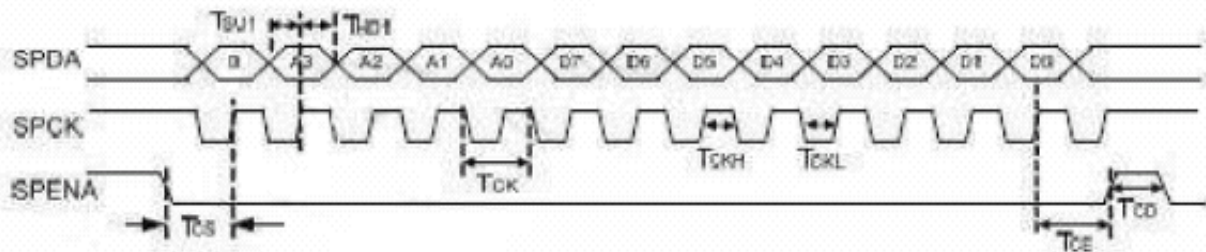


Figure11 SPI read and write timing

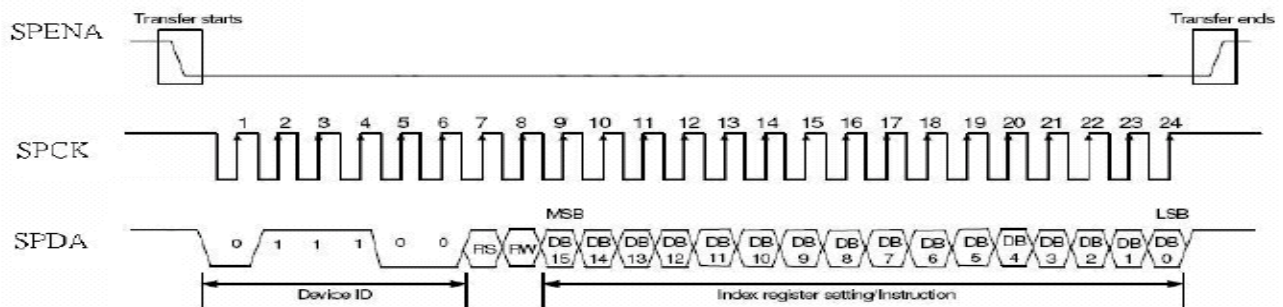


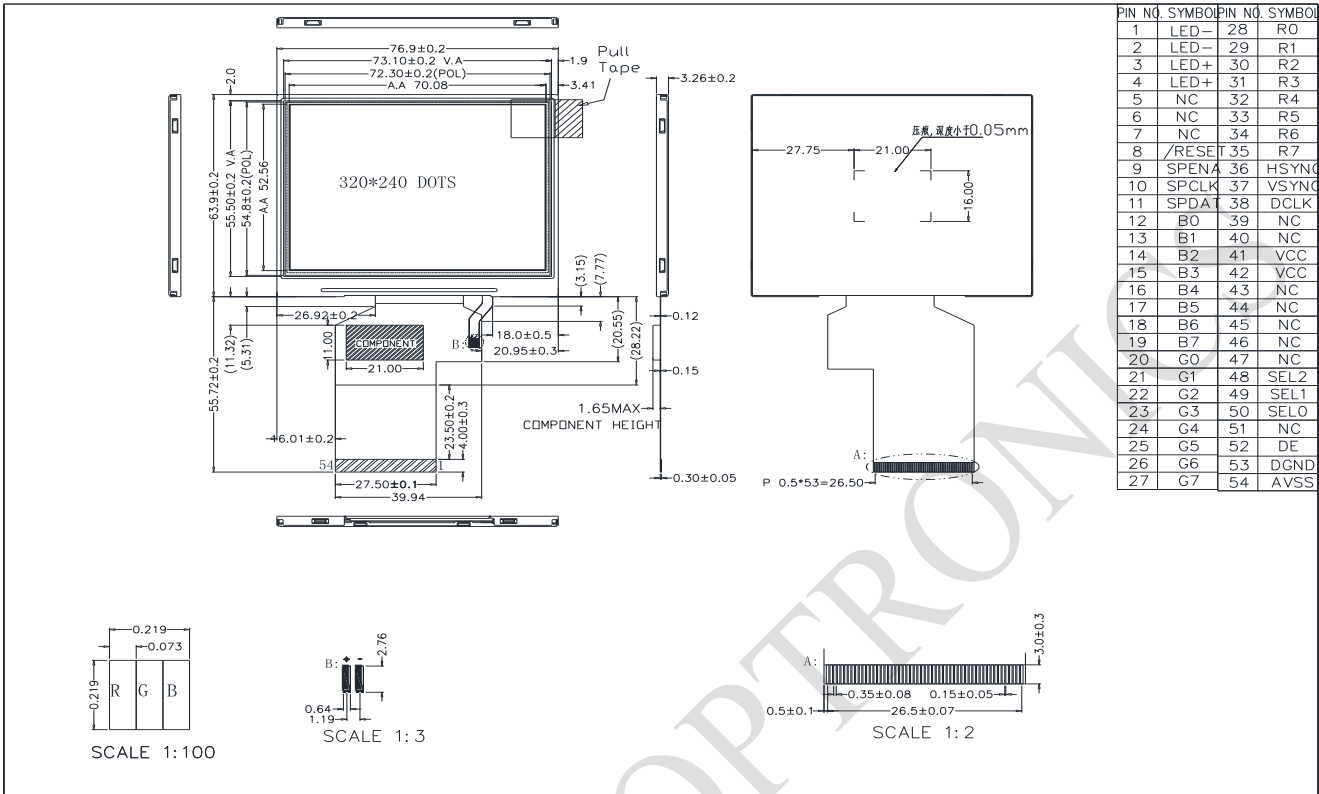
Figure12 SPI timing

### 4.3. 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   | 0  | 1  | 0  |
|              | :                 | :                | :  | :  | :  | :   | :  | :  | :  | :     | :  | :  | :  | :   | :  | :  | :  | :    | :  | :  | :  | :   | :  | :  |    |
|              | Blue(253)         | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 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  | 0  | 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  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |

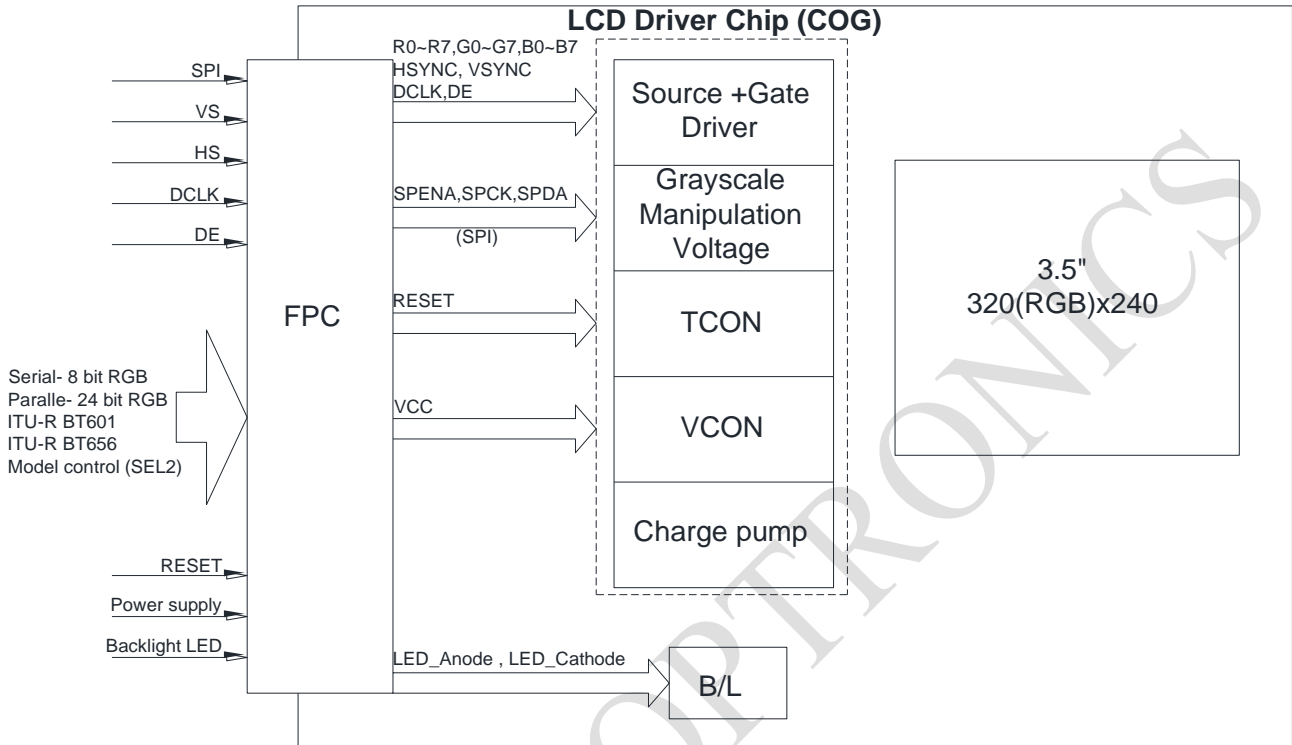
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# 5. Contour Drawing



## 6. Block Diagram

### LCD Panel

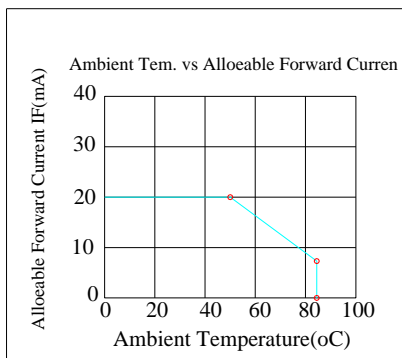


## 7. Absolute Maximum Ratings

| Item                  | Symbol | Min | Typ | Max | Unit |
|-----------------------|--------|-----|-----|-----|------|
| Operating Temperature | TOP    | -20 | —   | +70 | °C   |
| Storage Temperature   | TST    | -30 | —   | +80 | °C   |

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

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



## 8. Electrical Characteristics

### 8.1. Operating conditions:

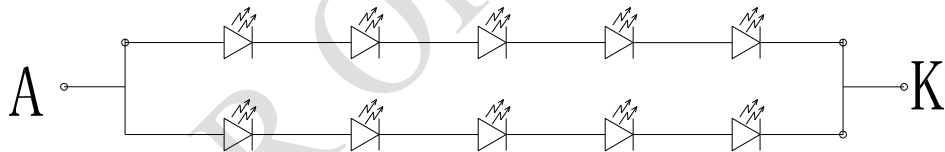
| Item                   | Symbol | Condition | Min | Typ | Max | Unit | Remark |
|------------------------|--------|-----------|-----|-----|-----|------|--------|
| Supply Voltage For LCM | VCC    | —         | 3.0 | 3.3 | 3.6 | V    |        |
| Supply Current For LCM | ICC    | —         | —   | 8.6 | 15  | mA   | Note 1 |

Note 1 : This value is test for VCC =3.3V , Ta=25 °C only

### 8.2. LED driving conditions

| Parameter         | Symbol | Min. | Typ.   | Max. | Unit | Remark     |
|-------------------|--------|------|--------|------|------|------------|
| LED current       | -      | -    | 38     | 40   | mA   | Note 5     |
| Power Consumption | -      | 550  | -      | 700  | mW   | -          |
| LED voltage       | VBL+   | 14.5 | -      | 17.5 | V    | Note 1     |
| LED Life Time     | -      | -    | 50,000 | -    | Hr   | Note 2,3,4 |

Note 1 : There are 1 Groups LED



Note 2 : Ta = 25 °C

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

Note 4 : The single LED lamp case

Note 5 : Make sure LED current less than Max. value

## 9.DC CHARATERISTICS

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

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## 10.AC Characteristics

### Digital Parallel RGB interface

| Signal | Item           | Symbol | Min | Typ | Max | Unit |
|--------|----------------|--------|-----|-----|-----|------|
| Dclk   | Frequency      | Tosc   | -   | 6.5 | 10  | MHz  |
|        | High Time      | Tch    | -   | 77  | -   | ns   |
|        | Low Time       | Tcl    | -   | 77  | -   | 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  | -    |
|        | 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, 1st data start from 68th 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   |

### 10.1. Waveform

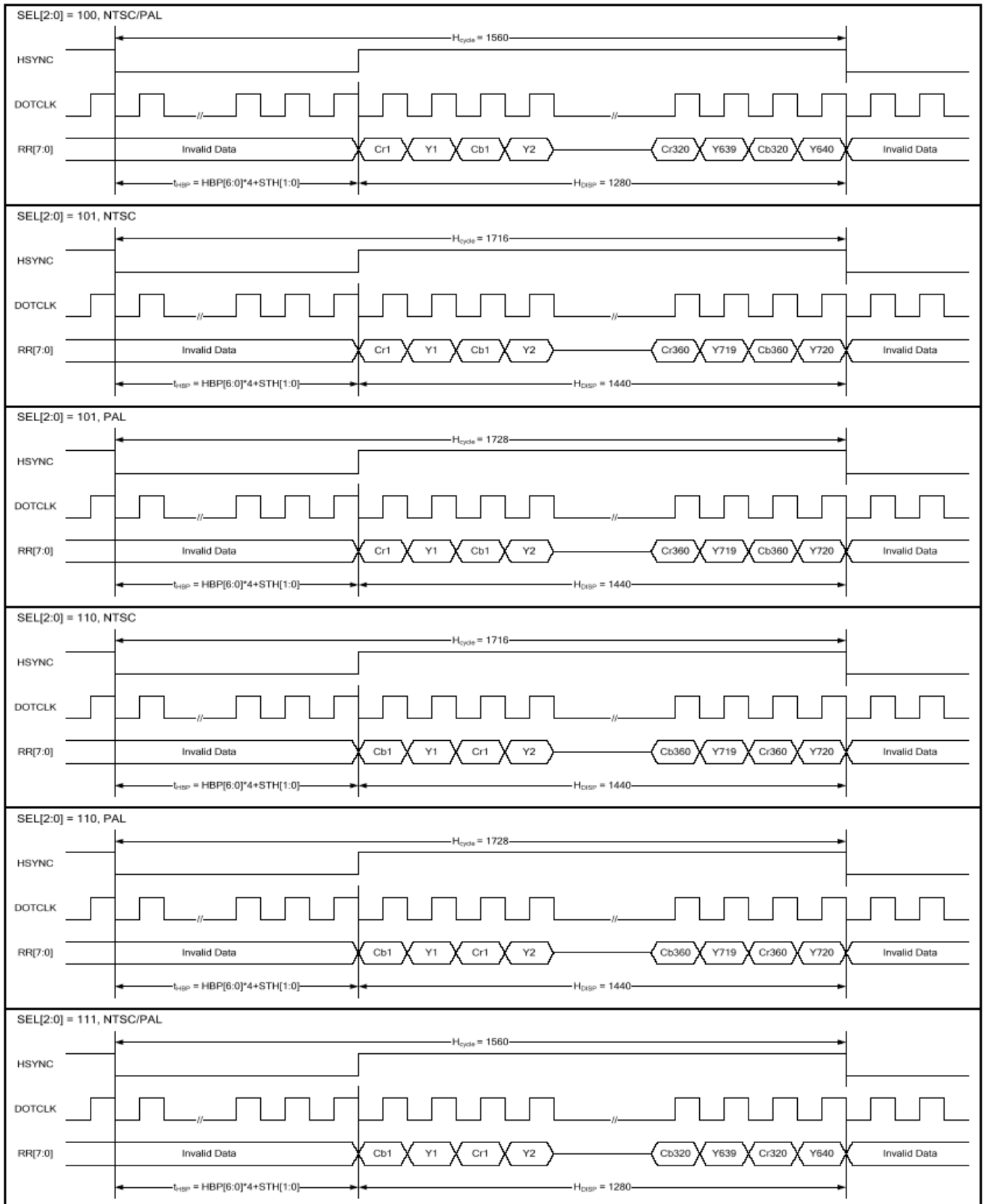


Figure 1 CCIR601 Horizontal Timing

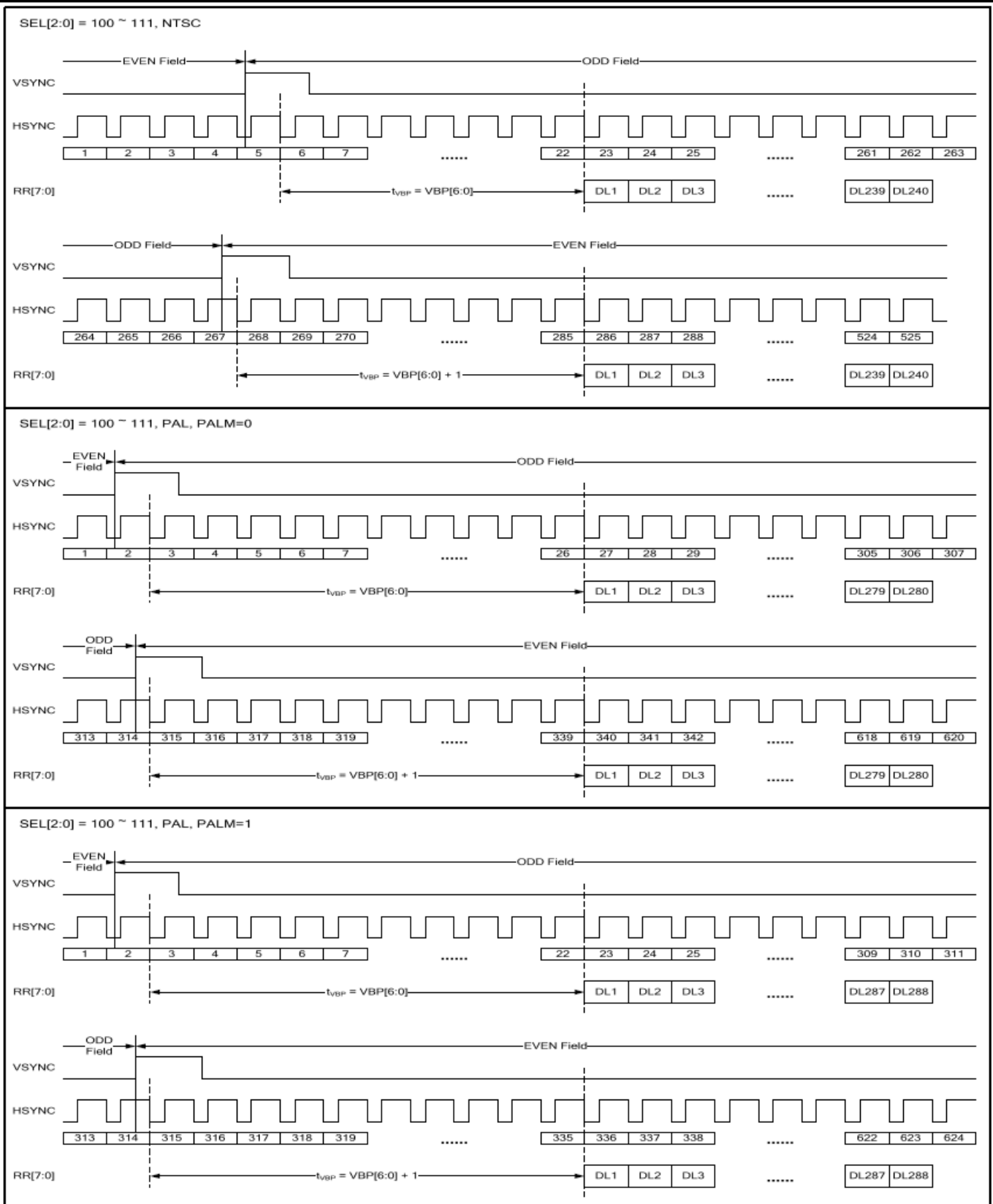


Figure 1 CCIR601 Vertical Timing

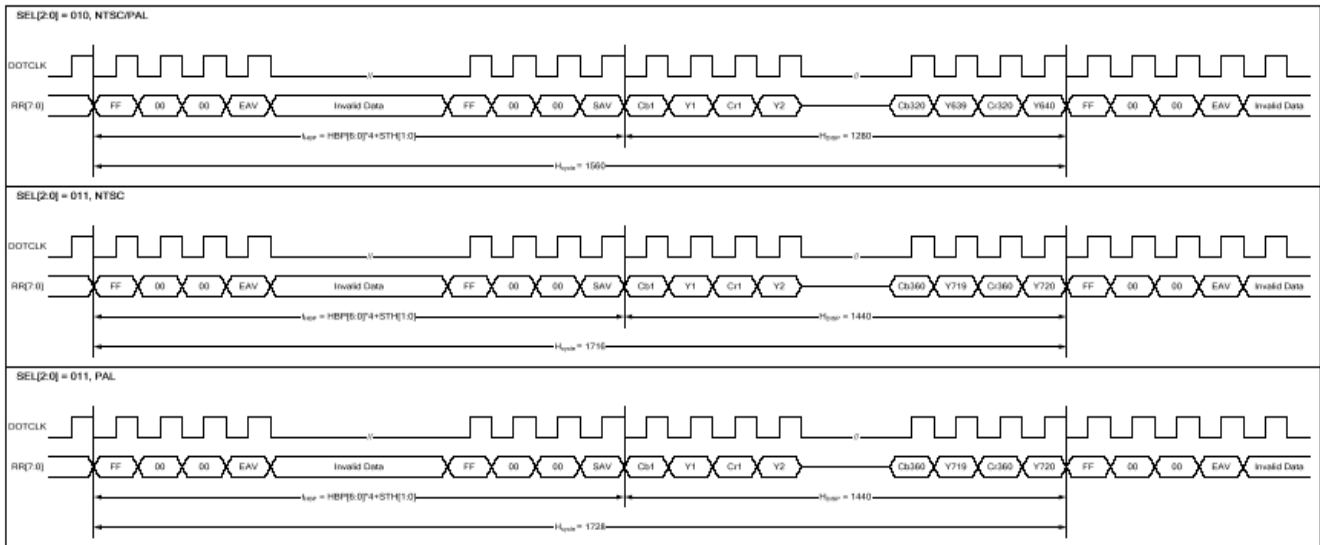


Figure 2 CCIR656 Horizontal Timing

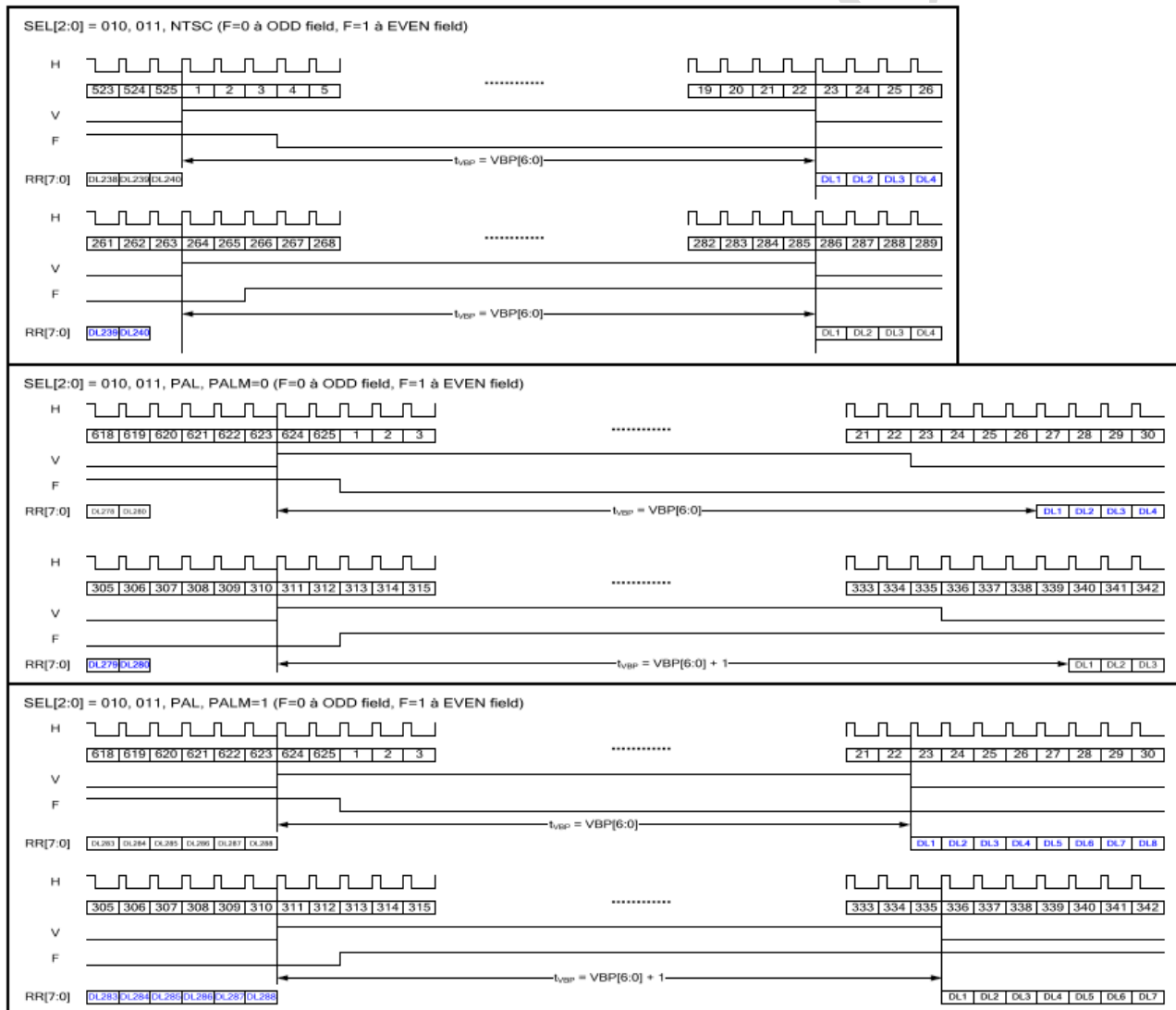


Figure 2 CCIR656 Vertical Timing

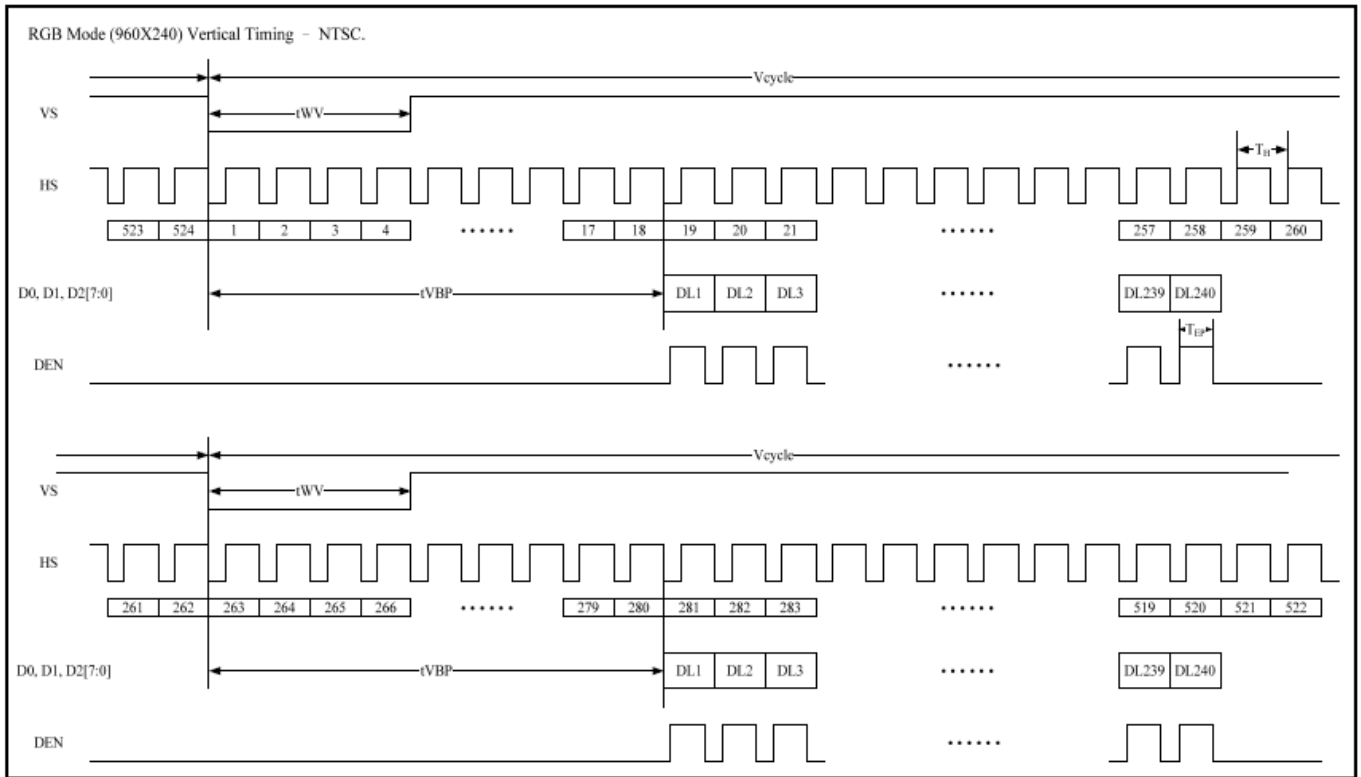
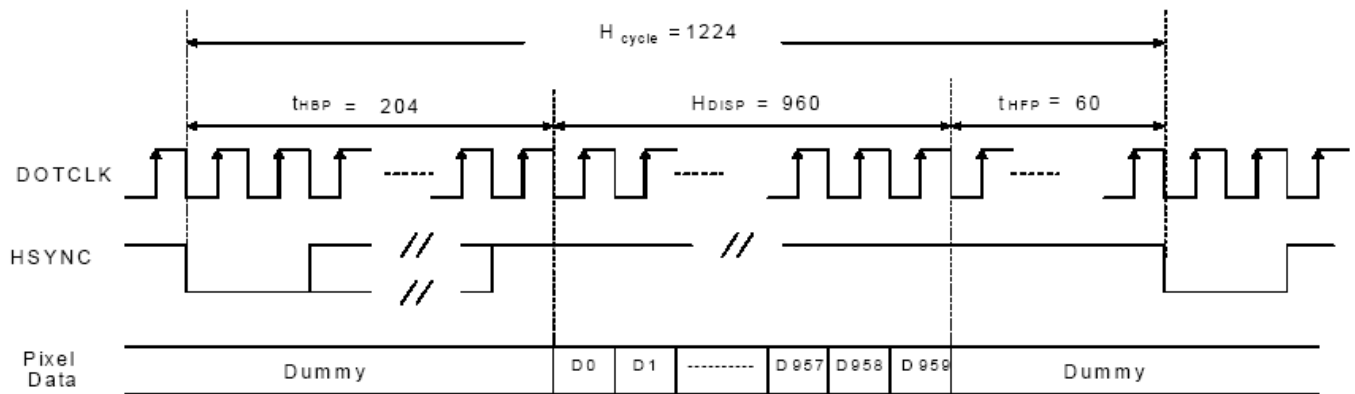
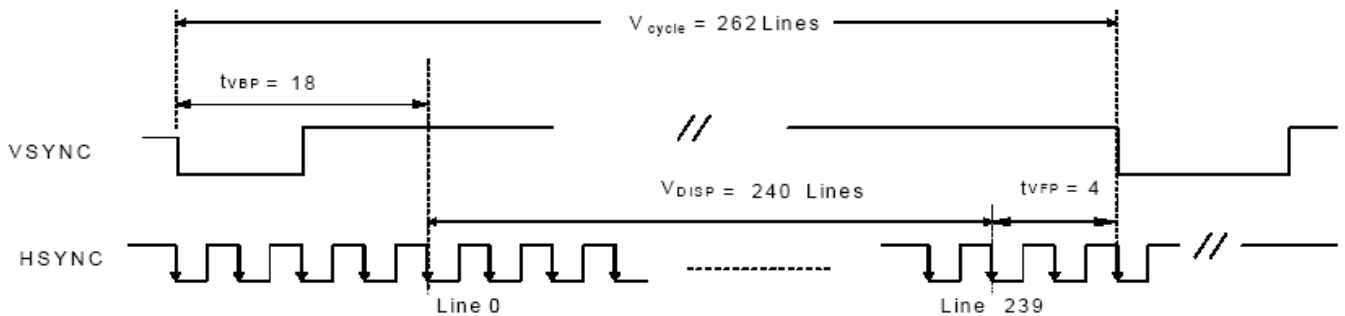


Figure 3 Digital RGB NTSC mode Vertical Data Format for 262Tn



a) Horizontal Data Transaction Timing



Vertical Data Transaction Timing

Figure 3 Data Transaction Timing in Serial RGB (8 bit) Interface (SYNC Mode)

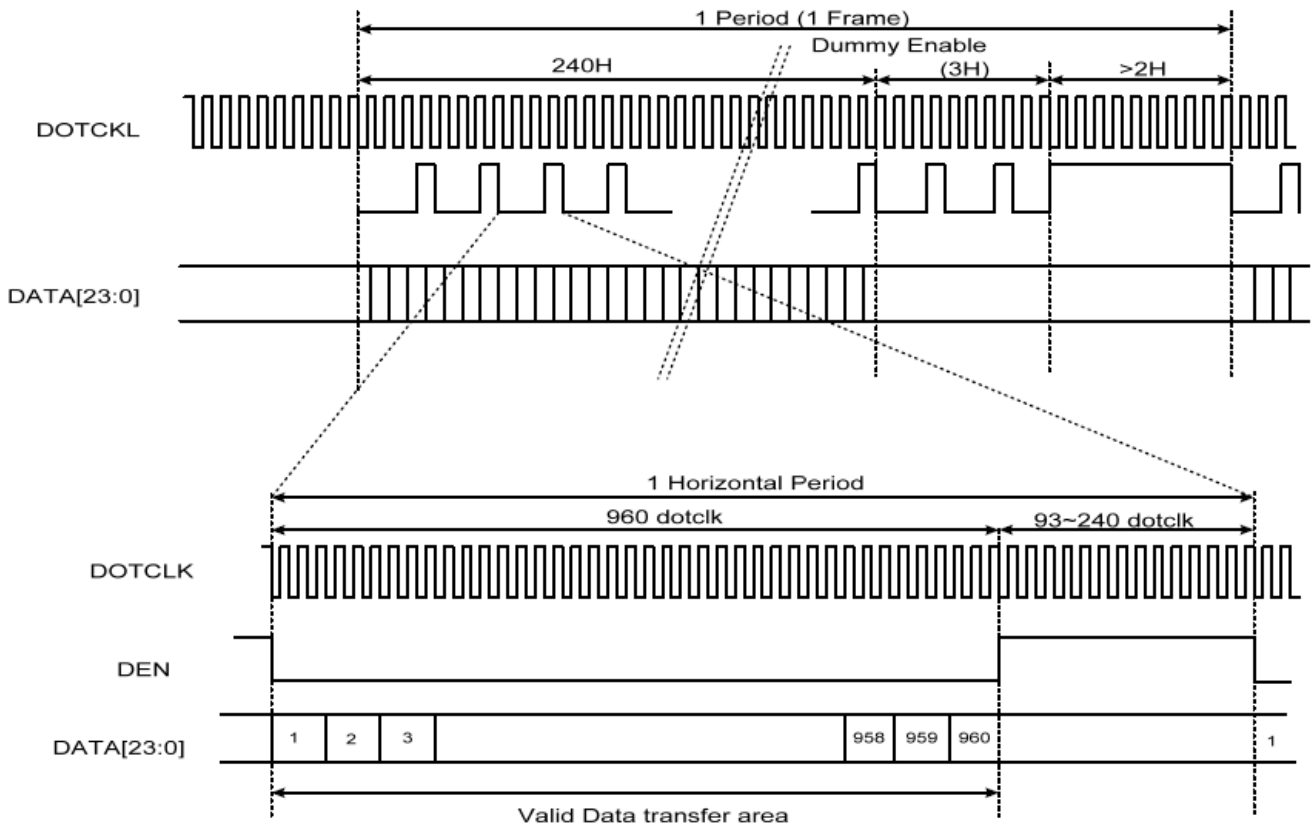
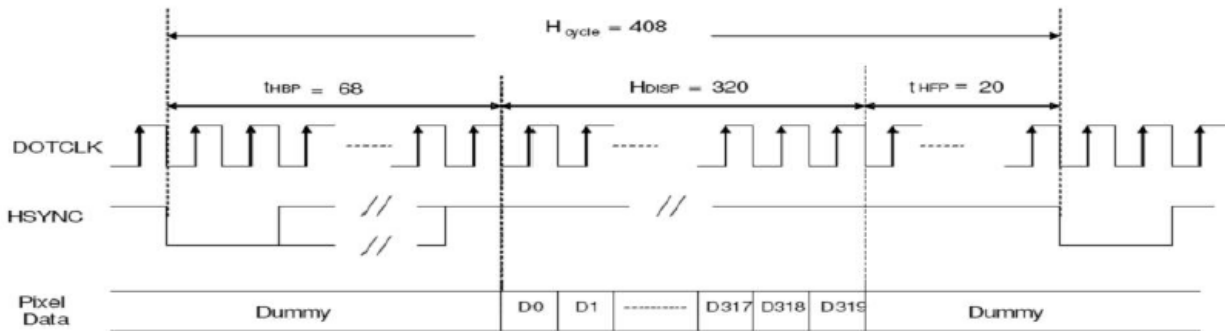
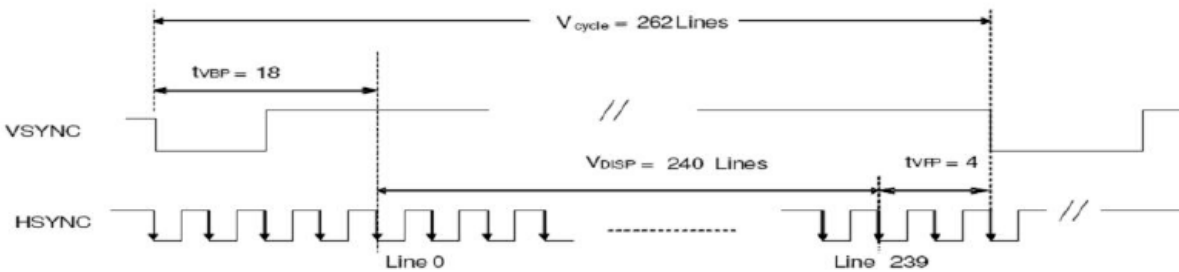


Figure 3 Data Transaction Timing in Serial RGB (8 bit) Interface (DE Mode)



a ) Horizontal Data Transaction Timing



b ) Vertical Data Transaction Timing

Figure 3 Data Transaction Timing in Parallel RGB (24 bit) Interface (SYNC Mode)

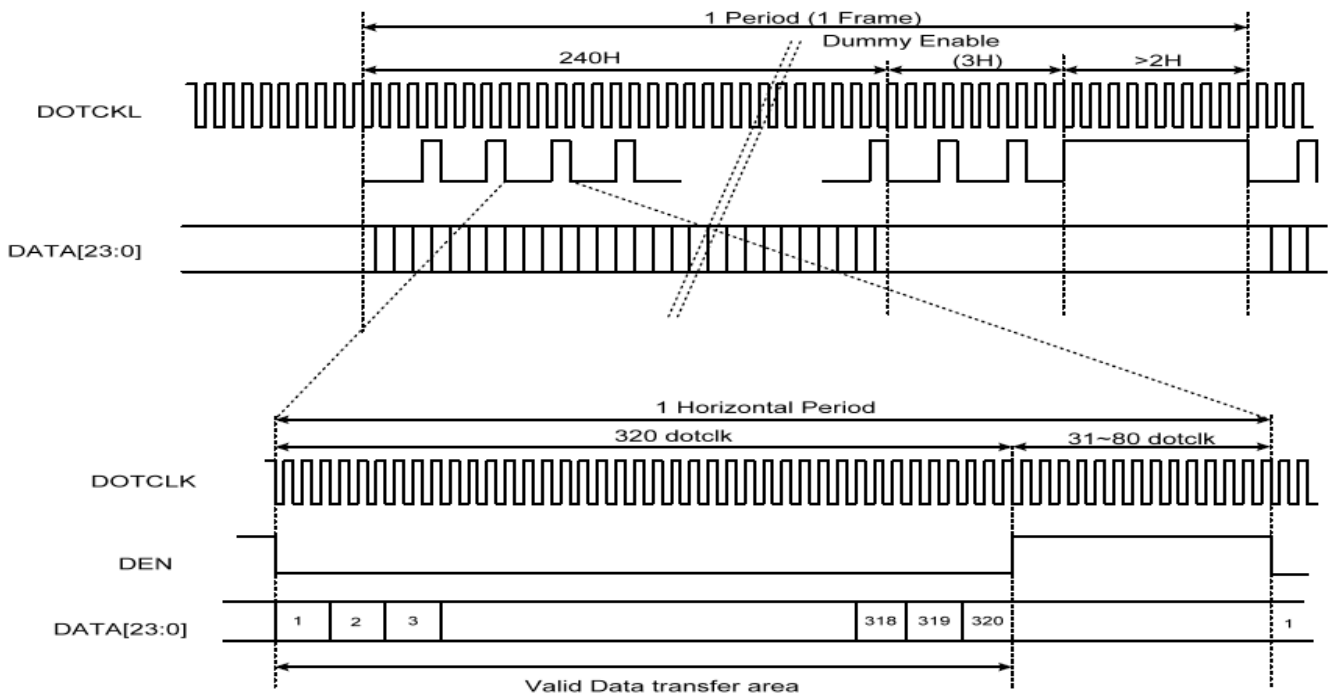


Figure 3 Data Transaction Timing in Parallel RGB (24 bit) Interface (DE Mode)

## 10.2. Clock and Sync waveforms

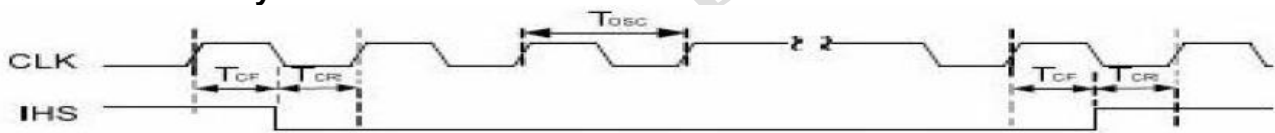


Figure 6 CLK and IHS timing waveform

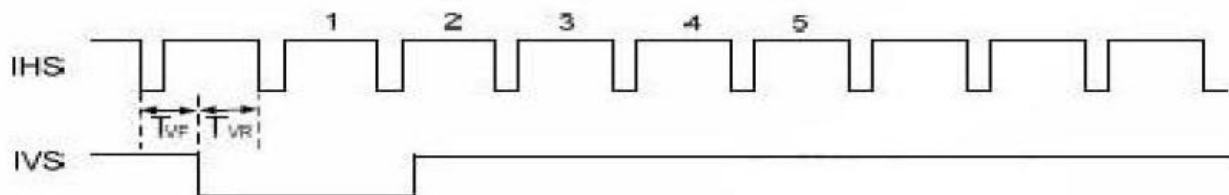
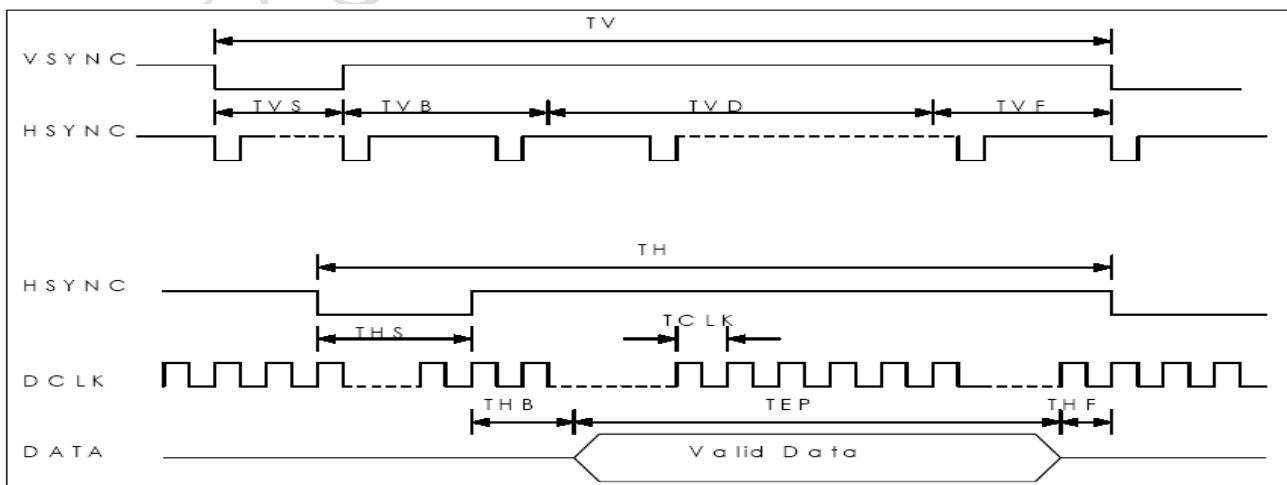
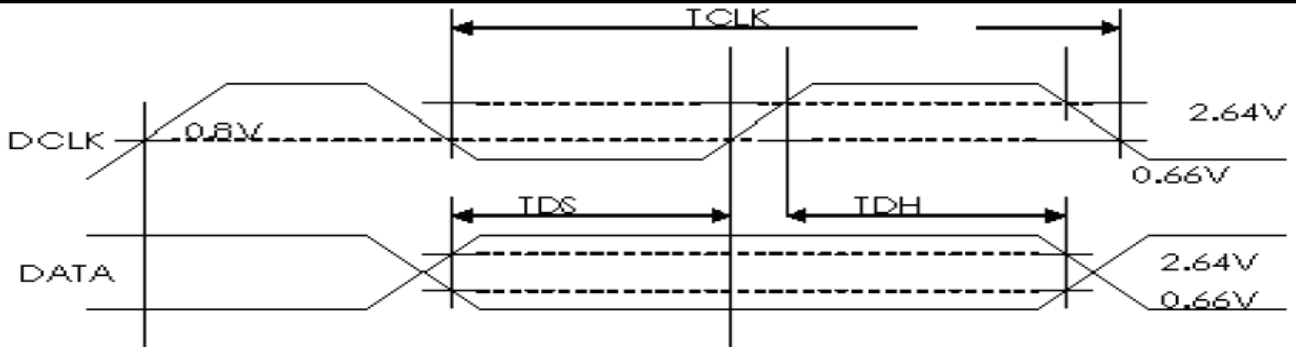


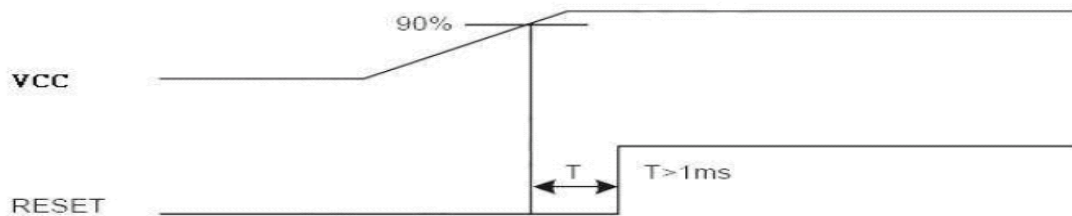
Figure 4 IHS and IVS timing waveforms





### 10.3. Reset Timing Chart

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



Reset timing



## 11. Optical Characteristics

| Item  | Symbol | Condition.                          | Min                                 | Typ. | Max. | Unit                  | Remark            |            |
|---|--------|-------------------------------------|-------------------------------------|------|------|-----------------------|-------------------|------------|
| Response time                                     | Tr     | $\theta=0^\circ \cdot \phi=0^\circ$ | -                                   | 10   | -    | ms                    | Note 3,5          |            |
|   | Tf     |                                     | -                                   | 15   | -    | ms                    |                   |            |
| Contrast ratio                                    | CR     | At optimized viewing angle          | 300                                 | 350  | -    | -                     | Note 4,5          |            |
| Color Chromaticity                                | White  | Wx                                  | $\theta=0^\circ \cdot \phi=0^\circ$ | 0.26 | 0.31 | 0.36                  | -                 | Note 2,6,7 |
|   |        |                                     |                                     | Wy   | 0.28 | 0.33                  | 0.38              | -          |
| Viewing angle<br>(Gray Scale Inversion Direction) | Hor.   | $\Theta_R$                          | CR $\geq 10$                        | -    | 55   | -                     | Deg.              | Note 1     |
|   |        | $\Theta_L$                          |                                     | -    | 55   | -                     |                   |            |
|   | Ver.   | $\Phi_T$                            |                                     | -    | 45   | -                     |                   |            |
|   |        | $\Phi_B$                            |                                     | -    | 50   | -                     |                   |            |
| Brightness  | -      | -                                   | 1000                                | 1100 | -    | cd/<br>m <sup>2</sup> | Center of display |            |

Ta=25±2°C, IL=38mA

Note 1: Definition of viewing angle range

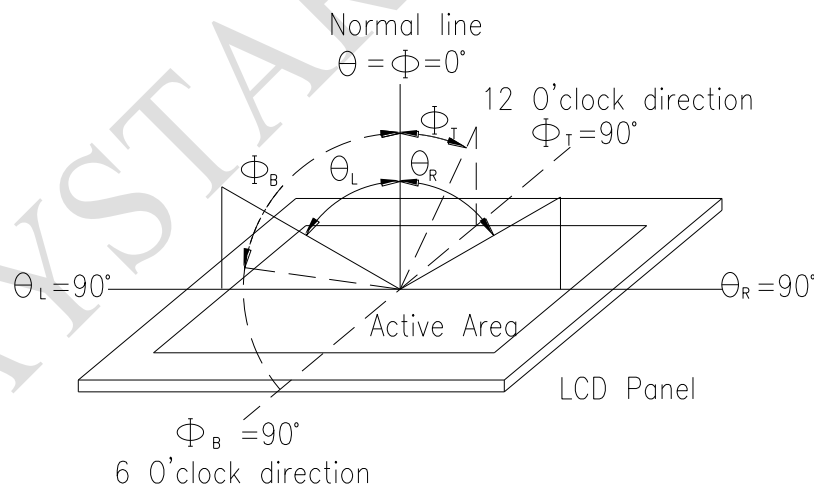


Fig. 11.1. Definition of viewing angle

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-7orBM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

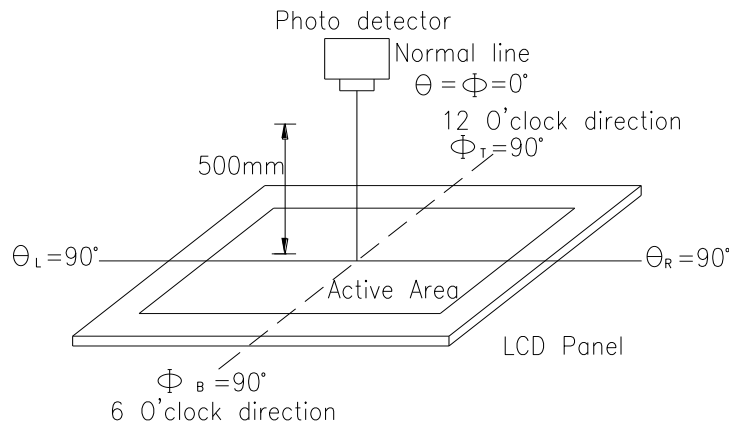
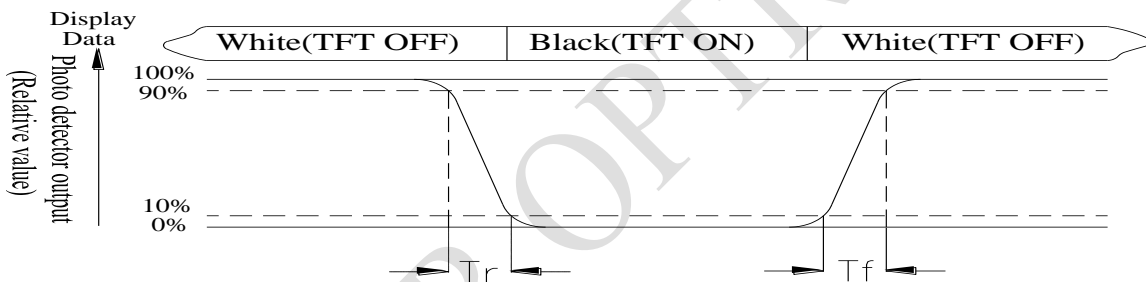


Fig. 11.2. Optical measurement system setup

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%



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.

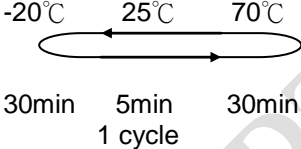
Note 6: Definition of color chromaticity (CIE 1931)

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.

## 12. Reliability

Content of Reliability Test (Wide temperature, -20°C~70°C)

| Environmental Test                   |   |  |      |
|--------------------------------------|---|--|------|
| Test Item                            | Content of Test   | Test Condition   | Note |
| High Temperature storage             | Endurance test applying the high storage temperature for a long time.   | 80°C<br>200hrs   | 2    |
| Low Temperature storage              | Endurance test applying the low storage temperature for a long time.  | -30°C<br>200hrs  | 1,2  |
| High Temperature Operation           | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.  | 70°C<br>200hrs   | —    |
| Low Temperature Operation            | Endurance test applying the electric stress under low temperature for a long time.  | -20°C<br>200hrs  | 1    |
| High Temperature/ Humidity Operation | The module should be allowed to stand at 60°C,90%RH max   | 60°C,90%RH<br>96hrs  | 1,2  |
| Thermal shock resistance             | The sample should be allowed stand the following 10 cycles of operation<br><br><div style="text-align: center;">  <p>-20°C      25°C      70°C</p> <p>30min    5min    30min</p> <p>1 cycle</p> </div> | -20°C/70°C<br>10 cycles  | —    |
| Vibration test                       | Endurance test applying the vibration during transportation and using.  | Total fixed amplitude : 3<br>1.5mm<br>Vibration Frequency :<br>10~55Hz<br>One cycle 60<br>seconds to 3<br>directions of X,Y,Z for<br>Each 15 minutes | 3    |
| Static electricity test              | Endurance test applying the electric stress to the terminal.  | VS=±600V(contact)<br>,±800v(air),<br>RS=330Ω<br>CS=150pF<br>10 times   | —    |

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

**LCM Sample Estimate Feedback Sheet**

**Module Number :** \_\_\_\_\_

**1 、 Panel Specification :**

|                            |                               |                                     |
|----------------------------|-------------------------------|-------------------------------------|
| 1. Panel Type :            | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. View Direction :        | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Numbers of Dots :       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. View Area :             | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Active Area :           | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Operating Temperature : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Storage Temperature :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Others :                | _____                         |                                     |

**2 、 Mechanical Specification :**

|                             |                               |                                     |
|-----------------------------|-------------------------------|-------------------------------------|
| 1. PCB Size :               | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Frame Size :             | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Material of Frame :      | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Connector Position :     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Fix Hole Position :      | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Backlight Position :     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Thickness of PCB :       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Height of Frame to PCB : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9. Height of Module :       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10. Others :                | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

**3 、 Relative Hole Size :**

|                             |                               |                                     |
|-----------------------------|-------------------------------|-------------------------------------|
| 1. Pitch of Connector :     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Hole size of Connector : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Mounting Hole size :     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Mounting Hole Type :     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Others :                 | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

**4 、 Backlight Specification :**

|   |                               |                                     |
|---|-------------------------------|-------------------------------------|
| 1. B/L Type :                                     | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. B/L Color :                                    | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. B/L Driving Voltage (Reference for LED Type) : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. B/L Driving Current :                          | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Brightness of B/L :                            | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. B/L Solder Method :                            | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Others :                                       | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

>> **Go to page 2** <<

|   |                               |                                     |
|---|-------------------------------|-------------------------------------|
| <b>Module Number :</b> _____  |                               |                                     |
| <b>5 · <u>Electronic Characteristics of Module</u> :</b>  |                               |                                     |
| 1.Input Voltage :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2.Supply Current :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3.Driving Voltage for LCD :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4.Contrast for LCD :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5.B/L Driving Method :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6.Negative Voltage Output :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7.Interface Function :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8.LCD Uniformity :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9.ESD test :  | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10.Others :   | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| <b>6 · <u>Summary</u> :</b>   |                               |                                     |
| <p style="text-align: right; margin-right: 100px;">Sales signature : _____</p> <p style="text-align: right; margin-right: 100px;">Customer Signature : _____      <u>Date</u> :   /   / _____</p> |                               |                                     |