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TITLE: HV208QX1-100

Product Specification

Rev. C

HYDIS Technologies

SPEC. NUMBER
S864-1217

PRODUCT GROUP
TFT-LCD PRODUCT

REV.
C

ISSUE DATE
2009.02.10

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REV.

ISSUE DATE

TFT-LCD PRODUCT

C

2009.02.10

REVISION HISTORY

| REV. | ECN NO. | DESCRIPTION OF CHANGES | DATE | PREPARED |
|----------------------------------|------------|--|----------|------------------------|
| 0 | | Initial Release | 05.04.04 | J.K Han |
| A | E0505-F019 | Optical Specification Contents changed - VDim : 0.8V to 0.0V | 05.07.08 | J.K Han |
| B | E0606-F029 | .Inverter Pin modification. (11 pin : NC → V dim signal, 12pin : NC → V on/off) | 06.07.10 | S.W.KANG |
| C | E0902-F003 | CI Logo Change (HYDIS) | 09.02.10 | S.T. KO |
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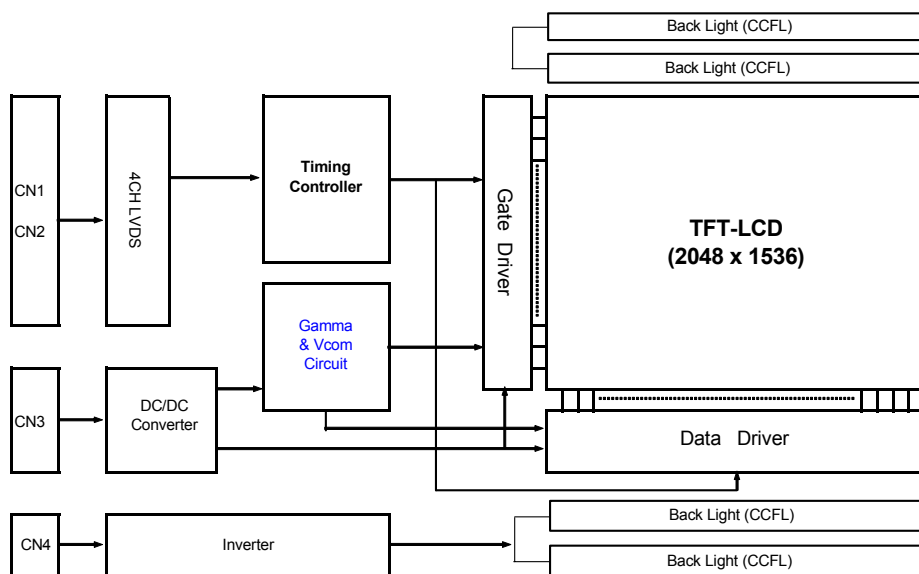
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1.0 GENERAL DESCRIPTION

1.1 Introduction

This specification applies to the 20.8”(3M) Black & White Monochrome TFT LCD module “HV208QX1”. This module shows a wide viewing angle using unique True Black AFFS (Advanced Fringe Field Switching) Technology with Dual Domain. Basically, module is controlled by amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has 20.8 inch diagonally measured active area with QXGA resolutions (2048 horizontal by 1536 vertical pixel array). Supported gray scale is 8-bit per one sub-pixel. Input signal is 4CH LVDS (Low Voltage Differential Signaling) Interface compatible.



1.2 Features

- True Black AFFS(Advanced Fringe Field Switching) Technology with Dual Domain
- High luminance, High contrast ratio and Wide viewing angle
- Gray scale is 8-bit per one sub-pixel
- High speed response
- H sync & V sync mode supports
- 4Ch LVDS Interface with dual pixel / clock
- Direct Type Back-Light (12 CCFL lamps)
- RoHS Adapted

1.3 Applications

- Medical Display

1.4 General Specifications

The following Items are general specifications of the model HV208QX1-100. (Listed in Table1)

<Table1 General Specifications>

| Parameter | Specification | Unit | Remark |
|---------------------|---|--------|--------|
| Active area | 423.9(H) × 318.0(V) | mm | |
| Number of pixels | 2048 × 3(H) × 1536(V) | Pixels | |
| Pixel pitch | 0.207(H) × 0.207(V) | mm | |
| Display mode | Normally Black | | |
| Dimensional outline | 457.0(H) × 350.0(V) × 45.0(D) | mm | |
| Weight | 2500 Typ. | gram | Note 1 |
| Back-light | Direct Type (12 CCFL) | | Note 2 |
| Surface treatment | Haze 13, Anti-glare & hard-coating (3H) | | |

Note: 1. Weight Max. 2700g

2. CCFL (Cold Cathode Fluorescent Lamp)

2.0 ABSOLUTE MAXIMUM RATINGS

The following Table show maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table2.

<Table2 Absolute Maximum Ratings>

| Parameter | Symbol | Min | Max | Unit | Remark |
|-------------------------------------|-----------------------|----------|-----------|-----------|------------|
| Logic & LCD Input Voltage | V _{DD} | -0.3 | 13.2 | V | Ta = 25 °C |
| Backlight Voltage | V _{INV} | -0.3 | 13.2 | V | |
| Brightness Control | V _{DIM} | -0.3 | 5.3 | V | |
| Backlight ON/OFF | B _{B_LON} | -1.0 | 5.3 | V | |
| Operating Temperature (Humidity) | T _{OP} RH | 0 8 | +50 80 | °C %RH | ≤ 40 °C |
| Storage Temperature (Humidity) | T _{ST} RH | -20 5 | +60 95 | °C %RH | ≤ 40 °C |

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Characteristics (Listed in Table3)

<Table3 Electrical specifications>

(Ta = 25°C)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-------------------------------------|--------------------|--------|--------|-------------|------------------|-----------------|
| Power Input Voltage | V _{DD} | 11.4 | 12.0 | 12.6 | V | |
| Inverter Power Input Voltage | V _{INV} | 11.4 | 12.0 | 12.6 | V | |
| Power Input Current | I _{DD} | - | 500 | 750 | mA | Note 1 |
| “H” level Differential input | V _{IL} | 100 | - | - | mV | Note 2 |
| “L” level Differential input | V _{IH} | - | - | -100 | mV | |
| Back-light lamp Voltage | V _{BL} | - | 700 | - | V _{rms} | |
| Back-light Lamp Operating Frequency | F _L | - | 60 | - | KHz | Per CCFL Note 3 |
| Lamp Start Voltage | V _S | - | 1200 | 1550 (0°C) | V _{rms} | Note 4 |
| | | - | 900 | 1100 (25°C) | V _{rms} | |
| Lamp Life | Hr | 40,000 | 50,000 | - | Hours | |
| Power Consumption | P _{DD} | - | 6 | - | W | |
| | P _{INV} | - | 46.2 | - | W | |
| | P _{total} | - | 52.2 | - | W | |

Notes:

1. Test Pattern of power supply current

- Typ: Vertical 8 Gray Bar
- Max: White (@L255)

2. LVDS Receiver common mode voltage, V_{CM} = 1.2V

3. The lamp frequency should be selected as different as possible from the horizontal synchronous frequency and its harmonics to avoid interference which may cause line flow on the display.

4. The voltage shown above should be applied to the lamps for more than 1 second to startup. Otherwise the lamps may not to be turned on.

4.0 OPTICAL SPECIFICATIONS

The optical characteristics are measured after 30 minutes warm-up period under 25 °C condition. Equipment for measurement is TOPCON-BM5. This Table shows optical specifications of the Model HV208QX1-100. (Listed in Table4)

<Table4 Optical Specifications>

| Parameter | | Symbol | Condition | Min | Typ | Max | Unit | Remark |
|------------------|-----------------------|---------------|----------------------------------|-------|-------|-------|-------------------|--------|
| Viewing Angle | Horizontal | Θ_3 | CR > 10 Horizontal & Vertical | 80 | 89 | - | Deg | Note 1 |
| | | Θ_9 | | 80 | 89 | - | Deg | |
| | Vertical | Θ_{12} | | 80 | 89 | - | Deg | |
| | | Θ_6 | | 80 | 89 | - | Deg | |
| White Luminance | TYP($V_{DIM}=0.0V$) | L_{WTYP} | $\Theta = 0^\circ$ Center | 690 | 800 | - | cd/m ² | Note 2 |
| | Min($V_{DIM}=3.0V$) | L_{WMIM} | | | 100 | 200 | cd/m ² | Note 9 |
| Black Luminance | | L_B | | | 1.1 | - | | Note 2 |
| Contrast Ratio | | CR | | | 700 | - | - | Note 3 |
| White Uniformity | Adjacent | A_{WU} | $\Theta = 0^\circ$ 9Points | 80 | - | - | % | Note 4 |
| | Total | T_{WU} | | 80 | - | - | | |
| Black Uniformity | Adjacent | A_{BU} | | 70 | - | - | % | Note 5 |
| | Total | T_{BU} | | 70 | - | - | | |
| White Balance | White x | W_x | $\Theta = 0^\circ$ (Center) | 0.264 | 0.294 | 0.324 | - | Note 6 |
| | White y | W_y | | 0.265 | 0.295 | 0.325 | | |
| Response time | Rising | Tr | $\Theta = 0^\circ$ 10% to 90% | - | 15 | - | msec | Note 7 |
| | Falling | Td | | - | 20 | - | | |
| Cross talk | | CT | $\Theta = 0^\circ$ | - | 2.0 | - | % | Note 8 |

Note:

- Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angle is determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface. (See Figure 1 shown in Appendix).
- Each White/Black Luminance (L_W/L_B) is defined as the luminance of L255/L0 Gray level at the center 1 point on LCD surface. (See Figure 1 shown in Appendix).
- Contrast Ratio measurements shall be made at viewing angle of $\Theta = 0^\circ$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See Figure 1 shown in Appendix) Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

4. White Uniformity on LCD surface is defined as follows : Where,

L_{MAX} : The brightest luminance at the measuring points of whole area of white state.

L_{MIN} : The darkest luminance at the measuring points of whole area of white state.

L_{Bright} : Bright luminance among the measuring points of adjacent area of white state.

L_{Dark} : Dark luminance among the measuring points of adjacent area of white state.

4.1 Adjacent White Uniformity (A_{WU}) is defined as the Minimum value of the Adjacent Luminance Uniformity Ratio. Measuring points are 9 points. (See Figure2 of Appendix)

$$\text{Adjacent Luminance Uniformity Ratio} = \frac{L_{Dark}}{L_{Bright}} \times 100\%$$

4.2 Total White Uniformity (T_{WU}) is defined as the Value of the Total Luminance Uniformity Ratio. Measuring points are 9 points. (See Figure2 of Appendix)

$$\text{Total Luminance Uniformity Ratio} = \frac{L_{Min}}{L_{Max}} \times 100\%$$

5. Black Uniformity on LCD surface is defined as follows : Where,

L_{MAX} : The brightest luminance at the measuring points of whole area of black state.

L_{MIN} : The darkest luminance at the measuring points of whole area of black state.

L_{Bright} : Bright luminance among the measuring points of adjacent area of black state.

L_{Dark} : Dark luminance among the measuring points of adjacent area of black state.

5.1 Adjacent Black Uniformity (A_{BU}) is defined as the Minimum value of the Adjacent Luminance Uniformity Ratio. Measuring points are 9 points. (See Figure2 of Appendix)

$$\text{Adjacent Luminance Uniformity Ratio} = \frac{L_{Dark}}{L_{Bright}} \times 100\%$$

5.2 Total Black Uniformity (T_{BU}) is defined as the Value of the Total Luminance Uniformity Ratio. Measuring points are 9 points. (See Figure2 of Appendix)

$$\text{Total Luminance Uniformity Ratio} = \frac{L_{Min}}{L_{Max}} \times 100\%$$

6. The White balance chromaticity coordinate shall be calculated from the spectral data measured with white state. Measurements shall be made at the center of the panel.

7. The electro-optical response time measurements shall be made as Figure 3 shown in Appendix by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is T_r , and 90% to 10% is T_d .

8. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (Y_A) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (Y_B) of that same area when any adjacent area is driven dark. (See Figure 4 shown in Appendix).

9. This following chart is V_{DIM} vs Dimming Range for you reference



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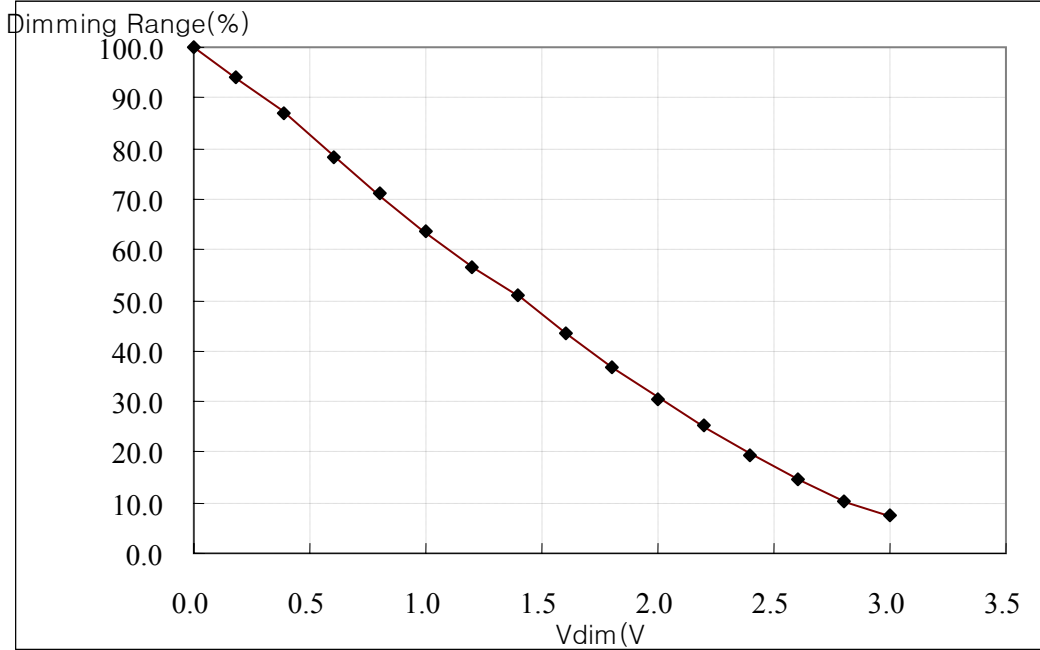
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5.0 INTERFACE CONNECTION

5.1 Electrical Interface Connection(Digital Signal Connector)

The module-side connector : FI-TWE31PB-VF or Equivalent

The user-side connector : FI-W31S or FI-WE31M or Equivalent

<Table5 Pin Assignment for Receiver Interface Connection>

| CN2 Pin Assignment | | | CN4 Pin Assignment | | |
|--------------------|----------|----------------------------|--------------------|----------|----------------------------|
| Pin No. | Symbol | Description | Pin No. | Symbol | Description |
| 1 | NC | No connection | 1 | VBLON | Backlight On/Off Signal |
| 2 | NC | No connection | 2 | VDIM_IN | Note1) |
| 3 | NC | No connection | 3 | VDIM_OUT | Note2) |
| 4 | NC | No connection | 4 | NC | No connection |
| 5 | NC | No connection | 5 | NC | No connection |
| 6 | GND | Ground | 6 | GND | Ground |
| 7 | SDATA | I2C Data for Brightness | 7 | NC | No connection |
| 8 | SCLK | I2C Clock(3.3V typ) | 8 | NC | No connection |
| 9 | GND | Ground | 9 | GND | Ground |
| 10 | GND | Ground | 10 | GND | Ground |
| 11 | LLVDO3+ | Positive LVDS signal(Odd) | 11 | RLVDO3+ | Positive LVDS signal(Odd) |
| 12 | LLVDO3- | Negative LVDS signal(Odd) | 12 | RLVDO3- | Negative LVDS signal(Odd) |
| 13 | LLVCLKO+ | Positive LVDS clock(Odd) | 13 | RLVCLKO+ | Positive LVDS clock(Odd) |
| 14 | LLVCLKO- | Negative LVDS clock(Odd) | 14 | RLVCLKO- | Negative LVDS clock(Odd) |
| 15 | LLVDO2+ | Positive LVDS signal(Odd) | 15 | RLVDO2+ | Positive LVDS signal(Odd) |
| 16 | LLVDO2- | Negative LVDS signal(Odd) | 16 | RLVDO2- | Negative LVDS signal(Odd) |
| 17 | LLVDO1+ | Positive LVDS signal(Odd) | 17 | RLVDO1+ | Positive LVDS signal(Odd) |
| 18 | LLVDO1- | Negative LVDS signal(Odd) | 18 | RLVDO1- | Negative LVDS signal(Odd) |
| 19 | LLVDO0+ | Positive LVDS signal(Odd) | 19 | RLVDO0+ | Positive LVDS signal(Odd) |
| 20 | LLVDO0- | Negative LVDS signal(Odd) | 20 | RLVDO0- | Negative LVDS signal(Odd) |
| 21 | LLVDE3+ | Positive LVDS signal(Odd) | 21 | RLVDE3+ | Positive LVDS signal(Odd) |
| 22 | LLVDE3- | Negative LVDS signal(Odd) | 22 | RLVDE3- | Negative LVDS signal(Odd) |
| 23 | LLVCLKE+ | Positive LVDS clock(Even) | 23 | RLVCLKE+ | Positive LVDS clock(Even) |
| 24 | LLVCLKE- | Negative LVDS clock(Even) | 24 | RLVCLKE- | Negative LVDS clock(Even) |
| 25 | LLVDE2+ | Positive LVDS signal(Even) | 25 | RLVDE2+ | Positive LVDS signal(Even) |
| 26 | LLVDE2- | Negative LVDS signal(Even) | 26 | RLVDE2- | Negative LVDS signal(Even) |
| 27 | LLVDE1+ | Positive LVDS signal(Even) | 27 | RLVDE1+ | Positive LVDS signal(Even) |
| 28 | LLVDE1- | Negative LVDS signal(Even) | 28 | RLVDE1- | Negative LVDS signal(Even) |
| 29 | LLVDE0+ | Positive LVDS signal(Even) | 29 | RLVDE0+ | Positive LVDS signal(Even) |
| 30 | LLVDE0- | Negative LVDS signal(Even) | 30 | RLVDE0- | Negative LVDS signal(Even) |
| 31 | GND | Ground | 31 | GND | Ground |

Note1) Brightness Dimming Control Voltage (0 ~ 3.0V, 0V : Max Brightness)

Note2) Brightness Dimming Control Voltage(Generated by I2C data)

Note3) LVDS signal & clock should be wired by twist – pairs or side by side FPC patterns, respectively

5.2 CN7 in Assignment (Analog Power Connector)

The module-side connector : IL-Z-8PL-SMTYE(JAE) or Equivalent

The user-side connector : IL-Z-8S-S125C3 or Equivalent

<Table6 Pin Assignment for Power Interface Connection>

| Pin No. | Symbol | Description |
|---------|--------|--|
| 1 ~ 4 | GND | Ground |
| 5 ~ 8 | VIN | +12[V] Power supply for LCD Module Power |

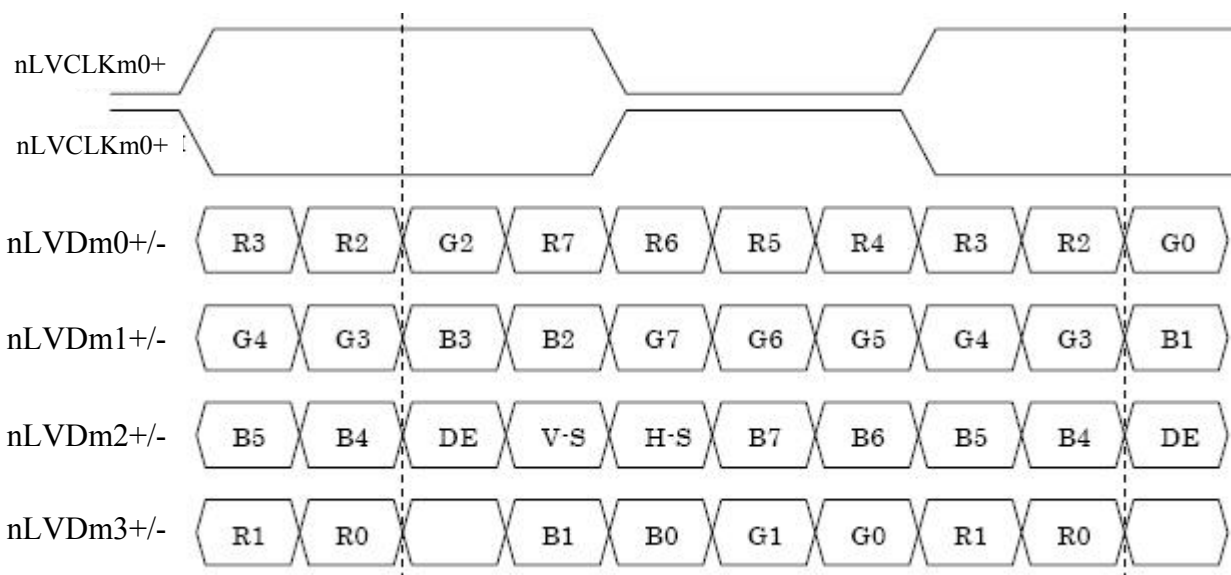
5.3 Inverter CN1 in Assignment (Inverter Connector)

The module-side connector : S12B-PH-SM3-TB(JST) or Equivalent

The user-side connector : PHR-12 or Equivalent

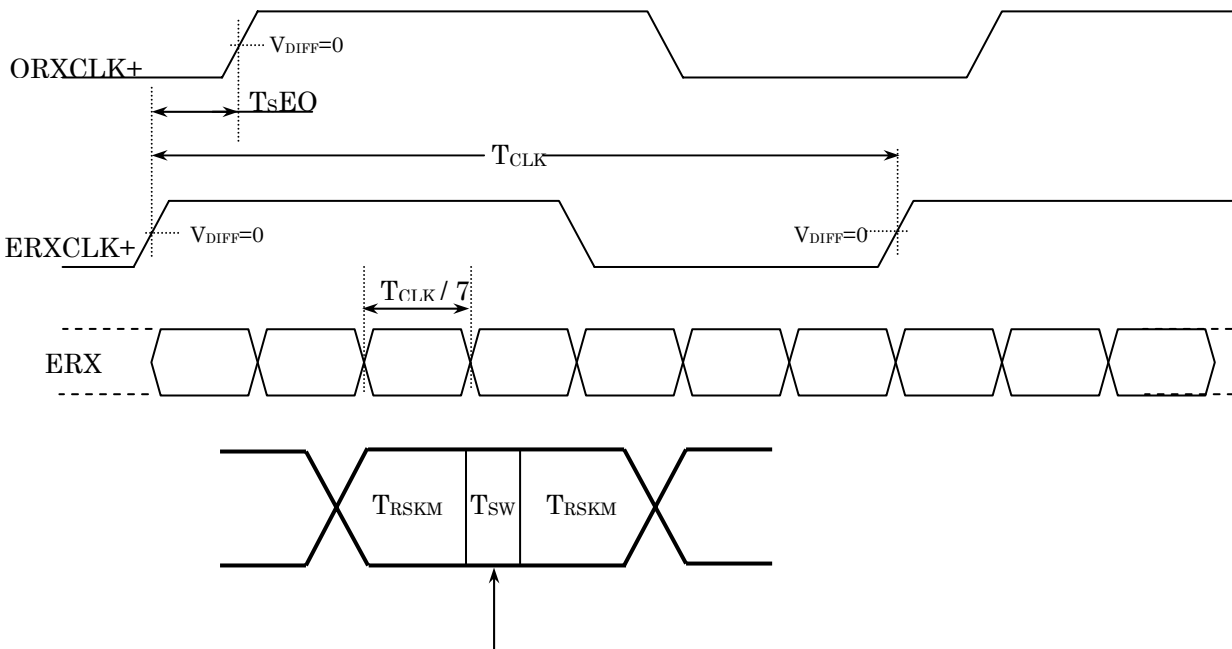
<Table7 Pin Assignment for Inverter Interface Connection>

| Pin No. | Symbol | Description |
|---------|----------|----------------------------------|
| 1 ~ 5 | VBL | +12[V] Power supply for Inverter |
| 6 ~ 10 | GND | Ground |
| 11 | V Dim | +3~0[V] V Dim |
| 12 | V on/off | +3.3[V] Von/off signal |

5.4 LVDS Data Mapping((n : L or R, m : D or CLK)


5.5 LVDS Macro AC characteristics

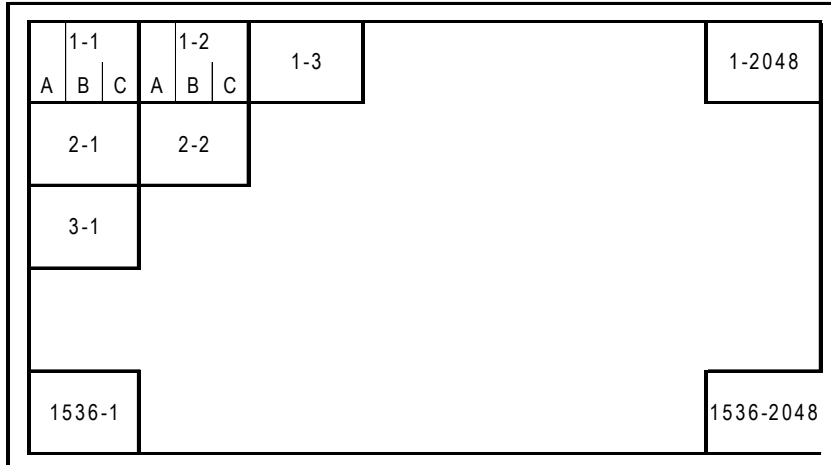
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|------------|-------------------------|--------------------------|------|------|------|-----------|
| T_{SW} | Sampling Window | | | | 820 | ps |
| T_{RSKM} | Receiver Skew Margin | $F_{CLK} = 75\text{MHz}$ | 540 | | | ps |
| T_{sEO} | Skew - Even to Odd port | | -3/7 | | 3/7 | T_{CLK} |





5.6 Data Input Format

EVE ODD



6.0 SIGNAL TIMING SPECIFICATIONS

The specification of the signal timing parameter is listed in Table 7.

The HV208QX1-100 is operated by Horizontal sync & Vertical Sync.

Therefore DE only mode are not used in HV208QX1-100.

<Table 7 Signal Timing Specifications>

| ITEM | | Symbol | Min. | Typ. | Max. | Unit |
|-----------------------|--------------------|---------------------------|-------|-------|-------|-------|
| Input Clock Frequency | | Fc | 60 | 65 | 66 | MHz |
| | | Tc | 15.15 | 15.38 | 16.66 | ns |
| Horizontal | Scan Rate | Fh | 92.86 | 96.72 | 96.72 | KHz |
| | | Th | 10.34 | 10.34 | 10.77 | us |
| | Horizontal Active | Tha | - | 1024 | - | pixel |
| | Hsync Front Porch | Thfp | - | 12 | - | Tc |
| | Hsync Active Width | Thaw | - | 68 | - | Tc |
| | Hsync Back Porch | Thbp | - | 80 | - | Tc |
| | Horizontal Total | Tht | - | 1344 | - | pixel |
| | Vertical | Scan Rate (Frame Rate) | Fv | - | 60 | - |
| Tv | | | - | 16.6 | - | ms |
| Vertical Active | | Tva | - | 1536 | - | Lines |
| Vsync Front Porch | | Tvfp | - | 6 | - | Lines |
| Vsync Active Width | | Tvsw | - | 12 | - | Lines |
| Vsync Back Porch | | Tvbp | - | 58 | - | Lines |
| Vertical Total | | Tvt | 1547 | 1612 | 1628 | Lines |

7.0 I2C SPECIFICATIONS

Following describes the I2C specifications equipped in the LCD module. Since the DAC (DALLAS DS1803) is used for Brightness and Contrast, Please refer to its own specifications in detail. 2 signals (SCLK and SDATA) in the LCD module interface are used for the DAC.

The address for DAC is '0101101'b. Its port-0 is for Contrast and its port-1 is for Brightness. Reserved addresses are from '0010000'b to '0011111'b and from '0110000'b to '0111111'b.

7.1 I2C Feature Summary

- Standard mode (100KHz max) support
- 3.3V interface
- Slave mode operation only

7.2 Electrical Specification

2 signals (SCLK and SDATA) are equipped at the LCD module interface. SCLK is the clock input as SCL and SDATA is the data input/output as SDA. These signals should be driven by Open-Drain or Open-Collector without any pull-up resistor. Both signals are pulled up by 5.1K ohm resistors to 3.3V typ respectively in the LCD module.

Electrical Specification of C/A

| | Symbol | Min | Max | Unit |
|--|--------|------|-----|------|
| Input Low voltage (*1) | Vil | -0.5 | 0.5 | V |
| Input High voltage (*2) | Vih | 2.3 | 3.6 | V |
| Input Hysteresis voltage | Vhys | 0.4 | - | V |
| Input leakage current @ Vil-Min or Vih-Max (*3) | Ii | -30 | 30 | uA |
| Output Low voltage | Vol | - | 0.5 | V |
| Output High impedance leakage current (*3) | Ioh | -30 | 30 | uA |
| Input capacitance | Ci | - | 35 | pF |

NOTE :

*1 : Vil (typ) = 0.9V

*2 : Vih (typ) = 1.8V

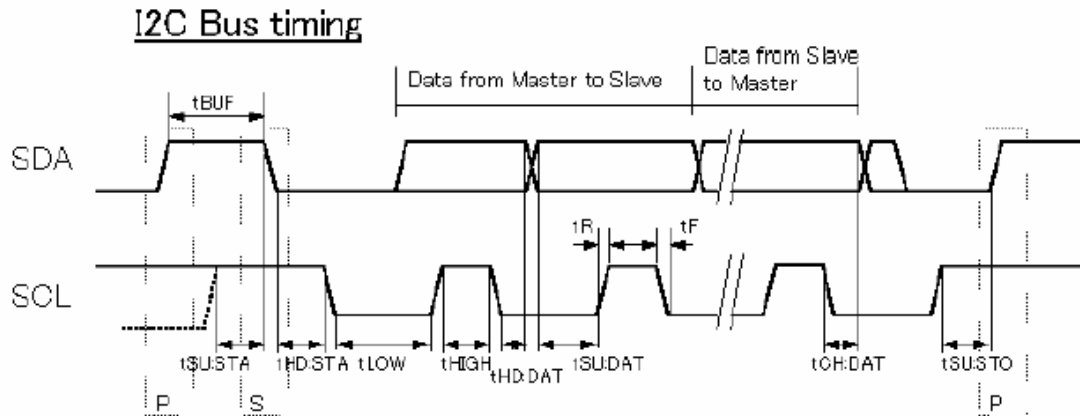
*3 : without pull up resistor (5.1K ohm)

7.3 Timing Specification

In the following figure and table, Slave is the control ASICs in the LCD module and Master is the controller to drive the LCD module.

“S” is the START condition and “P” is the STOP condition.

< I2C Bus timing >



Timing Specification of C/A

| | Symbol | Min | Max | Unit |
|--|---------|-----|------|------|
| Frequency of SCL | fSCL | 0 | 100 | KHz |
| Bus Free Time from STOP to START | tBUF | 4.7 | - | us |
| Setup time of START | tSU:STA | 4.7 | - | us |
| Hold time of START | tHD:STA | 4 | - | us |
| Low time of SCL | tLOW | 4.7 | - | us |
| High time of SCL | tHIGH | 4 | - | us |
| Data hold time for Slave | tHD:DAT | 0 | - | us |
| Data setup time for Slave | tSU:DAT | 250 | - | ns |
| Data change from SCL falling edge (to Master) | tCH:DAT | 300 | 900 | ns |
| Rise time Vil-Max --> Vih-Min | tR | - | 1000 | ns |
| Fall time Vil-Max <-- Vih-Min | tF | - | 300 | ns |
| Setup time of STOP | tSU:STO | 4 | - | us |
| Spike suppression | tSP | - | 50 | ns |

8.0 INPUT SIGNALS, GRAY SCALE DISPLAY AT EACH SUB-PIXEL



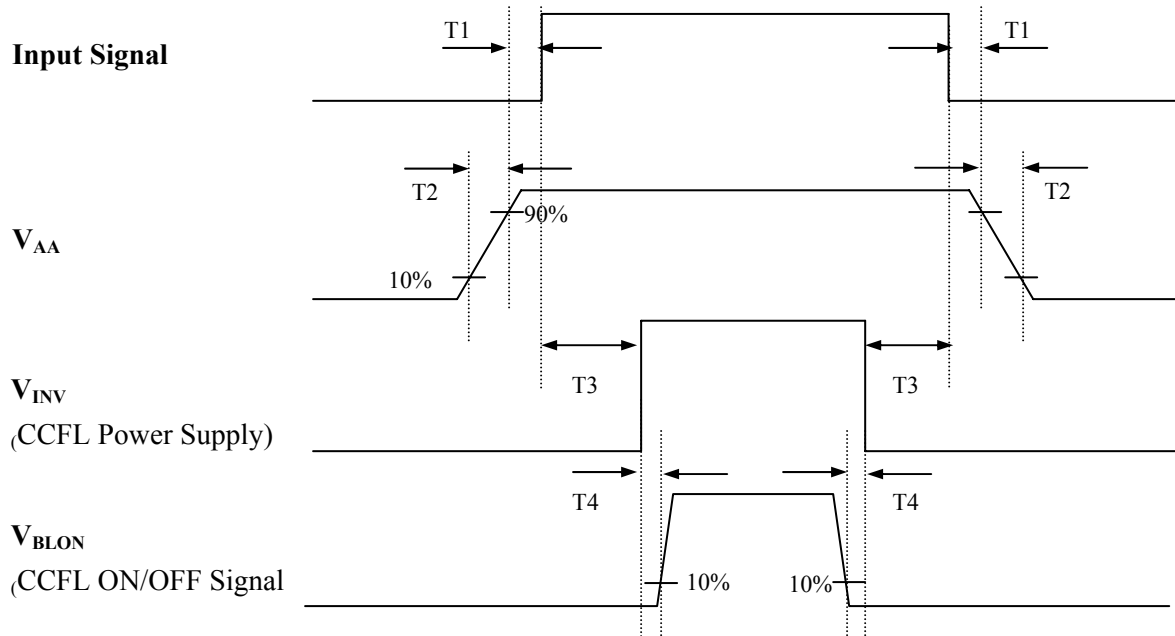
Each pixel is displayed in 256 gray scales from 8bit data signal inputs. Table 8 shows the 8bit input signals for gray scale display at each sub-pixel.

<Table 8 8bit Input signals, Gray scale display at each sub-pixel >

| | Data Signal | | | | | | | | | | | | | | | | |
|---------------------------|-----------------|---------------------------------|---------------------------------|---------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | AA7 AA6 AA5 AA4 AA3 AA2 AA1 AA0 | BA7 BA6 BA5 BA4 BA3 BA2 BA1 BA0 | CA7 CA6 CA5 CA4 CA3 CA2 CA1 CA0 | | | | | | | | | | | | | |
| | ODD | BB7 BB6 BB5 BB4 BB3 BB2 BB1 BB0 | BB7 BB6 BB5 BB4 BB3 BB2 BB1 BB0 | CB7 CB6 CB5 CB4 CB3 CB2 CB1 CB0 | | | | | | | | | | | | | |
| Gray Scale of A Sub Pixel | 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 | | | | | | | | | | | | | |
| | △ | 0 0 0 0 0 0 0 1 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | |
| | Darker | 0 0 0 0 0 0 1 0 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | |
| | △ | | | | | | | | | | | | | | | | |
| | ▽ | | | | | | | | | | | | | | | | |
| | Brighter | 1 1 1 1 1 1 0 1 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | |
| ▽ | 1 1 1 1 1 1 1 0 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | | |
| White | 1 1 1 1 1 1 1 1 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | | |
| Gray Scale of B Sub Pixel | 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 | | | | | | | | | | | | | |
| | △ | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 1 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | |
| | Darker | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 1 0 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | |
| | △ | | | | | | | | | | | | | | | | |
| | ▽ | | | | | | | | | | | | | | | | |
| | Brighter | 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 0 1 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | |
| ▽ | 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 1 0 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | | |
| White | 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 1 1 | 0 0 0 0 0 0 0 0 | | | | | | | | | | | | | | |
| Gray Scale of C Sub Pixel | 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 | | | | | | | | | | | | | |
| | △ | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 1 | | | | | | | | | | | | | |
| | Darker | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 1 0 | | | | | | | | | | | | | |
| | △ | | | | | | | | | | | | | | | | |
| | ▽ | | | | | | | | | | | | | | | | |
| | Brighter | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 0 1 | | | | | | | | | | | | | |
| ▽ | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 1 0 | | | | | | | | | | | | | | |
| White | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 1 1 | | | | | | | | | | | | | | |
| Gray Scale of White | 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 | | | | | | | | | | | | | |
| | △ | 0 0 0 0 0 0 0 1 | 0 0 0 0 0 0 0 1 | 0 0 0 0 0 0 0 1 | | | | | | | | | | | | | |
| | Darker | 0 0 0 0 0 0 1 0 | 0 0 0 0 0 0 1 0 | 0 0 0 0 0 0 1 0 | | | | | | | | | | | | | |
| | △ | | | | | | | | | | | | | | | | |
| | ▽ | | | | | | | | | | | | | | | | |
| | Brighter | 1 1 1 1 1 1 0 1 | 1 1 1 1 1 1 0 1 | 1 1 1 1 1 1 0 1 | | | | | | | | | | | | | |
| ▽ | 1 1 1 1 1 1 1 0 | 1 1 1 1 1 1 1 0 | 1 1 1 1 1 1 1 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 | | | | | | | | | | | | | | |

9.0 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as shown in below



- $T1 \geq 30$ (ms)
- $T2 \leq 30$ (ms)
- $T3 \geq 250$ (ms)
- $T4 \geq 5$ (ms)

Note: Do not keep the interface signal high-impedance when power is on.

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

FIGURE 5 & 6, shown in Appendix, shows mechanical outlines for the model HV208QX1-100

. Other parameters are shown in Table 10.

<Table10 Dimensional Parameters>

| Parameter | Specification | Unit | Remark |
|-------------------|-------------------------------|--------|--------|
| Active area | 423.9 (H) X 318.0 (V) | mm | |
| Number of pixels | 2048 (H) X 1536 (V) | pixels | |
| Pixel pitch | 0.207 (H) X 0.207 (V) | mm | |
| Pixel arrangement | Gray Vertical stripe | | |
| Display mode | Normally Black | | |
| Outline dimension | 457.0 (H) X 350.0 (V) X 45(D) | mm | 1) |
| Weight | 2500 Typ. | gram | 2) |
| Back-light | Direct 12-CCFL type | | |

1) General tolerance : H & V = $\pm 0.5\text{mm}$ / D = $\pm 0.5\text{mm}$

2) 2700 Max.

10.2 Mounting

See FIGURE 5 & 6, shown in Appendix

10.3 Anti-Glare and Polarizer Hardness.

The surface of the LCD has an anti-glare coating to minimize reflection and a hard coating to reduce scratch.

10.4 Light Leakage

There shall not be visible light from the back-lighting system around the edges of the screen as seen from a distance 50 cm from the screen with an overhead light level of 300lux.

11.0 RELIABILITY TEST

The Reliability test items and its conditions are shown in below.

<Table11 Reliability test>

| No. | Test Items | Conditions |
|-----|-----------------------------------|--|
| 1 | High temperature storage test | Ta = 60 °C, 240 hrs |
| 2 | Low temperature storage test | Ta = -20 °C, 240 hrs |
| 3 | High temperature & high humidity | Ta = 50 °C, 80 %RH, 240 hrs |
| 4 | High temperature operation test | Ta = 50 °C, 240 hrs |
| 5 | Low temperature operation test | Ta = 0 °C, 240 hrs |
| 6 | Thermal shock | Ta = -20 °C ↔ 60 °C (0.5 hr), 100 cycle |
| 7 | Vibration test (non-operating) | Frequency : 10 - 200 - 10 Hz, 0.29Oct./min Gravity/AMP : 1.5G Period : X,Y,Z 30min |
| 8 | Shock test (non-operating) | Gravity : 50G Pulse width : 11 ms, half sine wave Direction : ±X, ±Y, ±Z Two Times for each direction |
| 9 | Electrostatic discharge test | Contact : 150 pF, 330 Ω, ±8KV 9 Points Air : 150 pF, 330 Ω, ±15KV 9 Points |

12.0 HANDLING & CAUTIONS

(1) Cautions when taking out the module

- Pick the pouch only, when taking out module from a shipping package.

(2) Cautions for handling the module

- As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
- As the LCD panel and back-light element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
- As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
- Do not pull the interface connector in or out while the LCD module is operating.
- Put the module display side down on a flat horizontal plane.
- Handle connectors and cables with care.

(3) Cautions for the operation

- When the module is operating, do not lose MCLK, DE signals. If any one of these signals is lost, the LCD panel would be damaged.
- Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.

(4) Cautions for the atmosphere

- Dew drop atmosphere should be avoided.

- Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

(5) Cautions for the module characteristics

- Do not apply fixed pattern data signal to the LCD module at product aging.
- Applying fixed pattern for a long time may cause image sticking.

(6) Other cautions

- Do not disassemble and/or re-assemble LCD module.
- Do not re-adjust variable resistor or switch etc.
- When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

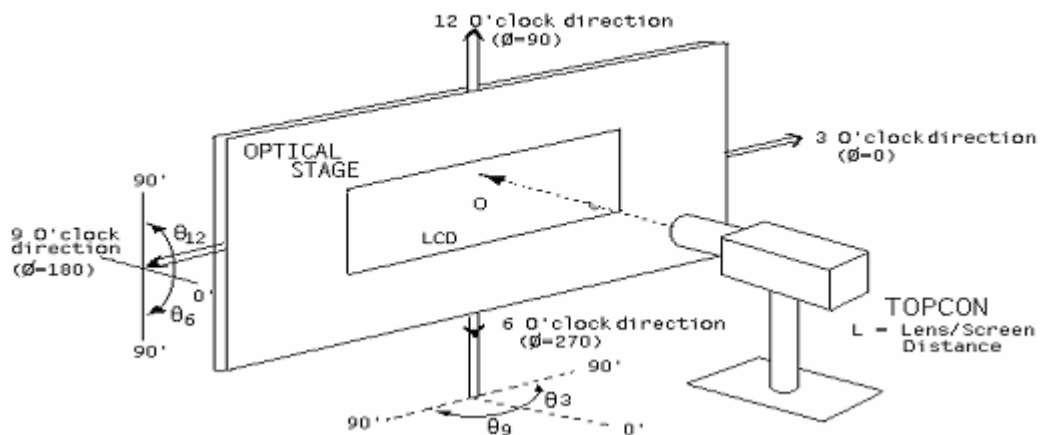
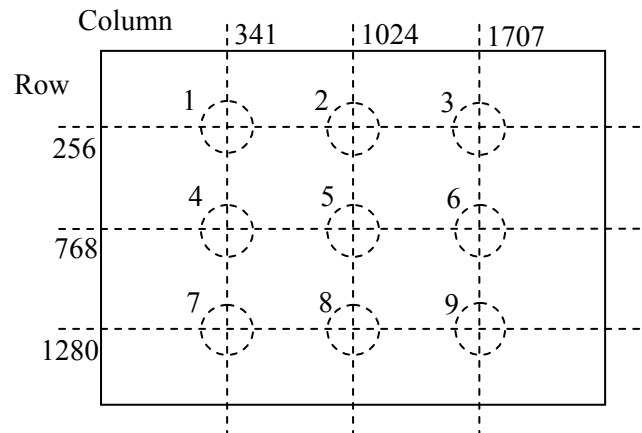
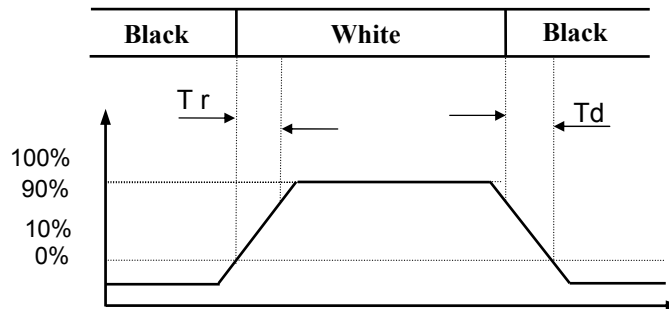
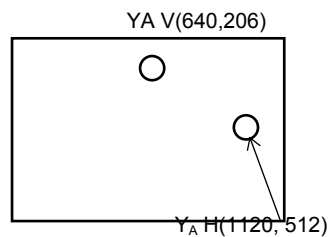
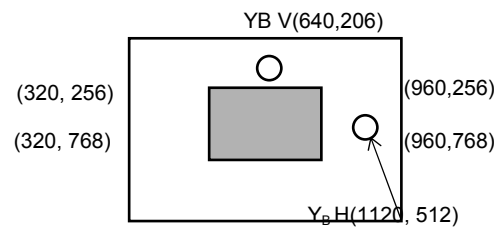
13.0 APPENDIX
Figure 1) Measurement Set Up


Figure 2) White and Black Uniformity Measurement Points (9 Points)

Figure 3) Response Time Testing

Figure 4) Cross Modulation Test Description

VIEW AREA



VIEW AREA



$$\text{Cross-Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Where:

 Y_A = Initial luminance of measured area (cd/m^2)

 Y_B = Subsequent luminance of measured area (cd/m^2)

The location measured will be exactly the same in both patterns

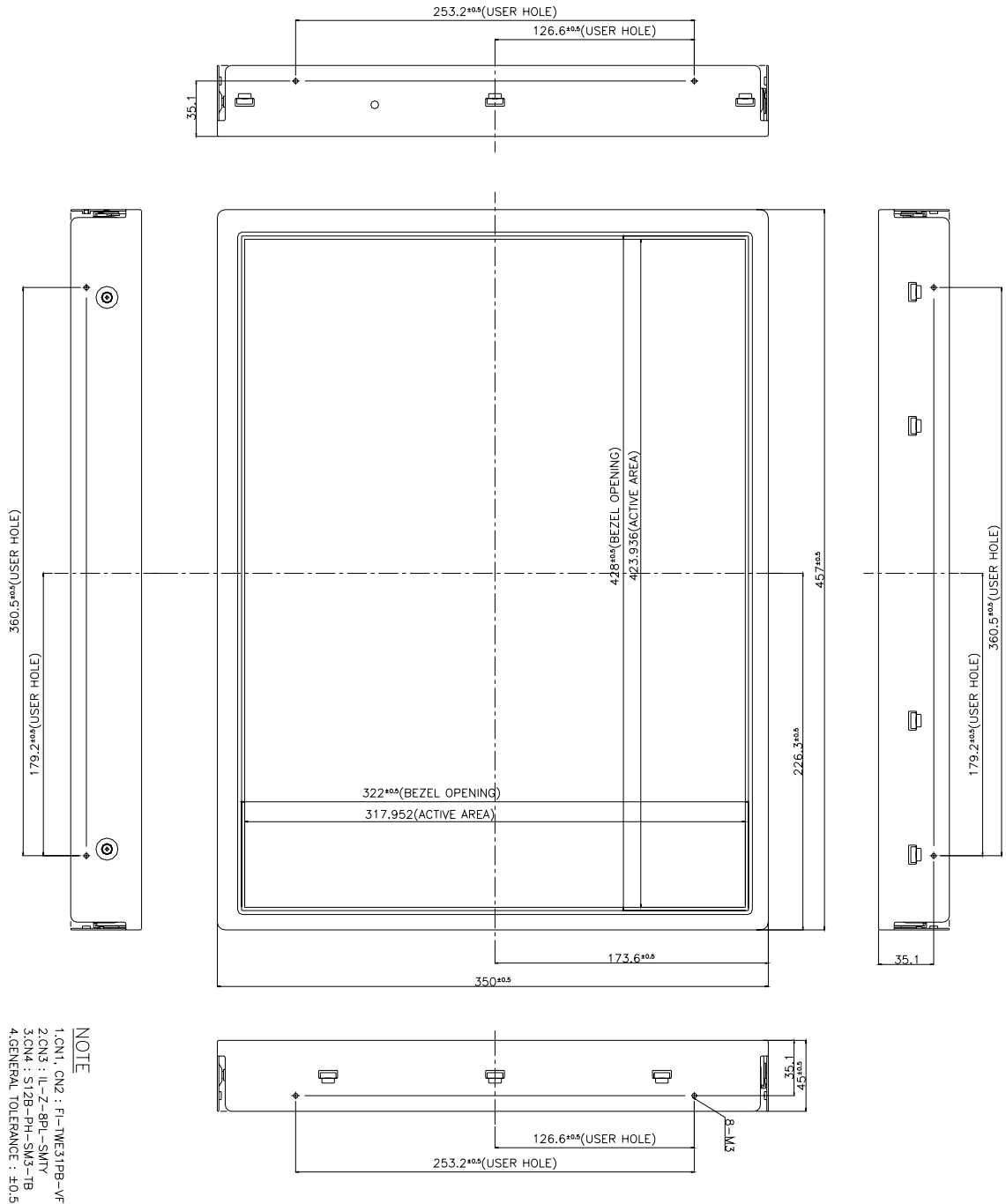
Figure 5) TFT-LCD Module Outline dimensions (Front view)


Figure 6) TF T-LCD Module Outline Dimensions (Back view)
