

# Crystal Clear Technology

## Product Specification

**G2432W33xxxxx**

(WITH CONTROLLER : S1D13700)

(5.7 INCH QVGA SERIES)

**Crystal Clear Technology sdn. bhd.**

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2.0 Record of revision

| Rev | Date     | Item | Page | Comment         | Originator | Checked By |
|-----|----------|------|------|-----------------|------------|------------|
| 1.0 | 23/07/10 |      |      | Initial Release | Khairiah   | Azhar      |



**3.0 General specification**

Display format: Graphics, 240 (H) x 320 (W)

Pixel size: 0.33 (H) x 0.33 (W) mm

Pixel pitch: 0.36 (H) x 0.36 (W) mm

View area: 92.0 (H) x 122.0 (W) mm

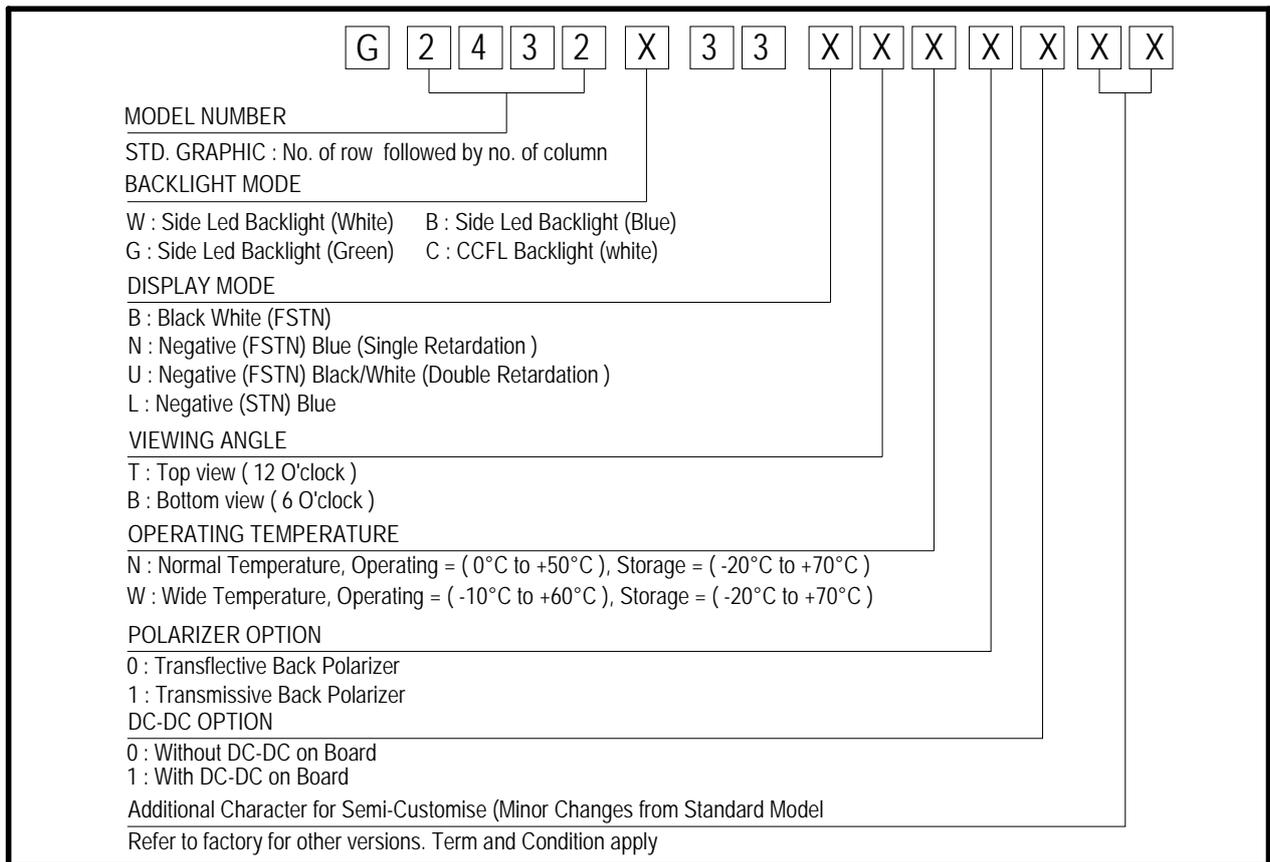
Active area: 86.37 (H) x 115.37 (W) mm

General dimensions: 109.0 (H) x 160.0 (W) x 10.0 max (T) mm

Controller: S1D13700

Driver : NT7701 and NT7702 or equivalent

Interface: Parallel



**4.0 Absolute maximum rating (at V<sub>SS</sub> = 0V, ambient temperature = 25°C)**

| NO | ITEM                              | SIMBOL                            | MIN          | MAX  | UNIT |
|----|-----------------------------------|-----------------------------------|--------------|------|------|
| 1. | Power Supply voltage (Logic)      | V <sub>DD</sub> – V <sub>SS</sub> | 0            | 5.5  | V    |
| 2. | Power Supply voltage (LCD Driver) | V <sub>DD</sub> – V <sub>0</sub>  | -            | 26.0 | V    |
| 3. | Operating Temperature             | T <sub>op</sub>                   | Refer page 3 |      | °C   |
| 4. | Storage Temperature               | T <sub>st</sub>                   | Refer page 3 |      | °C   |

**5.0 Electrical characteristics**

| NO | ITEM                                     | SYMBOL                            | CONDITION                                  | MIN                | TYP | MAX                | UNIT |
|----|--|-----------------------------------|--|--------------------|-----|--------------------|------|
| 1. | Power Supply voltage (Logic)             | V <sub>DD</sub> – V <sub>SS</sub> | -  | 4.5                | 5.0 | 5.5                | V    |
| 2. | Power Supply voltage (V <sub>LCD</sub> ) | V <sub>DD</sub> -V <sub>0</sub>   | 25°C                                       | 22.5±5%            |     |                    | V    |
| 3. | Input Voltage                            | V <sub>IH</sub>                   | -  | 0.8V <sub>DD</sub> | -   | V <sub>DD</sub>    | V    |
|    |  | V <sub>IL</sub>                   | -  | 0                  | -   | 0.3V <sub>DD</sub> | V    |
| 4. | Current Supply                           | I <sub>DD</sub>                   | V <sub>aDJ</sub> – V <sub>SS</sub> = 22.5V | -                  | 45  | -                  | mA   |

**5.1 Backlight Options**

| NO | COLOR | FORWARD VOLTAGE (V) |      |     | FORWARD CURRENT (mA) |      |     | MIN BRIGHTNESS (cd/m <sup>2</sup> ) * |
|----|-------|---------------------|------|-----|----------------------|------|-----|---------------------------------------|
|    |       | Min                 | Typ. | Max | Min                  | Typ. | Max |                                       |
| 1. | White | -                   | 5.0  | -   | -                    | 150  | 200 | 400                                   |
|    |       |                     |      |     |                      |      |     |                                       |

- \*Note :
- Brightness measured at backlight surface.
  - On LCD surface, brightness is only about 10% to 15% of backlight brightness.
  - Lifetime of backlight: For Yellow Green = 50K hrs. For White = 20k hrs.

**6.0 Environmental requirements**

| NO | ITEM                  | CONDITION  |
|----|-----------------------|--|
| 1. | Operating Temperature | Refer page 3   |
| 2. | Storage Temperature   | Refer page 3   |
| 3. | Operating Humidity    | 5% to 95% RH   |
| 4. | Cycle Test            | 0 C @ 30 min to 50 C @ 30min for 1 cycle run for 10 cycles |
| 5. | Lifetime              | 50000 HOURS (excluding backlight)                          |

Note: The background on LCD has the possibility to be changed in different temperature range.



## 7.0 LCD specification

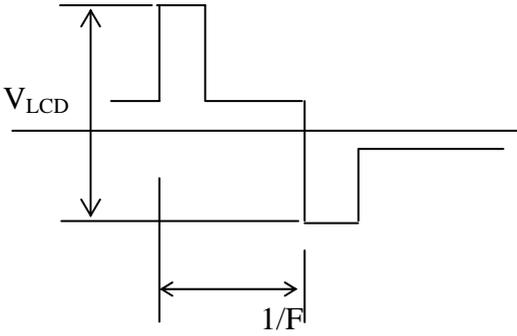
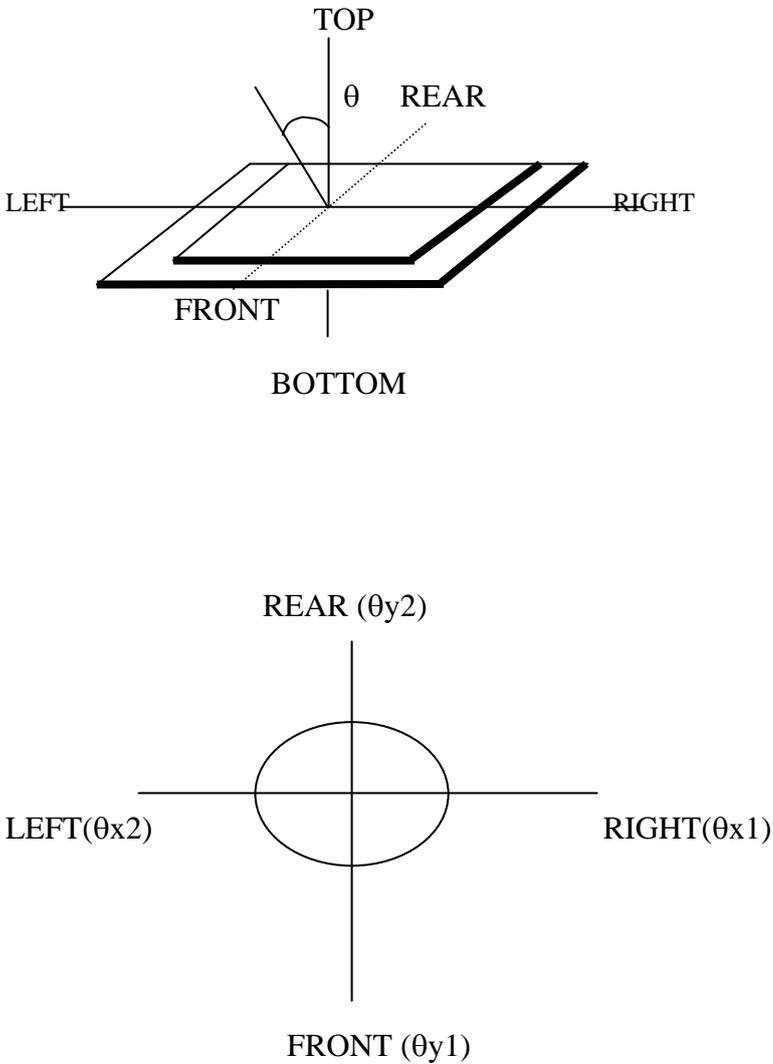
## 7.1 Electro-optical characteristics (at ambient temperature = 25°C)

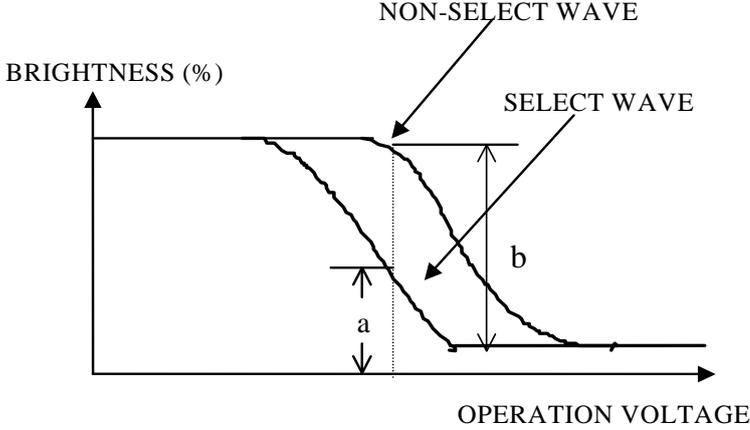
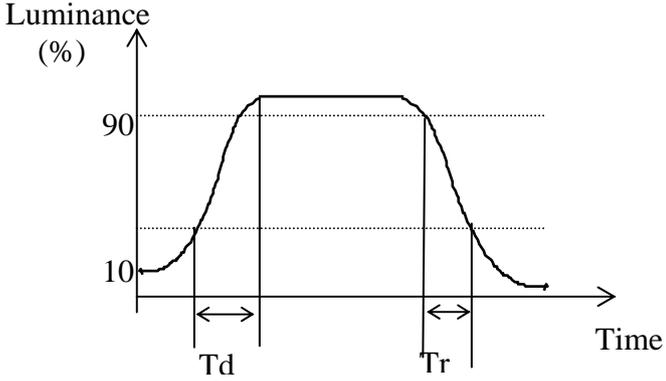
| NO | ITEM                     | SYMBOL          | CONDITION                           | LCD TYPE  |          |                     |              |               |                   |                   | REF.  |
|----|--------------------------|-----------------|-------------------------------------|-----------|----------|---------------------|--------------|---------------|-------------------|-------------------|-------|
|    |                          |                 |                                     | STN YG    | STN GREY | STN -VE BLUE/PURPLE | FSTN +VE B/W | FSTN -VE BLUE | FSTN -VE TRUE B/W | FSTN -VE TRI AXIS |       |
| 1  | Operating Voltage (Volt) | $V_{LCD}$       | $\theta = 0$<br>$Cr = \max$         | 22.5 ± 5% |          |                     |              |               |                   |                   | 7.1.1 |
| 2  | Viewing Angle (Deg)      | $\theta x 1$    | $CR \geq 2$<br>$V_{LCD} = 22.5V$    | +20       | +15      | +35                 | +20          | +35           | +30               | +40               | 7.1.2 |
|    |                          | $\theta x 2$    |                                     | -20       | -15      | -35                 | -20          | -35           | -35               | -40               |       |
|    |                          | $\theta y 1$    |                                     | -25       | -20      | -30                 | -25          | -30           | -30               | -50               |       |
|    |                          | $\theta y 2$    |                                     | +25       | +20      | +30                 | +25          | +30           | +30               | +30               |       |
| 3  | Contrast Ratio           | CR              | $\theta = 0^0$<br>$V_{LCD} = 22.5V$ | 2.5       | 2.0      | 5.5                 | 2.5          | 5.5           | 15                | 15                | 7.1.3 |
| 4  | Response Time (msec)     | Rise Time (Tr)  | $\theta = 0^0$                      | 400       |          |                     |              |               |                   |                   | 7.1.4 |
|    |                          | Decay Time (Td) | $\theta = 0^0$                      | 400       |          |                     |              |               |                   |                   |       |

## Note:

1. Viewing angle data is based on bottom view product by default. Should it be a top view product, values are then swap.
2. Contrast ratio is based on typical data when using white colour as backlight.
3. Equipment Used Eldim; Ez Contrast 120R , Spot Size = 2mm



| NO    | CHARACTERISTICS   | DEFINITIONS  |
|-------|---|--|
| 7.1.1 | <b>Definition of Operating Voltage (<math>V_{LCD}</math>)</b> |  <p><math>V_{LCD}</math> : Operating Voltage<br/>F : Frame Frequency</p> |
| 7.1.2 | <b>Definition of Viewing Angle</b>                            |   |

|              |  |   |
|--------------|--|---|
| <p>7.1.3</p> | <p><b>Definition of Contrast Ratio</b></p> |  <p>Contrast Ratio = <math>\frac{\text{Brightness of non-selected state (b)}}{\text{Brightness of selected state (a)}}</math></p> <p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>(a) Operating Voltage: <math>V_{LCD}</math></li> <li>(b) Temperature: <math>25^{\circ}C</math></li> <li>(c) Viewing Angle, <math>\theta = 0^{\circ}</math></li> </ul> |
| <p>7.1.4</p> | <p><b>Response Time</b></p>                |  <p>Tr: Measured between 10% and 90% of LCD segment maximum response with <math>V_{ON}</math>.</p> <p>Td: With voltage switches to zero and the instant LCD segment reaches 10% of its maximum response.</p>  |



## 8.0 Interface

| 8.1                      | <i>Display Controller</i>  | S1D13700F00   |
|--------------------------|----------------------------|---|
| 8.2                      | <i>Display Driver</i>      | NT7701 and NT7702   |
| 8.3                      | <i>Duty Cycle</i>          | 1/240   |
| 8.4                      | <i>Pin-out Assignments</i> |   |
| <b>CONNECTOR 1 (CNI)</b> |                            |   |
| Pin No                   | Symbol                     | Function  |
| 1                        | /RES                       | This active-low input performs a hardware reset of the S1D13700F00 which sets all internal registers to their default States and forces all signals to their inactive states.   |
| 2                        | /RD                        | * When the Generic host bus interface is selected, this pin is the active-LOW read strobe (RD#). The S1D13700F00 data output buffers are enabled when this signal is low.<br><br>* When the M6800 host bus interface is selected, this pin is the active-high enable clock (E). Data is read from or written to the S1D13700F00 when this clock goes high.  |
| 3                        | /WR                        | This input pin has multiple functions.<br>• When the Generic host bus interface is selected, this signal is active-low write strobe (WR#). The bus data is latched on the rising edge of this signal.<br>• When the M6800 host bus interface is selected, this signal is the read/write control signal (R/W#). Data is read from the S1D13700F00 if this signal is high, and written to the S1D13700F00 if it is low. |
| 4                        | /CS                        | Chip select.<br>This active-low input enables the S1D13700F00. It is usually connected to the output of an address decoder device that maps the S1D13700F00 into the memory space of the controlling microprocessor.  |
| 5                        | A0                         | System address pin 0<br>* Indirect addressing mode – in conjunction with RD# and Write# determine the type of data present in the data bus  |
| 6-13                     | DB0-DB7                    | Input /output System data bus.  |
| 14                       | VCC                        | Supply terminal of module   |
| 15                       | VSS                        | Ground terminal of module   |
| 16                       | VEE                        | Positive supply for Liquid Crystal Drive  |
| 17                       | Vadj                       | Liquid Crystal Display contrast adjust  |
| 18                       | *SEL1                      | Select Host bus interface<br>SEL1 = low, Generic Bus<br>SEL1 = high, M6800 Family Bus   |
| 19                       | A                          | Backlight power supply  |
| 20                       | K                          | Backlight ground  |

**\* Selection can be done by software or hardware. To use hardware option Remove R117 and put 0ohm to R26 (for generic) or to R25 (for M6800)**

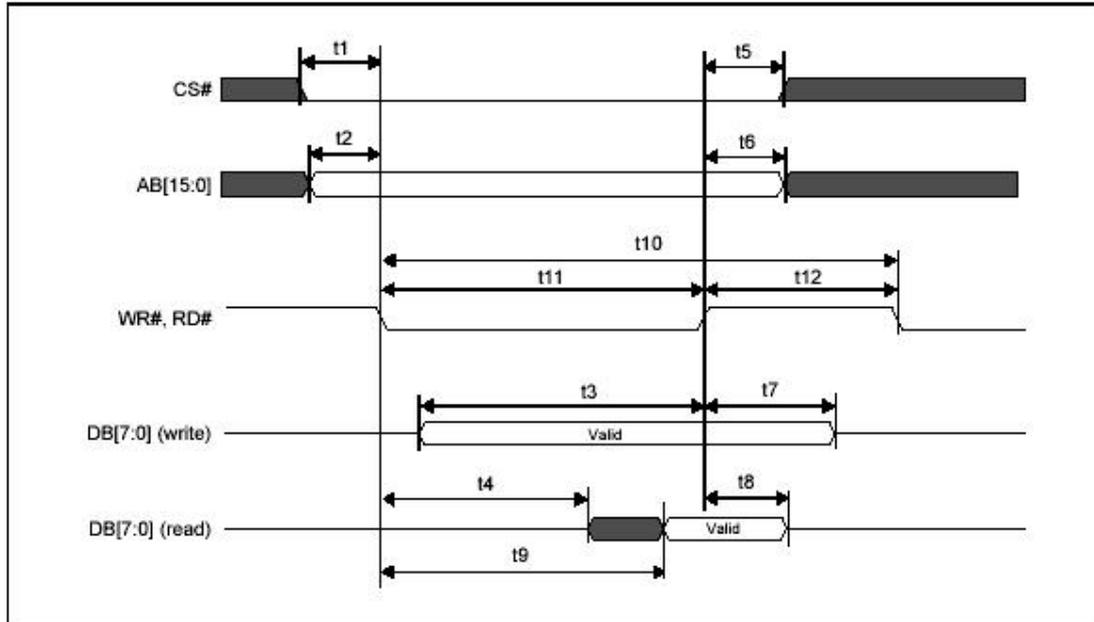


9.0 Timing Diagram

*Note: This module has been designed for Indirect addressing mode (A15-A1 pins are connected to VSS)*

9.1 Timing Characteristic for SID13700

Generic Bus Direct/Indirect Interface without WAIT# Timing

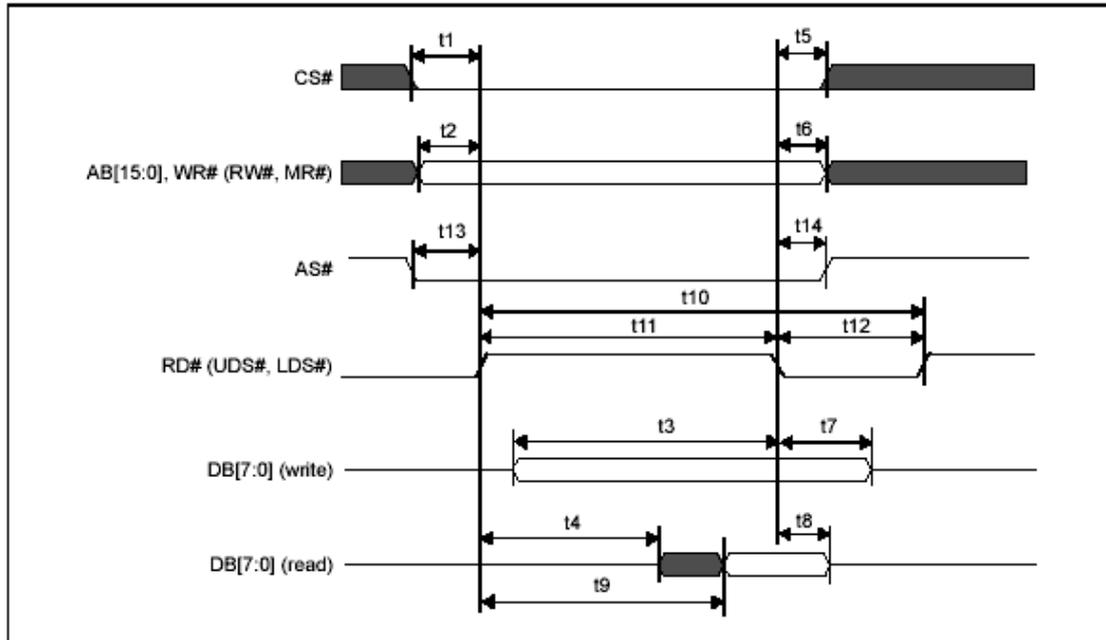


| Symbol | Parameter  | 3.3 Volt |        | 5.0 Volt |        | Units |
|--------|--|----------|--------|----------|--------|-------|
|        |  | Min      | Max    | Min      | Max    |       |
| t1     | CS# setup time                                       | 5        | —      | 5        | —      | ns    |
| t2     | AB[15:0] setup time                                  | 5        | —      | 5        | —      | ns    |
| t3     | DB[7:0] setup time to WR# rising edge (write cycle)  | Note 2   | —      | Note 2   | —      | ns    |
| t4     | RD# falling edge to DB[7:0] driven (read cycle)      | 3        | —      | 3        | —      | ns    |
| t5     | CS# hold time  | 7        | —      | 7        | —      | ns    |
| t6     | AB[15:0] hold time                                   | 7        | —      | 7        | —      | ns    |
| t7     | DB[7:0] hold time from WR# rising edge (write cycle) | 5        | —      | 5        | —      | ns    |
| t8     | DB[7:0] hold time from RD# rising edge (read cycle)  | 3        | 14     | 3        | 14     | ns    |
| t9     | RD# falling edge to valid Data (read cycle)          | —        | Note 3 | —        | Note 3 | ns    |
| t10    | RD#, WR# cycle time                                  | Note 4   | —      | Note 4   | —      | ns    |
| t11    | RD#, WR# pulse active time                           | 5        | —      | 5        | —      | Ts    |
| t12    | RD#, WR# pulse inactive time                         | Note 5   | —      | Note 5   | —      | ns    |

1. Ts = System clock period
2. t3min = 2Ts + 5
3. t9max = 4Ts + 18 (for 3.3V)  
= 4Ts + 20 (for 5.0V)
4. t10min = 6Ts (for a read cycle followed by a read or write cycle)  
= 7Ts + 2 (for a write cycle followed by a write cycle)  
= 10Ts + 2 (for a write cycle followed by a read cycle)
5. t12min = 1Ts (for a read cycle followed by a read or write cycle)  
= 2Ts + 2 (for a write cycle followed by a write cycle)  
= 5Ts + 2 (for a write cycle followed by a read cycle)

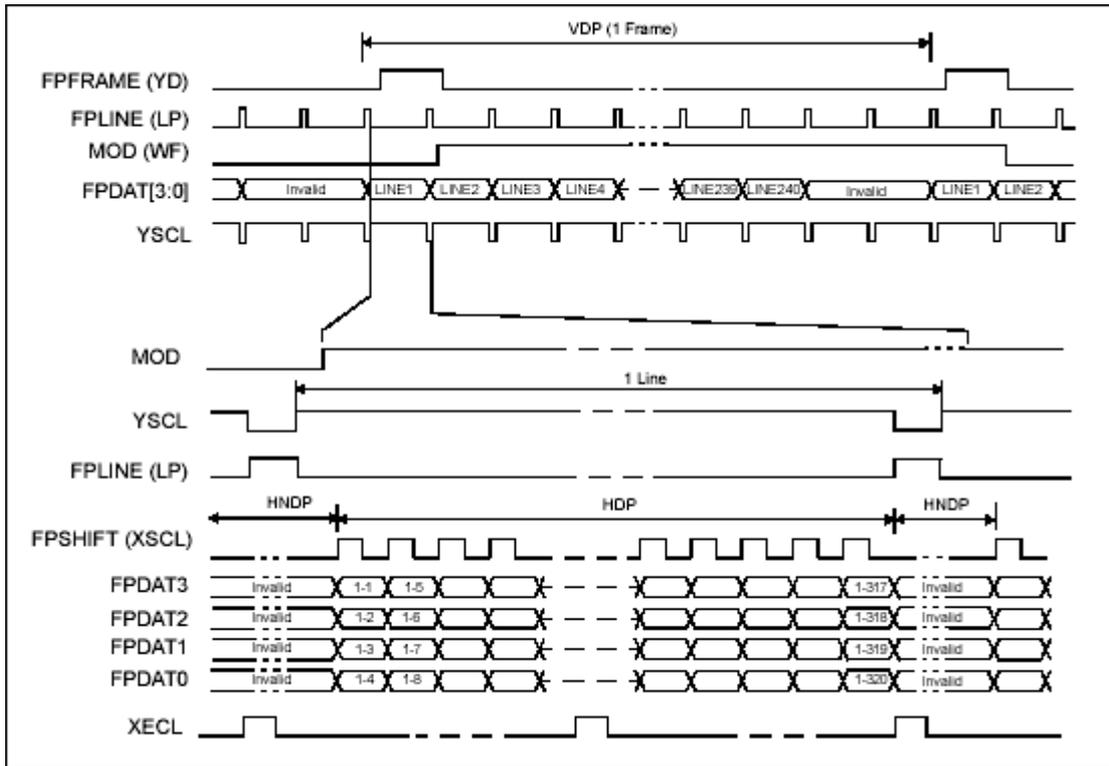


M6800 Family Bus Indirect Interface Timing

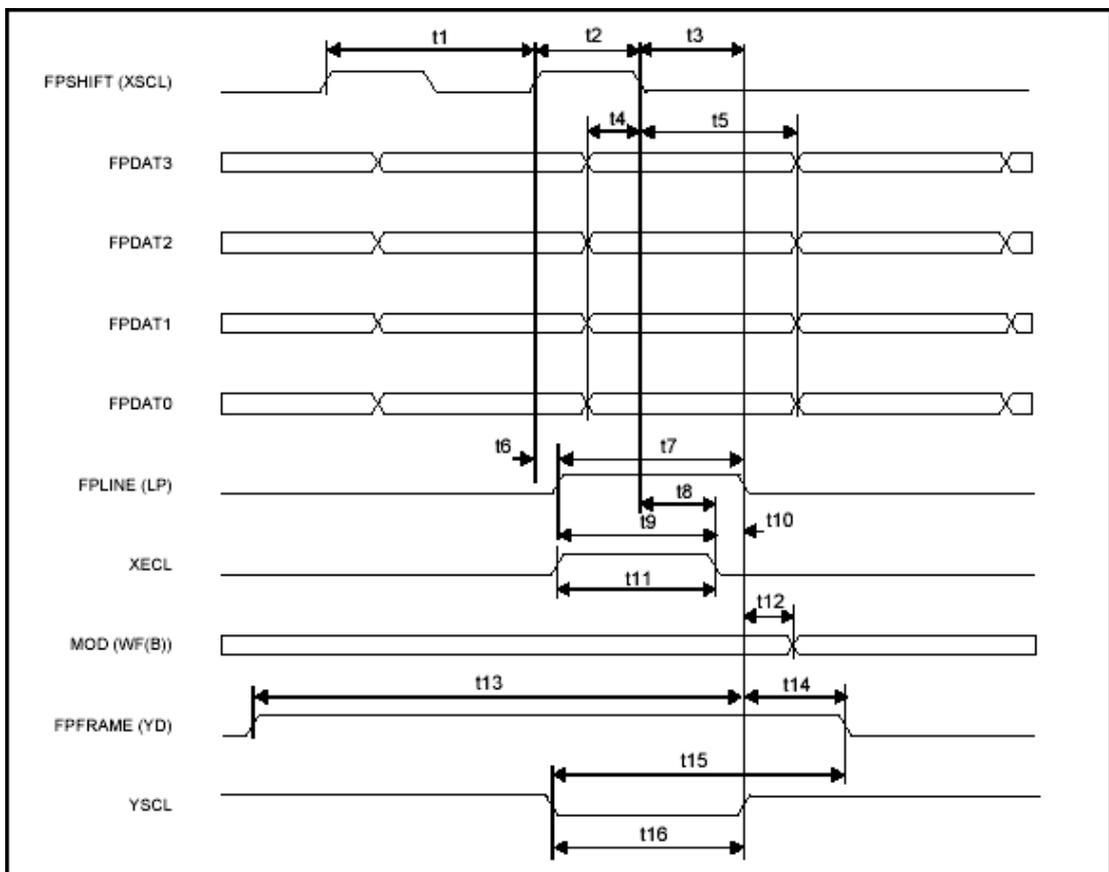


| Symbol | Parameter   | 3.3 Volt |        | 5.0 Volt |        | Units |
|--------|---|----------|--------|----------|--------|-------|
|        |   | Min      | Max    | Min      | Max    |       |
| t1     | CS# setup time  | 5        | —      | 5        | —      | ns    |
| t2     | AB[15:0] setup time                                   | 5        | —      | 5        | —      | ns    |
| t3     | DB[7:0] setup time to RD# falling edge (write cycle)  | Note 2   | —      | Note 2   | —      | ns    |
| t4     | RD# rising edge to DB[7:0] driven (read cycle)        | 3        | —      | 3        | —      | ns    |
| t5     | CS# hold time   | 7        | —      | 7        | —      | ns    |
| t6     | AB[15:0] hold time                                    | 7        | —      | 7        | —      | ns    |
| t7     | DB[7:0] hold time from RD# falling edge (write cycle) | 5        | —      | 5        | —      | ns    |
| t8     | DB[7:0] hold time from RD# falling edge (read cycle)  | 2        | 55     | 2        | 55     | ns    |
| t9     | RD# rising edge to valid Data                         | —        | Note 3 | —        | Note 3 | ns    |
| t10    | RD# cycle time  | Note 4   | —      | Note 4   | —      | ns    |
| t11    | RD# pulse active time                                 | 5        | —      | 5        | —      | Ts    |
| t12    | RD# pulse inactive time                               | Note 5   | —      | Note 5   | —      | ns    |
| t13    | AS# setup time  | 0        | —      | 0        | —      | ns    |
| t14    | AS# hold time   | 0        | —      | 0        | —      | ns    |

1. Ts = System clock period
2. t3min = 2Ts + 5
3. t9max = 4Ts + 18 (for 3.3V)  
= 4Ts + 20 (for 5.0V)
4. t13min = 6Ts (for a read cycle followed by a read or write cycle)  
= 7Ts + 2 (for a write cycle followed by a write cycle)  
= 10Ts + 2 (for a write cycle followed by a read cycle)
6. t15min = 1Ts (for a read cycle followed by a read or write cycle)  
= 2Ts + 2 (for a write cycle followed by a write cycle)  
= 5Ts + 2 (for a write cycle followed by a read cycle)



Monochrome 4-Bit Panel Timing



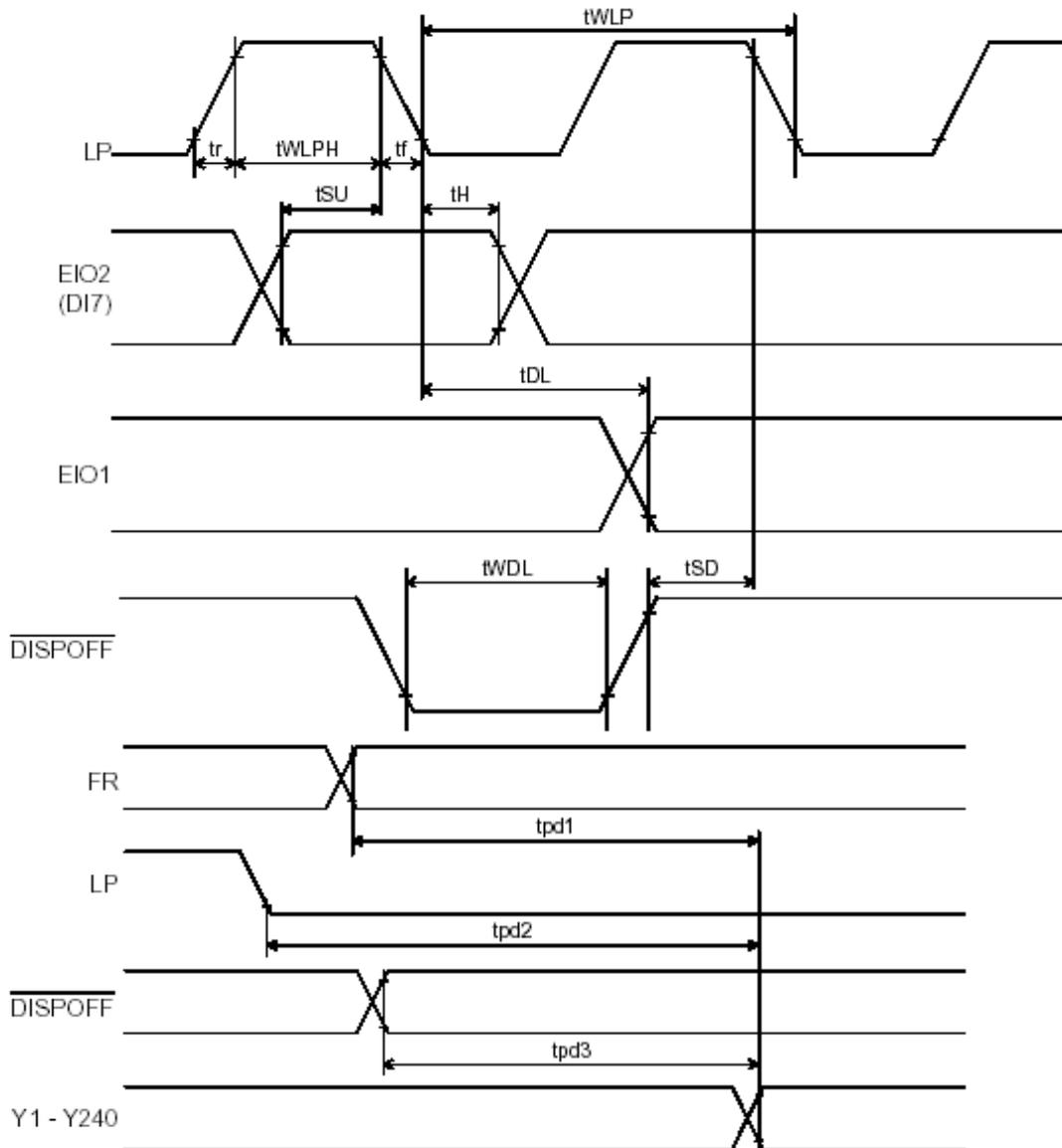


| Symbol | Parameter   | 3.3 Volts  |     | 5.0 Volts  |     | Units          |
|--------|---|------------|-----|------------|-----|----------------|
|        |   | Min        | Max | Min        | Max |                |
| t1     | FPSHIFT cycle time                                    | 1          | —   | 1          | —   | Tc<br>(Note 2) |
| t2     | FPSHIFT pulse width                                   | 0.5Tc - 5  | —   | 0.5Tc - 4  | —   | ns             |
| t3     | Latch data setup time from FPSHIFT falling edge       | 0.5Tc - 5  | —   | 0.5Tc - 4  | —   | ns             |
| t4     | FPDAT[3:0] setup to FPSHIFT falling edge              | 0.5Tc - 5  | —   | 0.5Tc - 4  | —   | ns             |
| t5     | FPDAT[3:0] hold from FPSHIFT falling edge             | 0.5Tc - 5  | —   | 0.5Tc - 4  | —   | ns             |
| t6     | FPLINE rising edge delay from FPSHIFT rising edge     | 0          | 4   | 0          | 4   | ns             |
| t7     | Latch pulse width                                     | Tc - 5     | —   | Tc - 4     | —   | ns             |
| t8     | XECL falling edge setup time to FPSHIFT falling edge  | 0.25Tc - 5 | —   | 0.25Tc - 4 | —   | ns             |
| t9     | XECL falling edge setup time from FPLINE rising edge  | 0.75Tc - 5 | —   | 0.75Tc - 4 | —   | ns             |
| t10    | XECL falling edge hold time to FPLINE falling edge    | Tc - 8     | —   | Tc - 8     | —   | ns             |
| t11    | XECL pulse width                                      | 0.75Tc - 5 | —   | 0.75Tc - 4 | —   | ns             |
| t12    | Permitted MOD delay time                              | —          | 4   | —          | 4   | ns             |
| t13    | FPLINE falling edge from FPFRAME rising edge          | 2Tc - 10   | —   | 2Tc - 10   | —   | ns             |
| t14    | FPLINE falling edge to FPFRAME falling edge           | 2Tc        | —   | 2Tc        | —   | ns             |
| t15    | FPFRAME falling edge hold time from YSCL falling edge | 3Tc - 10   | —   | 3Tc - 10   | —   | ns             |
| t16    | YSCL pulse width                                      | Tc - 5     | —   | Tc - 4     | —   | ns             |

1. Ts = System clock period
2. Tc = FPSHIFT cycle time
  - = 4Ts when CNF[1:0] = 00
  - = 8Ts when CNF[1:0] = 01
  - = 16Ts when CNF[1:0] = 10



9.2 LCD Driver Timing



Timing Characteristic for NT7702Common Mode ( $V_{SS} = V_5 = 0V$ ,  $V_{DD} = 2.5 - 5.5V$ ,  $V_0 = 15$  to  $30V$  and  $T_A = -30$  to  $+85^\circ C$ , unless otherwise noted)

| Parameter                               | Symbol     | Min. | Typ. | Max. | Unit    | Condition                 |
|---|------------|------|------|------|---------|---------------------------|
| Shift clock period                      | twLP       | 250  | -    | -    | ns      | $t_r, t_f \leq 20ns$      |
| Shift clock "H" pulse width             | twLPH      | 15   | -    | -    | ns      | $V_{DD} = +5.0V \pm 10\%$ |
|   |            | 30   | -    | -    | ns      | $V_{DD} = +2.5 - +4.5V$   |
| Data setup time                         | tsu        | 30   | -    | -    | ns      |                           |
| Data hole time                          | th         | 50   | -    | -    | ns      |                           |
| Input signal rise time                  | tr         |      | -    | 50   | ns      |                           |
| Input signal fall time                  | tr         |      | -    | 50   | ns      |                           |
| $\overline{DISPOFF}$ Removal time       | tsd        | 100  | -    | -    | ns      |                           |
| $\overline{DISPOFF}$ enable pulse width | twDL       | 1.2  | -    | -    | $\mu s$ |                           |
| Output delay time (1)                   | tdL        | -    | -    | 200  | ns      | $C_L = 15pF$              |
| Output delay time (2)                   | tpd1, tpd2 | -    | -    | 1.2  | $\mu s$ | $C_L = 15pF$              |
| Output delay time (3)                   | tpd3       | -    | -    | 1.2  | $\mu s$ | $C_L = 15pF$              |

Timing Characteristic for NT7701Segment Mode 1 ( $V_{SS}=0V$ ,  $V_{DD}= 4.5-5.5V$ ,  $V_0=15$  to  $30$ , and  $T_A=-20$  to  $+85^\circ C$ , unless otherwise noted.)

| Parameter                                 | Symbol     | Min. | Typ. | Max. | Unit    | Condition                     |
|---|------------|------|------|------|---------|-------------------------------|
| Shift clock period                        | twCK       | 71   | -    |      | ns      | $t_r, t_f \leq 10ns$ , Note 1 |
| Shift clock "H" pulse width               | twCKH      | 23   | -    |      | ns      |                               |
| Shift clock "L" pulse width               | twCKL      | 23   | -    |      | ns      |                               |
| Data setup time                           | tDS        | 10   | -    |      | ns      |                               |
| Data hole time                            | tdH        | 20   | -    |      | ns      |                               |
| Latch pulse "H" pulse width               | twLPH      | 23   | -    |      | ns      |                               |
| Shift clock rise to Latch pulse rise time | tLD        | 0    | -    |      | ns      |                               |
| Shift clock fall to Latch pulse fall time | tSL        | 25   | -    |      | ns      |                               |
| Latch pulse rise to Shift clock rise time | tLS        | 25   | -    |      | ns      |                               |
| Latch pulse fall to Shift clock rise time | tLH        | 25   | -    |      | ns      |                               |
| Input signal rise time                    | tr         |      | -    | 50   | ns      | Note 2                        |
| Input signal fall time                    | tr         |      | -    | 50   | ns      | Note 2                        |
| Enable setup time                         | ts         | 21   | -    |      | ns      |                               |
| $\overline{DISPOFF}$ Removal time         | tsd        | 100  | -    |      | ns      |                               |
| $\overline{DISPOFF}$ enable pulse width   | twDL       | 1.2  | -    |      | $\mu s$ |                               |
| Output delay time (1)                     | td         |      | -    | 40   | ns      | $C_L=15pF$                    |
| Output delay time (2)                     | tpd1, tpd2 |      | -    | 1.2  | $\mu s$ | $C_L=15pF$                    |
| Output delay time (3)                     | tpd3       |      | -    | 1.2  | $\mu s$ | $C_L=15pF$                    |

## Note

1. Take the cascade connection into consideration.
2.  $(t_{CK} - t_{WCKH} - t_{WCKL})/2$  is maximum in the case of high speed operation.



10.0 Instruction Set and Sample Code

10.1 Indirect addressing Command

| Class           | Register Address | Command     | Register Description                            | Control Byte Value | No. of Bytes |
|-----------------|------------------|-------------|---|--------------------|--------------|
| System Control  | 8000h - 8007h    | SYSTEM SET  | Initializes device and display                  | 40h                | 8            |
|                 | 8008h            | POWER SAVE  | Enters standby mode                             | 53h                | 0            |
| Display Control | 8009h - 800A     | DISP ON/OFF | Enables/disables display and display attributes | 58h<br>59h         | 1            |
|                 | 800Bh - 8014h    | SCROLL      | Sets screen block start addresses and sizes     | 44h                | 10           |
|                 | 8015h - 8016h    | CSRFORM     | Sets cursor type                                | 5Dh                | 2            |
|                 | 8017h            | CSRDIR      | Sets direction of cursor movement               | 4Ch - 4Fh          | 0            |
|                 | 8018h            | OVLAY       | Sets display overlay format                     | 5Bh                | 1            |
|                 | 8019h - 801Ah    | CGRAM ADR   | Sets start address of character generator RAM   | 5Ch                | 2            |
| Drawing Control | 801Bh            | HDOT SCR    | Sets horizontal scroll position                 | 5A                 | 1            |
|                 | 801Ch - 801Dh    | CSRW        | Sets cursor address                             | 46h                | 2            |
|                 | 801Eh - 801Fh    | CSRR        | Reads cursor address                            | 47h                | 2            |
|                 | 8020h            | GRAYSCALE   | Sets the Grayscale depth (bpp)                  | 60h                | 1            |
| Memory Control  |                  | MEMWRITE    | Writes to memory                                | 42h                | n/a          |
|                 |                  | MEMREAD     | Reads from memory                               | 43h                |              |

Generic Indirect Addressing Command/Write/Read

| A0 | $\overline{WR}$ | $\overline{RD}$ |                      |
|----|-----------------|-----------------|----------------------|
| 1  | 0               | 1               | Command [C]          |
| 1  | 1               | 0               | Parameter Read [P#]  |
| 0  | 0               | 1               | Parameter Write [P#] |

M6800 Indirect Addressing Command/Write/Read

| A0 | $\overline{R\overline{W}}$ | $\overline{E}$ |                                      |
|----|----------------------------|----------------|--------------------------------------|
| 1  | 0                          | 1              | Command write                        |
| 1  | 1                          | 1              | Display data and cursor address read |
| 0  | 0                          | 1              | Display data and parameter write     |

For more details, please refer to SID13700 datasheet



## 10.2 Sample code for initialisation

**Example of LCD initialisation using Generic Indirect Addressing (8051)**

*This code is written in assembly language.*

INIT\_LCD:

; System set

```
MOV      R3, #40H      ; C = 40H
LCALL   WRITE_COMM

MOV      R3, #30H      ; M0 = 0 internal CG ROM
LCALL   WRITE_PARAM   ; M1 = 0 CG RAM is 32 characters
                          ; M2 = 0 8 lines per character
                          ; W/S= 0 single panel drive
                          ; IV = 1 no top-line compensation

MOV      R3, #87H      ; FX = 8 pixels (Horizontal Char Size)
LCALL   WRITE_PARAM   ; WF = 1 two-frame AC Drive

MOV      R3, #07H      ; FY = 8 pixels (Vertical Char Size)
LCALL   WRITE_PARAM

MOV      R3, #27H      ; C/R = 40 characters/bytes per line
LCALL   WRITE_PARAM

MOV      R3, #2DH      ; TC/R = ( Fosc = 40MHz, Ffr = 100Hz )
LCALL   WRITE_PARAM

MOV      R3, #0EFH     ; L/F = 240 display lines
LCALL   WRITE_PARAM

MOV      R3, #28H      ; AP virtual screen horizontal size is 40 addresses
LCALL   WRITE_PARAM

MOV      R3, #00H
LCALL   WRITE_PARAM

; scroll set

MOV      R3, #44H      ; scroll command C = 44H
LCALL   WRITE_COMM

MOV      R3, #00H      ; SAD 1 = 0000H, character/text
LCALL   WRITE_PARAM

MOV      R3, #00H
LCALL   WRITE_PARAM

MOV      R3, #0F0H     ; SL 1 = 240 display lines
LCALL   WRITE_PARAM

MOV      R3, #0B0H     ; SAD 2 =04B0H
LCALL   WRITE_PARAM

MOV      R3, #04H
LCALL   WRITE_PARAM
```



```
MOV      R3, #0F0H      ; SL 2 = 240 display lines
LCALL    WRITE_PARAM

MOV      R3, #00H      ; P7-P10 -XX (don't care)
LCALL    WRITE_PARAM

MOV      R3, #00h
LCALL    WRITE_PARAM

MOV      R3, #00H
LCALL    WRITE_PARAM

MOV      R3, #00H
LCALL    WRITE_PARAM
; cursor form

MOV      R3, #5DH
LCALL    WRITE_COMM
MOV      R3, #04H      ; 4 pixels wide
LCALL    WRITE_PARAM
MOV      R3, #86H      ; 6 pixels high, block
LCALL    WRITE_PARAM

; cursor direction

MOV      R3, #4CH      ; right direction
LCALL    WRITE_COMM

; HDOT SCR

MOV      R3, #5AH
LCALL    WRITE_COMM
MOV      R3, #00H
LCALL    WRITE_PARAM

; OVLAY

MOV      R3, #5BH
LCALL    WRITE_COMM
MOV      R3, #01H      ; XOR,2LAYERS,TEXT AND GRAPHIC
LCALL    WRITE_PARAM

; Display OFF
LCALL DISP_OFF

; clear TEXT
LCALL CLEAR_GRP

; clear graphic
LCALL CLEAR_GRP

; Display ON
LCALL DISP_ON

RET
```

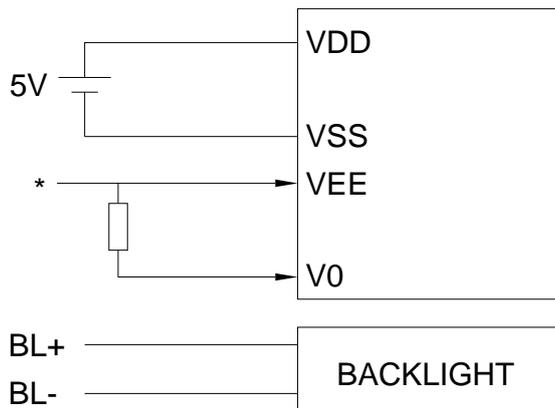


10.3 On chip character code

| Lower 4 bits | Upper 4 bits |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------|--------------|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|
|              | 0            | 1 | 2  | 3 | 4 | 5 | 6 | 7 | 8 | 8 | A | B | C | D | E | F |
| 0            |              |   |    | 0 | @ | P | ' | p |   |   |   | ー | 夕 | 三 |   |   |
| 1            |              |   | !  | 1 | A | Q | a | q |   |   | 。 | ア | 子 | 厶 |   |   |
| 2            |              |   | "  | 2 | B | R | b | r |   |   | 「 | イ | ツ | メ |   |   |
| 3            |              |   | #  | 3 | C | S | c | s |   |   | 」 | ウ | テ | モ |   |   |
| 4            |              |   | \$ | 4 | D | T | d | t |   |   | 、 | エ | ト | 巾 |   |   |
| 5            |              |   | %  | 5 | E | U | e | u |   |   | • | オ | ナ | ユ |   |   |
| 6            |              |   | &  | 6 | F | V | f | v |   |   | ヲ | カ | ニ | ヨ |   |   |
| 7            |              |   | '  | 7 | G | W | g | w |   |   | ヲ | キ | ヌ | ラ |   |   |
| 8            |              |   | (  | 8 | H | X | h | x |   |   | イ | ク | ネ | リ |   |   |
| 9            |              |   | )  | 9 | I | Y | i | y |   |   | ウ | ケ | ノ | ル |   |   |
| A            |              |   | *  | : | J | Z | j | z |   |   | エ | コ | ハ | レ |   |   |
| B            |              |   | +  | ; | K | [ | k | { |   |   | オ | サ | ヒ | □ |   |   |
| C            |              |   | ,  | < | L | ¥ | l |   |   |   | ハ | シ | コ | ワ |   |   |
| D            |              |   | .  | + | M | ] | m | } |   |   | ユ | ス | ハ | ン |   |   |
| E            |              |   | -  | > | N | ^ | n | → |   |   | ヨ | セ | ホ | ハ |   |   |
| F            |              |   | /  | ? | O | _ | o | ← |   |   | ツ | ソ | マ | □ |   |   |



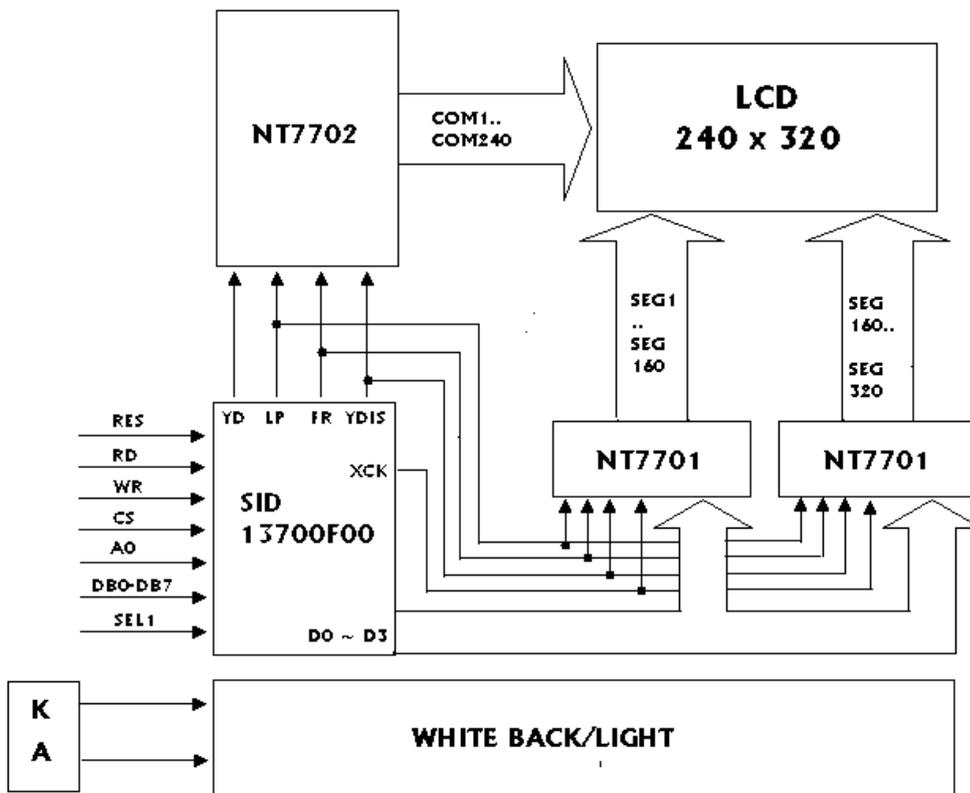
### 11. Power Supply



\*WITH BUILT IN DC-DC  
- VEE SUPPLIED BY INTERNAL DC-DC

\*WITHOUT DC-DC BUILT IN  
- CUSTOMER NEED TO SUPPLY EXTERNAL VEE

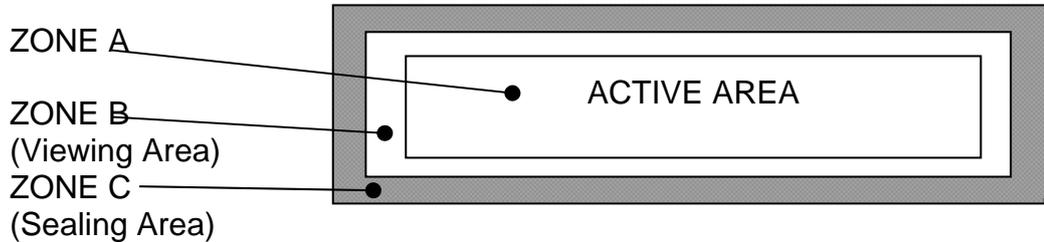
### 12. Block Diagram





13. Quality Assurance

1. CRITERIA INVOLVED:



- No.                      ITEM  
 1.1      Black Spot, Foreign Materials,  
             White Spot, Polarizer Damage

CRITERIA

Round Shape ( solid figure )

| Mean diameter = X<br>(Long axis + short axis) /2 | Maximum Acceptance Numbers |           |           |
|--|----------------------------|-----------|-----------|
|  | Zone A                     | Zone B    | Zone C    |
| $X \leq 0.10$                                    | Disregard                  | Disregard | Disregard |
| $0.10 < X \leq 0.15$                             | 3                          | 3         |           |
| $0.15 < X \leq 0.25$                             | 1                          | 2         |           |
| $0.25 < X \leq 0.35$                             | 1                          | 1         |           |
| $X > 0.35$                                       | 0                          | 0         |           |

\*The 1/3 or larger parts of individual dot has to be lighted on. The solid figure is that the defect has clear-cut outline at the optimum driving condition In both positive and negative, of which size does not change when the contrast changes.

| Mean diameter = X<br>(Long axis + short axis) /2 | Maximum Acceptance Numbers |           |           |
|--|----------------------------|-----------|-----------|
|  | Zone A                     | Zone B    | Zone C    |
| $X \leq 0.60$                                    | Disregard                  | Disregard | Disregard |
| $0.60 < X \leq 0.70$                             | 3                          |           |           |
| $0.70 < X \leq 0.80$                             | 1                          |           |           |
| $X > 0.80$                                       | 0                          |           |           |

\* The faded figure means that the defects has unclear outline at the optimum driving condition in both positive and negative, of which size seems to change when the contrast changes.



3) Linear (Fibrous)

| Size      |          | Maximum Acceptable No.  |        |           |
|-----------|----------|-------------------------|--------|-----------|
| Length    | Width    | Zone A                  | Zone B | Zone C    |
| Disregard | ≤ 0.03mm | Disregard               |        | Disregard |
| ≤ 2mm     | ≤ 0.05mm | 3                       |        |           |
| ≤ 1mm     | ≤ 0.10mm |                         |        |           |
| -----     | > 0.10mm | Due to (1) round defect |        |           |

\* Length is the whole length and width the maximum width of foreign material.

**Total amount of spotting defects including round and linear:-**  
**5 are the totally permissible numbers of defects in Zone A & B including above (1), (2), (3). In case of the total permissible, the minimum distance has to be 5mm or larger between every couple of defects.**

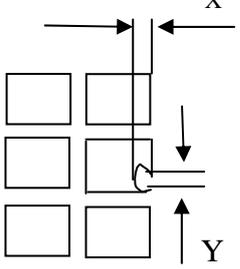
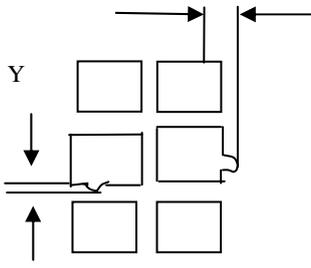
APPENDIX II

| NO  | ITEM     |
|-----|----------|
| 1.2 | Pin Hole |

|  |   |
|--|---|
|  | <p>Maximum acceptance numbers:<br/>           1 per dot<br/>           3 per display area (active area)</p>   |
|  | <p>Maximum acceptance numbers:<br/>           1 per dot<br/>           3 per display area (active area)</p> <p><i>¾ or larger part of dot area has to be effective for display.</i></p> |



1.3 Deformed display dot

|  |  |
|--|--|
| <p>1) Lacked deformation</p>  | <p><math>0.15 \geq X</math><br/><math>0.15 \geq Y</math></p> |
| <p>2) Added deformation</p>   | <p><math>0.02 &gt; X</math><br/><math>0.02 &gt; Y</math></p> |

1.4 Polarizer Air Bubbles  $D = \text{⌀}$

| Size                          | Maximum Acceptable No.                          |           |   |
|-------------------------------|---|-----------|---|
|                               | Zone A  | Zone B    | Zone C  |
| $D \leq 0.30\text{mm}$        | Disregard                                       | Disregard | Disregard<br>if the<br>polarizer not<br>lifted up<br>pealed off |
| $D \leq 0.50\text{mm}$        | 2   |           |   |
| $0.50 < D \leq 0.60\text{mm}$ | 1   | 2         |   |
| $D > 0.60\text{mm}$           | 0   |           |   |
| Total amount of bubbles       | 3 are the totally permissible numbers of bubble |           |   |

**REMARK**

All the other items of inspection that are not included herein must be determined by the "Limit Standard" sample, which were occasionally set up with the mutual consent of both parties. In every case of the items setup with the Limit Standard, the Limit Standard always takes precedence over the other means of definition.



## 14. Precaution for using LCM

### 1. Liquid Crystal Display (LCD)

LCD is made up of glass, organic sealant, organic fluid and polymer based polarizers. The following precautions should be taken when handling.

- b) Keep the temperature within the range of use and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel off or bubble.
- c) Do not contact the exposed polarizer with anything harder than HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzine.
- d) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or colour fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
- e) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
- f) Do not drive LCD with DC voltage.

### 2. Liquid Crystal Display Modules.

#### 2.1 Mechanical Considerations

LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modification. The following should be noted.

- a) Do not tamper in any way with the tabs on the metal frame.
- b) Do not modify the PCB by drilling extra holes, changing its outline, moving its component or modifying its pattern.
- c) Do not touch the elastomer connector, especially insert a backlight panel (for example, EL)
- d) When mounting a LCM make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.

- a) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

#### 2.2 Static Electricity

LCM contains CMOS LSI's and the same precaution for such devices should apply, namely

- a) The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
- b) The modules should be kept in antistatic bags or other containers to static for storage.
- c) Only properly grounded soldering irons should be used.
- d) If an electric screwdriver is used, it should be well grounded and shielded from commutator spark.
- e) The normal static prevention measures should be observed for work clothes and working benches, the latter conductive (rubber) mat is recommended.
- f) Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

#### 2.3 Soldering

- a) Solder only to the I/O terminals.
- b) Use only soldering irons with proper grounding and no leakage.
- c) Soldering temperature: 280°C
- d) Soldering time: 3 to 4 sec
- e) Use eutectic solder with resin flux fill.
- f) If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.



#### 2.4 Operation

- a) The contrast can be adjusted by varying the LCD driving voltage  $V_0$
- b) Driving voltage should be kept within specified range, excess voltage shortens display life.
- c) Response time increases with decrease in temperature.
- d) Display may turn black or dark blue at temperature above its operational range, this is (however not pressing on the viewing area) may cause the segments to appear “fractured”.
- e) Mechanical disturbance during operation ( such as pressing on the viewing area) may cause the segments to appear “fractured”.

#### 2.5 Storage

If any fluid leaks out of the damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

#### 2.6 Limited Warranty

Unless otherwise agreed between Crystal Clear Technology and customer, Crystal Clear Technology will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with Crystal Clear Technology acceptance standards, for a period of one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Crystal Clear Technology is limited to repair and/or replacement on the terms set forth above. Crystal Clear Technology will not be responsible for any subsequent or consequential events.





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