

## SPECIFICATIONS

**CUSTOMER** :

**SAMPLE CODE** :

(This Code will be changed while mass production)

**MASS PRODUCTION CODE** : **PG12864LRS-FTA-H (VER.0)**

**Customer Approved**

**Date:**

| Sales Sign | QC Confirmed | Checked By                | Designer |
|------------|--------------|---------------------------|----------|
|            |              | Newberry 5/11<br>Tom 5/12 | 宋玉標 5/10 |

☐ Approval For Specifications Only.

\* This specification is subject to change without notice.

Please contact Powertip or it's representative before designing your product based on this specification.

☒ Approval For Specifications and Sample.

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## RECORDS OF REVISION

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**Note :** For detailed information please refer to IC data sheet : **T6963C,LC7940,LC7942**

## 1. SPECIFICATIONS

### 1.1 Features

| Item              | Standard Value                                     |
|-------------------|----------------------------------------------------|
| Display Type      | 128 * 64 dots                                      |
| LCD Type          | STN, Gray, Transflective, Positive, Extended Temp. |
| Driver Condition  | LCD MODEL :1/64 Duty , 1/9 Bias                    |
| Viewing Direction | 6 O' clock                                         |
| Backlight         | YG LED B/L                                         |
| Weight            | 76 g                                               |
| Interface         | —                                                  |
| Other             | —                                                  |

### 1.2 Mechanical Specifications

| Item              | Standard Value                   | Unit |
|-------------------|----------------------------------|------|
| Outline Dimension | 78.0(L) * 70.0(w) * 14.3(H)(Max) | mm   |
| Viewing Area      | 62.0(L) * 44.0(w)                | mm   |
| Active Area       | 56.27(L) * 38.35(w)              | mm   |
| Dot Size          | 0.39(L) * 0.55(w)                | mm   |
| Dot Pitch         | 0.44(L) * 0.60(w)                | mm   |

Note : For detailed information please refer to LCM drawing

### 1.3 Absolute Maximum Ratings

| Item                      | Symbol                           | Condition    | Min. | Max.                 | Unit |
|---------------------------|----------------------------------|--------------|------|----------------------|------|
| Power Supply Voltage      | V <sub>DD</sub>                  | —            | 0    | 7.0                  | V    |
| LCD Driver Supply Voltage | V <sub>DD</sub> -V <sub>EE</sub> | —            | 5.3  | 25                   | V    |
| Input Voltage             | V <sub>IN</sub>                  | —            | -0.3 | V <sub>DD</sub> +0.3 | V    |
| Operating Temperature     | T <sub>OP</sub>                  | Excluded B/L | -20  | 70                   | °C   |
| Storage Temperature       | T <sub>ST</sub>                  | Excluded B/L | -30  | 80                   | °C   |
| Storage Humidity          | H <sub>D</sub>                   | Ta < 40 °C   | 20   | 60                   | %RH  |

## 1.4 DC Electrical Characteristics

$V_{DD} = 5.0 \text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{V}$ ,  $T_a = 25^\circ\text{C}$

| Item                 | Symbol   | Condition                                           | Min.         | Typ. | Max.     | Unit |
|----------------------|----------|-----------------------------------------------------|--------------|------|----------|------|
| Logic Supply Voltage | $V_{DD}$ | —                                                   | 4.5          | 5.0  | 5.5      | V    |
| “H” Input Voltage    | $V_{IH}$ | —                                                   | $V_{DD}-2.2$ | -    | $V_{DD}$ | V    |
| “L” Input Voltage    | $V_{IL}$ | —                                                   | 0            | -    | 0.8      | V    |
| “H” Output Voltage   | $V_{OH}$ | $I_{OH}=-0.4\text{mA}$                              | $V_{DD}-0.3$ | -    | $V_{DD}$ | V    |
| “L” Output Voltage   | $V_{OL}$ | $I_{OH}=0.4\text{mA}$                               | 0            | -    | 0.3      | V    |
| Supply Current       | $I_{DD}$ | $V_{DD} = 5.0 \text{ V}$<br>$f_{OSC}=3.0\text{MHz}$ | -            | 9.0  | -        | mA   |
| LCM Driver Voltage   | $V_{OP}$ | $V_{DD} - V_O (-20^\circ\text{C})$                  | -            | -    | -        | V    |
|                      |          | $V_{DD} - V_O (25^\circ\text{C})$                   | -            | 8.4  | -        |      |
|                      |          | $V_{DD} - V_O (70^\circ\text{C})$                   | -            | -    | -        |      |

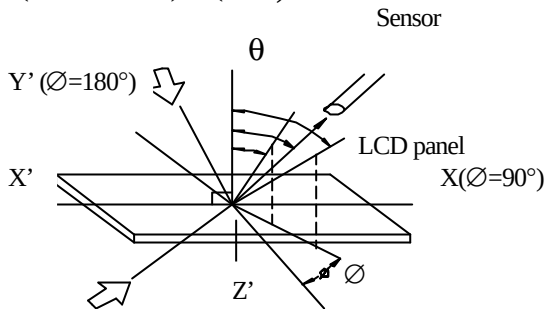
## 1.5 Optical Characteristics

LCD Panel : 1/64Duty, 1/9Bias,  $V_{LCD} = 8.8 \text{ V}$ ,  $T_a = 25^\circ\text{C}$

| Item                | Symbol   | Conditions                              | Min.       | Typ.   | Max. | Reference   |
|---------------------|----------|-----------------------------------------|------------|--------|------|-------------|
| View Angle          | $\theta$ | $C \geq 2.0$ , $\theta = 0^\circ$       | $40^\circ$ | -      | -    | Notes 1 & 2 |
| Contrast Ratio      | C        | $\theta = 5^\circ$ , $\theta = 0^\circ$ | 5          | 7      | -    | Note 3      |
| Response Time(rise) | $t_r$    | $\theta = 5^\circ$ , $\theta = 0^\circ$ | -          | 150 ms | -    | Note 4      |
| Response Time(fall) | $t_f$    | $\theta = 5^\circ$ , $\theta = 0^\circ$ | -          | 300 ms | -    | Note 4      |

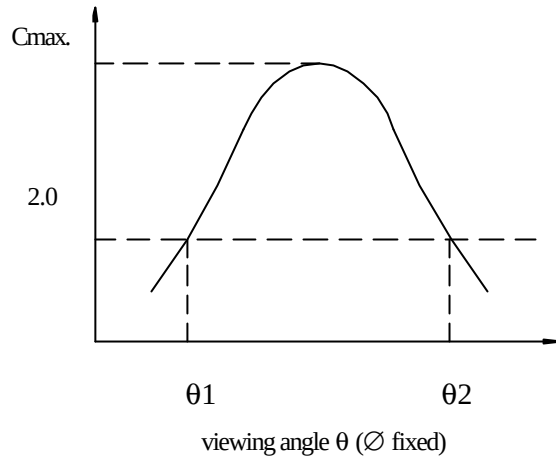
## Note 1: Definition of angles $\theta$ and $\varnothing$

Light (when reflected)  $z$  ( $\theta=0^\circ$ )



Light (when transmitted)  $Y$  ( $\varnothing=0^\circ$ )  
( $\theta=90^\circ$ )

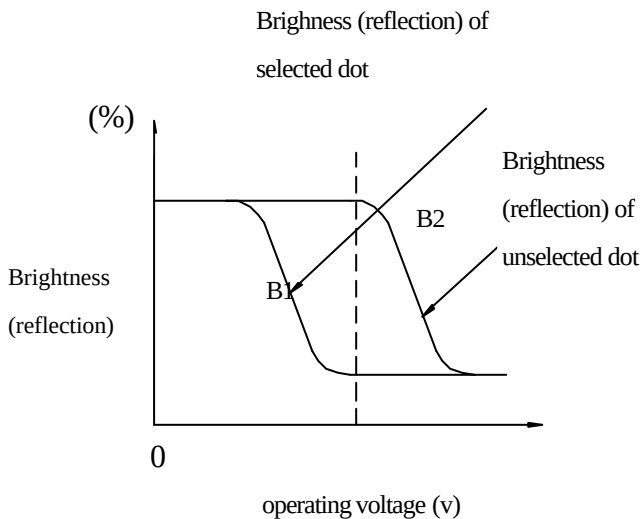
## Note 2: Definition of viewing angles $\theta_1$ and $\theta_2$



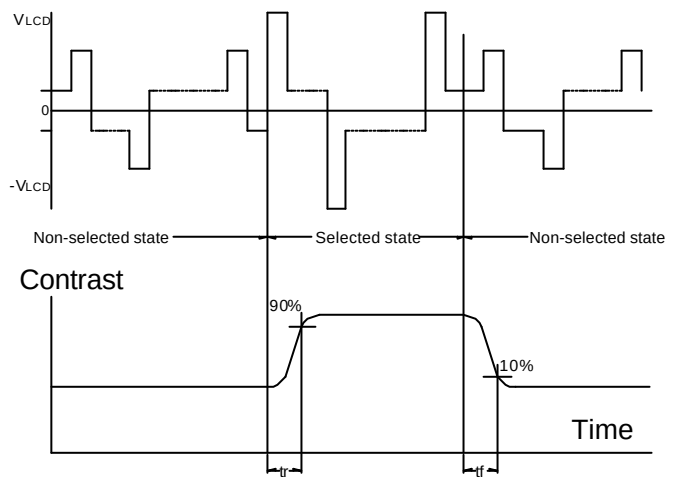
Note : Optimum viewing angle with the naked eye and viewing angle  $\theta$  at  $C_{max}$ . Above are not always the same

## Note 3: Definition of contrast $C$

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$



## Note 4: Definition of response time



Note: Measured with a transmissive LCD panel which is displayed  $1 \text{ cm}^2$

$V_{LCD}$  : Operating voltage  $f_{FRM}$  : Frame frequency

$t_r$  : Response time (rise)  $t_f$  : Response time (fall)

## 1.6 Backlight Characteristics

LCD Module with LED Backlight

### Maximum Ratings

| Item                      | Symbol          | Conditions | Min. | Max. | Unit |
|---------------------------|-----------------|------------|------|------|------|
| Forward Current           | IF              | Ta =25°C   | -    | 875  | mA   |
| Reverse Voltage           | VR              | Ta =25°C   | -    | 8    | V    |
| Power Dissipation         | PO              | Ta =25°C   | -    | 4.02 | W    |
| Operating Temperature     | T <sub>OP</sub> | -          | -20  | 70   | °C   |
| Storage Temperature       | T <sub>ST</sub> | -          | -40  | 80   | °C   |
| Solder Temp. for 3 Second | -               | -          | -    | 260  | °C   |

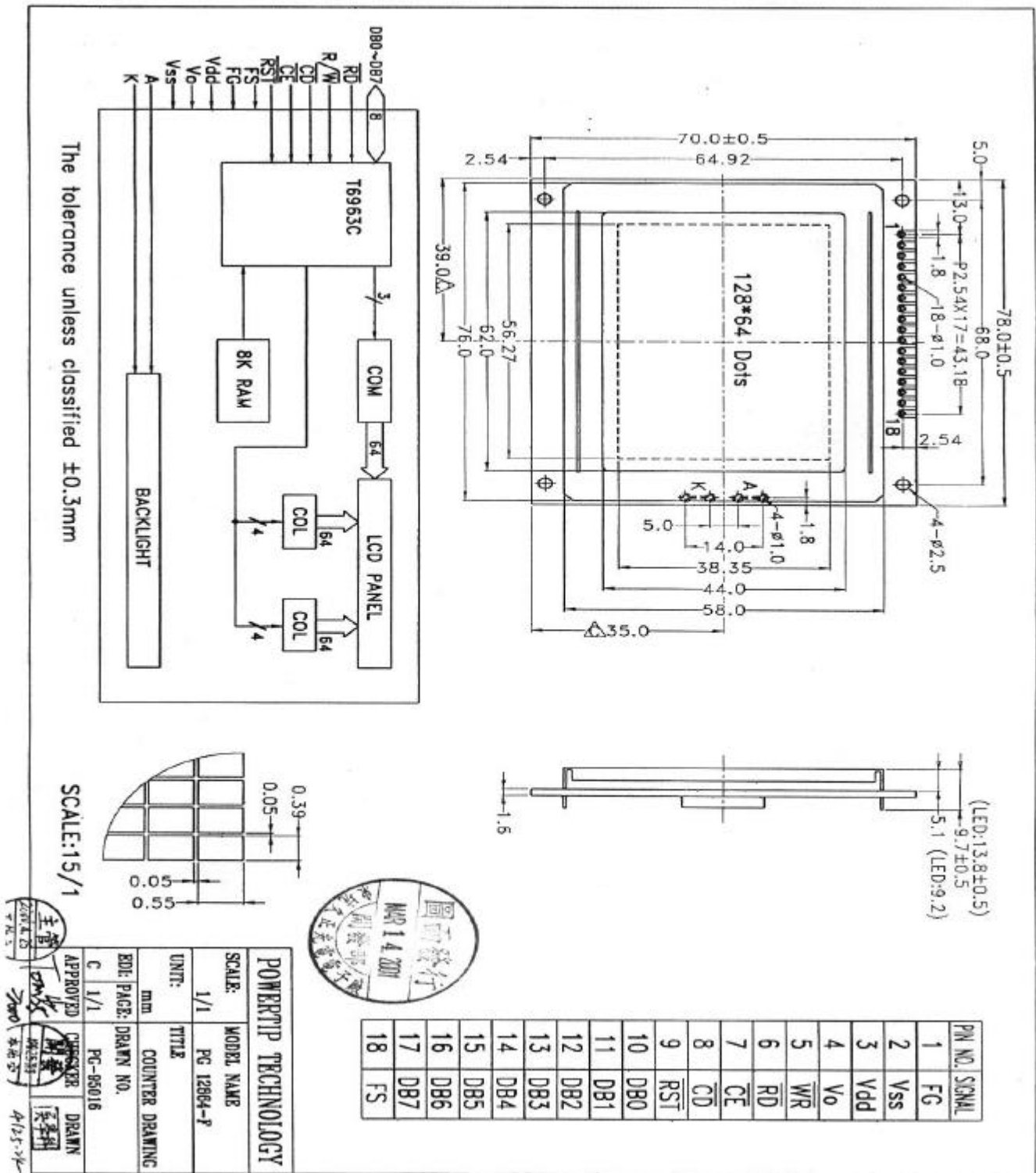
### Electrical / Optical Characteristics

Ta =25°C

| Item                                | Symbol         | Conditions | Min. | Typ. | Max. | Unit              |
|-------------------------------------|----------------|------------|------|------|------|-------------------|
| Forward Voltage                     | VF             | IF= 350 mA | 3.8  | 4.2  | 4.6  | V                 |
| Reverse Current                     | IR             | VR= 8 V    | -    | -    | 0.2  | mA                |
| Average Brightness<br>(with LCD)    | IV             | IF= 350 mA | -    | -    | -    | cd/m <sup>2</sup> |
| Wavelength                          | λ <sub>p</sub> | IF= 350 mA | 571  | -    | 576  | nm                |
| Luminous Intensity<br>(without LCD) | IV             | IF=350 mA  | 220  | 270  | -    | cd/m <sup>2</sup> |
| Color                               | Yellow-green   |            |      |      |      |                   |

## 2. MODULE STRUCTURE

### 2.1 Counter Drawing

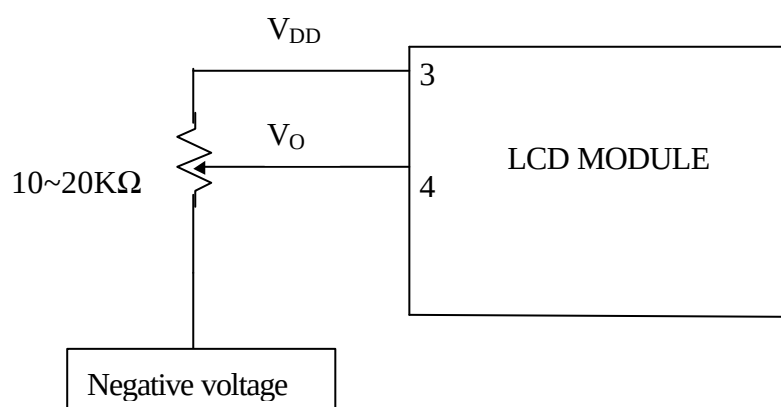




## 2.2 Interface Pin Description

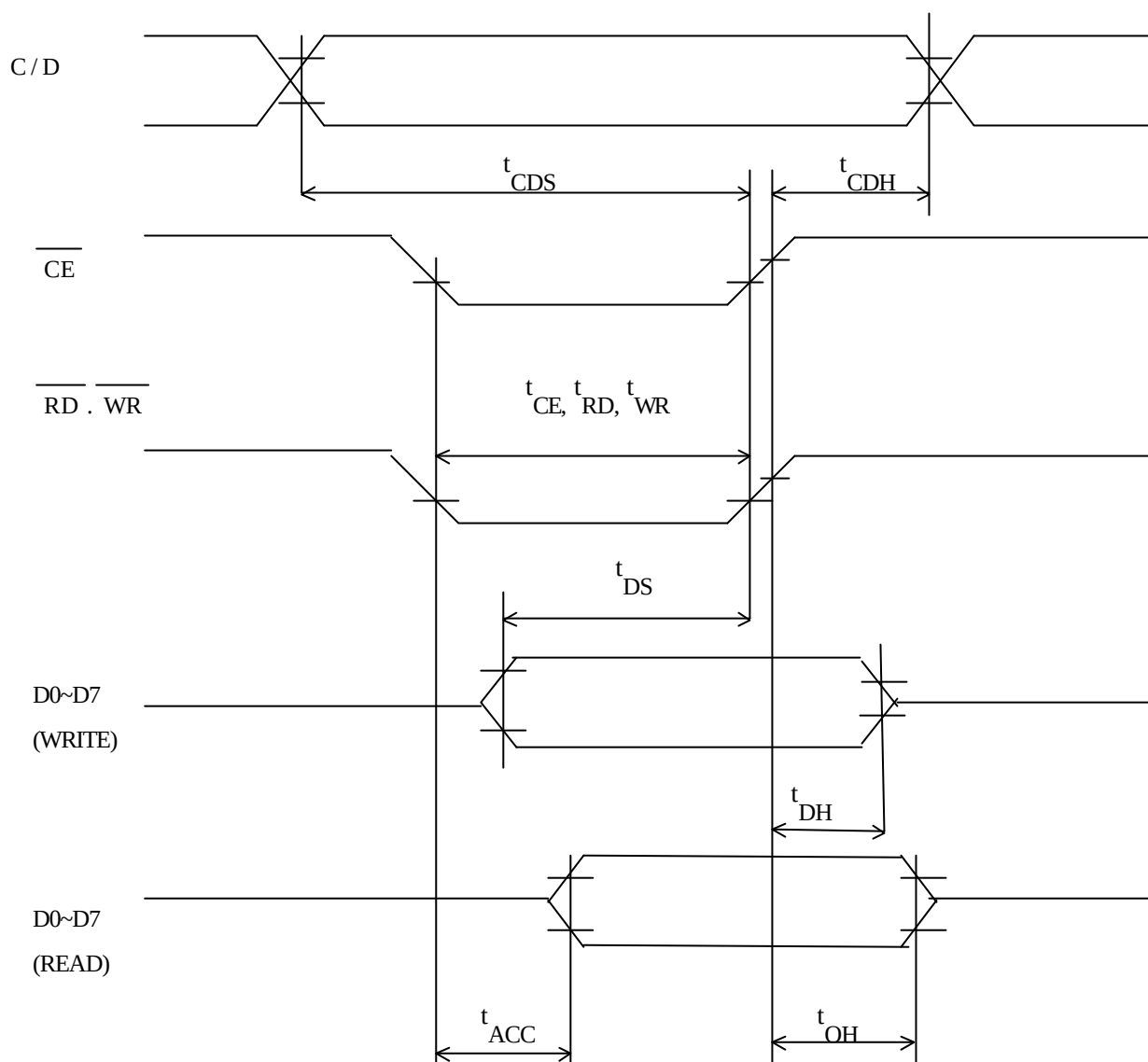
| Pin No. | Symbol             | Function                                                                                                      |
|---------|--------------------|---------------------------------------------------------------------------------------------------------------|
| 1       | FG                 | Frame ground (connected to metal bezel )                                                                      |
| 2       | VSS                | Power Supply ( $V_{SS}=0$ );Power supply for LED B/L(-)                                                       |
| 3       | V <sub>DD</sub>    | Power Supply ( $V_{DD}>V_{SS}$ ); Power supply for LED B/L(+)                                                 |
| 4       | V <sub>O</sub>     | Operating voltage for LCD (variable)                                                                          |
| 5       | $\overline{WR}$    | Data write (write data to the module at "L")                                                                  |
| 6       | $\overline{RD}$    | Data read (read data from the module at "L")                                                                  |
| 7       | $\overline{CE}$    | Chip enable for the module (active at "L")                                                                    |
| 8       | $\overline{C/D}$   | $\overline{C/D} = "H"$ : read or write command<br>$\overline{C/D} = "L"$ :read or write data.                 |
| 9       | $\overline{RESET}$ | Controller reset (module reset)                                                                               |
| 10~17   | DB0~DB7            | Data bus (DB0=MSB, DB7=LSB)                                                                                   |
| 18      | FS                 | Font select :open or connect to V <sub>DD</sub> : 6*8 Dots font<br>connect to V <sub>ss</sub> : 8*8 Dots font |

Contrast Adjust



## 2.3 Timing Characteristics

### Bus Timing



Unless otherwise noted,  $V_{DD}=5.0V\pm10\%$ ,  $V_{SS}=0V$ ,  $T_a=25^\circ C$

| ITEM                   | SYMBOL                   | TEST CONDITION | MIN. | MAX. | UNIT |
|------------------------|--------------------------|----------------|------|------|------|
| C/D Set Up Time        | $t_{CDS}$                | -              | 100  | -    | ns   |
| C/D Hold Time          | $t_{CDH}$                | -              | 10   | -    | ns   |
| CE, RD, WR Pulse Width | $t_{CE}, t_{RD}, t_{WR}$ | -              | 80   | -    | ns   |
| Data Set Up Time       | $t_{DS}$                 | -              | 80   | -    | ns   |
| Data Hold Time         | $t_{DH}$                 | -              | 40   | -    | ns   |
| Access Time            | $t_{ACC}$                | -              | -    | 150  | ns   |
| Output Hold Time       | $t_{OH}$                 | -              | 10   | 50   | ns   |

## 2.4 Display command

### 1.Register Set

| Code     | Hex. | Function            | D1       | D2        |
|----------|------|---------------------|----------|-----------|
| 00100001 | 21H  | Cursor pointer set  | X ADRS   | Y ADRS    |
| 00100010 | 22H  | Offset register set | Data     | 00H       |
| 00100100 | 24H  | Address pointer set | Low ADRS | High ADRS |

#### (1) Cursor pointer set

The position of cursor is specified by X ADRS, Y ADRS. The cursor position is moved only by this command. The cursor pointer doesn't have the function of increment and decrement. The shift of cursor are set by this command. X ADRS, Y ADRS are specified following.

X ADRS 00H~4FH (Lower 7bits are valid)

Y ADRS 00H~1FH (Lower 5 bits are valid)

1. 1 screen drive

X ADRS 00~4FH

Y ADRS 00H~0FH

2. 2 screens drive

X ADRS 00~4FH

Y ADRS 00H~0FH  
Upper screen

Y ADRS 10H~1FH  
Lower screen

#### (2) Offset register set

The offset register is used to determine external character generator RAM area.

T693C has 16 bit address lines as follow.

|      |      |      |      |      |      |     |     |     |     |     |     |     |     |     |     |
|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| MSB  |      |      |      |      |      |     |     |     |     |     |     |     |     | LSB |     |
| ad15 | ad14 | ad13 | ad12 | ad11 | ad10 | ad9 | ad8 | ad7 | ad6 | ad5 | ad4 | ad3 | ad2 | ad1 | ad0 |

The upper 5 bit (ad15~ad11) are determined by offset register. The middle 8 bit (ad10~ad3) are determined by character code. The lower 3 bit (ad2~ad0) are determined by vertical counter. The lower 5 bit of D1 (data) are valid.

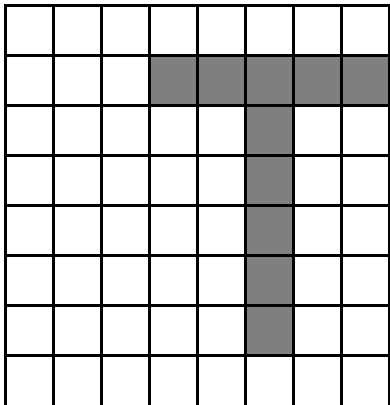
The data format of external character generator RAM.

### The relationship of display RAM address and offset register

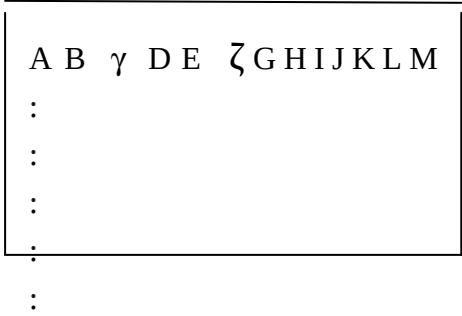
| Data of offset register | CG RAM HEX. Address (start-end) |
|-------------------------|---------------------------------|
| 00000                   | 0000-07FFH                      |
| 00001                   | 0800-0FFFH                      |
| 00010                   | 1000-17FFH                      |
| 11100                   | E000-E7FFH                      |
| 11101                   | E800-EFFFH                      |
| 11110                   | F000-F7FFH                      |
| 11111                   | F800-FFFFH                      |

(Example 1)

|                                       |                     |
|---------------------------------------|---------------------|
| Offset register                       | 02H                 |
| Character code                        | 80H                 |
| Character generator RAM start address | 0001 0100 0000 0000 |
|                                       | 1 4 0 0 H           |

|                                                                                    | (Address) | (Data) |
|------------------------------------------------------------------------------------|-----------|--------|
|  | 1400H     | 00H    |
|                                                                                    | 1401H     | 1FH    |
|                                                                                    | 1402H     | 04H    |
|                                                                                    | 1403H     | 04H    |
|                                                                                    | 1404H     | 04H    |
|                                                                                    | 1405H     | 04H    |
|                                                                                    | 1406H     | 04H    |
|                                                                                    | 1407H     | 00H    |

(Example 2) The relationship of display RAM data and display character

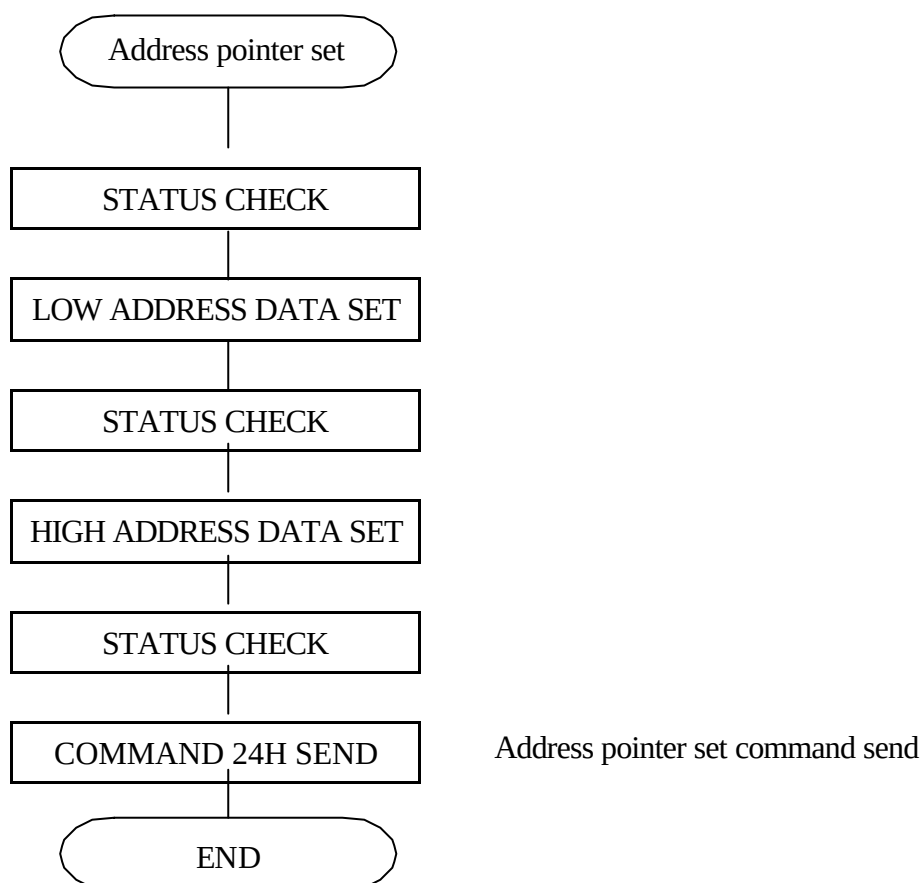
|                                                                                     | (RAM DATA) | (Character) |
|-------------------------------------------------------------------------------------|------------|-------------|
|  | 21H        | A           |
|                                                                                     | 22H        | B           |
|                                                                                     | 83H        | γ           |
|                                                                                     | 24H        | D           |
|                                                                                     | 25H        | E           |
|                                                                                     | 86H        | ζ           |

γ and ζ are displayed by character generator RAM.

### (3)Address pointer set

The address pointer set command is used to indicate the start address for writing (or reading) to external RAM.

The flow chart address pointer set command



## 2.Control word set

| Code     | Hex. | Function                 | D1          | D2           |
|----------|------|--------------------------|-------------|--------------|
| 01000000 | 40H  | Text home address set    | Low address | High address |
| 01000001 | 41H  | Text area set            | Columns     | 00H          |
| 01000010 | 42H  | Graphic home address set | Low address | High address |
| 01000011 | 43H  | Graphic area set         | Columns     | 00H          |

The home address and column size are defined by this command.

### (1)Text home address set

The starting address of external display RAM for Text display is defined by this command. The text home address shows the left end and most upper position.

The relationship of external display RAM address and display position

|             |  |               |
|-------------|--|---------------|
| TH          |  | TH+CL         |
| TH+TA       |  | TH+TA+CL      |
| (TH+TA)+TA  |  | TH+2TA+CL     |
| (TH+2TA)+TA |  | TH+3TA+CL     |
|             |  |               |
| TH+(n-1)TA  |  | TH+(n-1)TA+CL |

TH : Text home address

TA : Text area number (columns)

CL : Columns are fixed by hardware. (pin-programmable)

### (Example)

Text home address : 0000H

Text area : 0020H

MD2=H, MD3=H : 32 columns

DUAL=H, MDX=L, MD1=H : 4 lines

|       |       |  |       |       |
|-------|-------|--|-------|-------|
| 0000H | 0001H |  | 001EH | 001FH |
| 0020H | 0021H |  | 003EH | 003FH |
| 0040H | 0041H |  | 005EH | 005FH |
| 0060H | 0061H |  | 007EH | 007FH |

### (2)Graphic home address set

The starting address of external display RAM for Graphic display is defined by this command.

The Graphic home address show the left end most upper line.

The relationship of external display RAM address and display position

|             |  |               |
|-------------|--|---------------|
| GH          |  | GH+CL         |
| GH+GA       |  | GH+GA+CL      |
| (GH+GA)+GA  |  | GH+2GA+CL     |
| (GH+2GA)+GA |  | GH+3GA+CL     |
|             |  |               |
| GH+(n-1)GA  |  | GH+(n-1)GA+CL |

GH : Graphic home address

GA : Graphic area number (columns)

CL : Columns area fixed by hardware. (pin-programmable)

(Example)

Graphic home address : 0000H  
 Graphic area : 0020H  
 MD2=H, MD3=H : 32 columns  
 \_\_\_\_\_  
 DUAL =H, MDS=L, MD0=H, MD1=H : 2 lines

|       |       |  |       |       |
|-------|-------|--|-------|-------|
| 0000H | 0001H |  | 001EH | 001FH |
| 0020H | 0021H |  | 003EH | 003FH |
| 0040H | 0041H |  | 005EH | 005FH |
| 0060H | 0061H |  | 007EH | 007FH |
| 0080H | 0081H |  | 009EH | 009FH |
| 00A0H | 00A1H |  | 00BEH | 00BFH |
| 00C0H | 00C1H |  | 00DEH | 00DFH |
| 00E0H | 00E1H |  | 00FEH | 00FFH |
| 0100H | 0101H |  | 011EH | 011FH |
| 0120H | 0121H |  | 013EH | 013FH |
| 0140H | 0141H |  | 015EH | 015FH |
| 0160H | 0161H |  | 017EH | 017FH |
| 0180H | 0181H |  | 019EH | 019FH |
| 01A0H | 01A1H |  | 01BEH | 01BFH |
| 01C0H | 01C1H |  | 01DEH | 01DFH |
| 01E0H | 01E1H |  | 01FEH | 01FFH |

(3)Text area set

The columns of display are defined by the hardware setting. This command can be used to adjust columns of display.

(Example)

LCD size : 20 columns, 4 lines  
 Text home address : 0000H  
 Text area : 0014H  
 MD2=H, MD3=H : 32 columns  
 DUAL=H, MDS=L, MD0=L, MD1=H : 4 lines

|      |      |           |      |      |           |      |
|------|------|-----------|------|------|-----------|------|
| 0000 | 0001 | . . . . . | 0013 | 0014 | . . . . . | 001F |
| 0014 | 0015 | . . . . . | 0027 | 0028 | . . . . . | 0033 |
| 0028 | 0029 | . . . . . | 003B | 003C | . . . . . | 0047 |
| 003C | 003D | . . . . . | 004F | 0050 | . . . . . | 005B |



#### (4)Graphic area set

The columns of display are defined by the hardware setting. This command can be used to adjust columns of graphic display.

#### (Example)

LCD size : 20 columns, 2 lines

Text home address : 0000H

Text area : 0014H

MD2=H, MD3=H : 32 columns

DUAL=H, MDS=L, MDD=H, MD1=H : 2 lines

|      |      |           |      |      |           |      |
|------|------|-----------|------|------|-----------|------|
| 0000 | 0001 | . . . . . | 0013 | 0014 | . . . . . | 001F |
| 0014 | 0015 | . . . . . | 0027 | 0028 | . . . . . | 0033 |
| 0028 | 0029 | . . . . . | 003B | 003C | . . . . . | 0047 |
| 003C | 003D | . . . . . | 004F | 0050 | . . . . . | 005B |
| 0050 | 0051 | . . . . . | 0063 | 0064 | . . . . . | 006F |
| 0064 | 0065 | . . . . . | 0077 | 0078 | . . . . . | 0083 |
| 0078 | 0079 | . . . . . | 008B | 008C | . . . . . | 0097 |
| 008C | 008D | . . . . . | 009F | 00A0 | . . . . . | 00AB |
| 00A0 | 00A1 | . . . . . | 00B3 | 00B4 | . . . . . | 00BF |
| 00B4 | 00B5 | . . . . . | 00C7 | 00C8 | . . . . . | 00D3 |
| 00C8 | 00C9 | . . . . . | 00DB | 00DC | . . . . . | 00E7 |
| 00DC | 00DD | . . . . . | 00EF | 00F0 | . . . . . | 00FD |
| 00F0 | 00F1 | . . . . . | 0103 | 0104 | . . . . . | 011F |
| 0104 | 0105 | . . . . . | 0127 | 0128 | . . . . . | 0123 |
| 0128 | 0129 | . . . . . | 013B | 013C | . . . . . | 0147 |
| 013C | 013D | . . . . . | 014F | 0150 | . . . . . | 0158 |



The address in graphic area can be continuous and RAM area can be used without ineffective area, if graphic area is defined the same number as the actual column number of LCD display.



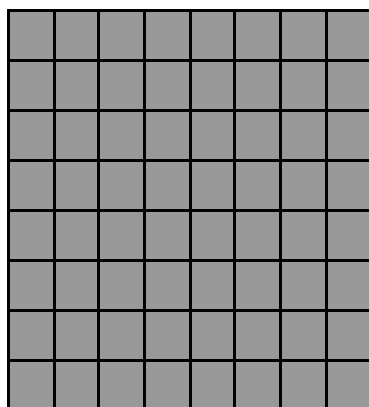
### 3.Mode set

| Code     | Function                          | Operand |
|----------|-----------------------------------|---------|
| 1000x000 | “OR” Mode                         | -       |
| 1000x001 | “EXOR” Mode                       | -       |
| 1000x011 | “AND” Mode                        | -       |
| 1000x100 | “TEXT ATTRIBUTE” Mode             | -       |
| 10000xxx | Internal Character Generator Mode | -       |
| 10001xxx | External Character Generator Mode | -       |

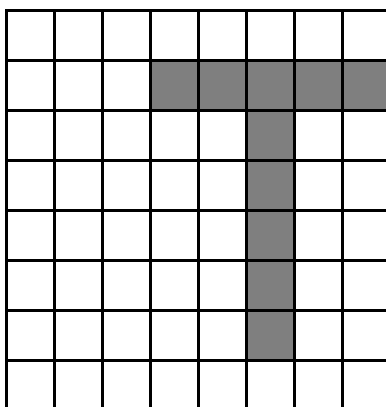
The display mode is defined by this command. The display mode don't have changed until to send next this command. Logically “OR”, “EXOR”, “AND” of text and graphic display can be displayed.

When internal character generator mode is selected, character code 00H~7FH are selected from built-in character generator ROM. The character code 80H~FFH are automatically selected external character generator RAM.

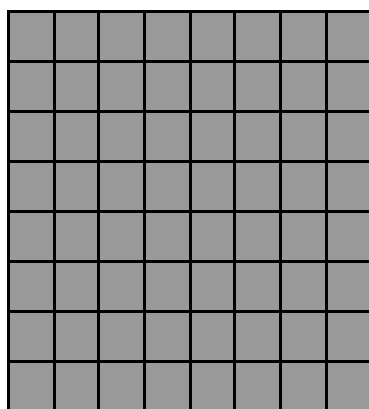
(Example)



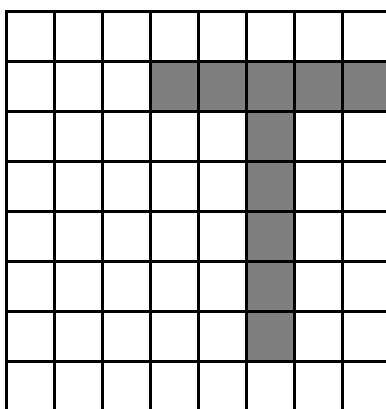
Graphic



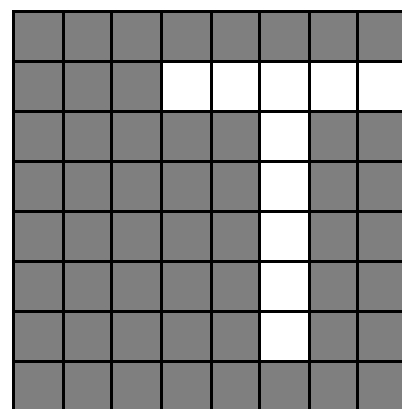
Text



“OR”



“AND”



“EXOR”

Note: Only text display is attributed, because attribute data is located in graphic RAM area.

### Attribute function

“Reverse display” , “Character blink” and “Inhibit” are called “Attribute”. The attribute data is written in the graphic area defined by Control word set command.

The mode set command selects text display only and graphic display cannot be displayed.

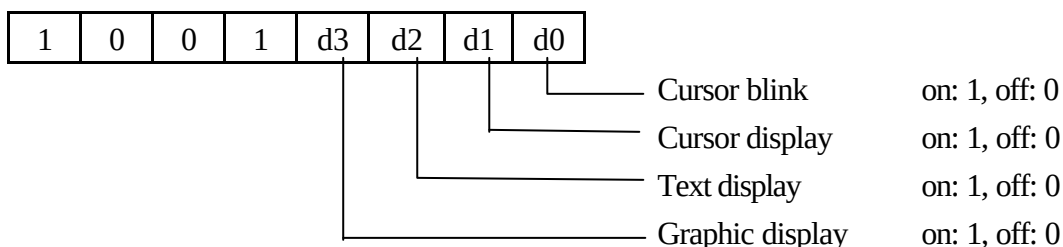
The attribute data of the 1st character in text area is written at the 1st 1byte in graphic area, and attribute data of n-th character is written at the n-th 1byte in graphic area. Attribute function is defined as follow.

|                     |   |   |   |   |    |    |    |    |
|---------------------|---|---|---|---|----|----|----|----|
| Attribute RAM 1byte | X | X | X | X | d3 | d2 | d1 | d0 |
|---------------------|---|---|---|---|----|----|----|----|

| d3 | d2 | d1 | d0 | Function                 |
|----|----|----|----|--------------------------|
| 0  | 0  | 0  | 0  | Normal display           |
| 0  | 1  | 0  | 1  | Reverse display          |
| 0  | 0  | 1  | 1  | Inhibit display          |
| 1  | 0  | 0  | 0  | Blink of normal display  |
| 1  | 1  | 0  | 1  | Blink of reverse display |
| 1  | 0  | 1  | 1  | Blink of inhibit display |

### 4.Display mode

| Code     | Function              | Operand |
|----------|-----------------------|---------|
| 10010000 | Display off           | -       |
| 1001xx10 | Cursor on , blink off | -       |
| 1001xx11 | Cursor on , blink on  | -       |
| 100101xx | Text on, graphic off  | -       |
| 100110xx | Text off, graphic on  | -       |
| 100111xx | Text on , graphic on  | -       |



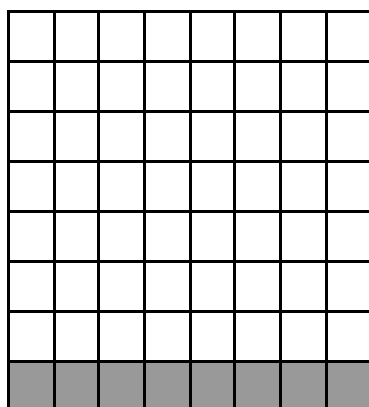
Note: It is necessary to turn on “Text display” and “ Graphic display “ in following case.

- (1) Combination of text/graphic display
- (2) Attribute function

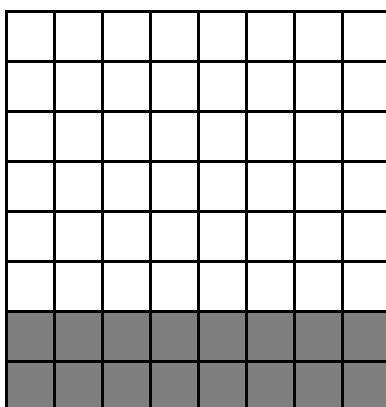
## 5.Cursor pattern select

| Code     | Function       | Operand |
|----------|----------------|---------|
| 10100000 | 1 line cursor  | -       |
| 10100001 | 2 lines cursor | -       |
| 10100010 | 3 lines cursor | -       |
| 10100011 | 4 lines cursor | -       |
| 10100100 | 5 lines cursor | -       |
| 10100101 | 6 lines cursor | -       |
| 10100110 | 7 lines cursor | -       |
| 10100111 | 8 lines cursor | -       |

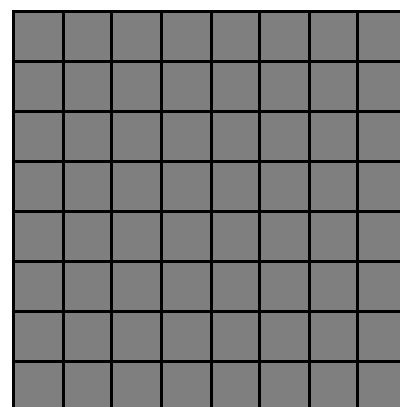
When cursor display is ON, this command selects the cursor pattern from 1 line to 8 lines. The cursor address is defined by cursor pointer set command.



1 line cursor



2 lines cursor



8 lines cursor

## 6.Data auto read/write

| Code     | Hex. | Function            | Operand |
|----------|------|---------------------|---------|
| 10110000 | B0H  | Data auto write set | -       |
| 10110001 | B1H  | Data auto read set  | -       |
| 10110010 | B2H  | Auto reset          | -       |

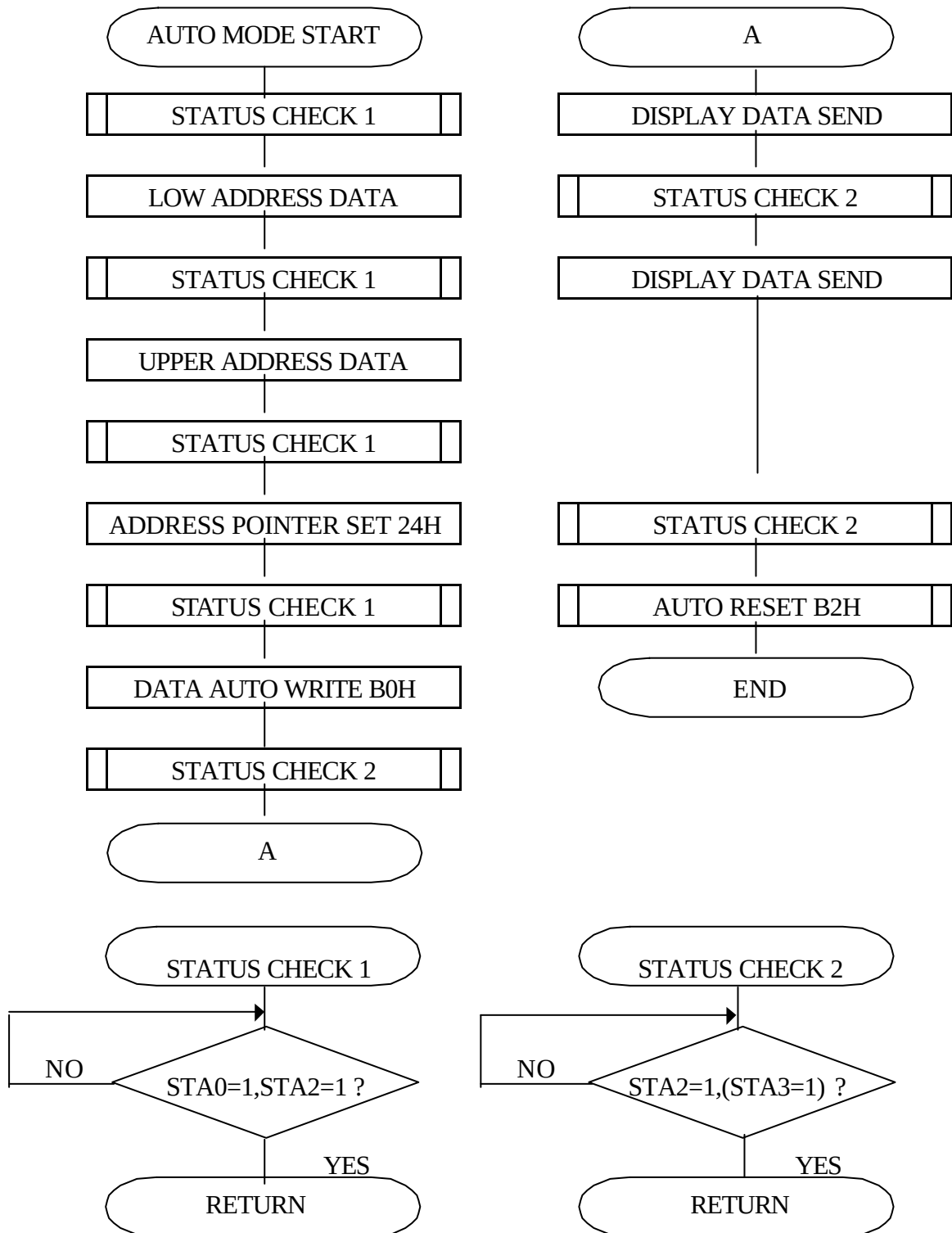
This command is convenient to send full screen data from external display RAM.

After setting auto mode, “Data write (or read)” command is not necessary between each data. “Data write (or read)” command should follow the “Address pointer set” and address pointer is automatically increment by + 1 after each data. After sending (or receiving) all data “Auto reset” is necessary to return normal operation because all data is regarded “Display data” and no command can be accepted in the auto mode.

Note : Status check for auto mode (STA2, STA should be checked between each data.

Auto reset should be performed after checking STA3=1 (STA2=1).

Please refer following flow chart.



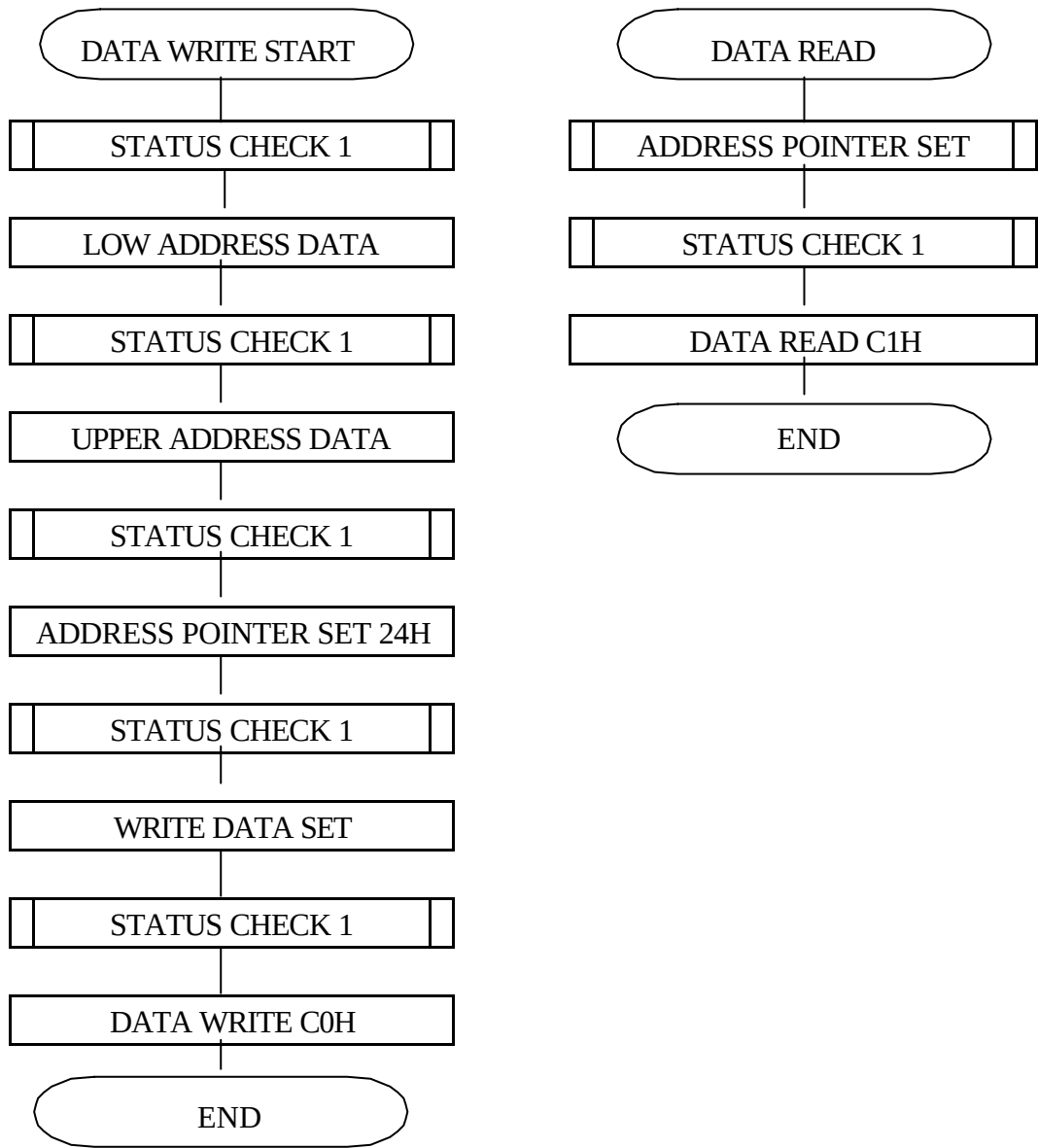
## 7.Data read write

| Code     | Hex. | Function                       | Operand |
|----------|------|--------------------------------|---------|
| 11000000 | C0H  | Data write and ADP increment   | Data    |
| 11000001 | C1H  | Data read and ADP increment    | -       |
| 11000010 | C2H  | Data write and ADP decrement   | Data    |
| 11000011 | C3H  | Data read and ADP decrement    | -       |
| 11000100 | C4H  | Data write and ADP nonvariable | Data    |
| 11000101 | C5H  | Data read and ADP nonvariable  | -       |

This command is used for data write from MPU to external display RAM, and data read from external display RAM to MPU. Data write/data read should be executed after setting address by address pointer set command. Address pointer can be automatically increment or decrement by setting this command.

Note: This command is necessary for each 1 byte data.

Please refer following flow chart.



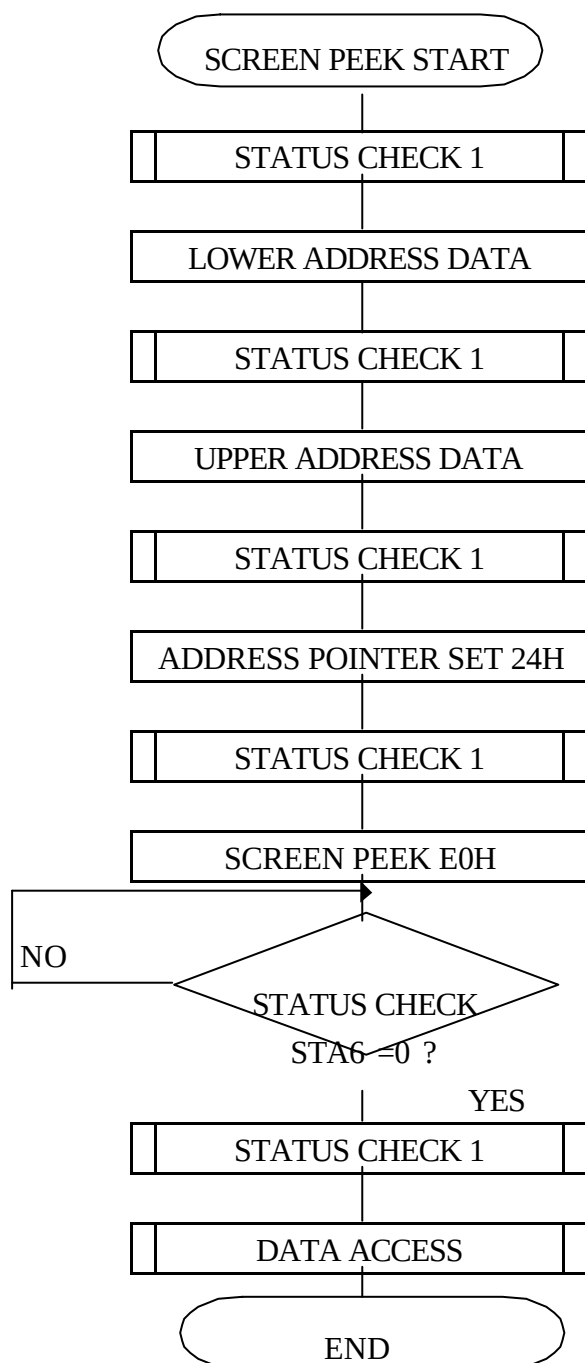
### 8.Screen peek

| Code     | Hex. | Function    | Operand |
|----------|------|-------------|---------|
| 11100000 | E0H  | screen peek | -       |

This command is used to transfer displayed 1 byte data to data stack, and this 1 byte data can be read from MPU by data access. The logical combination data of text and graphic display on LCD screen can be read by this command.

The status (STA6) should be checked just after “Screen peek” command. If the address determined by “Address pointer set” command is not in graphic area, this command ignored and status flag (STA6) is set.

Please refer following flow chart.



## 9.Screen copy

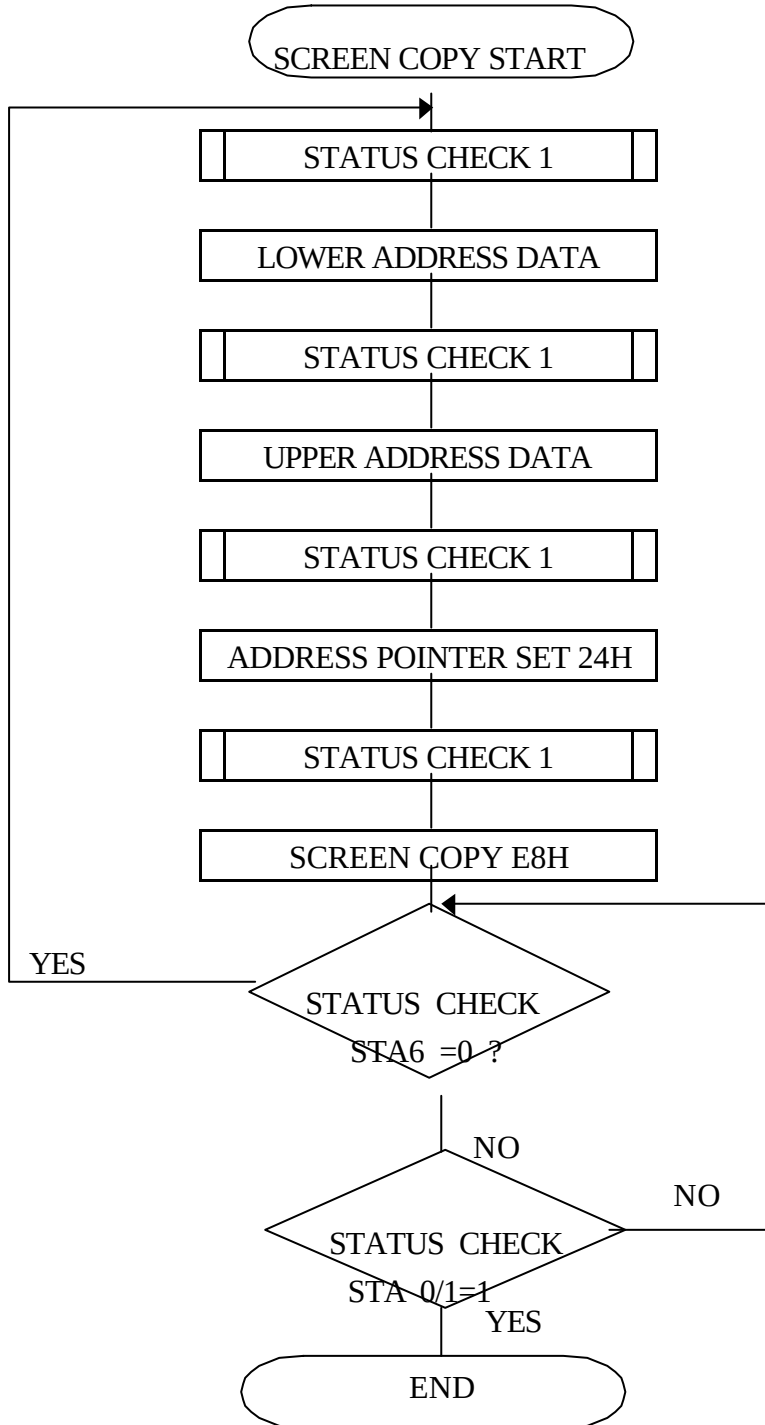
| Code     | Hex. | Function    | Operand |
|----------|------|-------------|---------|
| 11101000 | E8H  | screen copy | -       |

This command is used to copy displayed 1 line data to graphic area. The start point of 1 line data in the screen is determined by the address pointer.

Note: (1) In attribute function, this command is invalid. (Because attribute data is in the graphic area.)

(2) In case of 2 screen drive, this command is invalid. (Because T693C cannot separate upper screen data and lower screen data.)

Please refer following flow chart.



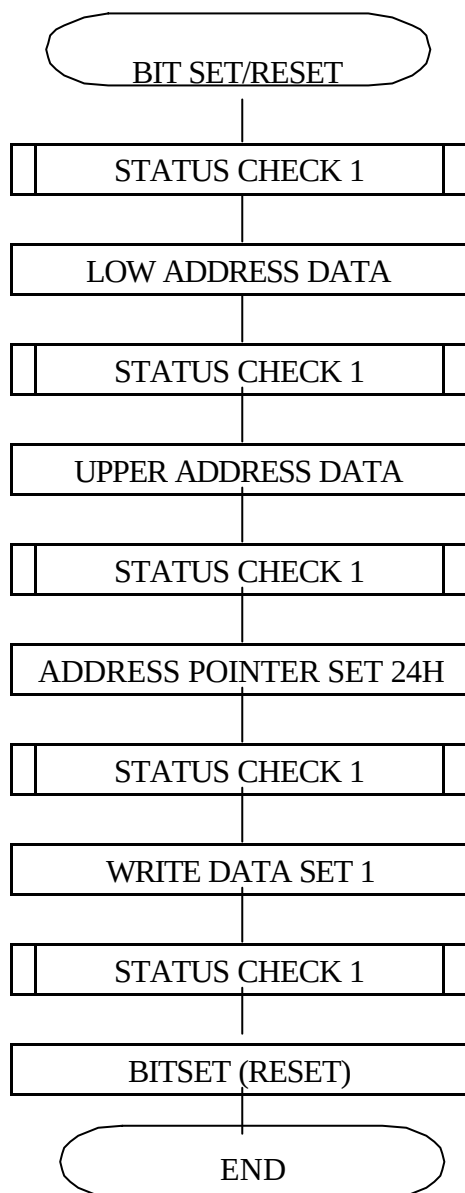


**10.Bit set/reset**

| Code     | Function    | Operand |
|----------|-------------|---------|
| 11110xxx | bit reset   | -       |
| 11111xxx | bit set     | -       |
| 1111x000 | bit 9 (LSB) | -       |
| 1111x001 | bit 1       | -       |
| 1111x010 | bit 2       | -       |
| 1111x011 | bit 3       | -       |
| 1111x100 | bit 4       | -       |
| 1111x101 | bit 5       | -       |
| 1111x110 | bit 6       | -       |
| 1111x111 | bit 7 (MSB) | -       |

This command is used to set or reset a bit of 1 byte is specified by address pointer. Plural bits in the 1 byte data cannot be set/reset at a time.

Please refer following flow chart.



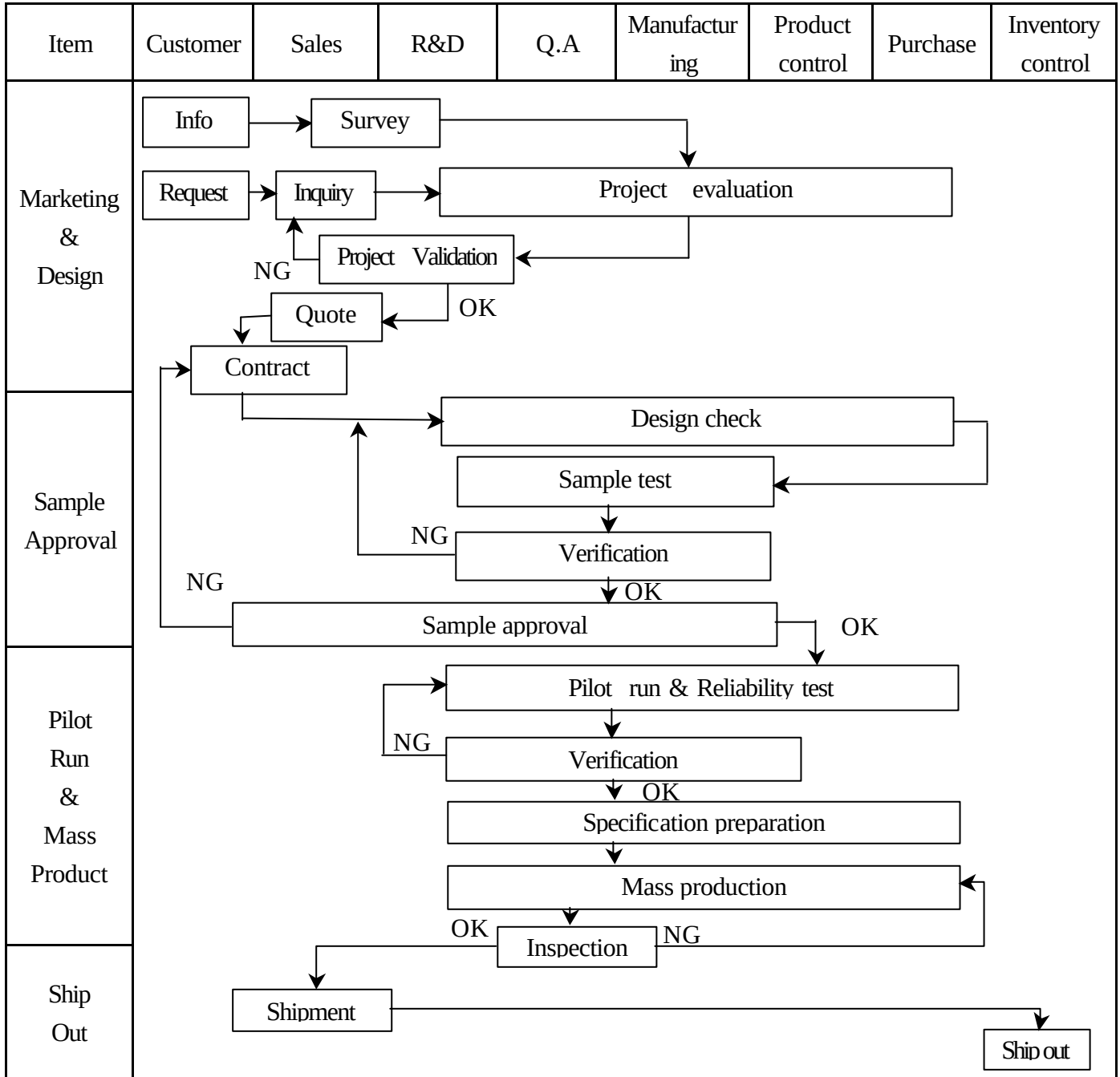
• Command list

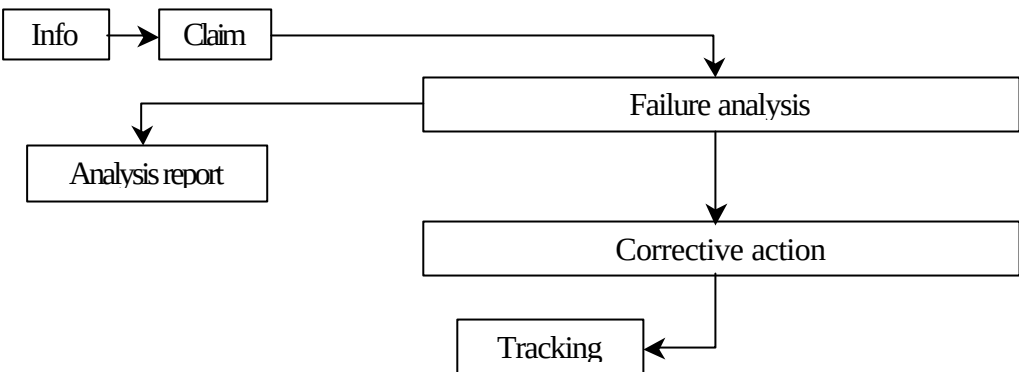
| Command               | Code     | D1          | D2           | Function                     |
|-----------------------|----------|-------------|--------------|------------------------------|
| Register Set          | 00100001 | X address   | Y address    | Cursor pointer set           |
|                       | 00100010 | Data        | 00H          | Offset register set          |
|                       | 00100100 | Low address | High address | Address pointer set          |
| Control Word Set      | 01000000 | Low address | High address | Text home address set        |
|                       | 01000001 | Columns     | 00H          | Text area set                |
|                       | 01000010 | Low address | High address | Graphic home address set     |
|                       | 01000011 | Columns     | 00H          | Graphic area set             |
| Mode Set              | 1000x000 | -           | -            | “OR” mode                    |
|                       | 1000x001 | -           | -            | “EXOR” mode                  |
|                       | 1000x011 | -           | -            | “AND” mode                   |
|                       | 1000x100 | -           | -            | “Text attribute” mode        |
|                       | 10000xxx | -           | -            | “Internal CG ROM mode        |
|                       | 10001xxx | -           | -            | “External CG CG RAM mode     |
| Display Mode          | 10010000 | -           | -            | Display off                  |
|                       | 1001xx10 | -           | -            | Cursor on, blink off         |
|                       | 1001xx11 | -           | -            | Cursor on, blink on          |
|                       | 100101xx | -           | -            | Text on, graphic off         |
|                       | 100110xx | -           | -            | Text off, graphic on         |
|                       | 100111xx | -           | -            | Text on, graphic on          |
| Cursor Pattern Select | 10100000 | -           | -            | 1 line cursor                |
|                       | 10100001 | -           | -            | 2 lines cursor               |
|                       | 10100010 | -           | -            | 3 lines cursor               |
|                       | 10100011 | -           | -            | 4 lines cursor               |
|                       | 10100100 | -           | -            | 5 lines cursor               |
|                       | 10100101 | -           | -            | 6 lines cursor               |
|                       | 10100110 | -           | -            | 7 lines cursor               |
|                       | 10100111 | -           | -            | 8 lines cursor               |
| Data Auto Read/Write  | 10110000 | -           | -            | Data auto write set          |
|                       | 10110001 | -           | -            | Data auto read set           |
|                       | 10110010 | -           | -            | Auto reset                   |
| Data Read Write       | 11000000 | Data        | -            | Data write and ADP increment |
|                       | 11000001 | -           | -            | Data read and ADP increment  |
|                       | 11000010 | Data        | -            | Data write and ADP decrement |
|                       | 11000011 | -           | -            | Data read and ADP decrement  |

|                  |          |      |   |                                |
|------------------|----------|------|---|--------------------------------|
|                  | 11000100 | Data | - | Data write and ADP nonvariable |
|                  | 11000101 | -    | - | Data read and ADP nonvariable  |
| Screen Peek      | 11100000 | -    | - | Screen peek                    |
| Screen Copy      | 11101000 |      |   | Screen copy                    |
| Bit<br>Set/Reset | 11110xxx | -    | - | bit reset                      |
|                  | 11111xxx | -    | - | bit set                        |
|                  | 1111x000 | -    | - | bit0 (LSB)                     |
|                  | 1111x001 | -    | - | bit1                           |
|                  | 1111x010 | -    | - | bit2                           |
|                  | 1111x011 | -    | - | bit3                           |
|                  | 1111x100 | -    | - | bit4                           |
|                  | 1111x101 | -    | - | bit5                           |
|                  | 1111x110 | -    | - | bit6                           |
|                  | 1111x111 | -    | - | bit7 (MSB)                     |

### 3. QUALITY ASSURANCE SYSTEM

#### 3.1 Quality Assurance Flow Chart



| Item          | Customer                                                                                                                                                                                                                                                                                                                    | Sales | R&D | Q.A | Manufacturing | Product control | Purchase | Inventory control |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|-----|---------------|-----------------|----------|-------------------|
| Sales Service |  <pre> graph TD     Info[Info] --&gt; Claim[Claim]     Claim --&gt; Failure[Failure analysis]     Claim --&gt; Report[Analysis report]     Failure --&gt; Action[Corrective action]     Action --&gt; Tracking[Tracking]           </pre> |       |     |     |               |                 |          |                   |
| Q.A Activity  | <div> 1. ISO 9001 Maintenance Activities<br/> 3. Equipment calibration<br/> 5. Standardization Management </div> <div> 2. Process improvement proposal<br/> 4. Education And Training Activities </div>                                                                                                                     |       |     |     |               |                 |          |                   |

## 3.2 Inspection Specification

Inspection Standard : MIL-STD-105E Table Normal Inspection Single Sampling Level II。

Equipment : Gauge、MIL-STD、Powertip Tester、Sample。

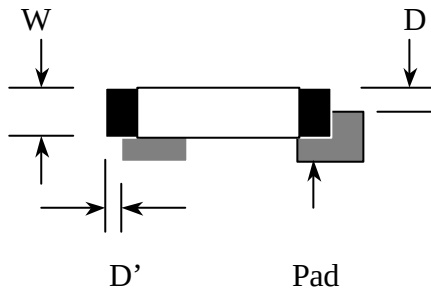
IQC Defect Level : Major Defect AQL 0.4; Minor Defect AQL 1.5。

FQC Defect Level : 100% Inspection。

OUT Going Defect Level : Sampling。

Specification :

| NO | Item                                                                                        | Specification                                                                                         | Judge | Level |
|----|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------|-------|
| 1  | Part Number                                                                                 | The part number is inconsistent with work order of production                                         | N.G.  | Major |
| 2  | Quantity                                                                                    | The quantity is inconsistent with work order of production                                            | N.G.  | Major |
| 3  | Electronic characteristics of LCM<br>$A = (L + W) \div 2$                                   | The display lacks of some patterns.                                                                   | N.G.  | Major |
|    |                                                                                             | Missing line.                                                                                         | N.G.  | Major |
|    |                                                                                             | The size of missing dot, A is $> 1/2$ Dot size                                                        | N.G.  | Major |
|    |                                                                                             | There is no function.                                                                                 | N.G.  | Major |
|    |                                                                                             | Output data is error                                                                                  | N.G.  | Major |
| 4  | Appearance of LCD<br>$A = (L + W) \div 2$<br><br>Dirty particle (Including scratch、bubble ) | Material is different with work order of production                                                   | N.G.  | Major |
|    |                                                                                             | LCD is assembled in inverse direction                                                                 | N.G.  | Major |
|    |                                                                                             | Bezel is assembled in inverse direction                                                               | N.G.  | Major |
|    |                                                                                             | Shadow is within LCD viewing area + 0.5 mm                                                            | N.G.  | Major |
|    |                                                                                             | The diameter of dirty particle, A is $> 0.4$ mm                                                       | N.G.  | Minor |
|    |                                                                                             | Dirty particle length is $> 3.0$ mm, and $0.01$ mm $<$ width $\leq 0.05$ mm                           | N.G.  | Minor |
|    |                                                                                             | Display is without protective film                                                                    | N.G.  | Minor |
|    |                                                                                             | Conductive rubber is over bezel 1mm                                                                   | N.G.  | Minor |
|    |                                                                                             | Polarizer exceeds over viewing area of LCD                                                            | N.G.  | Minor |
|    |                                                                                             | Area of bubble in polarizer, A $> 1.0$ mm, the number of bubble is $> 1$ piece.                       | N.G.  | Minor |
|    |                                                                                             | $0.4$ mm $<$ Area of bubble in polarizer, A $< 1.0$ mm, the number of bubble is $> 4$ pieces.         | N.G.  | Minor |
| 5  | Appearance of PCB<br>$A = (L + W) \div 2$                                                   | Burned area or wrong part number is on PCB                                                            | N.G.  | Major |
|    |                                                                                             | The symbol, character, and mark of PCB are unidentifiable.                                            | N.G.  | Minor |
|    |                                                                                             | The stripped solder mask , A is $> 1.0$ mm                                                            | N.G.  | Minor |
|    |                                                                                             | $0.3$ mm $<$ stripped solder mask or visible circuit, A $< 1.0$ mm, and the number is $\geq 4$ pieces | N.G.  | Minor |
|    |                                                                                             | There is particle between the circuits in solder mask                                                 | N.G.  | Minor |
|    |                                                                                             | The circuit is peeled off or cracked                                                                  | N.G.  | Minor |
|    |                                                                                             | There is any circuits risen or exposed.                                                               | N.G.  | Minor |
|    |                                                                                             | $0.2$ mm $<$ Area of solder ball, A is $\leq 0.4$ mm                                                  | N.G.  | Minor |
|    |                                                                                             | The number of solder ball is $\geq 3$ pieces                                                          | N.G.  | Minor |
|    |                                                                                             | The magnitude of solder ball, A is $> 0.4$ mm.                                                        | N.G.  | Minor |

| NO | Item                                                           | Specification                                                                                                  | Judge | Level |
|----|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------|-------|
| 6  | Appearance of molding<br>$A = (L + W) \div 2$                  | The shape of modeling is deformed by touching.                                                                 | N.G.  | Major |
|    |                                                                | Insufficient epoxy: Circuit or pad of IC is visible                                                            | N.G.  | Minor |
|    |                                                                | Excessive epoxy: Diameter of modeling is $> 20\text{mm}$ or height is $> 2.5\text{mm}$                         | N.G.  | Minor |
|    |                                                                | The diameter of pinhole in modeling, A is $> 0.2\text{mm}$ .                                                   | N.G.  | Minor |
| 7  | Appearance of frame<br>$A = (L + W) \div 2$                    | The folding angle of frame must be $> 45^\circ + 10^\circ$                                                     | N.G.  | Minor |
|    |                                                                | The area of stripped electroplate in top-view of frame, A is $> 1.0\text{mm}$ .                                | N.G.  | Minor |
|    |                                                                | Rust or crack is (Top view only)                                                                               | N.G.  | Minor |
|    |                                                                | The scratched width of frame is $> 0.06\text{mm}$ . (Top view only)                                            | N.G.  | Minor |
| 8  | Electrical characteristic of backlight<br>$A = (L + W) \div 2$ | The color of backlight is nonconforming                                                                        | N.G.  | Major |
|    |                                                                | Backlight can't work normally.                                                                                 | N.G.  | Major |
|    |                                                                | The LED lamp can't work normally                                                                               | N.G.  | Major |
|    |                                                                | The unsoldering area of pin for backlight, A is $> 1/2$ solder joint area.                                     | N.G.  | Minor |
|    |                                                                | The height of solder pin for backlight is $> 2.0\text{mm}$                                                     | N.G.  | Minor |
| 10 | Assembly parts<br>$A = (L + W) \div 2$                         | The mark or polarity of component is unidentifiable.                                                           | N.G.  | Minor |
|    |                                                                | The height between bottom of component and surface of the PCB is floating $> 0.7\text{mm}$                     | N.G.  | Minor |
|    |                                                                | $D > 1/4W$<br>              | N.G.  | Minor |
|    |                                                                | End solder joint width, D' is $> 50\%$ width of component termination or width of pad                          | N.G.  | Minor |
|    |                                                                | Side overhang, D is $> 25\%$ width of component termination.                                                   | N.G.  | Minor |
|    |                                                                | Component is cracked, deformed, and burned, etc.                                                               | N.G.  | Minor |
|    |                                                                | The polarity of component is placed in inverse direction.                                                      | N.G.  | Minor |
|    |                                                                | Maximum fillet height of solder extends onto the component body or minimum fillet height is $< 0.5\text{mm}$ . | N.G.  | Minor |



## 4. RELIABILITY TEST

### 4.1 Reliability Test Condition

| NO | Item                               | Test Condition                                                                                                                                                                                                                                                                                |                                                                               |
|----|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 1  | High Temperature Storage           | Storage at $80 \pm 2^{\circ}\text{C}$ 96~100 hrs<br>Surrounding temperature, then storage at normal condition 4hrs                                                                                                                                                                            |                                                                               |
| 2  | Low Temperature Storage            | Storage at $-30 \pm 2^{\circ}\text{C}$ 96~100 hrs<br>Surrounding temperature, then storage at normal condition 4hrs                                                                                                                                                                           |                                                                               |
| 3  | High Temperature /Humidity Storage | 1.Storage 96~100 hrs $60 \pm 2^{\circ}\text{C}$ , 90~95%RH surrounding temperature, then storage at normal condition 4hrs.<br>(Excluding the polarizer).<br>or<br>2.Storage 96~100 hrs $40 \pm 2^{\circ}\text{C}$ , 90~95%RH surrounding temperature, then storage at normal condition 4 hrs. |                                                                               |
| 4  | Temperature Cycling                | $-20^{\circ}\text{C} \rightarrow 25^{\circ}\text{C} \rightarrow 70^{\circ}\text{C} \rightarrow 25^{\circ}\text{C}$<br>$\xleftarrow{(30\text{mins}) (5\text{mins}) (30\text{mins}) (5\text{mins})} \xrightarrow{\hspace{1cm}}$<br>10 Cycle                                                     |                                                                               |
| 5  | Vibration                          | 10~55Hz ( 1 minute ) 1.5mm<br>X,Y and Z direction * (each 2hrs)                                                                                                                                                                                                                               |                                                                               |
| 6  | ESD Test                           | Air Discharge:<br>Apply 6 KV with 5 times discharge for each polarity +/-                                                                                                                                                                                                                     | Contact Discharge:<br>Apply 250V with 5 times discharge for each polarity +/- |
|    |                                    | Testing location:<br>Around the face of LCD                                                                                                                                                                                                                                                   | Testing location:<br>1.Apply to bezel.<br>2.Apply to Vdd, Vss.                |
| 7  | Drop Test                          | Packing Weight (Kg)                                                                                                                                                                                                                                                                           | Drop Height (cm)                                                              |
|    |                                    | 0 ~ 45.4                                                                                                                                                                                                                                                                                      | 122                                                                           |
|    |                                    | 45.4 ~ 90.8                                                                                                                                                                                                                                                                                   | 76                                                                            |
|    |                                    | 90.8 ~ 454                                                                                                                                                                                                                                                                                    | 61                                                                            |
|    |                                    | Over 454                                                                                                                                                                                                                                                                                      | 46                                                                            |

## **5. PRECAUTION RELATING PRODUCT HANDLING**

### **5.1 SAFETY**

- 5.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.
- 5.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

### **5.2 HANDLING**

- 5.2.1 Avoid any strong mechanical shock which can break the glass.
- 5.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module , be sure to ground your body and any electrical equipment you may be using.
- 5.2.3 Do not remove the panel or frame from the module.
- 5.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully ,do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)
- 5.2.5 Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.
- 5.2.6 Do not touch the display area with bare hands , this will stain the display area.
- 5.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

### **5.3 STORAGE**

- 5.3.1 Store the panel or module in a dark place where the temperature is  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  and the humidity is below 65% RH.
- 5.3.2 Do not place the module near organics solvents or corrosive gases.
- 5.3.3 Do not crush , shake , or jolt the module.

### **5.4 TERMS OF WARRANTY**

- 5.4.1 Applicable warrant period  
The period is within thirteen months since the date of shipping out under normal using and storage conditions.
- 5.4.2 Unaccepted responsibility  
This product has been manufactured to your company' s specification as a part for use in your company' s general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronequipment , we cannot take responsibility if the product is used in nuclear power control equipment , aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required.