**POWERTIP TECH. CORP.**

**DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN**

# Specification for Approval

Customer : _____

Model Type : LCD Module

Model Number : PG24064LRS-ETA-H

Edi : A

| Customer Sign | Sales Sign | Approved By | Prepared By |
|---|---|---|---|
| | | | |

# CONTENTS

# 1. SPECIFICATIONS

## 1.1 Features

- Full dot-matrix structure with 240 dots *64 dots
- 1/64 Duty, 1/9 bias
- STN LCD, positive, gray display
- Transflective LCD
- 6 o'clock viewing angle
- 8 bits parallel data input ,with controller IC T6963C, QFP type
- Built-in negative voltage generator circuit and LED backlight

## 1.2 Mechanical Specifications

- Outline dimension : 180.0mm(L)*65.0mm(W)*15.0mm max.(H)
- Viewing area : 134.0mm *40.4mm
- Active area : 127.16mm *33.88mm
- Dot size : 0.49mm *0.49mm
- Dot pitch : 0.53mm *0.53mm

## 1.3 Absolute Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Power supply Voltage | $V_{DD}$ | - | 0 | 7.0 | V |
| LCD drive Supply voltage | $V_{DD}$-$V_{EE}$ | - | - | 17.0 | V |
| Input voltage | $V_{IN}$ | - | -0.3 | $V_{DD}$+0.3 | V |
| Operating temperature | $T_{OPR}$ | - | -20 | 70 | °C |
| Storage temperature | $T_{STG}$ | - | -30 | 70 | °C |
| Humidity*1 | $H_D$ | - | - | 90 | %RH |

## 1.4 DC Electrical Characteristics

$V_{DD}$=+5V±10%,$V_{SS}$=0V,$T_A$=25°C

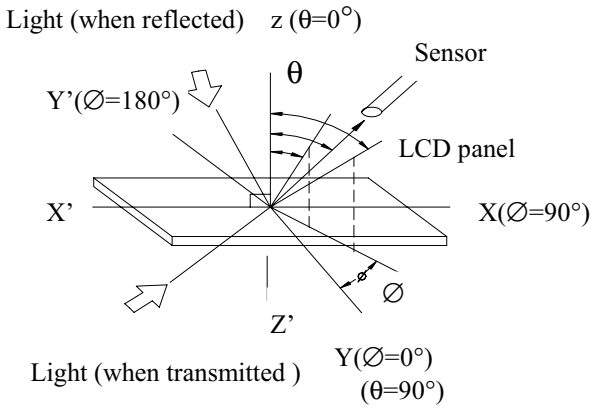
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Logic Supply voltage | $V_{DD}$ | - | 4.5 | 5 | 5.5 | V |
| "H" input voltage | $V_{IH}$ | - | 0.8$V_{DD}$ | - | $V_{DD}$ | V |
| "L" input voltage | $V_{IL}$ | - | 0 | - | 0.2$V_{DD}$ | V |
| "H" output voltage | $V_{OH}$ | - | $V_{DD}$-0.3 | - | - | V |
| "L" output voltage | $V_{OL}$ | - | - | - | 03 | V |
| Supply current | $I_{OP}$ | $V_{DD}$=5V | - | - | - | mA |
| LCD driving voltage | $V_{LCD}$ | $V_{DD}$-$V_O$ | 9.4 | - | 10.6 | V |

## 1.5 Optical Characteristics

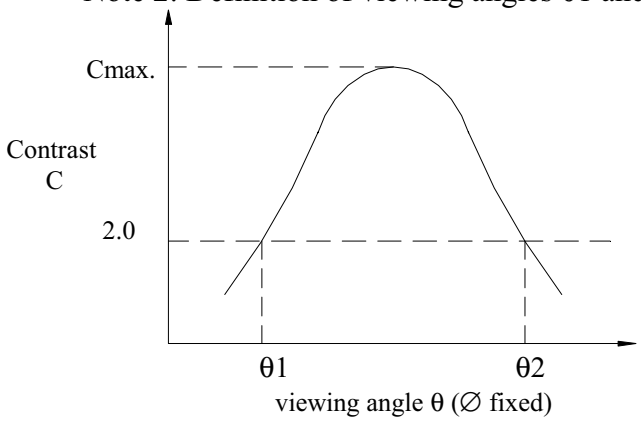
1/64 duty, 1/9 bias, Vopr=9.7V, Ta=25°C

| Item | Symbol | Conditions | Min. | Typ. | Max | Reference |
|---|---|---|---|---|---|---|
| Viewing angle | θ | C≥2.0,∅=0°C | 30° | - | - | Notes 1 & 2 |
| Contrast | C | θ=5°, ∅=0° | 2 | 3 | - | Note 3 |
| Response time(rise) | ton | θ=5°, ∅=0° | - | 140ms | 200ms | Note 4 |
| Response time(fall) | toff | θ=5°, ∅=0° | - | 300ms | 500ms | Note 4 |

Note 1: Definition of angles θ and ∅



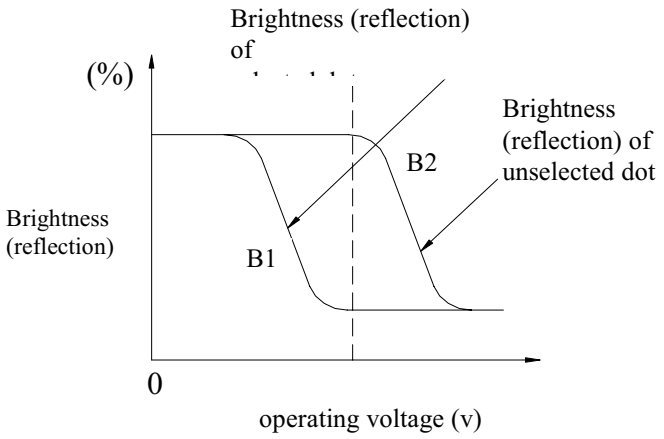

Note 2: Definition of viewing angles θ1 and θ2



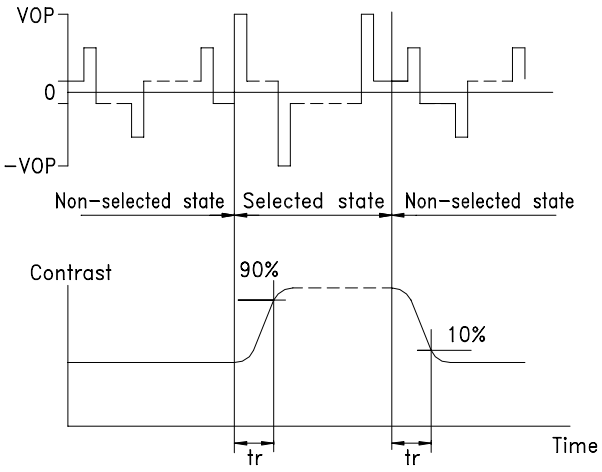

Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

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 $cm^2$

Vopr : Operating voltgae
ton : Response time (rise)
fFRM : Frame frequency
toff : Response time (fall)

## 1.6 Backlight Characteristic

The LCD Module is using a LED backlight panel

•.Maximum ratings

| Item | Symbol | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Peak Forward Current | If | Ta=25℃ | - | 1625 | mA |
| Reverse Voltage | Vr | Ta=25℃ | - | 8 | V |
| Power Dissipation | Po | Ta=25℃ | - | 7.4 | W |
| Operating Temperature | Topr | - | -20 | 70 | ℃ |
| Storage Temperature | Tstg | - | -40 | 80 | ℃ |

•.Electrical/Optical Characteristics

| ITEM | Symbol | Condition | Min. | Typ | Max. | Unit |
|---|---|---|---|---|---|---|
| Forward Voltage | Vf | If=650mA | - | 4.2 | 4.6 | V |
| Reverse Current | Ir | VR= 8V | - | - | 0.2 | mA |
| Luminous Intensity | Iv | If= 650mA | 176 | 220 | - | $cd/m^2$ |
| Wevelength | Hue | If= 650mA | 571 | - | 576 | nm |
| Color | Yellow green | | | | | |

# 2. MODULE STRUCTURE

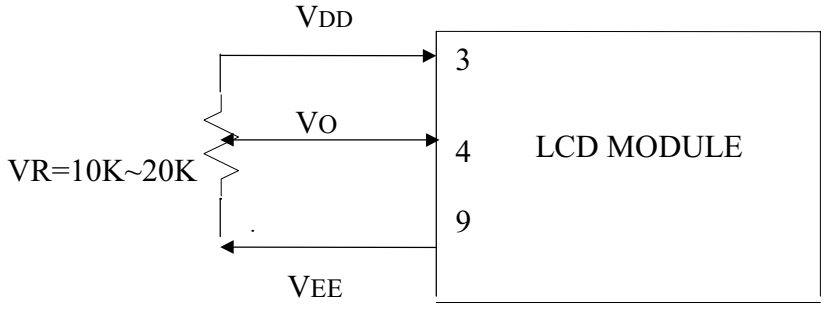
## 2.1 Counter Drawing

*See Appendix

## 2.2 Interface Pin Description

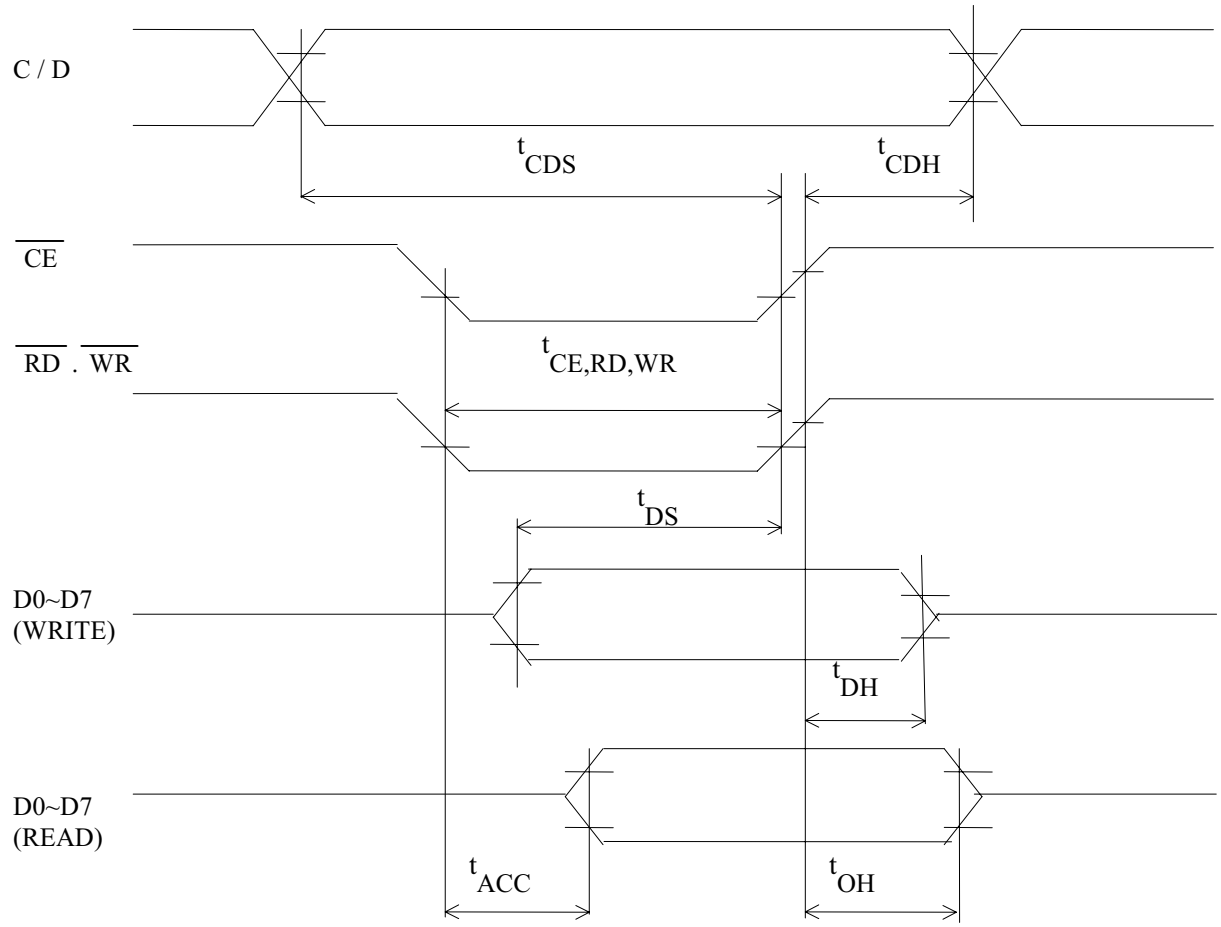
| Pin No. | Symbol | Function |
|---|---|---|
| 1 | FG | Frame ground (connected to metal bezel ) |
| 2 | Vss | Signal ground (GND) |
| 3 | Vdd | Power supply for logic (+5V) |
| 4 | Vo | Power supply for lcd drive (contrast adjust) |
| 5 | $\overline{WR}$ | Data write (write data to the module at "L") |
| 6 | $\overline{RD}$ | Data read (read data from the module at "L") |
| 7 | $\overline{CE}$ | Chip enable for the module (active at "L") |
| 8 | C/ $\overline{D}$ | $\overline{WR}$ ="L";C/ $\overline{D}$ = "H" :command write, C/ $\overline{D}$ ="L":data write<br>$\overline{WR}$ ="H";C/ $\overline{D}$ = "H" :command read, C/ $\overline{D}$ ="L":data read |
| 9 | Vee | Negative voltage output |
| 10 | $\overline{RESET}$ | Controller reset (module reset) |
| 11~18 | D0~D7 | Data bus (D0=MSB, D7=LSB) |
| 19 | FS | Font select :open or connect to Vdd : 6*8 Dots font<br>connect to Vss : 8*8 Dots font |
| 20 | NC | Not connection |

Contrast Adjust



## 2.3 Timing Characteristics

Bus Timing



Read cycle

$V_{DD}$=+5V±10%,$V_{SS}$=0V,$T_A$=25°C

| Item | Symbol | Conditions | Min. | Max | Unit |
|---|---|---|---|---|---|
| C/D Set up time | tCDS | - | 100 | - | ns |
| C/D Hold time | tCDH | - | 10 | - | ns |
| $\overline{CE}$ , $\overline{RD}$ , $\overline{WR}$ Pulse width | tCE,tRD,tWR | - | 80 | - | ns |
| Access time | tACC | - | - | 150 | ns |
| Output hold time | tOH | - | 10 | 50 | ns |

Write cycle

| Item | Symbol | Conditions | Min. | Max | Unit |
|---|---|---|---|---|---|
| C/D Set up time | tCDS | - | 100 | - | ns |
| C/D Hold time | tCDH | - | 10 | - | ns |
| $\overline{CE}$ , $\overline{RD}$ , $\overline{WR}$ Pulse width | tCE,tRD,tWR | - | 80 | - | ns |
| Data set up time | tDS | - | 80 | - | ns |
| Data hold time | tDH | - | 40 | - | 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<br>Upper screen |
|---|

| Y ADRS 10H~1FH<br>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.

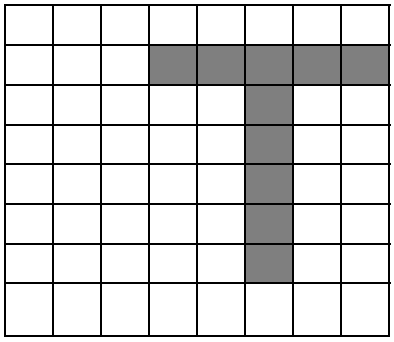
The data format of external character generator RAM.

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


Display character

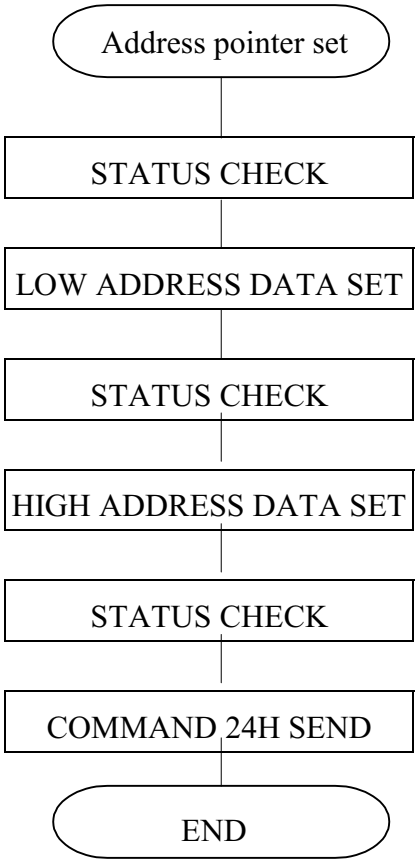
| (RAM DATA) | (Character) |
|---|---|
| 21H | A |
| 22H | B |
| 83H | γ |
| 24H | D |
| 25H | E |
| 86H | ζ |

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




Address pointer set command send

**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

$\overline{\text{DUAL}}$ =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 |

LCD

(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 |

LCD

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.

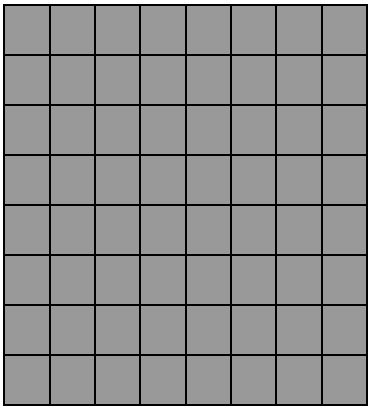
**3.Mode set**

| 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 | - |

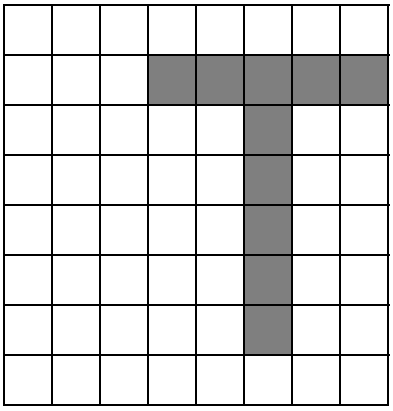
The display mode is defined by this command. The display mode don’t have changed until to send next this command. Logically “OR”, “EXOR”, “AND” of text and graphic display canbe displayed.

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.

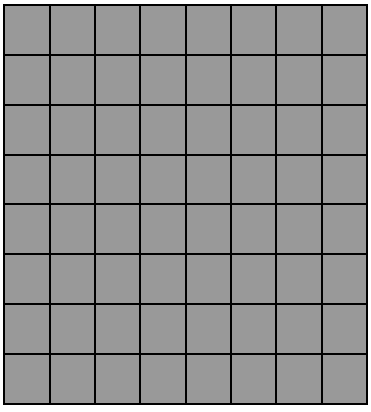
(Example)



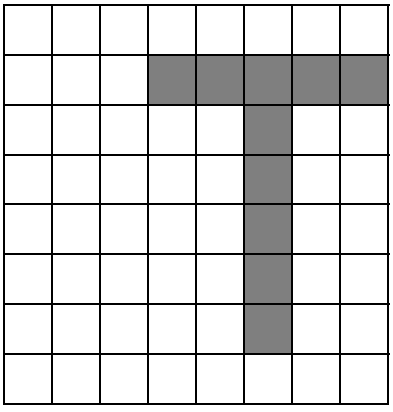
Graphic



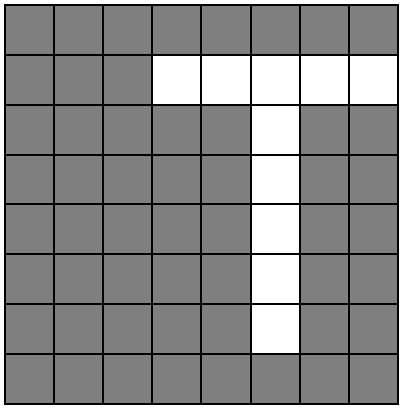
Text



“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 lst character in text area is written at the lst 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 |

X : Don't care

**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 | - |

| 1 | 0 | 0 | 1 | d3 | d2 | d1 | d0 |
|---|---|---|---|---|---|---|---|

Cursor blink on: 1, off: 0

Cursor display on: 1, off: 0

Text display on: 1, off: 0

Graphic display on: 1, off: 0

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

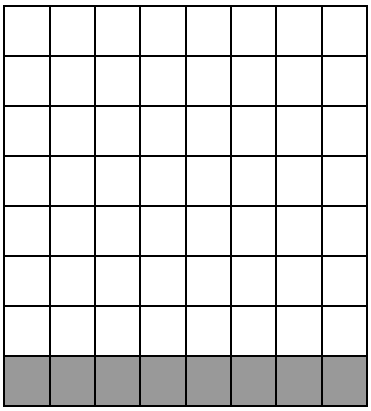
(1) Combination of text/graphic display

(2) Attribute function

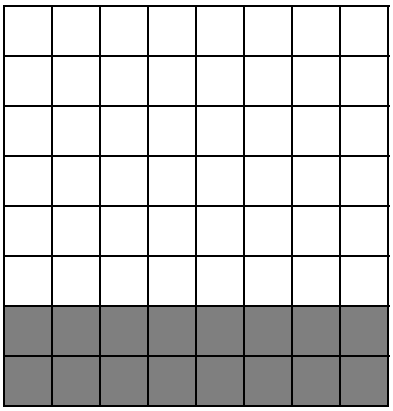
**5.Cursor pattern select**

| 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 | - |

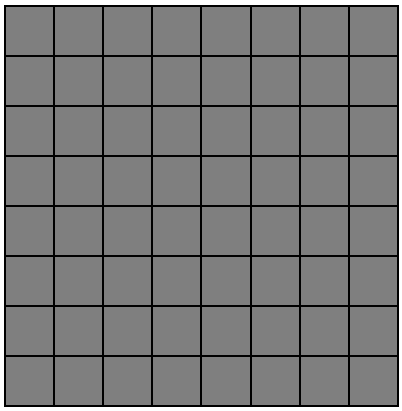
When cursor display is ON, this command selects the cursor pattern from 1 line to 8 lines. The cursor address is defined by cursor pointer set command.



1 line cursor



2 lines cursor



8 lines cursor

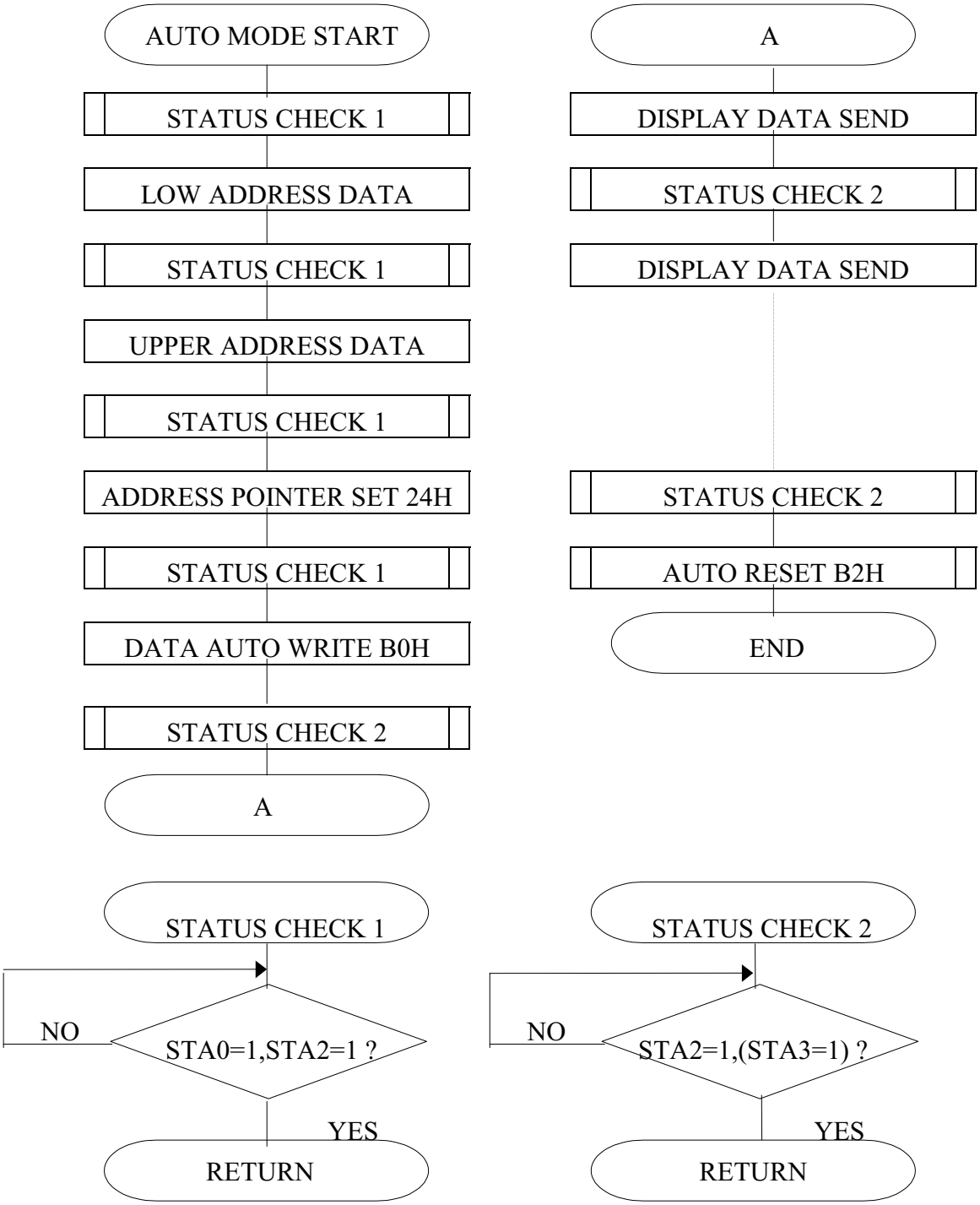
**6.Data auto read/write**

| 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.



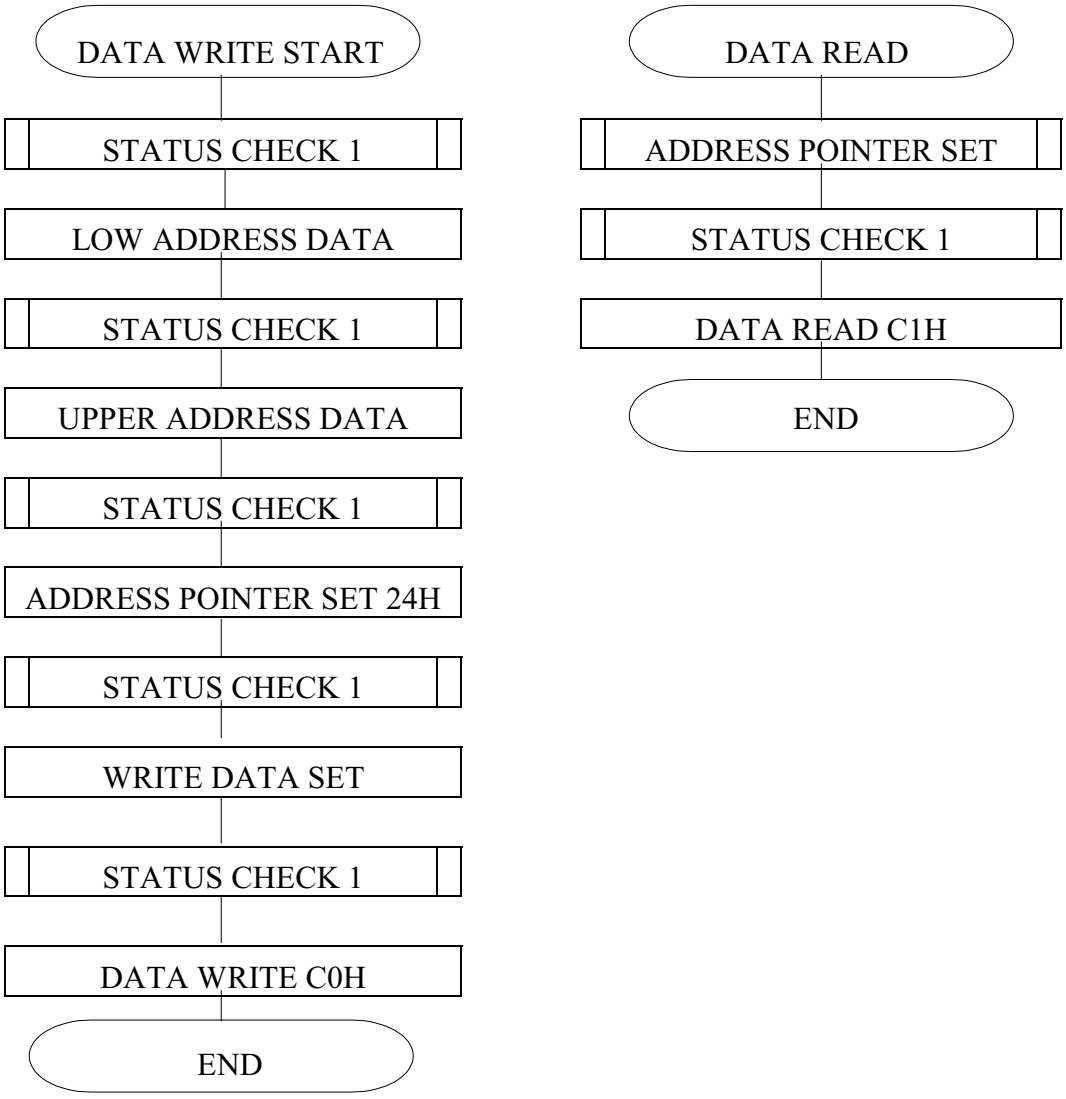
**7.Data read write**

| 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.

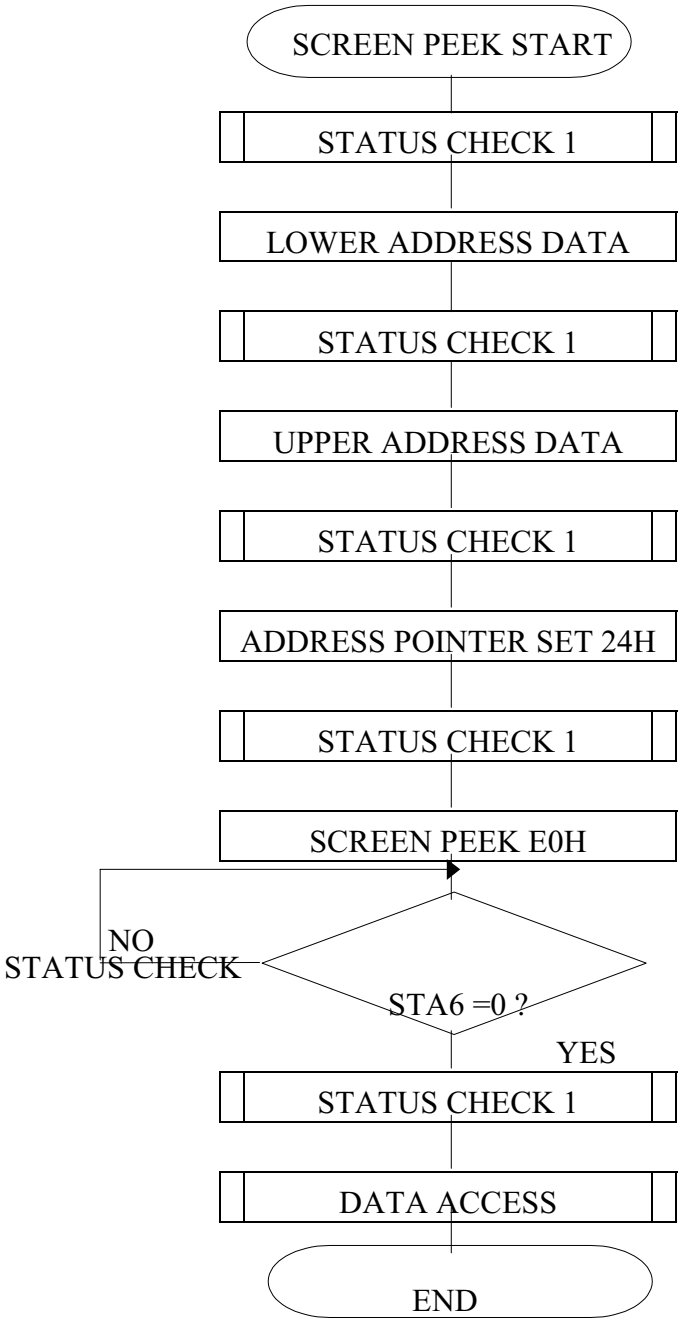
Please refer following flow chart.



**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.

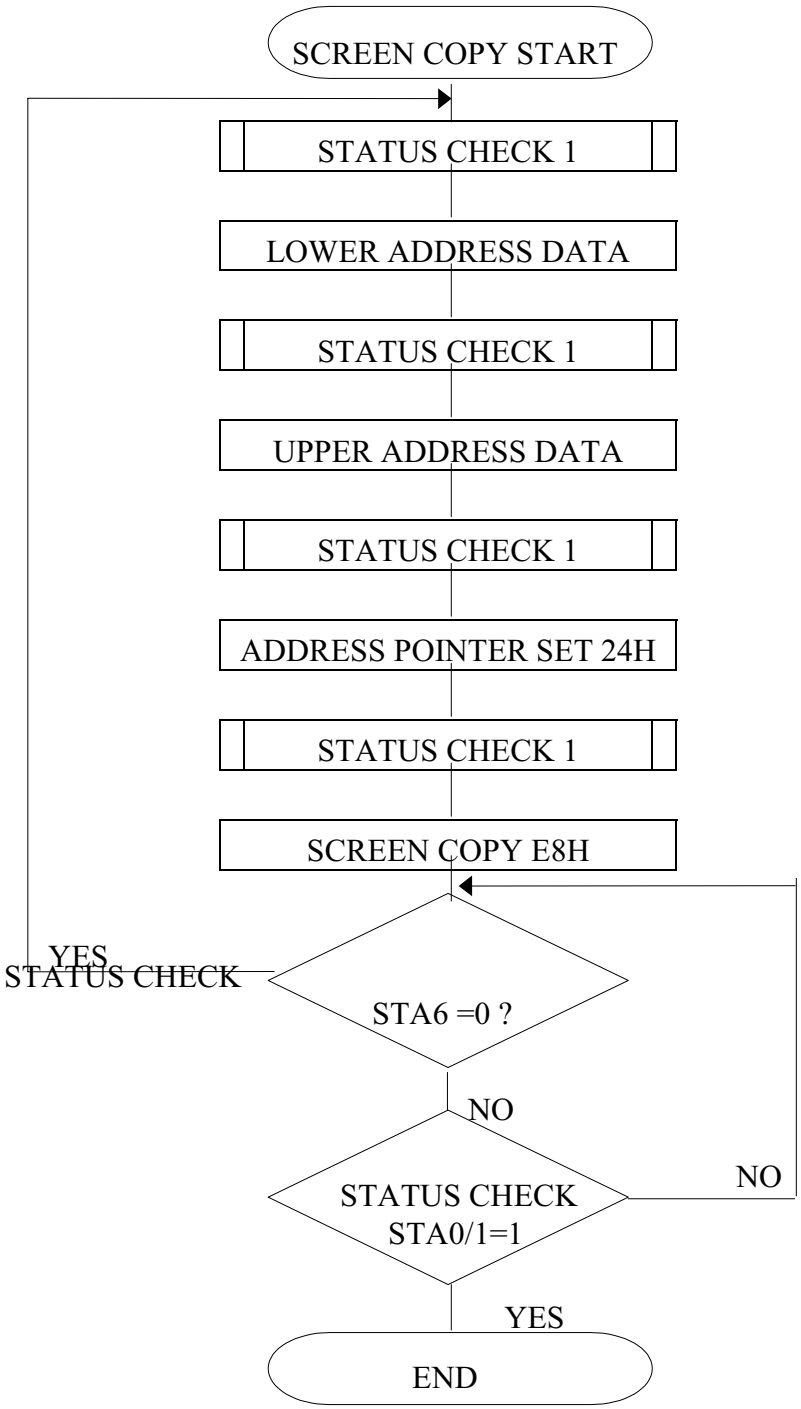


**9.Screen copy**

| 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.

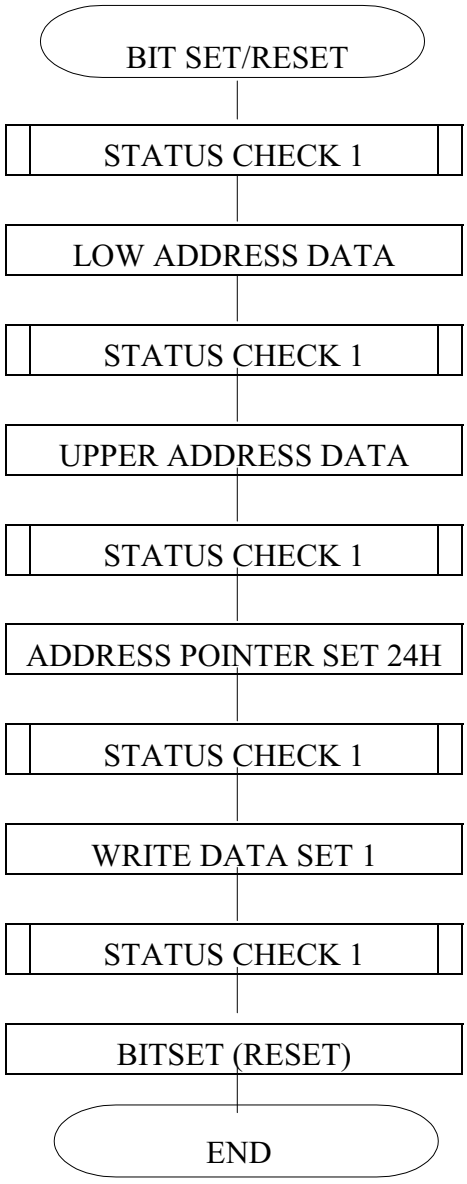
Note: (1) In attribute function, this command is invalid.
(Because attribute data is in the graphic area.)
(2) In case of 2 screen drive, this command is invalid. (Because T693C cannot eparate upper screen data and lower screen data.)
Please refer following flow chart.



**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 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) |

## 2.5 Character Pattern