

SPECIFICATION



YM240128A-11

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Version 1.0



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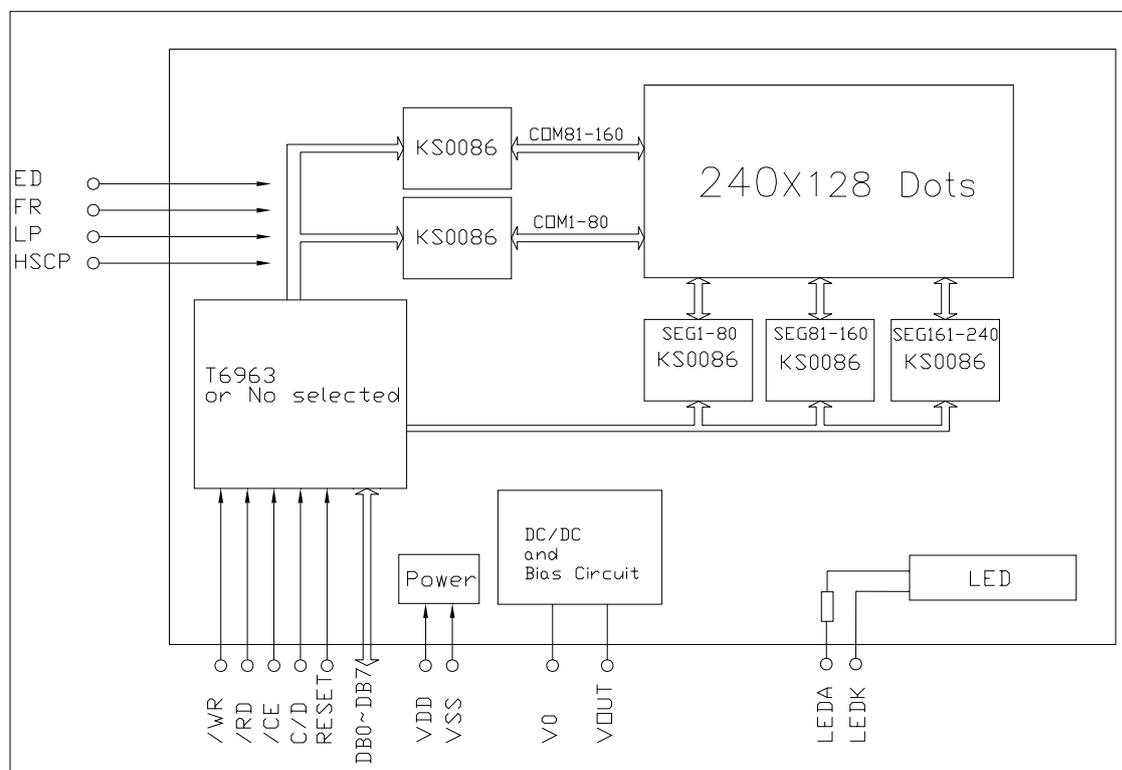
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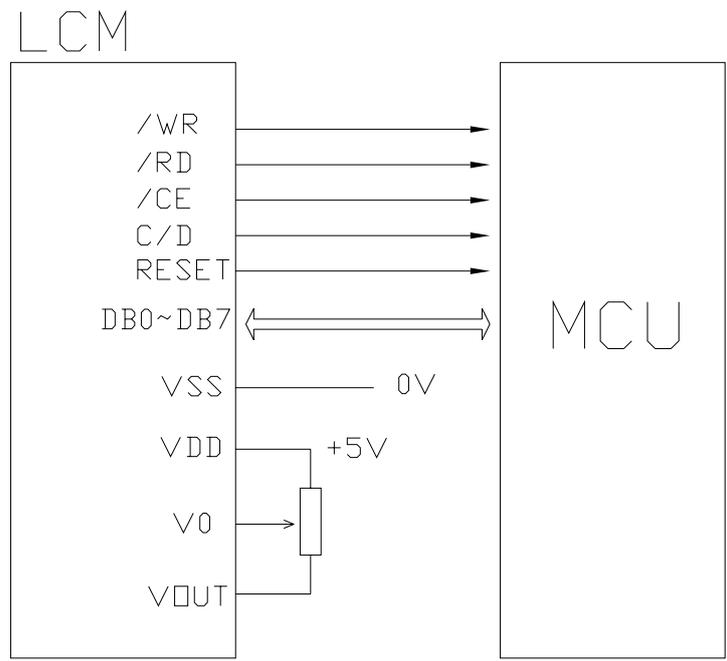
1. FEATURES :

| ITEM | STANDARD VALUE | UNIT |
|------------------------|---|------|
| Display Type | 240 x 128 dots | |
| LCD Type | <input type="checkbox"/> STN, Blue-white mode, Transmissive, Negative, Extend Temp <input type="checkbox"/> STN, Gray mode, Transflective, Positive, Extend Temp <input type="checkbox"/> STN, Yellow-green mode, Transflective, Positive, Extend Temp <input type="checkbox"/> FSTN, Transflective, Positive, Extend Temp | - |
| LCD Duty | 1/128 duty | |
| LCD Bias | 1/12 bias | |
| Viewing Direction | 6:00 | - |
| Backlight Type | <input checked="" type="checkbox"/> LED(White) <input type="checkbox"/> LED(Yellow-Green) | - |
| Interface | 6800 Series or 8080 series | - |
| Driver IC | <input checked="" type="checkbox"/> T6963 <input type="checkbox"/> KS0086 (No controller) | - |
| Module Dimension | 144.0(W) x 105.5(H) x 15.0 (MAX)(T) | mm |
| Effective Display Area | 107.95 (W) x 57.55 (H) | mm |
| Dot Size | 0.40 (W) x 0.40 (H) | mm |
| Dot Pitch | 0.45 (W) x 0.45 (H) | mm |

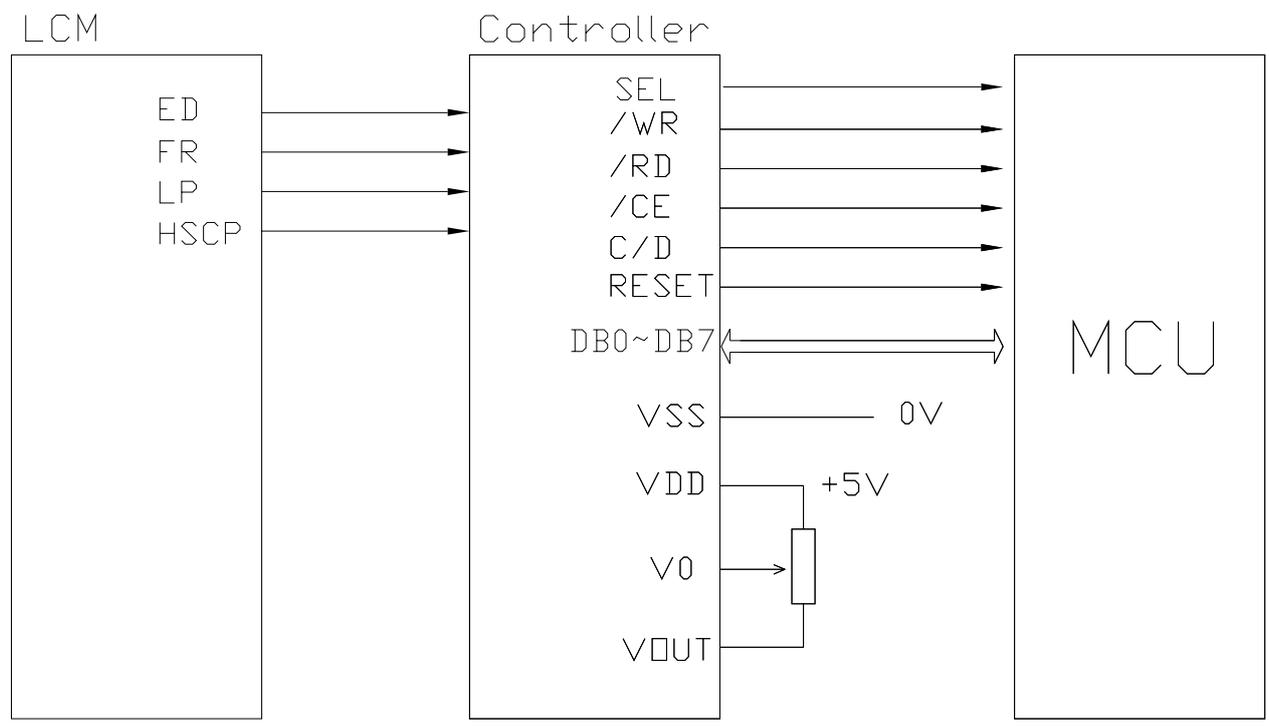
2. BLOCK DIAGRAM & APPLICATION CIRCUIT :



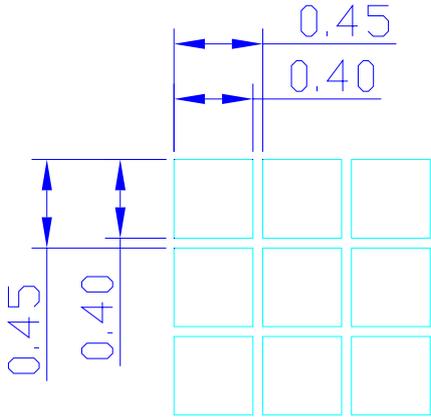
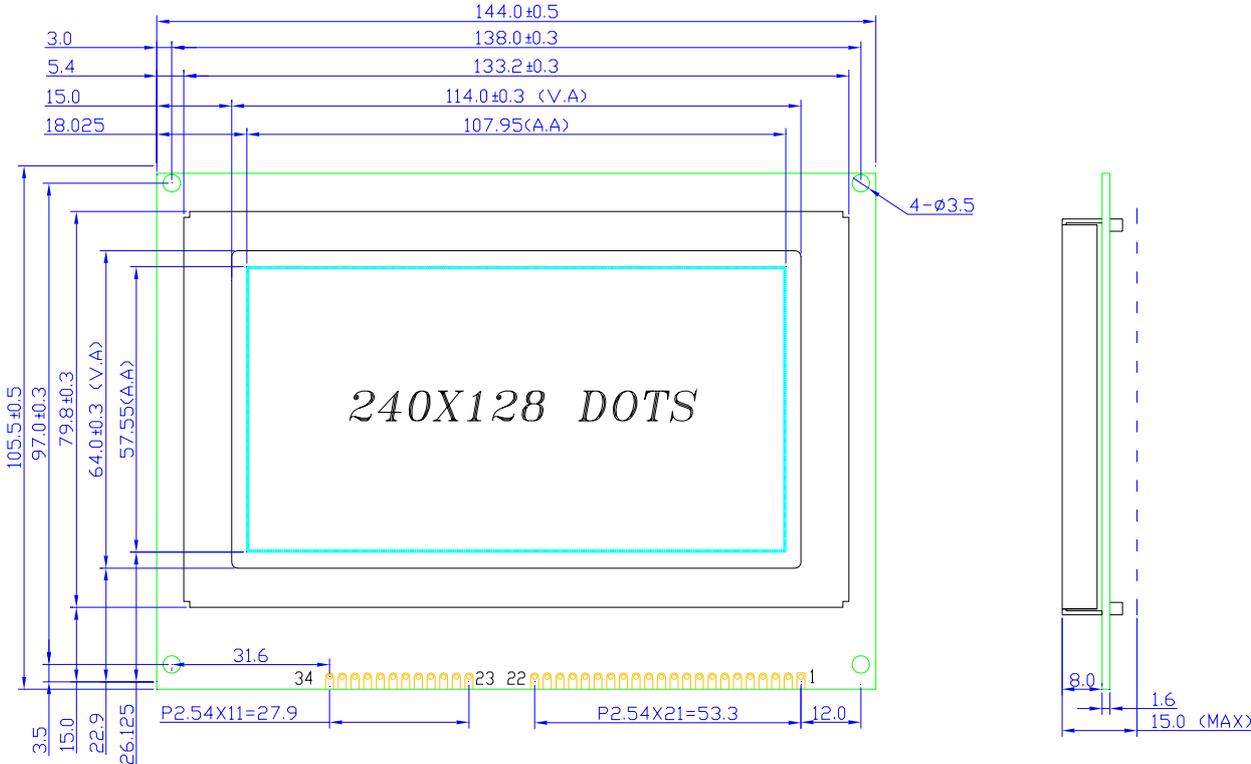
Built-in T6963 Application



KS0086(No controller) Application



3. OUTLINE DIMENSIONS



4. ABSOLUTE MAXIMUM RATING

| ITEM | SYMBOL | CONDITION | STANDARD VALUE | | | UNIT |
|------------------------------|----------------|------------|----------------|-----|---------|------|
| | | | MIN | TYP | MAX | |
| POWER SUPPLY FOR LOGIC | VDD | Ta=25°C | -0.3 | — | 7.0 | V |
| INPUT VOLTAGE | VIN | Ta=25°C | -0.3 | — | VDD+0.3 | V |
| Module OPERATION TEMPERATURE | TOPR | --- | -20 | — | +70 | °C |
| Module STORAGE TEMPERATURE | TSTG | --- | -30 | — | +80 | °C |
| Storage Humidity | H _D | Ta < 40 °C | - | | 90 | %RH |

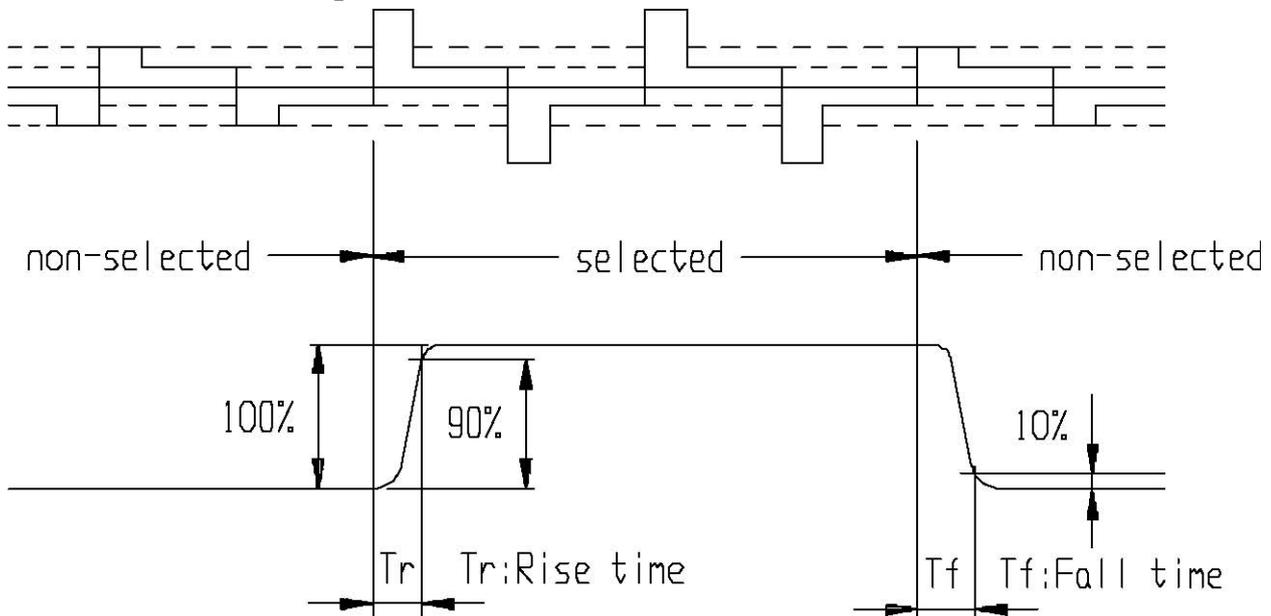
5. ELECTRICAL CHARACTERISTICS

| ITEM | SYMBOL | CONDITION | MIN | TYP | MAX | UNIT |
|------------------------|---------|---------------------------------|---------|----------------|-----|------|
| Supply Voltage (logic) | VDD-VSS | - | 4.5 | 5 | 5.5 | V |
| Supply Voltage (LCD) | VDD-V0 | Ta= +25°C Blue Ta= +25°C Y-G | - | -18.5 -18.5 | - | V |
| Input signal voltage | V-IH | “H” level | VDD-2.2 | - | VDD | V |
| | V-IL | “L” level | 0 | - | 0.8 | V |
| Output signal voltage | V-OH | “H” level | VDD-0.3 | - | VDD | V |
| | VOL | “H” level | 0 | - | 0.3 | V |
| Supply Current (logic) | IDD | VDD=5.0V | - | - | - | mA |
| Backlight Voltage | V-BL | LED(Yellow-Green) | - | 4.2V | - | V |
| | | LED(White) | - | 3.1 | - | |
| Backlight Current | I-BL | LED(Yellow-Green) | - | 200 | - | mA |
| | | LED(White) | 70 | 130 | 150 | |
| Backlight Driver Wave | | - | | - | - | kHz |
| Backlight Brightness | | | | | | |
| Backlight Life Time | | | | | | |

6. OPTICAL CHARACTERISTICS

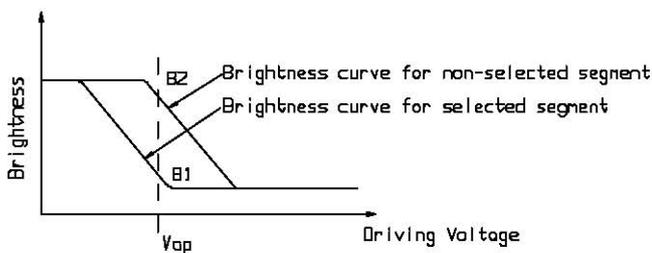
| Item | Symbol | Condition | Min | Typ | Max | Unit | Remarks | Note |
|---------------------|----------|-------------|-----|------|-----|------|---------------------|------|
| Response Time | Tr | - | - | 498 | - | ms | - | 1 |
| | Tf | - | - | 123 | - | ms | - | 1 |
| Contrast Ratio | Cr | - | - | 11.6 | - | - | - | 2 |
| Viewing Angle Range | θ | $Cr \geq 2$ | 26 | - | - | deg | $\varnothing = 90$ | 3 |
| | | | 26 | - | - | deg | $\varnothing = 270$ | 3 |
| | | | 29 | - | - | deg | $\varnothing = 0$ | 3 |
| | | | 57 | - | - | deg | $\varnothing = 180$ | 3 |

Note 1. Definition of response time

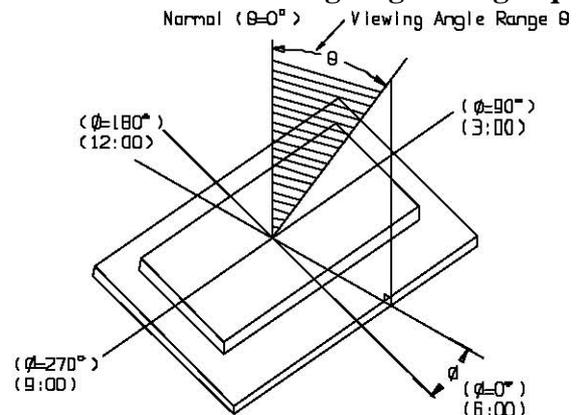


Note 2. Definition of Contrast Ratio 'Cr'

$$Cr = \frac{\text{Brightness of non-selected segment}(B2)}{\text{Brightness of selected segment}(B1)}$$



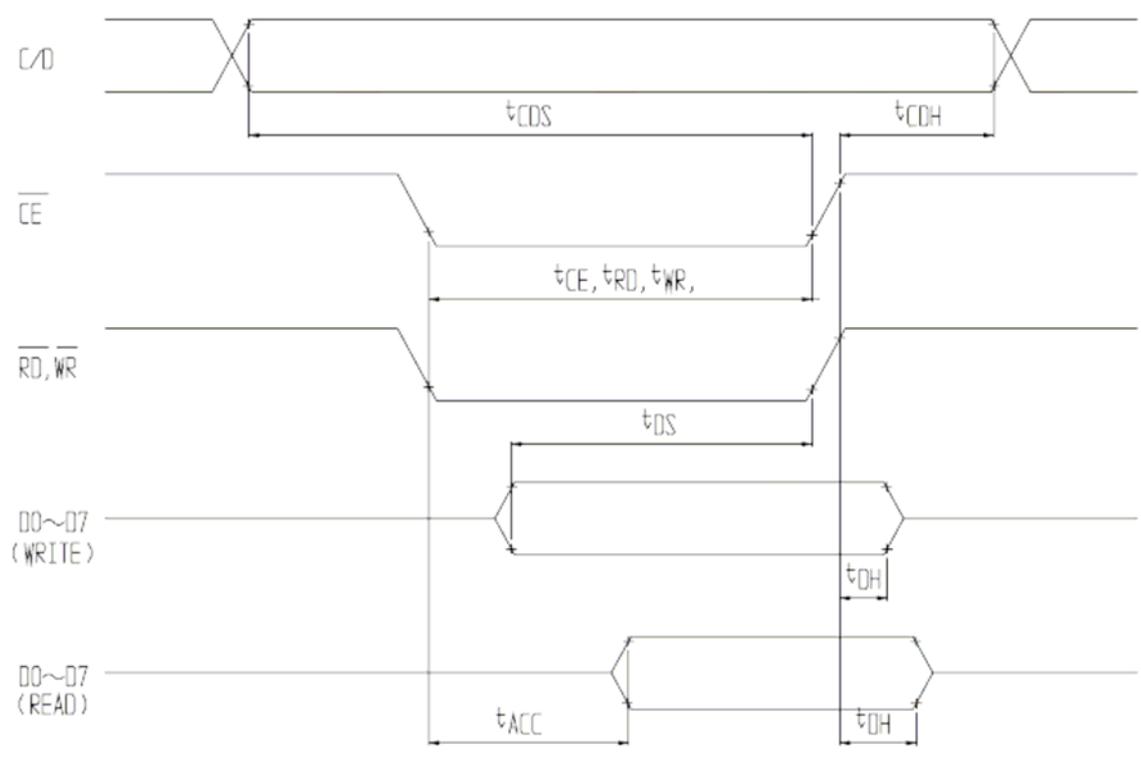
Note 3. Definition of Viewing Angle Range 'q'



7. TIMING CHARACTERISTICS

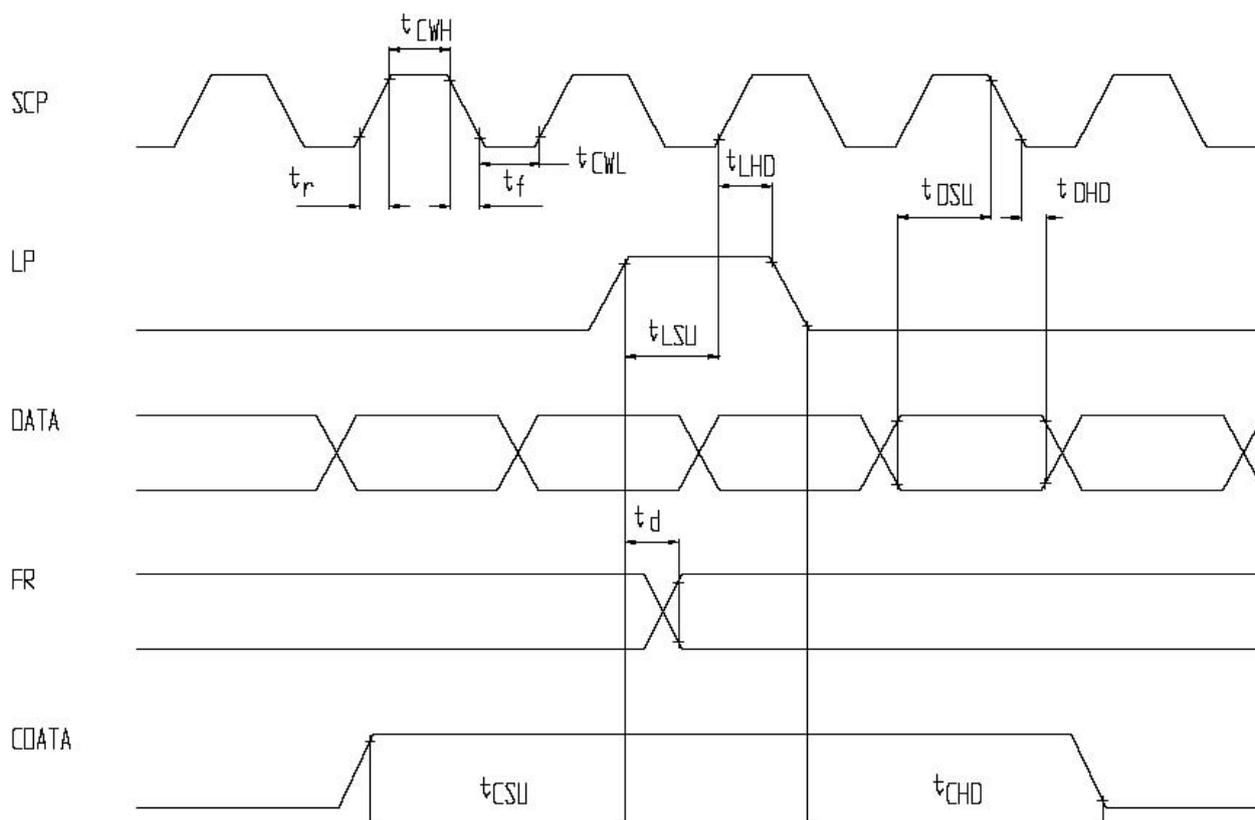
7.1 T6963 Timing

| Parameter | Symbol | 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 |



7.2 KS0086 Timing

| Parameter | Symbol | Min | Max | Unit |
|---------------------|--------------------|-----|------|---------|
| Operating frequency | f_{SCP} | - | 2.75 | MHz |
| SCP pulse width | t_{CWH}, t_{CWL} | 45 | - | ns |
| SCP rise/fall time | t_r, t_f | - | 30 | ns |
| LP set up time | t_{LSU} | 80 | - | ns |
| LP hold time | t_{LHD} | 80 | - | ns |
| Data set up time | t_{DSU} | 30 | - | ns |
| Data hold time | t_{DHD} | 30 | - | ns |
| FR delay time | t_d | 0 | 1.0 | μs |
| CDATA set up time | t_{CSU} | 30 | - | ns |
| CDATA hold time | t_{CHD} | 30 | - | ns |



8. Display Control Instruction

Please Consult T6963 Data Sheet

u Flowchart of Communications with MPU

● Status Read

Before sending data (Read/Write) command, it is necessary to check the status.

Status check

Status of T6963C can be read from data lines.

| | |
|-------|-------------|
| RD | L |
| WR | H |
| CE | L |
| C/D | H |
| D0-D7 | Status word |

T6963C status word format is following.

| MSB | | | | | | LSB | |
|------|------|------|------|------|------|------|------|
| STA7 | STA6 | STA5 | STA4 | STA3 | STA2 | STA1 | STA0 |
| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

| | | |
|------|--|---------------------------------------|
| STA0 | Check capability of command execution | 0 : Disable 1 : Enable |
| STA1 | Check capability of data read/write | 0 : Disable 1 : Enable |
| STA2 | Check capability of auto mode data read | 0 : Disable 1 : Enable |
| STA3 | Check capability of auto mode data write | 0 : Disable 1 : Enable |
| STA4 | Not use | |
| STA5 | Check capability of controller operation | 0 : Disable 1 : Enable |
| STA6 | Error flag. Using screen peek/copy command | 0 : No error 1 : Error |
| STA7 | Check the condition blink | 0 : Display off 1 : Normal display |

Note 1 : It is necessary to check STA0 and STA1 at the same time. The error is happened by sending data at executing command.

Note 2 : The status check will be enough to check STA0/STA1.

Note 3 : STA2/STA3 are valid in auto mode STA0/STA1 are invalid.

Status checking flow

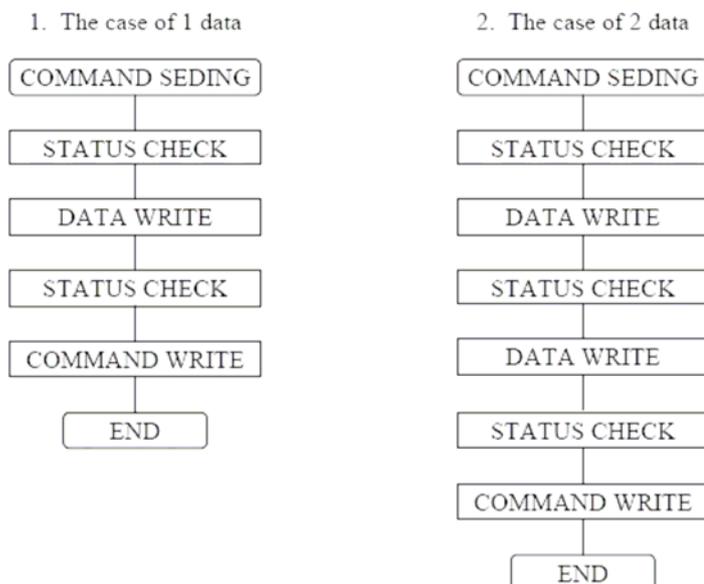


Note 4 : It is impossible to save status check in the case of command of MSB0. To have the delay time cannot be save status check. The interrupt of hardware is happened at the end of lines. If command of MSB0 is sent in this period, the command executing is waited. The state of waiting doesn't be known without to check status. The sending next command or data is disregarded or rewrites data of waiting command.

● Data Set

In T6963C, the data have been set and command executes.

The order of procedure of command sending



Note : In case of over 2 data sending, the last data (or last 2 data) is valid.

u Description of Command

● 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.

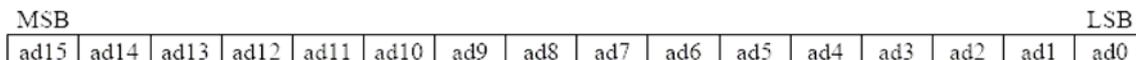
X ADRS 00H~4FH (Lower 7bits are valid)
 Y ADRS 00H~1FH (Lower 5bits are valid)

| 1 screen drive | 2 screens drive |
|----------------|--------------------------------|
| X ADRS 00~4FH | X ADRS 00~4FH |
| Y ADRS 00H~0FH | 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.

T6963C has 16 bit address lines as follow.



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) |
|----------------|-------------|----------|
| [10x10 grid] | 1400H | 00H |
| [10x10 grid] | 1401H | 1FH |
| [10x10 grid] | 1402H | 04H |
| [10x10 grid] | 1403H | 04H |
| [10x10 grid] | 1404H | 04H |
| [10x10 grid] | 1405H | 04H |
| [10x10 grid] | 1406H | 04H |
| [10x10 grid] | 1407H | 00H |

(Example 2)

The relationship of display RAM data and display character

| | (RAM Data) | (Character) |
|---------------|--------------|---------------|
| [1x12 grid] | 21H | A |
| [1x12 grid] | 22H | B |
| [1x12 grid] | 83H | γ |
| [1x12 grid] | 24H | D |
| [1x12 grid] | 25H | E |
| [1x12 grid] | 86H | ζ |

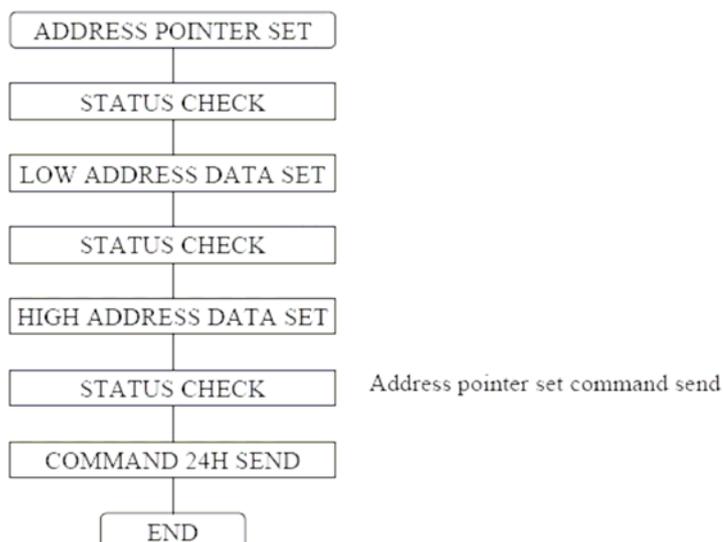
Display character

Note : 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



● 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, MDS=L, MD0=L, MD1=L : 16 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 |

(2) Graphic Home Address Set

The starting address of external display RAM for Graphic display is defined by this command. The graphic home address shows 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 are fixed by hardware. (pin-programmable)

(Example)

Graphic home address : 0000H
 Graphic area : 0020H
 MD2=H, MD3=H : 32 columns
 DUAL=H, MDS=L, MD0=L, MD1=L : 16 lines

| | | | | |
|-------|-------|-------|-------|-------|
| 0000H | 0001H | ..... | 001EH | 001FH |
| 0020H | 0021H | ..... | 003EH | 003FH |
| 0040H | 0041H | ..... | 005EH | 005FH |
| 0060H | 0061H | ..... | 007EH | 007FH |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| 0F80H | 0F81H | ..... | 0F9EH | 0F9FH |
| 0FA0H | 0FA1H | ..... | 0FBEH | 0FBFH |
| 0FC0H | 0FC1H | ..... | 0FDEH | 0FDFH |
| 0FE0H | 0FE1H | ..... | 0FFEH | 0FFFH |

● Mode Set

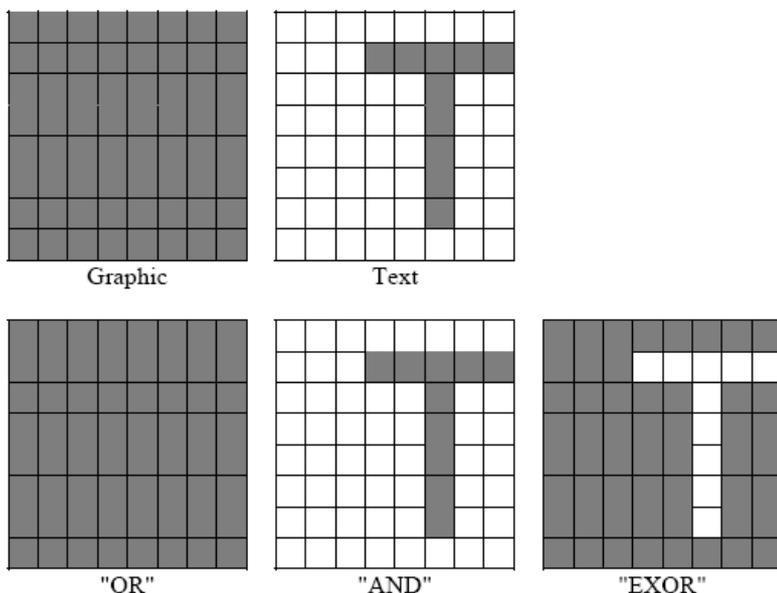
| Code | Function | Operand |
|----------|-----------------------------------|---------|
| 1000x000 | "OR" Mode | --- |
| 1000x001 | "EXOR" Mode | --- |
| 1000x011 | "AND" Mode | --- |
| 1000x100 | "TEXT ATTRIBUTE" Mode | --- |
| 10000xxx | Internal Character Generator Mode | --- |
| 10001xxx | External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

x : Don't care

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)



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

Attribute RAM byte

| | | | | | | | |
|---|---|---|---|----|----|----|----|
| 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 |

● 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 |
|---|---|---|---|----|----|----|----|

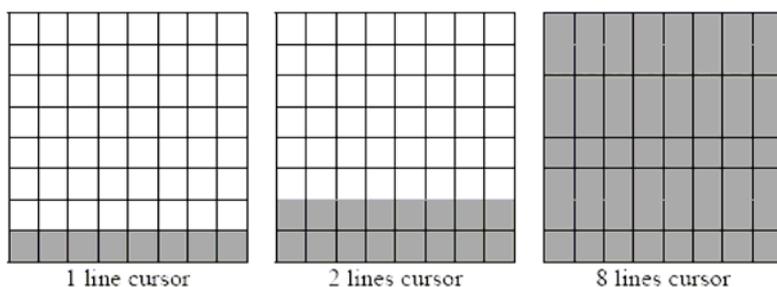
d0: Cursor blink on : 1, off : 0
d1: Cursor display on : 1, off : 0
d2: Text display on : 1, off : 0
d3: Graphic display on : 1, off : 0

Note : It is necessary to turn on "Text display" and "Graphic display" in following case.
1) Combination of text/graphic display, 2) Attribute function.

● 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.

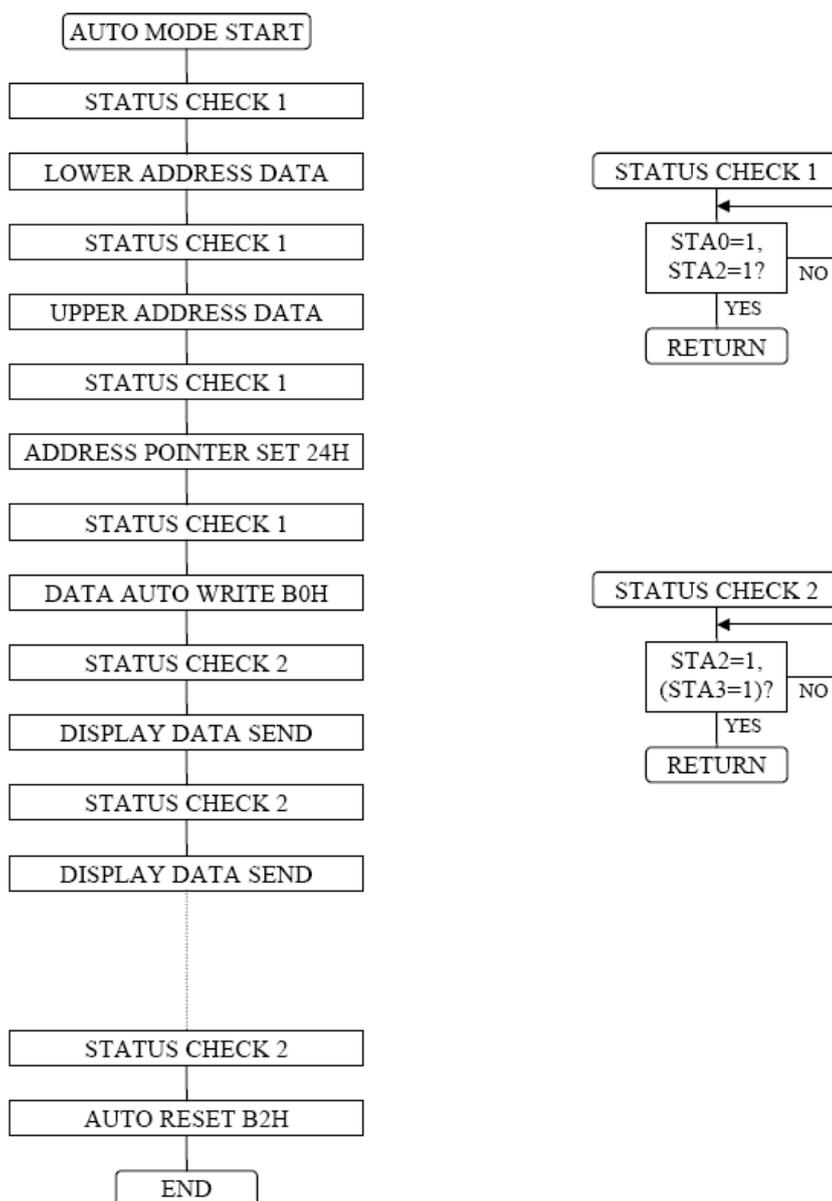


● Data Auto Read/Write

| 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 auto 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,STA3) should be checked between each data. Auto reset should be performed after checking STA3=1 (STA2=1). Please refer following flow chart.

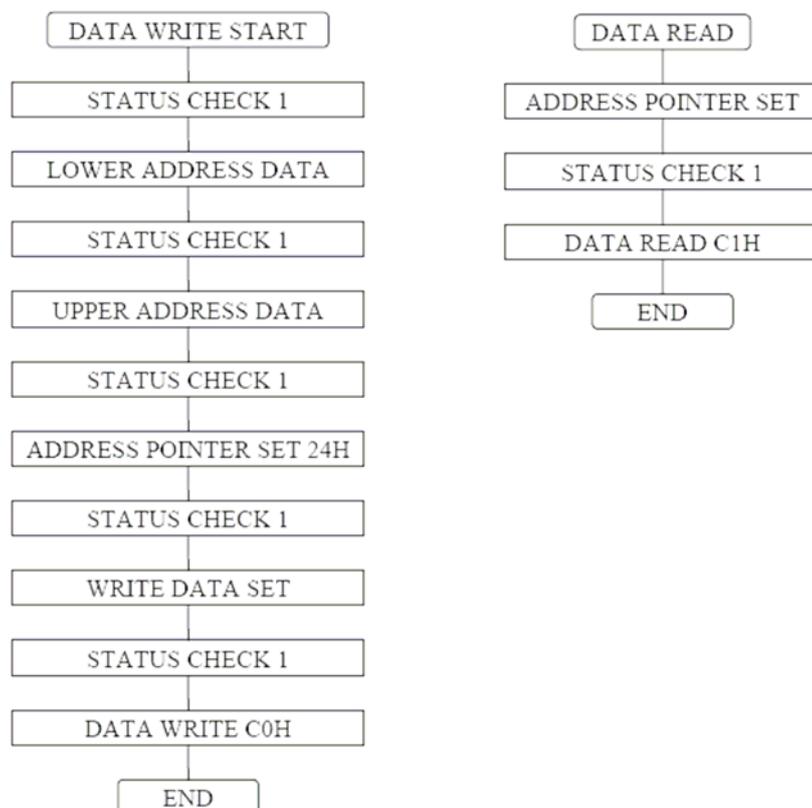


● Data Read Write

| 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.

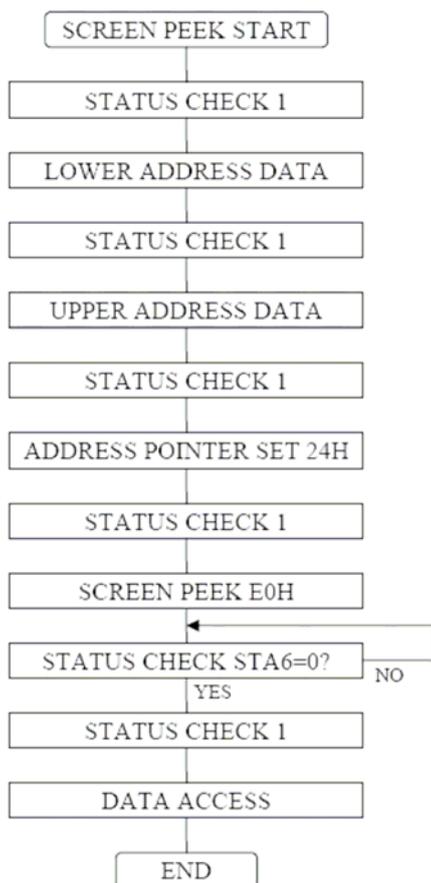


● Screen Peek

| 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.



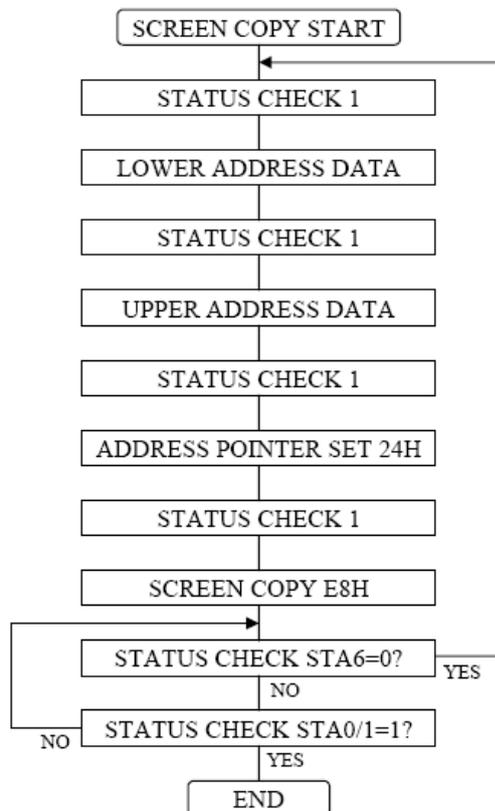
● Screen Copy

| 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. Please refer following flow chart.

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

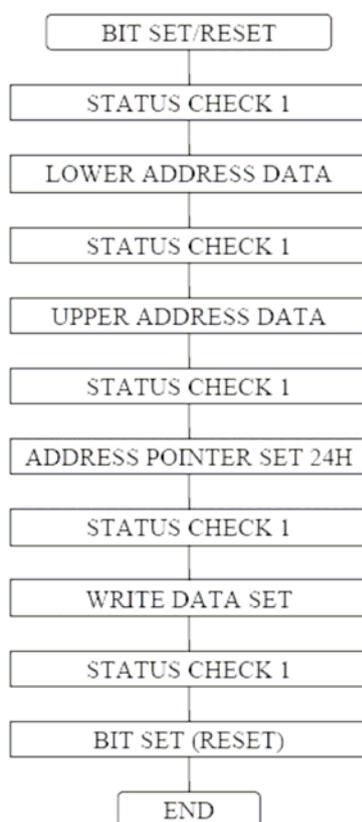
Note 2 : In case of 2 screen drive, this command is invalid. (Because T6963C cannot separate upper screen data and lower screen data.)



- Bit Set/Reset

| Code | Function | Operand |
|----------|-------------|---------|
| 11110xxx | bit reset | --- |
| 11111xxx | bit set | --- |
| 1111x000 | bit 0 (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 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 | --- | --- | bit 0 (LSB) |
| | 1111x001 | --- | --- | bit 1 |
| | 1111x010 | --- | --- | bit 2 |
| | 1111x011 | --- | --- | bit 3 |
| | 1111x100 | --- | --- | bit 4 |
| | 1111x101 | --- | --- | bit 5 |
| | 1111x110 | --- | --- | bit 6 |
| | 1111x111 | --- | --- | bit 7 (MSB) |

Character Code Map

ROM CODE 0101

| LSB MSB | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|------------|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | ! | " | # | \$ | % | & | ' | (|) | * | + | , | - | . | / |
| 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | < | = | > | ? |
| 2 | a | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
| 3 | P | Q | R | S | T | U | U | W | X | Y | Z | [| \ |] | ^ | _ |
| 4 | ` | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 5 | p | q | r | s | t | u | v | w | x | y | z | { | \| | } | ~ |  |
| 6 | ç | ü | é | à | á | â | ç | ê | ë | è | é | í | î | ï | ä | å |
| 7 | ê | æ | Æ | ô | ö | ö | ö | ü | ö | ü | ø | ø | ¥ | £ | £ | £ |

9. INTERFACE PIN CONNECTIONS

| PIN | SYMBOL | I/O | FUNCTION | | |
|-----|--------|-----|--|---------------|-------------|
| 1 | FG | | Frame Ground | | |
| 2 | VSS | I | Ground pin, connected to 0V | | |
| 3 | VDD | I | Power supply pin for logic .(+5V) | | |
| 4 | V0 | I | Contrast control (VDD~VOOUT) | | |
| 5 | /WR | I | Data write: Write data into T6963 when /WR is L. | | |
| 6 | /RD | I | Data Read: Read data from T6963 when /RD is L. | | |
| 7 | /CE | I | Chip enable for T6963: /CE must be L when CPU communicates with T6963 | | |
| 8 | C/D | I | C/D | /WR=L | /RD=L |
| | | | L | Data Write | Data Read |
| | | | H | Command Write | Status Read |
| 9 | NC | I | No connect | | |
| 10 | RESET | I | Reset signal: H: Normal (T6963 has internal pull-up resistor) L: Initialize T6963. Text and graphic have address and text and graphic area setting are retained. | | |
| 11 | DB0 | I/O | Data I/O pins for display memory. | | |
| 12 | DB1 | I/O | Data I/O pins for display memory. | | |
| 13 | DB2 | I/O | Data I/O pins for display memory. | | |
| 14 | DB3 | I/O | Data I/O pins for display memory. | | |
| 15 | DB4 | I/O | Data I/O pins for display memory. | | |
| 16 | DB5 | I/O | Data I/O pins for display memory. | | |
| 17 | DB6 | I/O | Data I/O pins for display memory. | | |
| 18 | DB7 | I/O | Data I/O pins for display memory. | | |
| 19 | FS | I- | Pin for selection of font: FS=H: 7×8 dots FS=L: 8×8 dots | | |
| 20 | VOOUT | O | Power output , LCD power supply | | |
| 21 | LEDA | I | LED anode (+5V) | | |
| 22 | LEDK | I | LED cathode (0V) | | |
| 23 | ED | | Display data input | | |
| 24 | CDATA | | Frame signal | | |
| 25 | FR | | AC signal for LCD driver output Alternate signal input pin for LCD driving. Normal frame inversion signal is input in to this pin. | | |
| 26 | LP | | Data latch clock | | |

| | | | |
|----|------|--|---|
| | | | this signal is used for latching the shift register contents at the falling edge of this clock pulse. CL1 pulse "High" level initializes power-down function block. |
| 27 | HSCP | | Clock pulse input for the bi-directional shift register. the data is shifted to 20 x 4-bit segment data shift The clock pulse, which was input when the enable bit (ELB/ERB) is in not active condition, is invalid. |
| 28 | NC | | |
| 29 | VDD | | Power supply pin for logic .(+5V) |
| 30 | VSS | | Ground pin, connected to 0V |
| 31 | V0 | | Contrast control (VDD~VOUT) |
| 32 | VOUT | | Power output , LCD power supply |
| 33 | LEDA | | LED anode (+5V) |
| 34 | LEDK | | LED cathode (0V) |

10. RELIABILITY

Content of Reliability Test

| Environmental Test | | | | |
|--------------------|-------------------------------------|---|---|--|
| No. | Test Item | Content of Test | Test Condition | Applicable Standard |
| 1 | High temperature storage | Endurance test applying the high storage temperature for a long time. | 80 °C 200 hrs | |
| 2 | Low temperature storage | Endurance test applying the low storage temperature for a long time. | -30 °C 200 hrs | |
| 3 | High temperature operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 70 °C 200 hrs | |
| 4 | Low temperature operation | Endurance test applying the electric stress under low temperature for a long time. | -20 °C 200 hrs | |
| 5 | High temperature Humidity storage | Endurance test applying the high temperature and high humidity storage for a long time. | 50 °C , 90,RH 96 hrs | MIL-202E-103B JIS-C5023 |
| 6 | High temperature Humidity operation | Endurance test applying the electric stress (Voltage & Current) and temperature humidity stress to the element for a long time. | 50 °C , 90,RH 96 hrs | MIL-202E-103B JIS-C5023 |
| 7 | Temperature cycle | Endurance test applying the low and high temperature cycle. $\begin{array}{c} -20^{\circ}\text{C} \quad \rightleftharpoons \quad 25^{\circ}\text{C} \quad \rightleftharpoons \quad 70^{\circ}\text{C} \\ 30\text{min.} \quad \leftarrow \quad 5\text{min.} \quad \leftarrow \quad 30\text{min.} \\ \longleftarrow \hspace{10em} \longrightarrow \\ \text{1 cycle} \end{array}$ | -20°C – 70°C 10 cycles | |
| Mechanical Test | | | | |
| 8 | Vibration test | Endurance test applying the vibration during transportation and using. | 10-22Hz → 1.5mmp-p 22-500Hz → 1.5G Total 0.5hrs | MIL-202E-201A JIS-C5025 JIS-C7022-A-10 |
| 9 | Shock test | Constructional and mechanical endurance test applying the shock during transportation. | 50G half sign wave 1l msdc 3 times of each direction | MIL-202E-213B |
| 10 | Atmospheric pressure test | Endurance test applying the atmospheric pressure during transportation by air. | 115 mbar 40 hrs | MIL-202E-105C |
| Others | | | | |
| 11 | Static electricity test | Endurance test applying the electric stress to the terminal. | VS=800V, RS=1.5 k CS=100 pF 1 time | MIL-883B-3015.1 |

*** Supply voltage for logic system = 3V. Supply voltage for LCD system = Operating voltage at 25°C.

Failure Judgement Criterion

| Criterion Item | Test Item No. | | | | | | | | | | | Failure Judgment Criterion |
|---------------------------|---------------|---|---|---|---|---|---|---|---|----|----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| Basic specification | | | | | | | | | | | | Out of the Basic Specification |
| Electrical characteristic | | | | | | | | | | | | Out of the DC and AC Characterstic |
| Mechanical characteristic | | | | | | | | | | | | Out of the Mechanical Specification Color change : Out of Limit Apperance Specification |
| Optical characteristic | | | | | | | | | | | | Out of the Apperance Standard |

11. QUALITY GUARANTEE

Acceptable Quality Level

Each lot should satisfy the quality level defined as follows.

- Inspection method : MIL-STD-105E LEVEL II Normal one time sampling
- AQL

| Partition | AQL | Definition |
|-----------|------|--|
| A: Major | 0.4% | Functional defective as product |
| B: Minor | 1.5% | Satisfy all functions as product but not satisfy cosmetic standard |

Definition of 'LOT'

One lot means the delivery quantity to customer at one time.

Conditions of Cosmetic Inspection

Environmental condition

The inspection should be performed at the 1cm of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25°C and normal humidity 60±15%RH).

Inspection method

The visual check should be performed vertically at more than 30cm distance from the LCD panel.

Driving voltage

The VO value which the most optimal contrast can be obtained near the specified VO in the specification. (Within ±0.5V of typical value at 25°C.).

12. INSPECTION CRITERIA

12.1 Module Cosmetic Criteria

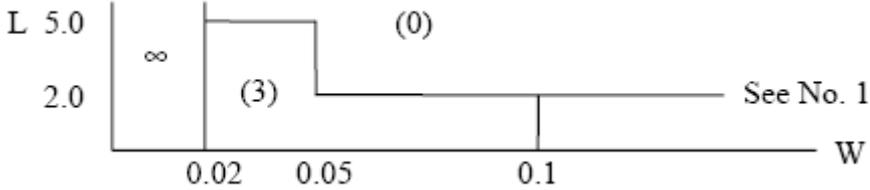
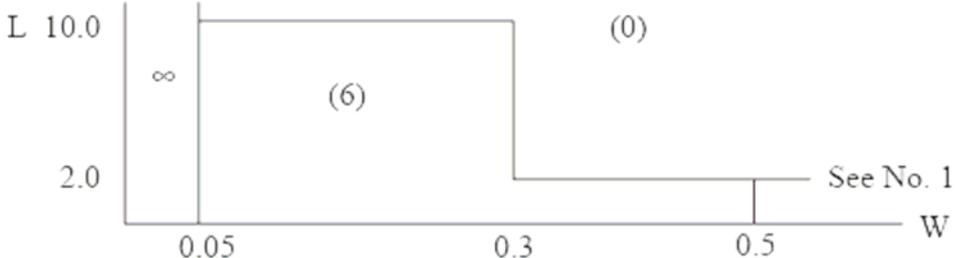
| No. | Item | Judgement Criterion | Partition |
|-----|--------------------------------------|---|-------------------------|
| 1 | Difference in Spec. | None allowed | Major |
| 2 | Pattern peeling | No substrate pattern peeling and floating | Major |
| 3 | Soldering defects | No soldering missing No soldering bridge No cold soldering | Major Major Major |
| 4 | Resist flaw on substrate | Invisible copper foil ('0.5mm or more) on substrate pattern | Minor |
| 5 | Accretion of metallic Foreign matter | No soldering dust No accretion of metallic foreign matters (Not exceed '0.2mm) | Minor Minor |
| 6 | Stain | No stain to spoil cosmetic badly | Minor |
| 7 | Plate discoloring | No plate fading, rusting and discoloring | Minor |
| 8 | Solder amount | a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the lead form perfectly. (too much) | Minor |
| | 1. Lead parts | b. Components side (In case of 'Through Hole PCB') Solder to reach the Components side of PCB. | |
| | 2. Flat packages | Either 'Toe' (A) or 'Seal' (B) of the lead to be covered by 'Filet'. Lead form to be assume over solder. A B | |
| | 3. Chips | $(3/2) H \geq h \geq (1/2) H$ | Minor |

12.2 Screen Cosmetic Criteria (Non-Operating)

| No. | Defect | Judgement Criterion | Partition | | | | | | | | | | |
|--------------------|-------------------------------|--|-------------|-------------------------------|--------------|-----------|--------------------|---|--------------------|---|-----------|---|-------|
| 1 | Spots | In accordance with <i>Screen Cosmetic Criteria (Operating) No.1.</i> | Minor | | | | | | | | | | |
| 2 | Lines | In accordance with <i>Screen Cosmetic Criteria (Operating) No.2.</i> | Minor | | | | | | | | | | |
| 3 | Bubbles in polarizer | <table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.3$</td> <td>Disregard</td> </tr> <tr> <td>$0.3 < d \leq 1.0$</td> <td>3</td> </tr> <tr> <td>$1.0 < d \leq 1.5$</td> <td>1</td> </tr> <tr> <td>$1.5 < d$</td> <td>0</td> </tr> </tbody> </table> | Size : d mm | Acceptable Qty in active area | $d \leq 0.3$ | Disregard | $0.3 < d \leq 1.0$ | 3 | $1.0 < d \leq 1.5$ | 1 | $1.5 < d$ | 0 | Minor |
| Size : d mm | Acceptable Qty in active area | | | | | | | | | | | | |
| $d \leq 0.3$ | Disregard | | | | | | | | | | | | |
| $0.3 < d \leq 1.0$ | 3 | | | | | | | | | | | | |
| $1.0 < d \leq 1.5$ | 1 | | | | | | | | | | | | |
| $1.5 < d$ | 0 | | | | | | | | | | | | |
| 4 | Scratch | In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable. | Minor | | | | | | | | | | |
| 5 | Allowable density | Above defects should be separated more than 30mm each other. | Minor | | | | | | | | | | |
| 6 | Coloration | Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only. | Minor | | | | | | | | | | |
| 7 | Contamination | Not to be noticeable. | Minor | | | | | | | | | | |

12.3. Screen Cosmetic Criteria (Operating)

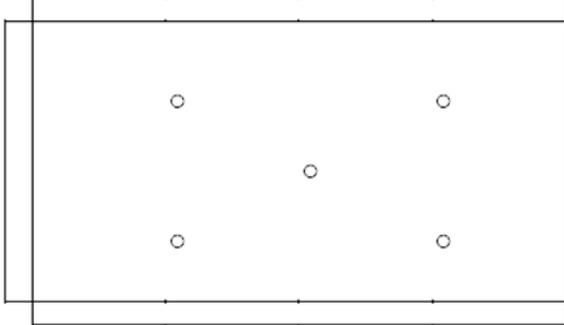
| No. | Defect | Judgement Criterion | Partition | | | | | | | | | | | | | | | | | | | | |
|--------------------|-------------------------------|--|-------------|-------------------------------|--------------|-----------|--------------------|---|--------------------|---|-----------|---|-------------|-------------------------------|--------------|-----------|--------------------|---|--------------------|---|-----------|---|-------|
| 1 | Spots | <p>A) Clear Note :</p> <table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.1$</td> <td>Disregard</td> </tr> <tr> <td>$0.1 < d \leq 0.2$</td> <td>3</td> </tr> <tr> <td>$0.2 < d \leq 0.3$</td> <td>2</td> </tr> <tr> <td>$0.3 < d$</td> <td>0</td> </tr> </tbody> </table> <p>Including pin holes and defective dots which must be within one pixel size.</p> <p>B) Unclear Size :</p> <table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.2$</td> <td>Disregard</td> </tr> <tr> <td>$0.2 < d \leq 0.5$</td> <td>6</td> </tr> <tr> <td>$0.5 < d \leq 0.7$</td> <td>2</td> </tr> <tr> <td>$0.7 < d$</td> <td>0</td> </tr> </tbody> </table> | Size : d mm | Acceptable Qty in active area | $d \leq 0.1$ | Disregard | $0.1 < d \leq 0.2$ | 3 | $0.2 < d \leq 0.3$ | 2 | $0.3 < d$ | 0 | Size : d mm | Acceptable Qty in active area | $d \leq 0.2$ | Disregard | $0.2 < d \leq 0.5$ | 6 | $0.5 < d \leq 0.7$ | 2 | $0.7 < d$ | 0 | Minor |
| Size : d mm | Acceptable Qty in active area | | | | | | | | | | | | | | | | | | | | | | |
| $d \leq 0.1$ | Disregard | | | | | | | | | | | | | | | | | | | | | | |
| $0.1 < d \leq 0.2$ | 3 | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < d \leq 0.3$ | 2 | | | | | | | | | | | | | | | | | | | | | | |
| $0.3 < d$ | 0 | | | | | | | | | | | | | | | | | | | | | | |
| Size : d mm | Acceptable Qty in active area | | | | | | | | | | | | | | | | | | | | | | |
| $d \leq 0.2$ | Disregard | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < d \leq 0.5$ | 6 | | | | | | | | | | | | | | | | | | | | | | |
| $0.5 < d \leq 0.7$ | 2 | | | | | | | | | | | | | | | | | | | | | | |
| $0.7 < d$ | 0 | | | | | | | | | | | | | | | | | | | | | | |

| | | | |
|---|-------|---|-------|
| 2 | Lines | <p>A) Clear</p>  <p>Note : () - Acceptable Qty in active area L -Length (mm) W - Width (mm) ∞ - Disregard</p> <p>B) Unclear</p>  | Minor |
|---|-------|---|-------|

'Clear' = The shade and size are not changed by VO.

'Unclear' = The shade and size are changed by VO.

12.4. Screen Cosmetic Criteria (Operating) (Continued)

| No. | Defect | Judgement Criterion | Partition |
|-----|---|--|-----------|
| 3 | Rubbing line | Not to be noticeable. | |
| 4 | Allowable density | Above defects should be separated more than 10mm each other. | Minor |
| 5 | Rainbow | Not to be noticeable. | Minor |
| 6 | Dot size | To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'Spot'. (see <i>Screen Cosmetic Criteria (Operating) No.1</i>) | Minor |
| 7 | Uneven brightness (only back-lit type module) | <p>Uneven brightness must be $B_{MAX} / B_{MIN} \leq 2$</p> <ul style="list-style-type: none"> - B_{MAX} : Max. value by measure in 5 points - B_{MIN} : Min. value by measure in 5 points <p>Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.</p>  <p>○ : Measuring points</p> | Minor |

Note :

- (1) Size : $d = (\text{long length} + \text{short length}) / 2$
- (2) The limit samples for each item have priority.

(3) Complexed defects are defined item by item, but if the number of defects are defined in above table, the total number should not exceed 10.

- (4) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed.

Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of '5mm.
- 10 or over defects in circle of '10mm.
- 20 or over defects in circle of '20mm.

13. PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

- (1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- (2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- (5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :
 - Isopropyl alcohol
 - Ethyl alcohol
- (6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
 - Water
 - Ketone
 - Aromatic solvents
- (7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- (8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the IO cable or the backlight cable.
- (9) Do not attempt to disassemble or process the LCD module.
- (10) NC terminal should be open. Do not connect anything.
- (11) If the logic circuit power is off, do not apply the input signals.
- (12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD modules.

-
- Tools required for assembling, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.

- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature, high humidity and low temperatures below 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

14. USING LCD MODULES

Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

- (1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.
- (2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).
- (3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.
- (4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzine. Do not scrub hard to avoid damaging the display surface.
- (5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.
- (6) Avoid contacting oil and fats.
- (7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming

is contacting with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

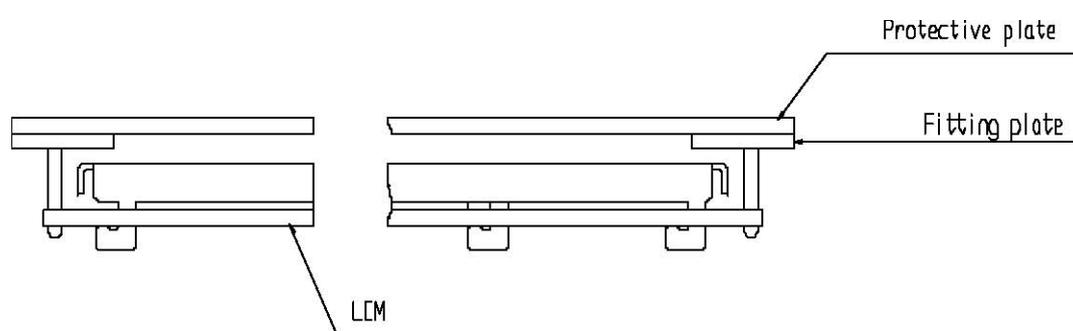
(9) Do not touch the display with bare hands. This will stain the display area and degrade insulation between terminals (some cosmetics are determined to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be 0.1mm.

Precaution for Handling LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the the shape of the tab on the metal frame.

(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

(3) Do not damage or modify the pattern writing on the printed circuit board.

(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.

(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

(6) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

(1) Make certain that you are grounded when handling LCM.

(2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.

(3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not

leak.

(4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.

(5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.

(6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%~60% is recommended.

Precaution for soldering to the LCM

(1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.

- Soldering iron temperature : 280°C ~ 300°C
- Soldering time : 3-4 sec.
- Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.

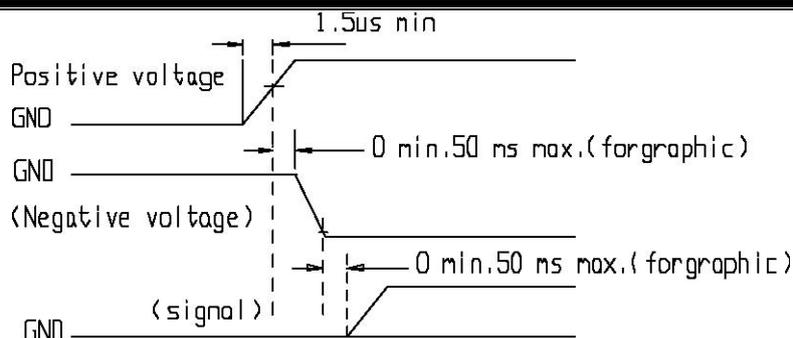
(2) Driving the LCD in the voltage above the limit shortens its life.

(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C , 50% RH.

(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



Storage

When storing LCDs as spares for some years, the following precaution are necessary.

- (1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.
- (2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

Safety

- (1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- (2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed between Good Display and customer, we will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with Good Display acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to Good Display within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Good Display limited to repair and/or replacement on the terms set forth above. Good Display will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.