# LEADER TIME SRL

# PRODUCT SPECIFICATION

## 128*64 GRAPHIC COB LCD MODULE
## MODEL: LT-12864K-801 Ver:2.0

< ◇ > Finally Specification

| CUSTOMER'S APPROVAL | |
|---|---|
| CUSTOMER : | |
| SIGNATURE: | DATE: |
| | |

| APPROVED BY | PM REVIEWD | PD REVIEWD | PREPARED By |
|---|---|---|---|
| | | | |


**Prepared By:**

**LEADER TIME SRL**

**VIA MONS. PROSDOCIMI, 27**

**36042 BREGANZE (VI)**


- This specification is subject to change without notice. Please contact LT or it's representative before designing your product based on this specification.

# Revision Status

| Version | Revise Date | Page | Content | Modified By |
|---|---|---|---|---|
| **Ver. 1.0** | 2007.05.12 | | First Issued | |
| **Ver. 1.1** | 2007.12.14 | 7,21 | Change the pin fanction description | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# Table of Contents

| No. | Contents | Page |
|---|---|---|

# 1. Features

The features of LCD are as follows

* Display mode : STN/Blue, Transmissive,Negaitive
* Drive IC : PTC PT6607 & PT6608
* Display format : Graphic
* Interface Input Data : 8-Bit
* Driving Method : 1/64 Duty, 1/6 Bias
* Viewing Direction : 6 O'clock
* Backlight : LED Unit (White)

# 2. MECHANICAL SPECIFICATIONS

| Item | Specification | Unit |
|---|---|---|
| Module Size | 93(W) x 70(H) x 13MAX(T) | mm |
| Number of Dots | 128 x 64 Dots | |
| View display area | 70.7(W) x 38.8(H) | mm |
| Dot Size | 0.48(W) x 0.48(H) | mm |
| Dot Pitch | 0.52(W) x 0.52(H) | mm |

# 3. ELECTRICAL SPECIFICATIONS

3-1 ABSOLUTR MAZIMUM RATINGS (Ta = 25 °C)

| Item | Symbol | Standard Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Supply Voltage For Logic | $V_{DD} - V_{SS}$ | -0.3 | 5.0 | 7.0 | V |
| Supply Voltage For LCD Drive | $V_{OP} = V_{DD} - V_{EE}$ | $V_{DD}$ –19 | | $V_{DD}$ +0.3 | V |
| Input Voltage | Vin | -0.3 | - | $V_{DD+0.3}$ | V |
| Operating Temp. | Top | -20 | - | +60 | °C |
| Storage Temp. | Tst | -30 | - | +80 | °C |

*****. NOTE: The response time will be extremely slow when the operating temperature is around -20℃, and the back ground will become darker at high temperature operating.

3-2 ELECTICAL CHARACTERISTICS

| Item | | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Logic supply Voltage | | $V_{DD}$ - $V_{SS}$ | | 4.5 | 5 | 5.5 | V |
| LCD Drive | | $V_{OP}$=$V_{DD}$–$V_{EE}$ | | 7.5 | 8.0 | 8.5 | V |
| Input Voltage | "H" Level | $V_{IH}$ | $V_{DD}$=5V ± 5% | 0.7 $V_{DD}$ | | $V_{DD}$ | V |
| | "L" Level | $V_{IL}$ | | 0 | | 0.3$V_{DD}$ | V |
| Frame Frequency | | $f_{FLM}$ | $V_{DD}$ = 5V | 65 | 78 | 85 | Hz |
| Current Consumption | | $I_{DD}$ | $V_{DD}$ = 5V | - | 2.09 | - | mA |
| | | $I_{EE}$ | $V_{DD}$-$V_{EE}$=8V | - | 2.4 | - | |

3-3. BACKLIGHT

3-3-1. Absolute Maximum Ratings

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Forward Current | IF | Ta = 25 °C | | 60 | - | mA |
| Reverse Voltage | VR | | | - | 3.5 | V |
| Power Dissipation | PD | | | 180 | - | mW |

3-3-2. Electrical-optical Characteristics

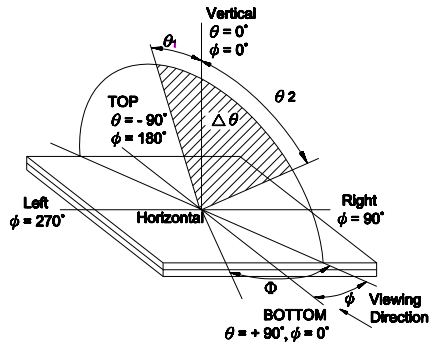
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Forward Voltage | VF | If=60mA Ta = 25 °C | - | 3.1 | 3.5 | V |
| Average Luminous Intensity | Iv | Ta = 25 °C If=60mA | - | 150 | - | cd/m$^2$ |

The brightness is measured without LCD panel

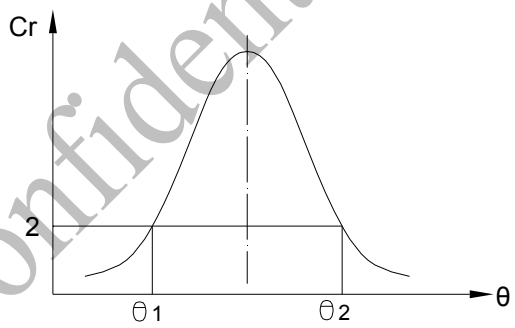
# 4 . ELECTRO – OPTICAL CHARACTERISTICS

| Item | Symbol | Temp. | Min. | Typ. | Max. | Unit | Conditions | Note |
|---|---|---|---|---|---|---|---|---|
| Viewing Angle | Θ2 –Θ1 | 25℃ | 30 | 86 | - | Deg. | - | 1,2 |
| | Φ | | 60 | 60 | - | | | |
| Contrast Ratio | Cr | 25℃ | 2 | 5.59 | 6.96 | - | Θ=0°<br>Φ=0° | 3 |
| Response Time(rise) | Tr | 25℃ | - | 65 | 250 | | | |
| | | 0℃ | - | 950 | 1150 | | | |
| Response Time(fall) | Tf | 25℃ | - | 163 | 250 | | | |
| | | 0℃ | - | 950 | 1150 | | | |

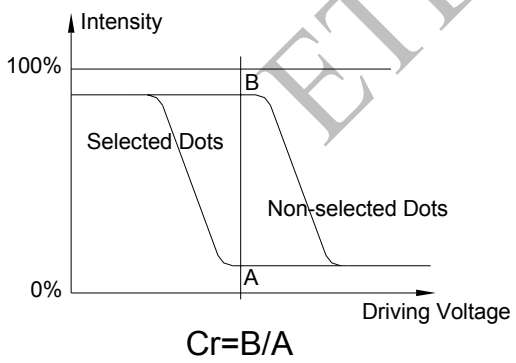
Note1 . Definition of Angle Θ&Φ




Note2. Definition of Viewing Angle Θ1&Θ1

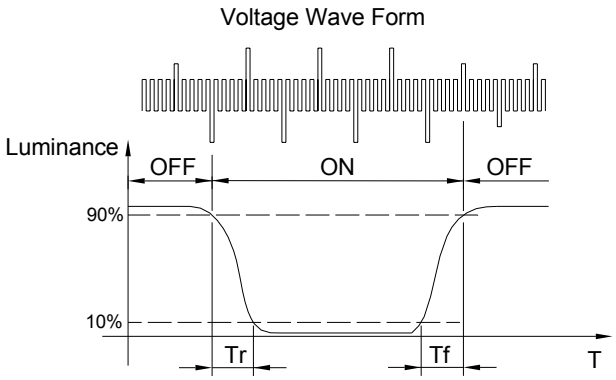



Note3 . Definition of Contrast Cr




Cr=B/A

Note4. Definition of Optical Response



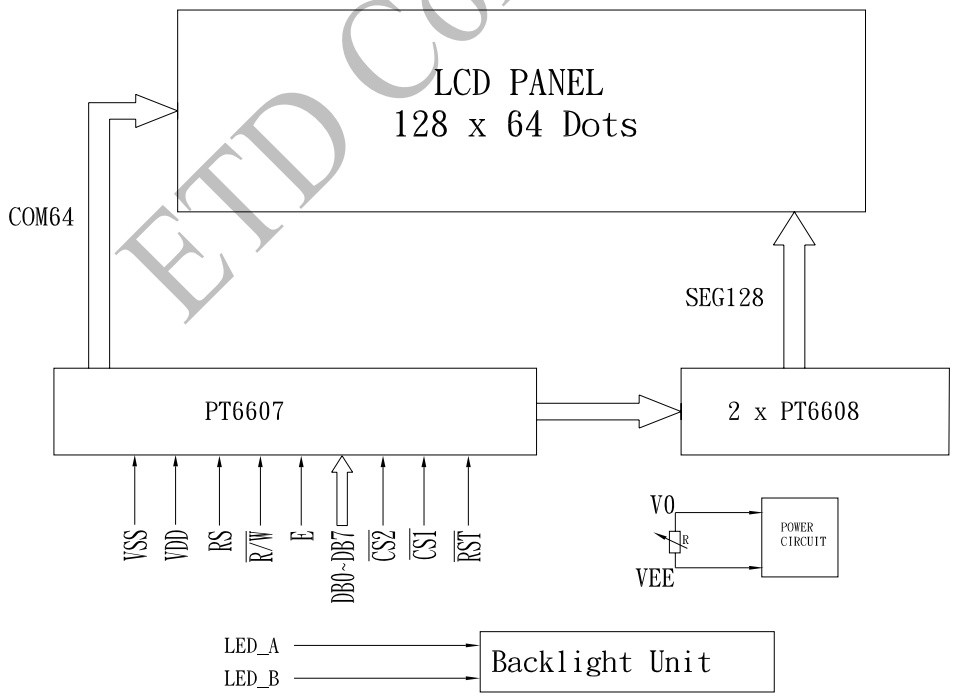
# 5. TERMINAL FUNCTIONS AND BLOCK DIAGRAM

## 5-1. INTERFACE PIN FUNCTION DESCRIPTION

| PIN NO. | SYMBOL | FUNCIONS |
|---|---|---|
| 1 | VSS | Ground (0V) |
| 2 | VDD | Supply voltage for logical circuit(5V) |
| 3 | V0 | Supply voltage for LCD driving |
| 4 | RS | Select register signal |
| 5 | R/W | H: Data Read (LCM to MPU) ; L: Data Write (MPU to LCM) |
| 6 | E | Enable Signal |
| 7~14 | DB0~DB7 | Data bus line |
| 15 | /CS2 | Chip Selection Signal for IC2 |
| 16 | /CS1 | Chip Selection Signal for IC1 |
| 17 | /RST | Reset (Active “LOW”) |
| 18 | VEE | Negetive voltage supply pin |
| 19 | LED_A | Backlight (+) |
| 20 | LED_K | Backlight (-) |

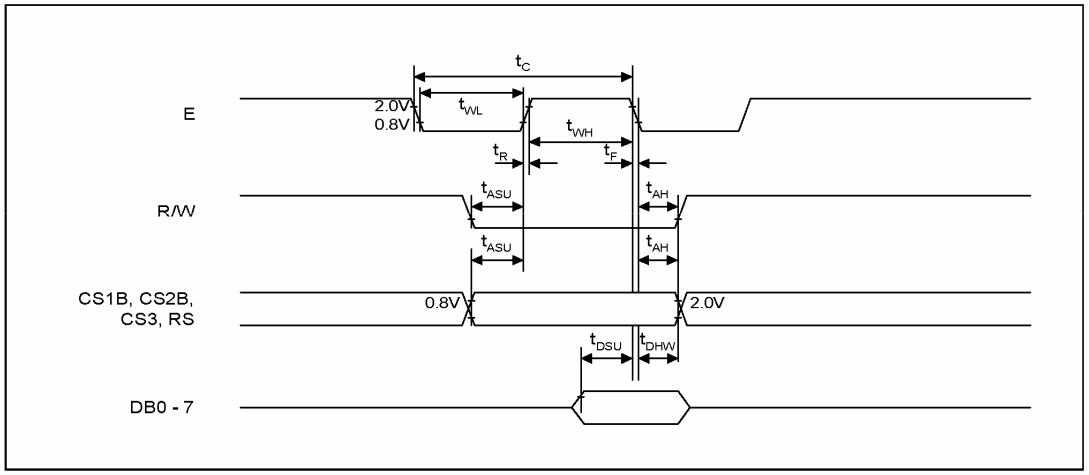


## 5-2. BLOCK DIAGRAM

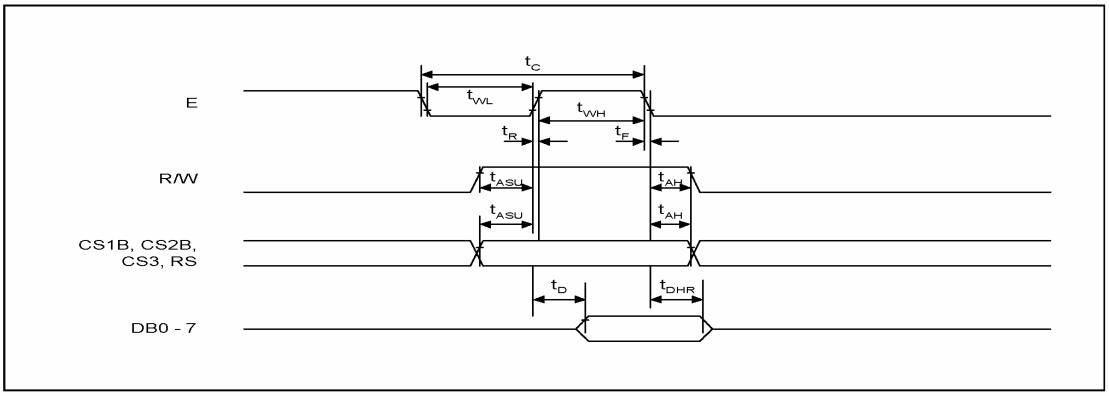


# 6. TIMING CHARACTERISTICS

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| E cycle | $t_C$ | 1000 | - | - | ns |
| E high level width | $t_{WH}$ | 450 | - | - | ns |
| E low level width | $t_{WL}$ | 450 | - | - | ns |
| E rise time | $t_R$ | - | - | 25 | ns |
| E fall time | $t_F$ | - | - | 25 | ns |
| Address set-up time | $t_{ASU}$ | 140 | - | - | ns |
| Address hold time | $t_{AH}$ | 10 | - | - | ns |
| Data set-up time | $t_{DSU}$ | 200 | - | - | ns |
| Data delay time | $t_D$ | - | - | 320 | ns |
| Data hold time (write) | $t_{DHW}$ | 10 | - | - | ns |
| Data hold time (read) | $t_{DHR}$ | 20 | - | - | ns |




MPU Write Timing




MPU Read Timing

# 7. INSTRUCTION SET

## 7-1. Function of Each Block

Both input register and output register are provided to interface with MPU of which The speed is different from that of internal operation. The selection of these registers Registers depend on the combination of R/W and D/I signals.

Table1. Register selection

| D/I | R/W | Operation |
|---|---|---|
| 1 | 1 | Read data out of output register as internal operation (Display data RAM to output register) |
| 1 | 0 | Writes data into register as internal operation (Input register to display data RAM) |
| 0 | 1 | Busy check. Read of status data |
| 0 | 0 | Instruction |

(1) Input Register

Input register is used to store Data temporarily before writing it into display data RAM. The data from MPU is written into input register, then into display data RAM Automatically by internal operation.

When chip select signal is in the active mode and D/I and R/W select the input Register as shown in table1, Data is latched at the fall of "E" signal.

(2) Output register

The output register is used to store data temporarily that is read from display data RAM. To read out the data from output register. Chip select signal should be in the Active mode and both D/I and R/W should be "1". With the read instruction, data stored in the output register is output while "E", the display data at the indicated address is latched into the output register and address is increased by 1. The contents in the output register is rewritten by read instructions, but are held by address set instruction, ect.

Therefore, the data of the specified address can not be output with read display Instruction, right after the address is set, but can be output at the second read of data. That is to say, on dummy read is necessary, Fig 8-1. Shows the CPU read timming.

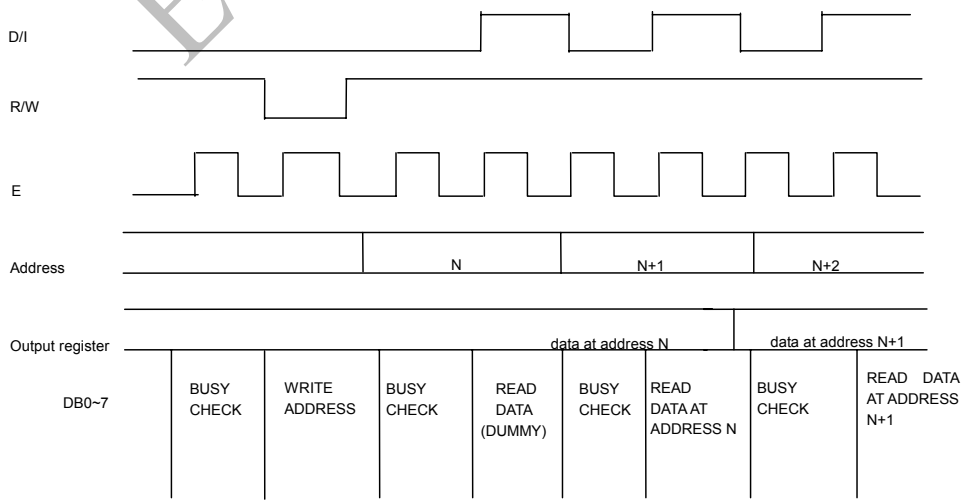
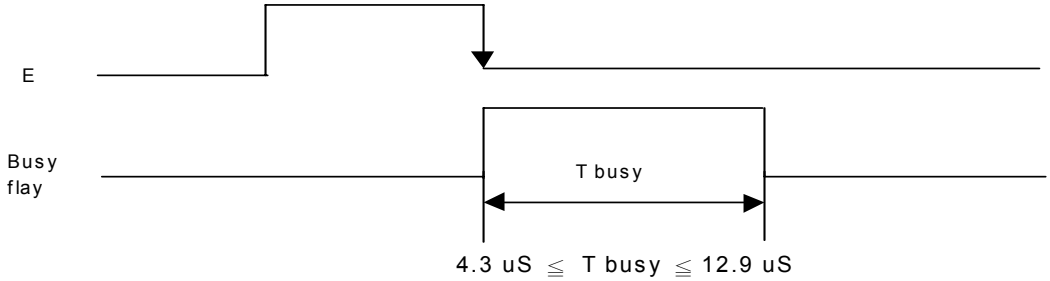



fig 8-1. CPU read timming

### 7-1-2. Busy flag

"1" of busy flag indicates that KS0108B is on the move and any instruction except status read instruction can not be accepted the value of the busy flag is read out on DB7 by the status read instruction make sure that the busy flag is reset("0") before The issue of instruction.




### 7-1-3. Display on/off flip flop

Display on/off flip flop selects one of two states, on state and off state of segments, the Display data corresponding to that in RAM is output to the segments. On the other hand, The display data at all segments disappear in off state independent of ehte data in RAM. It is controlled by display on/off instruction "0" of RST signal sets the segments in off state, The status of the flip flop is output to DB5 by status read instruction. Display on/off Instruction does not inflence data in RAM.

### 7-1-4. Display start register

The register specifies A line in RAM which corresponds to the top line of LCD panel, When displaying contents in display data RAM on the LCD panel. It is used for scrolling Of the screen. 6-bit display start line information is written into this register by display Start the display, the information in this register is transferred to Z address, and the Z Address counter is preset.

### 7-1-5. X, Y address counter

This is 9 bit counter which designates address of internal display data RAM, X address Counter of upper 3 bits and Y address counter of lower 6 bits should be set each Address by respective instruction.

(1). X address counter
Ordinary register with no count functions. An address is set in by instruction.

(2). Y address counter
An address is set in by instruction and it is increased by 1 automatically by R/W Operations of display data. The address counter loops the value of 0 to 63 count.

### 7-1-6. Display data RAM

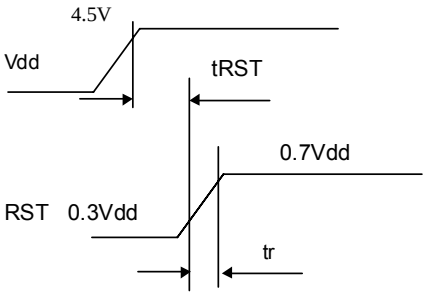
Dot data for display is stored in this RAM 1 bit data of this RAM corresponds to light on (data=1) and light off (data=0) of 1 dot in the display panel.

### 7-1-7. Reset

The system can initialized by setting RST terminal at "low" level when turning power on.
(1) Display off
(2) Set display start line register 0 line.
When RST is in low level, any instruction except status read can not be accepted, Therefore, carry out other instruction after making sure that DB4="0" (clear reset) And DB7="0" (ready) by status read instruction the conditions of power supply at Initial power up are as follows.

| Item | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Reset time | tRST | 1.0 | | | uS |
| Rise time | tr | | | 200 | uS |

Do not fail to set the system again because resetduring operation may destroy the data in all the register except on/off register and in RAM




### 7-2. Display control instructions

Table 2 shows the instructions. Read/write (R/W) signal, data instruction (D/I) sihnal and data bus signal (DB0 to DB7) are also called instructions because the internal operation depends on the signal from MPU generally, there are following three kinds of instructions.

1) Instruction to give address in the internal RAM

2) Instruction to transfer data from/to the internal RAM

3) Other instructions.

In general use, the instruction"2)" are used most frequently, but , since Y address of the internal RAM is increased by 1 automatically after writing (reading) data, the program can be lessened, during the execution of an instruction, the system can not accept other instructions than status read instruction, send instruction from MPU after making sure if the busy flag is "0", which is the proof an instruction is not being executed.



Table 2

| Function | D/I | R/W | DB7 | DD6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Display On/Off | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0/1 | Controls the on/off display RAM data and internal status are not affected. 0 : off ; 1: on. |
| Set Address | 0 | 0 | 0 | 1 | Y address (0 ~ 63) | | | | | | Sets the Y address in the Y address counter. |
| Set Page (X address) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | Page(0~7) | | | Sets the X address in the X address register. |
| Display Start Line | 0 | 0 | 1 | 1 | Display start line (0~63) | | | | | | Indicates the display data RAM Displayed at the top of the screen. |
| Status Line | 0 | 1 | BUSY | 0 | ON/OFF | RESET | 0 | 0 | 0 | 0 | Read status:<br>BUSY : 0: Ready<br>1: In operation<br>ON/Off 0: Display ON<br>1: Display Off<br>RESET 0: Normal<br>1: Reset |

| | | | | |
|---|---|---|---|---|
| **Write display Data** | **1** | **0** | **Write Data** | **Writes data (DB0~7) into display Data RAM. After writing instruction, Y address is increased by 1 automatically.** |
| **Read display Data** | **1** | **1** | **Read Data** | **Reads data (DB0~7) into display data RAM to the data bus.** |

### 7-2-1. Display on/off

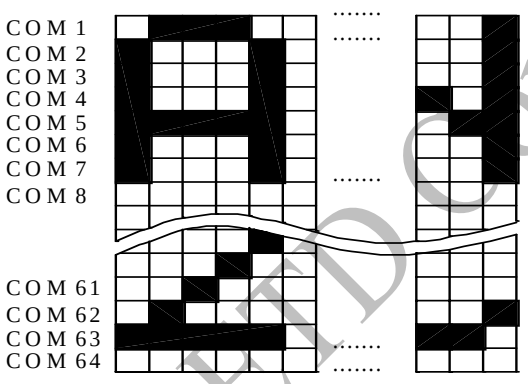
| | R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CODE | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | D |

The display data appears when dis 1 and disappears when D is 0
Through the data is not on the screen whdth D = “0”, it remains in the
Display data RAM, there fore, you can make it appear by changing
D = ”0” into D = “1”

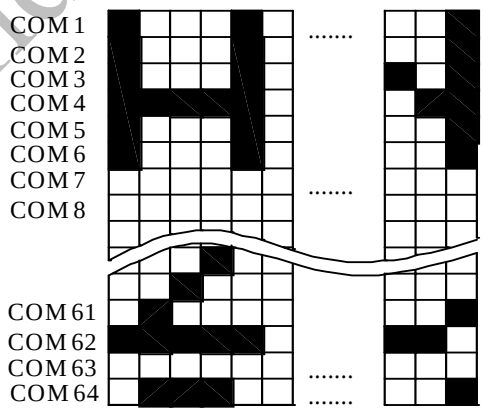
### 7-2-2. Display start line

| | R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CODE | 0 | 0 | 1 | 1 | A | A | A | A | A | A |

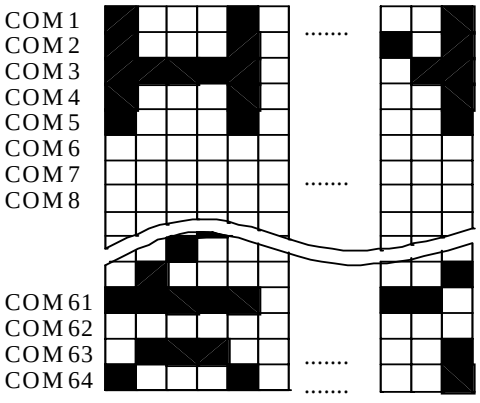
Z address AAAAAA (binary) of the display data RAM is set at the
Display start line register and displayed at the top of the screen fig. 8-2
Are the examples of display when the start line = 0 ~ 3.



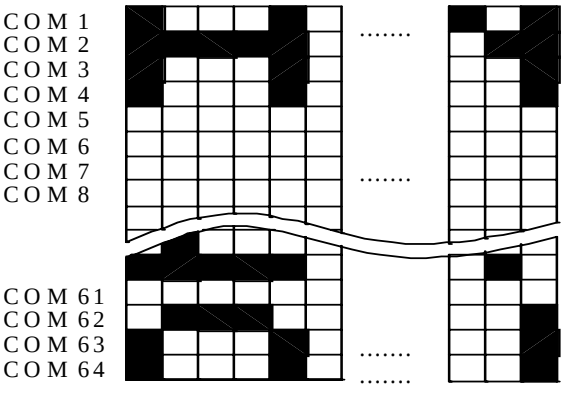

Start line = 0




Start line = 1




Start line = 2




Start line = 3

### 7-2-3. Set page (X address)

| | R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CODE | 0 | 0 | 1 | 0 | 1 | 1 | 1 | A | A | A |

X address AAA ( binary) of the display data RAM is set at the
X address register. After that, writing or reading to or from MPU
Is executed in this specified page until the next page is set.

### 7-2-2. Set Y address

| | R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CODE | 0 | 0 | 0 | 1 | A | A | A | A | A | A |

Y address AAAAAA (binary) of the display data RAM is set at the
Address counter. After that, Y address counter is increased by 1 every time
the data is written or read to or from MPU.

### 7-2-5. Status read

| | R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CODE | 1 | 0 | Busy | 0 | On/Off | Reset | 0 | 0 | 0 | 0 |

**Busy : When "Busy" is "1". The LSI is in internal operation. On instructions are accepted while busy is "1". So you should make sure that busy is "0"**
before writing the next instruction.

On/Off : This bit shows the display conditions.
When On/Off is "1", the display is in off condition.
When On/Off is "0", the display is on condition.

Reset : Reset = "1" shows that the system is being initialized. In this condition, any instructions except status read instruction cannot be accepted.
Reset = "0" shows that initializling has finished and the system is in the usual operation.

### 7-2-6. Write display data

| | R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CODE | 0 | 1 | A | A | A | A | A | A | A | A |

Write 8-bit data AAAAAAAA (binary) into the display data RAM then Y address is increased by 1 automatically.

### 7-2-7. Write display data

| | R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CODE | 1 | 1 | A | A | A | A | A | A | A | A |

Read out 8-bit data AAAAAAAA (binary) from the display data RAM then Y address is increased by 1 automatically.

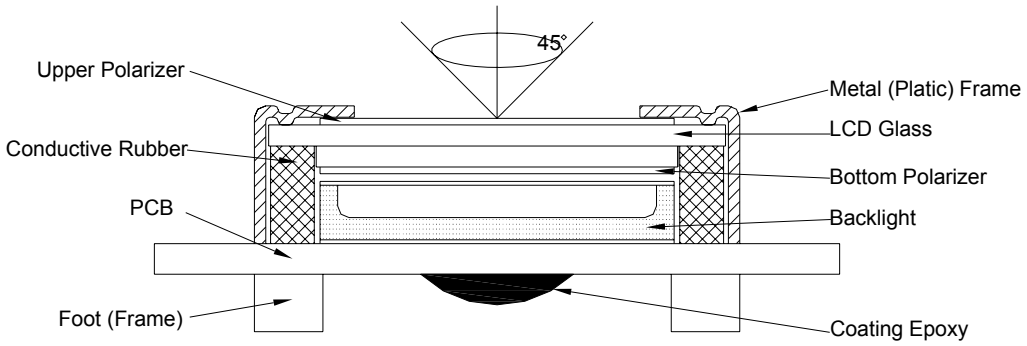
One dummy read is necessary soon after the address seting.



# 8. QUALITY SPECIFICATIONS

### 8 - 1. LCM Appearance and Electric inspection Condition

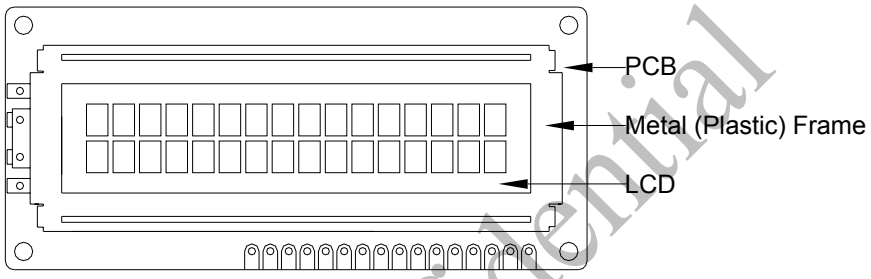
**1. Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.**



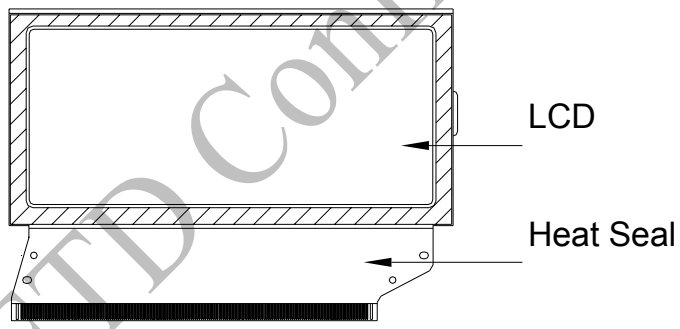

**2. View Angle: with in 45˚around perpendicular line.**

## 8 - 2. Definition

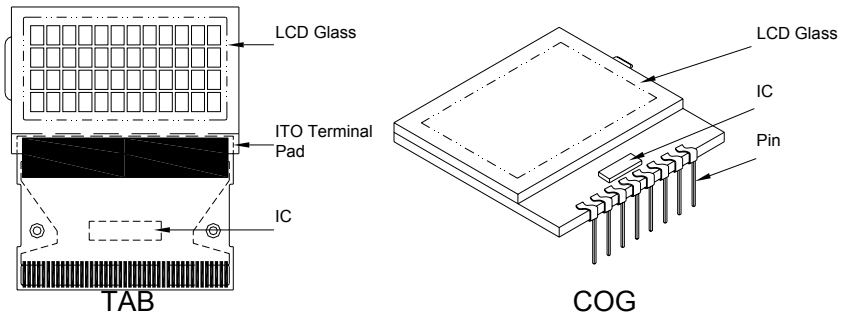
**1. COB**




**2. Heat Seal**




**3. TAB and COG**






## 8-3. Sampling Plan and Acceptance

1.Sampling Plan

MIL - STD - 105E ( ‖ ) ordinary single inspection is used.

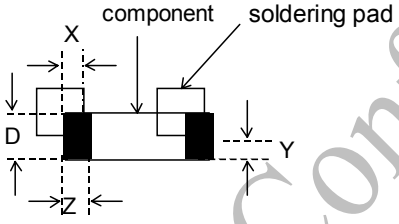
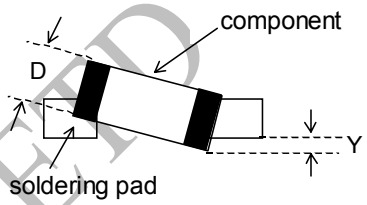
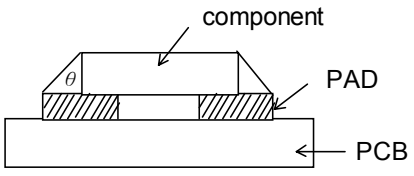
2. Acceptance
   Major defect: AQL = 0.25%
   Minor defect: AQL = 0.65%

**8-4. Criteria**

**1. COB**

| Defect | Inspection Item | Inspection Standards | |
|---|---|---|---|
| Major | PCB copper flakes peeling off | Any copper flake in viewing Area should be greater than 1.0mm$^2$ | Reject |
| Major | Height of coating epoxy | Exceed the dimension of drawing | Reject |
| Major | Void or hole of coating epoxy | Expose bonding wire or IC | Reject |
| Major | PCB cutting defect | Exceed the dimension of drawing | Reject |

**2. SMT**

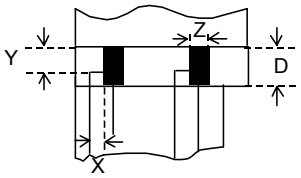
| Defect | Inspection Item | Inspection Standards | |
|---|---|---|---|
| Minor | Component marking not readable | | Reject |
| Minor | Component height | Exceed the dimension Of drawing | Reject |
| Major | Component solder defect (missing , extra, wrong component or wrong orientation | | Reject |
| Minor | Component position shift   | X < 3/4Z<br>Y > 1/3D | Reject<br>Reject |
| Minor | Component tilt   | Y > 1/3D | Reject |
| Minor | Insufficient solder   | $\theta \leq 20^\circ$ | Reject |



**3. Metal (Plastic) Frame**

| Defect | Inspection Item | Inspection Standards | | |
|---|---|---|---|---|
| Major | Crack / breakage | Anywhere | | Reject |
| Minor | Frame Scratch | W | L | Acceptable of Scratch |
| | | w<0.1mm | Any | Ignore |
| | | 0.1≤w<0.2mm | L≤5.0mm | 2 |
| | | 0.2≤w<0.3mm | L≤3.0mm | 1 |
| | | w≥0.3mm | Any | 0 |
| | | Note : 1. Above criteria applicable to scratch lines with distance greater than 5mm.<br>2. Scratch on the back side of frame (not visible) can be ignored . | | |
| Minor | Frame Dent , Prick<br>$\Phi = \frac{L+W}{2}$ | | | Acceptable of Dents / Pricks |
| | | $\Phi \leq 1.0$mm | | 2 |
| | | $1.0 < \Phi \leq 1.5$mm | | 1 |
| | | $1.5\text{mm} < \Phi$ | | 0 |
| | | Note : 1. Above criteria applicable to any two dents / pricks with distance greater than 5mm<br>2. Dent / prick on the back side of frame (not visible) can be ignored | | |
| Minor | Frame Deformation | Exceed the dimension of drawing | | |
| Minor | Metal Frame Oxidation | Any rust | | |

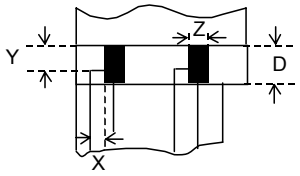
**4. Flexible Film Connector (FFC)**

| Defect | Inspection Item | Inspection Standards | |
|---|---|---|---|
| Minor | Tilted soldering | Within the angle +5° | Acceptable |
| Minor | Uneven solder joint /bump | | Reject |
| Minor | Hole $\Phi = \frac{L+W}{2}$ | Expose the conductive line | Reject |
| | | $\Phi$ > 1.0mm | Reject |
| Minor | Position shift   | Y > 1/3D | Reject |
| | | X > 1/2Z | Reject |

**5. Screw**

| Defect | Inspection Item | Inspection Standards | |
|---|---|---|---|
| Major | Screw missing/loosen | | Reject |
| Minor | Screw oxidation | Any rust | Reject |
| Minor | Screw deformation | Difficult to accept screw driver | Reject |

**6. Heatseal 、TCP 、FPC**

| Defect | Inspection Item | Inspection Standards | |
|---|---|---|---|
| Major | Scratch expose conductive layer | | Reject |
| Minor | HS Hole $\Phi = \frac{L + W}{2}$ | $\Phi$> 0.5mm | Reject |
| Major | Adhesion strength | Less than the specification | Reject |
| Minor | Position shift   | Y > 1/3D | Reject |
| | | X > 1/2Z | Reject |
| Major | Conductive line break | | Reject |

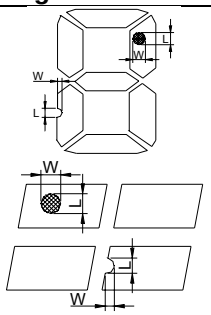
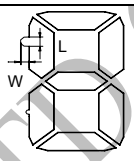
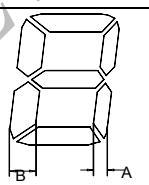
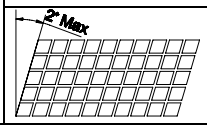
**7. LED Backing Protective Film and Others**

| Defect | Inspection Item | Inspection Standards | |
|---|---|---|---|
| Minor | LED dirty, prick | Acceptable number of units | |
| | | $\Phi \leq$0.10mm | Ignore |
| | | 0.10< $\Phi \leq$0.15mm | 2 |
| | | 0.15< $\Phi \leq$0.2mm | 1 |
| | | $\Phi$>0.2mm | 0 |
| | | The distance between any two spots should be $\geq$5mm<br>Any spot/dot/void outside of viewing area is acceptable | |
| Minor | Protective film tilt | Not fully cover LCD | Reject |
| Major | COG coating | Not fully cover ITO circuit | Reject |

**8. Electric Inspection**

| Defect | Inspection Item | Inspection Standards | |
|---|---|---|---|
| Major | Short | | Reject |
| Major | Open | | Reject |

## 9. Inspection Specification of LCD

| Defect | Inspect Item | | Inspection Standards | | | | |
|---|---|---|---|---|---|---|---|
| Minor | Linear Defect | ∗ Glass Scratch<br>∗ Polarizer Scratch<br>∗ Fiber and Linear material | W | W≤0.03 | | 0.03<W≤0.05 | W>0.05 |
| | | | L | L<5 | | L<3 | Any |
| | | | ACC. NO. | 1 | | 1 | Reject |
| | | | Note | L is the length and W is the width of the defect | | | |
| Minor | Black Spot and Polarizer Pricked | ∗ Foreign material between glass and polarizer or glass and glass<br>∗ Polarizer hole or protuberance by external force | Φ | Φ≤0.1 | 0.1<Φ≤0.15 | 0.15<Φ≤0.2 | Φ>0.2 |
| | | | ACC. NO. | 3EA / 100mm$^2$ | 2 | 1 | 0 |
| | | | Note | Φ is the average diameter of the defect.<br>Distance between two defects > 10mm. | | | |
| Minor | White Spot and Bubble in polarizer | ∗ Unobvious transparant foreign material between glass and glass or glass and polarizer<br>∗ Air protuberance between polarizer and glass | Φ | Φ≤0.3 | 0.3<Φ≤0.5 | 0.5<Φ | |
| | | | ACC. NO. | 3EA / 100mm$^2$ | 1 | 0 | |
| | | | Note | Φ is the average diameter of the defect.<br>Distance between two defects > 10mm. | | | |
| Minor | Segment Defect |  | Φ | Φ≤0.10 | 0.10<Φ≤0.20 | 0.20<Φ≤0.25 | Φ>0.25 |
| | | | ACC. NO. | 3EA / 100mm$^2$ | 2 | 1 | 0 |
| | | | Note | W is more than 1/2 segment width | | | Reject |
| | | | | $\Phi = \frac{L + W}{2}$<br>Distance between two defect is 10mm | | | |
| Minor | Protuberant Segment |  <br>Φ = ( L + W ) / 2 | Φ | Φ≤0.10 | 0.10<Φ≤0.20 | 0.20<Φ≤0.25 | Φ>0.25 |
| | | | W | Glue | W≤1/2 Seg<br>W≤0.2 | W≤1/2 Seg<br>W≤0.2 | Ignore |
| | | | ACC. NO. | 3EA / 100mm$^2$ | 2 | 1 | 0 |
| Minor | Assembly Mis-alignment |  | 1. Segment | | | | |
| | | | B | B≤0.4mm | 0.4<B≤1.0mm | B>1.0mm | |
| | | | B-A | B-A<1/2B | B-A<0.2 | B-A<0.25 | |
| | | | Judge | Acceptable | Acceptable | Acceptable | |
| | |  | 2. Dot Matrix | | | | |
| | | | Deformation>2° | | | | Reject |
| Minor | Stain on LCD Panel Surface | | Accept when stains can be wiped lightly with a soft cloth or a similar one. Otherwise, judged according to the above items: “Black spot” and “White Spot” | | | | |

# 9. RELIABILITY

| NO. | Item | Condition | Criterion |
|---|---|---|---|
| 1 | High Temperature Operating | 70℃, 96Hrs | No defect in cosmetic and operational function allowable.<br>Total current Consumption should be below double of initial value. |
| 2 | Low Temperature Operating | -20℃, 96Hrs | |
| 3 | High Humidity | 60℃, 90%RH, 96Hrs | |
| 4 | High Temperature Storage | 80℃, 96Hrs | |
| 5 | Low Temperature Storage | -30℃, 96Hrs | |
| 6 | Vibration | Random wave<br>10 ~ 100Hz<br>Acceleration: 2g<br>2 Hrs per direction(X,Y,Z) | |
| 7 | Thermal Shock | -20℃ to 25℃ to 70℃<br>(60Min) (5Min) (60Min)<br>16Cycles | |
| 8 | ESD Testing | Contract Discharge Voltage:<br>+1 ~ 5kV and –1 ~ –5kV | There will be discharged ten times at every discharging voltage cycle. The voltage gap is 1kV. |
| | | Air Discharge Voltage:<br>+1 ~ 8kV and –1 ~ -8kV | |

Note: 1) Above conditions are suitable for EASTTOP DISPLAY standard products.
2) For restrict products, the test conditions listed as above must be revised.

# 10. HANDLING PRECAUTION

(1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

(2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichloro trifloro thane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- Water
- Ketone
- Aromatics

(3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

(4) Packaging

- Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.
- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

(5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is reequired.

(6) Storage

In the case of storing for a long period of time (for instance.) For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

(7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol.

Which should be burned up later.

- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

# 11. OUTLINE DIMENSION