晶采光電科技股份有限公司
AMPIRE CO., LTD.

# SPECIFICATIONS FOR LCD MODULE

| | |
|---|---|
| CUSTOMER | |
| CUSTOMER PART NO. | |
| AMPIRE PART NO. | AO-09664DFI-00H |
| APPROVED BY | |
| DATE | |

☑ **Approved For Specifications**
☐ Approved For Specifications & Sample

**AMPIRE CO., LTD.**
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| APPROVED BY | CHECKED BY | ORGANIZED BY |
|---|---|---|
| | | |

# RECORD OF REVISION

| Revision Date | Contents | Editor |
|---|---|---|
| 2003/7/16 | New Release | Eric |
| 2006/06/13 | Correct LCD driver IC material number to S6D0724 | Emil |

# 1 FEATURES

(1) Display format : 96×64 dots, 1/64 duty, 1/9 bias.

(2) Construction : LCD panel, FPC and COG technology.

(3) Display type : FSTN, Transflective, Positive , 6 o'clock view

(4) Controller : S6B0724

(5) Interface for 80 series family MPU

(6) Extend temperature type.

# 2 MECHANICAL DATA

| Parameter | Stand Value | Unit |
|---|---|---|
| Dot size | 0.195(W) × 0.21(H) | mm |
| Dot pitch | 0.21(W) × 0.225(H) | mm |
| Active area | 20.145(W) × 14.385 (H) | mm |
| Viewing area | 22.6(W) × 16.8 (H) | mm |
| Module size | 25.9(W) ×38.94(H) × 1.4 Max. (T) | mm |

# 3 ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Logic Circuit Supply Voltage | VDD-VSS | -0.3 | +7.0 | V |
| LCD Driving Voltage | VLCD | -0.3 | +17.0 | V |
| Input Voltage | VIN | -0.3 | VDD+0.3 | V |
| Operating Temp. | TOP | -20 | 70 | °C |
| Storage Temp. | TSTG | -30 | 80 | °C |

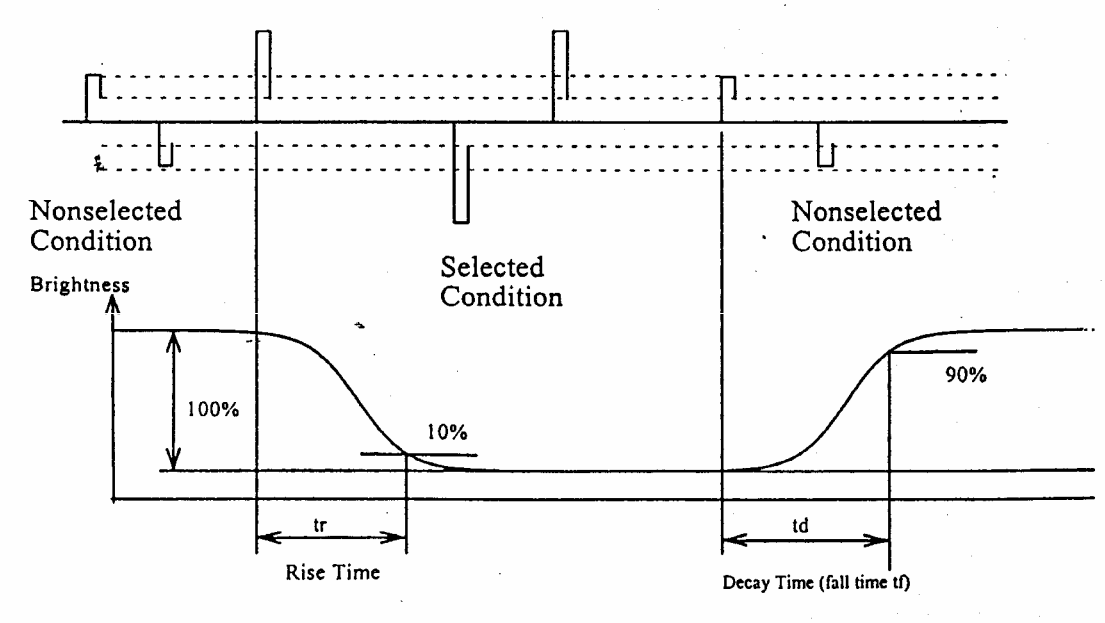
# 4 ELECTRO-OPTICAL CHARACTERISTICS

| Parameter | Symbol | Condition | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| **----- Electronic Characteristics -----** | | | | | | | |
| Logic Circuit Supply Voltage | VDD-VSS | -- | 2.4 | 3.0 | 3.6 | V | |
| LCD Driving Voltage (FSTN ) | VLCD | -20 °C | -- | -- | -- | V | |
| | | 25 °C | 10.15 | 10.45 | 10.75 | | |
| | | 70 °C | | | | | |
| Input Voltage | VIH | -- | 0.7VDD | -- | VDD | V | |
| | VIL | -- | -0.3 | -- | 0.15 VDD | V | |
| Logic Supply Current | IDD | VDD=3.0V | -- | 0.05 | 0.15 | mA | |
| **----- Optical Characteristics ( FSTN ) -----** | | | | | | | |
| Contrast | CR | 25°C | -- | 8 | -- | | Note 1 |
| Rise Time | tr | 25°C | -- | 200 | -- | ms | Note 2 |
| Fall Time | tf | 25°C | -- | 200 | -- | ms | |
| Viewing Angle Range | θ f | 25°C & CR≥2 | -- | 51 | -- | Deg. | Note 3 |
| | θ b | | -- | 30 | -- | | |
| | θ l | | -- | 31 | -- | | |
| | θ r | | -- | 33 | -- | | |
| Frame Frequency | fF | 25°C | -- | 70 | -- | Hz | |

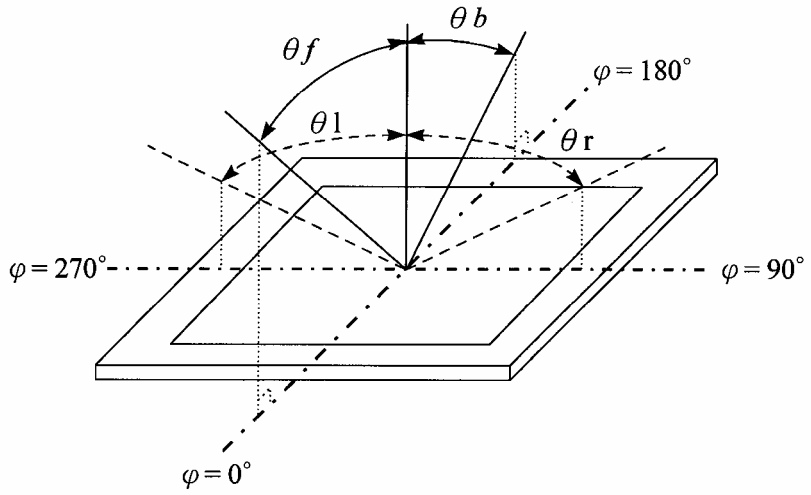
(NOTE 1) Contrast ratio :

CR = (Brightness in OFF state) / (Brightness in ON state)

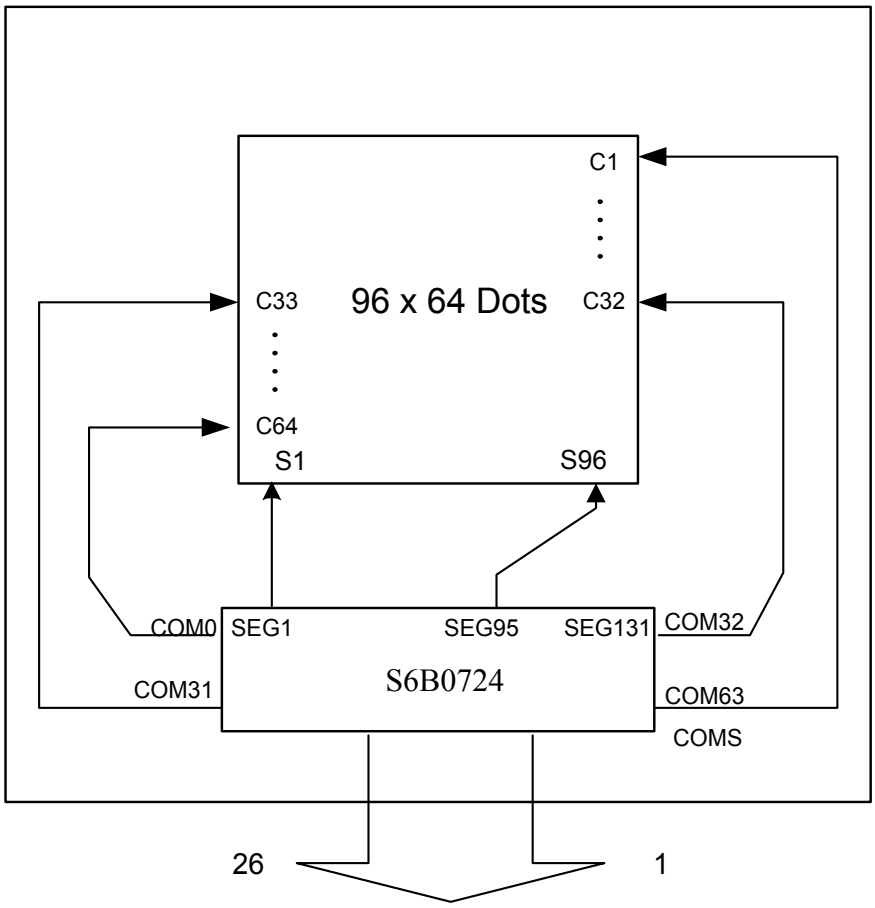
( NOTE 2 ) Response time :




(NOTE 3) Viewing angle

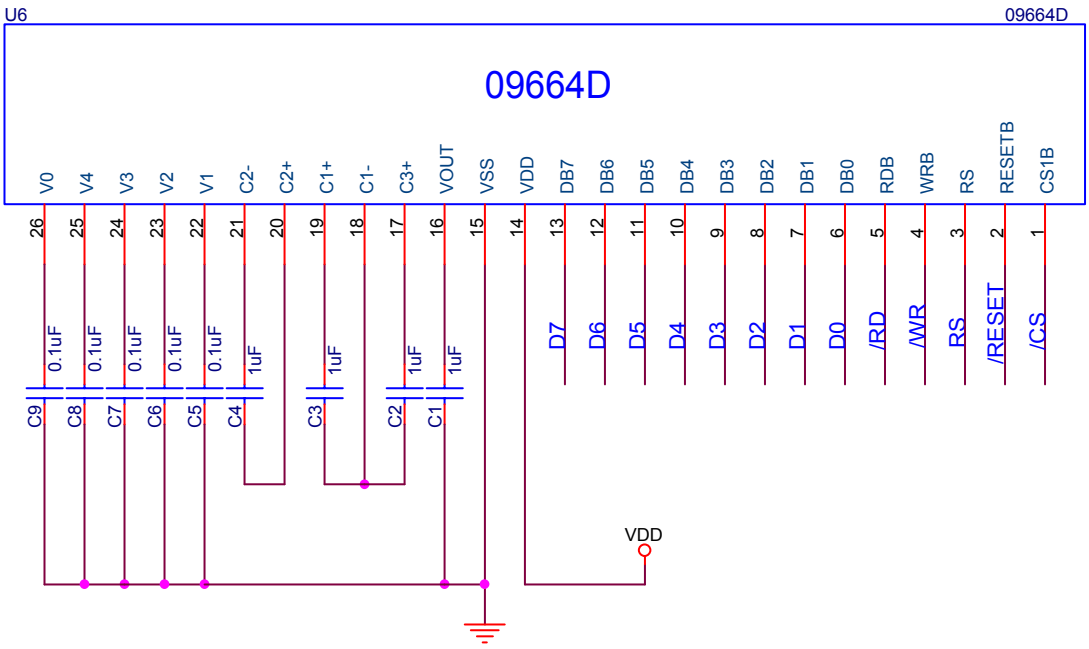


# 5 BLOCK DIAGRAM & POWER SUPPLY




**Default Setting:**

| Symbol | H/L | Description |
|---|---|---|
| FR, FRS, M, CL, DISP | NC | Single chip; No used |
| TEST[4:1] | NC | Test pin; no used |
| CS2 | H | When /CS1=”L”, then the Chip select become active. |
| DUTY[1:0] | HH | 1/65 Duty |
| VEXT, VR | NC | Internal voltage regulator |
| REF | H | Internal VREF |
| M/S | H | Master mode |
| CLS | H | Internal clock is enable |
| C68 | L | 8080 Series MPU interface |
| P/S | H | Parallel data input |
| /HPM | L | High power current mode |
| INTRS | H | Internal resistor |


U6
09664D
09664D
V0
V4
V3
V2
V1
C2-
C2+
C1+
C1-
C3+
VOUT
VSS
VDD
DB7
DB6
DB5
DB4
DB3
DB2
DB1
DB0
RDB
WRB
RS
RESETB
CS1B
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0.1uF
0.1uF
0.1uF
0.1uF
0.1uF
1uF
1uF
1uF
1uF
1uF
C9
C8
C7
C6
C5
C4
C3
C2
C1
D7
D6
D5
D4
D3
D2
D1
D0
/RD
/WR
RS
/RESET
/CS
VDD

# 6 INTERFACE

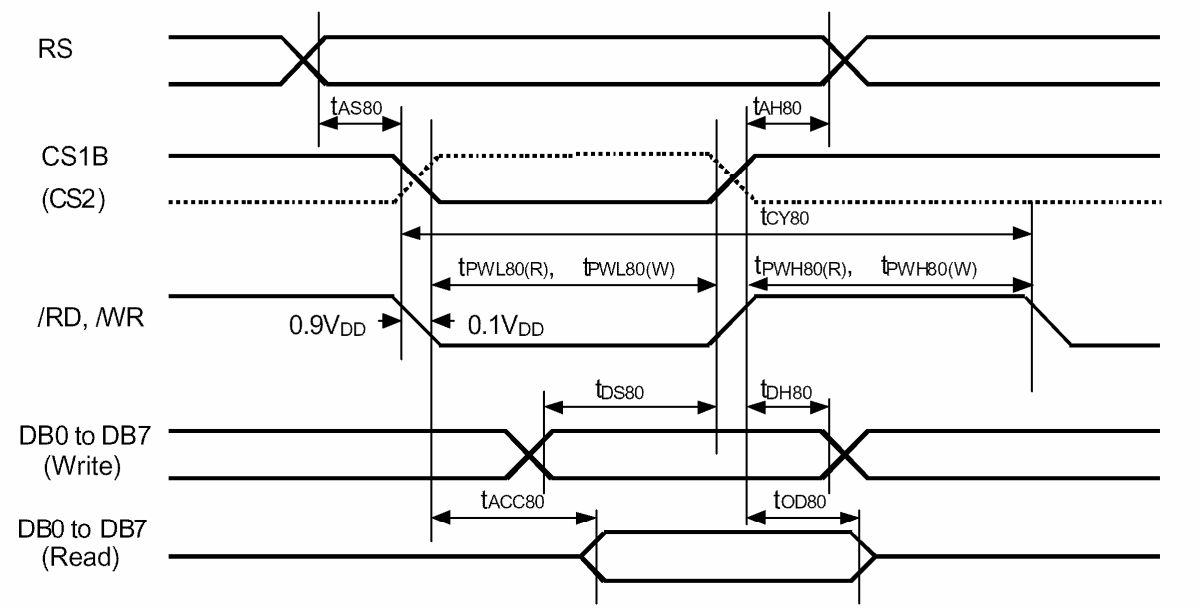
| No. | Signal | Level | Function |
|---|---|---|---|
| 1 | /CS | H/L | Chip Select Signal |
| 2 | /RESET | H/L | Reset Signal |
| 3 | RS | H/L | Data/Instruction Selection Signal |
| 4 | /WR | H/L | Write enable clock input pin.<br>The data on D0 to D7 are latched at the rising edge of the /WR signal. |
| 5 | /RD | H/L | Read enable clock input pin.<br>When /RD is “L” D0 to D7 are in an output status |
| 6 | D0 | H/L | 8 bits Data Bus for 8080 Series MPU |
| 7 | D1 | H/L | |
| 8 | D2 | H/L | |
| 9 | D3 | H/L | |
| 10 | D4 | H/L | |
| 11 | D5 | H/L | |
| 12 | D6 | H/L | |
| 13 | D7 | H/L | |
| 14 | VDD | - | Power Supply |
| 15 | VSS | - | Ground |
| 16 | VOUT | - | Voltage converter output pin.<br>Connect this pin to VSS through capacitor. |
| 17 | C3+ | - | Boost capacitor (quadruple) |
| 18 | C1- | - | Boost capacitor |
| 19 | C1+ | - | Boost capacitor |
| 20 | C2+ | - | Boost capacitor (triple or more) |
| 21 | C2- | - | Boost capacitor (triple or more) |
| 22 | V1 | - | LCD driver supply voltages<br>The voltage determined by LCD pixel is impedance-converted by an operational amplifier for application.<br>Voltages should have the following relationship:<br>V0 ≧V1 ≧ V2 ≧ V3 ≧ V4 ≧ VSS |
| 23 | V2 | - | |
| 24 | V3 | - | |
| 25 | V4 | - | |
| 26 | V0 | - | |

# 7 INSTRUCTION DESCRIPTION

| Instruction | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Display ON / OFF | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | DON | Turn on/off LCD panel<br>When DON = 0: display OFF<br>When DON = 1: display ON |
| Initial display line | 0 | 0 | 0 | 1 | ST5 | ST4 | ST3 | ST2 | ST1 | ST0 | Specify DDRAM line for COM0 |
| Set page address | 0 | 0 | 1 | 0 | 1 | 1 | P3 | P2 | P1 | P0 | Set page address |
| Set column address MSB | 0 | 0 | 0 | 0 | 0 | 1 | Y7 | Y6 | Y5 | Y4 | Set column address MSB |
| Set column address LSB | 0 | 0 | 0 | 0 | 0 | 0 | Y3 | Y2 | Y1 | Y0 | Set column address LSB |
| Read status | 0 | 1 | BUSY | ADC | ONOFF | RESETB | 0 | 0 | 0 | 0 | Read the internal status |
| Write display data | 1 | 0 | Write data | | | | | | | | Write data into DDRAM |
| Read display data | 1 | 1 | Read data | | | | | | | | Read data from DDRAM |
| ADC select | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | ADC | Select SEG output direction<br>When ADC = 0: normal direction (SEG0→SEG131)<br>When ADC = 1: reverse direction (SEG131→SEG0) |
| Reverse display ON / OFF | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | REV | Select normal / reverse display<br>When REV = 0: normal display<br>When REV = 1: reverse display |
| Entire display ON / OFF | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | EON | Select normal/entire display ON<br>When EON = 0: normal display.<br>When EON = 1: entire display ON |
| LCD bias select | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | BIAS | Select LCD bias |
| Set modify-read | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Set modify-read mode |
| Reset modify-read | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | release modify-read mode |
| Reset | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | Initialize the internal functions |
| SHL select | 0 | 0 | 1 | 1 | 0 | 0 | SHL | × | × | × | Select COM output direction<br>When SHL = 0: normal direction (COM0→COM63)<br>When SHL = 1: reverse direction (COM63→COM0) |
| Power control | 0 | 0 | 0 | 0 | 1 | 0 | 1 | VC | VR | VF | Control power circuit operation |
| Regulator resistor select | 0 | 0 | 0 | 0 | 1 | 0 | 0 | R2 | R1 | R0 | Select internal resistance ratio of the regulator resistor |
| Set reference voltage mode | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set reference voltage mode |
| Set reference voltage register | 0 | 0 | × | × | SV5 | SV4 | SV3 | SV2 | SV1 | SV0 | Set reference voltage register |
| Set static indicator mode | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | SM | Set static indicator mode |
| Set static indicator register | 0 | 0 | × | × | × | × | × | × | S1 | S0 | Set static indicator register |
| Power save | - | - | - | - | - | - | - | - | - | - | Compound Instruction of display OFF and entire display ON |

# 8 TIMING CHARACTERISTICS

## 80-SYSTEM




** $t_{PWL80(W)}$ and $t_{PWL80(R)}$ is specified in the overlapped period when CS1B is low (CS2 is high) and /WR(/RD) is low.

Read / Write Characteristics (8080-series MPU)

($V_{DD}$ = 2.4 to 3.6V, Ta = -40 to +85°C)

| Item | | Signal | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Address setup time<br>Address hold time | | RS | $t_{AS80}$<br>$t_{AH80}$ | 0<br>0 | - | - | ns | |
| System cycle time | | /WR, /RD | $t_{CY80}$ | 300 | - | - | ns | |
| Enable Pulse Low width | Read | /RD | $t_{PWL80 (R)}$ | 120 | - | - | ns | |
| | Write | /WR | $t_{PWL80 (W)}$ | 60 | - | - | ns | |
| Enable Pulse High width | Read | /RD | $t_{PWH80 (R)}$ | 60 | - | - | ns | |
| | Write | /WR | $t_{PWH80 (W)}$ | 60 | - | - | ns | |
| Data setup time<br>Data hold time | | DB7 To DB0 | $t_{DS80}$<br>$t_{DH80}$ | 40<br>15 | - | - | ns | |
| Read access time<br>Output disable time | | | $t_{ACC80}$<br>$t_{OD80}$ | -<br>10 | - | 140<br>100 | ns | $C_L$ = 100 pF |

# 9 QUALITY AND RELIABILITY

## 9.1 TEST CONDITIONS

Tests should be conducted under the following conditions :

Ambient temperature : 25 ± 5°C

Humidity : 60 ± 25% RH.

## 9.2 SAMPLING PLAN

Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .

## 9.3 ACCEPTABLE QUALITY LEVEL

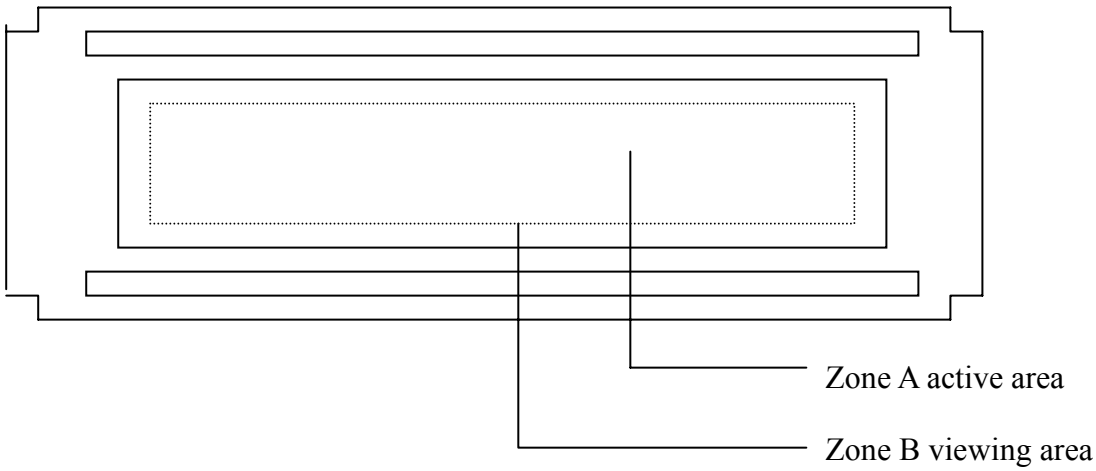
A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

## 9.4 APPEARANCE

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under flourescent light. The inspection area of LCD panel shall be within the range of following limits.

## 9.5 INSPECTION QUALITY CRITERIA

| Item | Description of defects | | | Class of Defects | Acceptable level (%) |
|---|---|---|---|---|---|
| Function | Short circuit or Pattern cut | | | Major | 0.65 |
| Dimension | Deviation from drawings | | | Major | 1.5 |
| Black spots | Ave . dia . D | area A | area B | Minor | 2.5 |
| | D≤0.2 | Disregard | | | |
| | 0.2<D≤0.3 | 3 | 4 | | |
| | 0.3<D≤0.4 | 2 | 3 | | |
| | 0.4<D | 0 | 1 | | |
| Black lines | Width W, Length L | A | B | Minor | 2.5 |
| | W≤0.03 | disregard | | | |
| | 0.03<W≤0.05 | 3 | 4 | | |
| | 0.05<W≤0.07 , L≤3.0 | 1 | 1 | | |
| | See line criteria | | | | |
| Bubbles in polarizer | Average diameter D 0.2 < D < 0.5 mm for N = 4 , D > 0.5 for N = 1 | | | Minor | 2.5 |
| Color uniformity | Rainbow color or newton ring. | | | Minor | 2.5 |
| Glass Scratches | Obvious visible damage. | | | Minor | 2.5 |
| Contrast ratio | See note 1 | | | Minor | 2.5 |
| Response time | See note 2 | | | Minor | 2.5 |
| Viewing angle | See note 3 | | | Minor | 2.5 |



## 9.6 RELIABILITY

| Test Item | Test Conditions | Note |
|---|---|---|
| | Extend Temp. type | |
| High Temperature Operation | 70±3°C , t=96 hrs | |
| Low Temperature Operation | -20±3°C , t=96 hrs | |
| High Temperature Storage | 80±3°C , t=96 hrs | 1,2 |
| Low Temperature Storage | -30±3°C , t=96 hrs | 1,2 |
| Thermal Shock Test | -30°C ~ 25°C ~ 80°C<br>30 m in. 5 min. 30 min. ( 1 cycle )<br>Total 5 cycle | 1,2 |
| Humidity Test | 40 °C, Humidity 90%, 96 hrs | 1,2 |
| Vibration Test (Packing) | Sweep frequency : 10 ~ 55 ~ 10 Hz/1min<br>Amplitude : 0.75mm<br>Test direction : X.Y.Z/3 axis<br>Duration : 30min/each axis | 2 |

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions (15-35°C , 45-65%RH).

Definitions of life end point :

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

## 10 HANDLING PRECAUTIONS

(1) A LCD module is a fragile item and should not be subjected to strong mechanical shocks.

(2) Avoid applying pressure to the module surface. This will distort the glass and cause a change in color.

(3) Under no circumstances should the position of the bezel tabs or their shape be modified.

(4) Do not modify the display PCB in either shape or positioning of components.

(5) Do not modify or move location of the zebra or heat seal connectors.

(6) The device should only be soldered to during interfacing. Modification to other areas of the board should not be carried out.

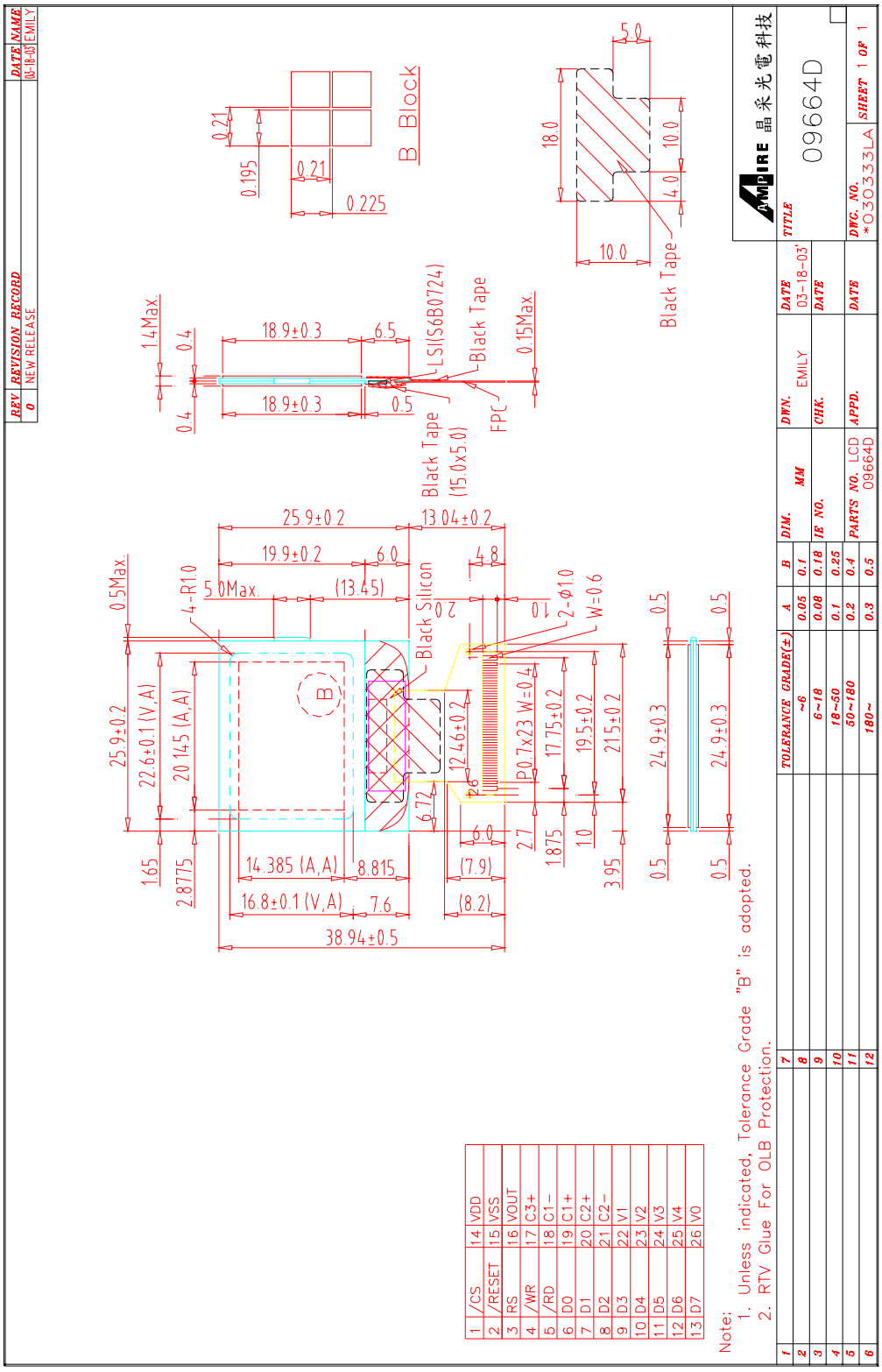
(7) In the event of LCD breakage and resultant leakage of fluid do not inhale, ingest or make contact with the skin. If contact is made rinse immediately.

(8) When cleaning the module use a soft damp cloth with a mild solvent, such as Isopropyl or Ethyl alcohol. The use of water, ketone or aromatic is not permitted.

(9) Prior to initial power up input signals should not be applied.

(10) Protect the module against static electricity and observe appropriate anti-static precautions.

# 11 OUTLINE DIMENSION




| | |
|---|---|
| 1 | /CS |
| 2 | /RESET |
| 3 | RS |
| 4 | /WR |
| 5 | /RD |
| 6 | D0 |
| 7 | D1 |
| 8 | D2 |
| 9 | D3 |
| 10 | D4 |
| 11 | D5 |
| 12 | D6 |
| 13 | D7 |
| 14 | VDD |
| 15 | VSS |
| 16 | VOUT |
| 17 | C3+ |
| 18 | C1− |
| 19 | C1+ |
| 20 | C2+ |
| 21 | C2− |
| 22 | V1 |
| 23 | V2 |
| 24 | V3 |
| 25 | V4 |
| 26 | V0 |