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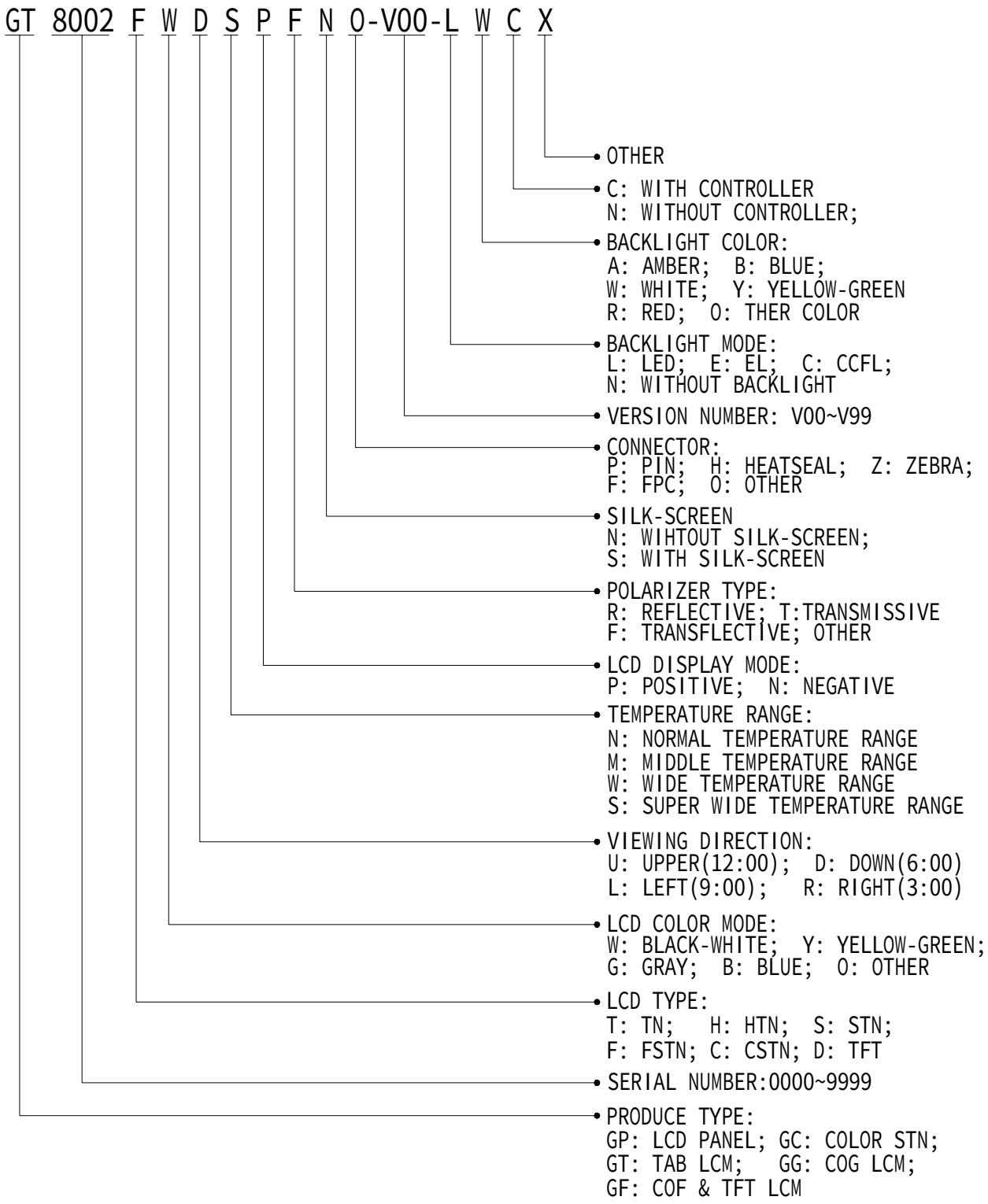
# LCM Number System



# 1. GENERAL DESCRIPTION

The GT8002 is a 128 x 16 Dots Graphic LCD module. It has a FSTN panel composed of 128 segments and 16 commons. The LCM can be easily accessed by microcontroller via parallel 6800 timing interface.

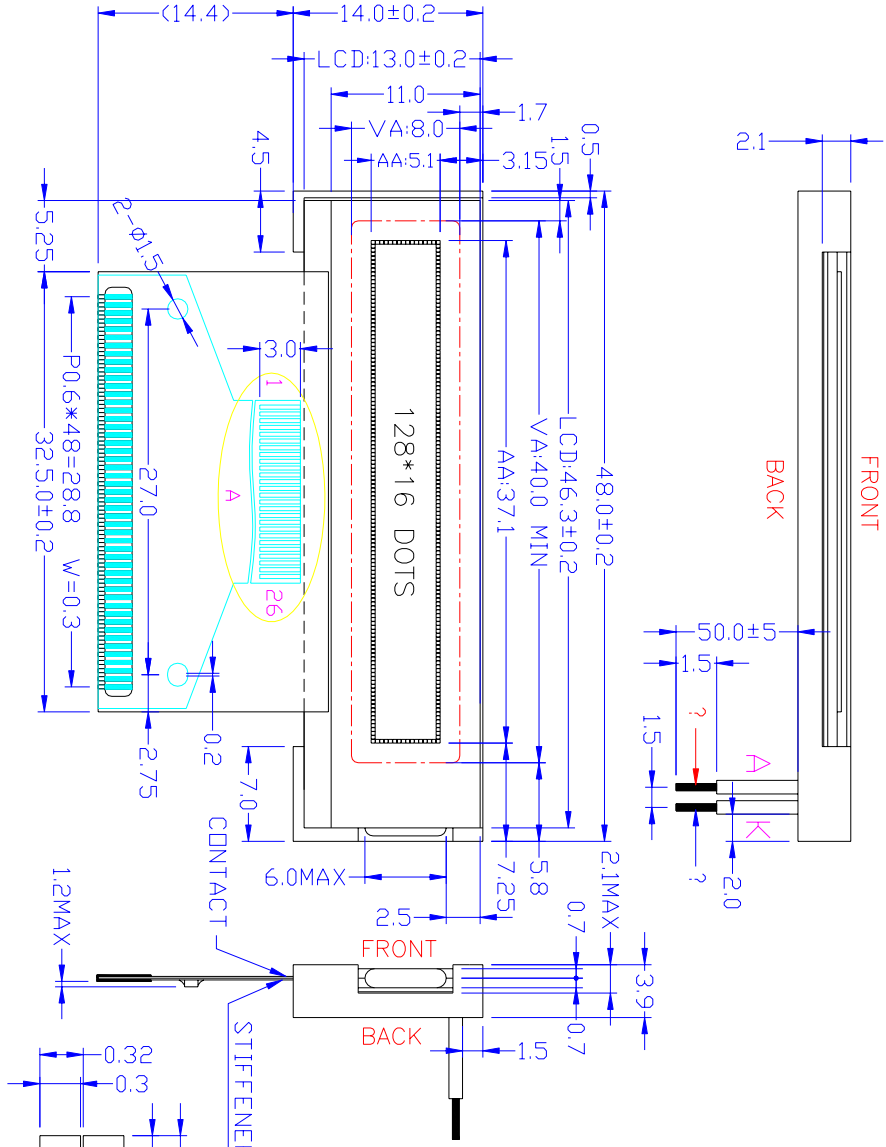
# 2. FEATURES

| | |
|---|---|
| Display Mode | Transflective and positive |
| | FSTN module |
| Display Format | Graphic 128x16 dots |
| Input Data | 8 bit parallel input from MPU |
| Multiplexing Ratio | 1/33 Duty |
| Bias | 1/6 Bias |
| Viewing Direction | 6 O'clock |
| Backlight | LED(White) |

# 3. MECHANICAL SPECIFICATION

| Item | Specifications | Unit |
|---|---|---|
| Dimensional outline | 48.0(LED) x (14.0+14.4) x 3.9(max) | mm |
| Resolution | 128segs x 16coms | dots |
| Active area | 37.1(W) x 5.1(H) | mm |
| Dots pitch | 0.29 (W)×0.32(H) | mm |
| Dots size | 0.27(W)×0.3(H) | mm |

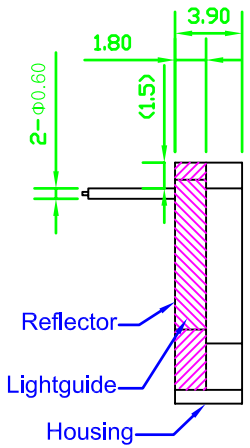
# 4. MECHANICAL DIMENSION

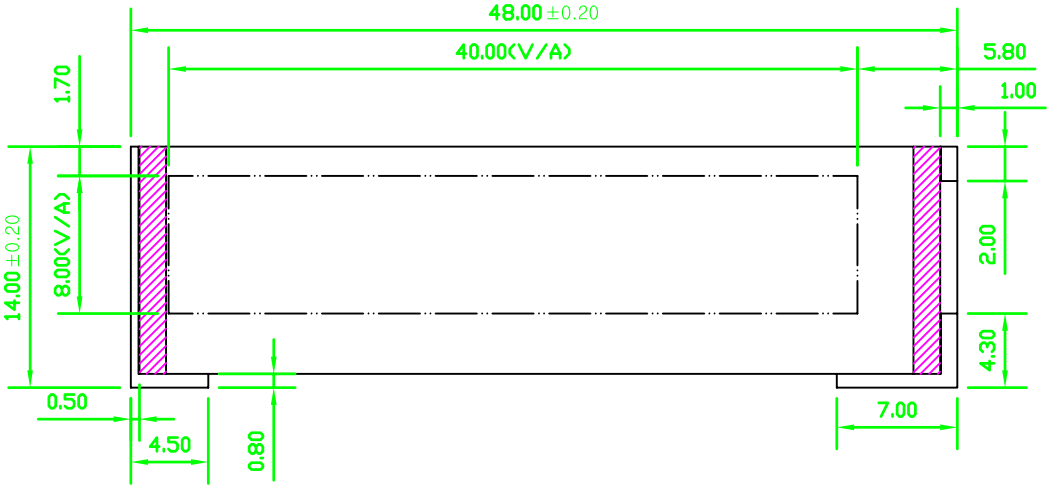



| NO. | SYMBOL |
|---|---|
| 1 | V0 |
| 2 | V1 |
| 3 | V2 |
| 4 | V3 |
| 5 | V4 |
| 6 | CAP2N |
| 7 | CAP2P |
| 8 | CAP1P |
| 9 | CAP1N |
| 10 | CAP3P |
| 11 | VOUT |
| 12 | VSS |
| 13 | VDD |

| NO. | SYMBOL |
|---|---|
| 14 | DB7 |
| 15 | DB6 |
| 16 | DB5 |
| 17 | DB4 |
| 18 | DB3 |
| 19 | DB2 |
| 20 | DB1 |
| 21 | DB0 |
| 22 | E |
| 23 | R/W |
| 24 | A0 |
| 25 | RES |
| 26 | CS1 |

CUSTOMER'S APPROVED:



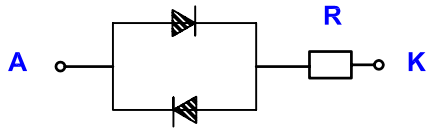





## SPECIFCATION:

1) Light color : White
2) Unifonnity : >75%
3) RoHS compliant

### Circuit Diagram (LED 1 dies)




| | | |
|---|---|---|
| JEWEL HILL ELECTRONIC CO.,L | | |
| TEL: 0755-83617492 FAX: 0755--83365871 | | |
| DESIGNED BY: PeterHuang | SCALE: | DWG NO: GT8002 |
| CHECKED BY: PeterHuang | UNIT: mm | |
| APPROVED BY: | REV. 1 | DATE: 2006- |
| | | PAGE: 1 O |

# JEWEL HILL ELECTRONICS LTD.

PRELIMINARY
GT8002
LED BACKLIGHT
FORLCD DISPLAY

## 1、极限参数 ABSOLUTE MAXIMUM RATINGE:

（除非特别说明，环境温度T=25° Unless specified,The Ambient temperature T=25° ）

| 项目 Item | 符号 Symbel | 条件 Conditions | 值 Rating | 单位 Unit |
|---|---|---|---|---|
| * 极限直流正向电流 Absolute maximum forware current | Ifm | | 50 | mA |
| * 脉冲驱动极限正向电流 Peak forward current | Ifp | I mseo plus10% Dutg Cyele | 100 | mA |
| 反向电压 Reversr Voltage | Vr | | 0.8 | V |
| * 极限功耗 Power dissipation | pd | | 60 | mW |
| 工作温度 Operating Temperature Range | Topr | | -20～ +70 | °C |
| 贮存温度 Storage Temperature Range | Tstg | | -40～ +85 | °C |

## 2、光电特性 ELECTRICAL-OPTICAL CHARACTERISTICS:

(除非特别说明，环境温度 T=25° C Unless specified,The Ambient tempetature T=25° C)

| 项目 Item | 符号 Symbel | 最小值 min. | 典型值 typ. | 最大值 max. | 单位 Unit. | 条件 Condition. |
|---|---|---|---|---|---|---|
| 正向电压 Forward Voltage | Vf | 3.2 | 3.5 | 3.8 | V | If= 15 mA |
| 反向电流 Reverse Current | Ir | | | 30 | mA | Vr= 0.8 V |
| Color Colorimeter | x | 0.283 | | 0.330 | | If= 15 mA |
| | y | 0.276 | | 0.338 | | |
| *亮度 Luminance | Lv | 80 | 100 | | cd/m² | If= 15 mA |

| Design: 杨 旭 | Review: | COUNTERSIGH: | APPROVED: |
|---|---|---|---|

# 5. MAXIMUM RATINGS

| Item | Symbol | Min | Max | Unit | Note |
|---|---|---|---|---|---|
| Supply voltage | $V_{DD}$ - Vss | -0.3 | 4.0 | V | |
| | $V_{LCD}$ | -0.3 | 18.0 | V | |
| Input Voltage | $V_{IN}$ | -0.3 | $V_{DD}$+0.3 | V | |
| Operating temperature | $T_{OPR}$ | -25 | +70 | ℃ | |
| Storage temperature | $T_{STR}$ | -40 | +85 | ℃ | |
| Humidity | --- | --- | 90 | %RH | |

# 6. ELECTRICAL CHARACTERISTICS

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Supply Voltage | Logic | $V_{DD}$ | --- | 3.2 | 3.3 | 3.4 | V |
| Input Voltage | H level | $V_{IH}$ | --- | 0.8$V_{DD}$ | --- | $V_{DD}$ | V |
| | L level | $V_{IL}$ | | $V_{SS}$ | --- | 0.2$V_{DD}$ | |
| Current Consumption (LCM:WITHOUT LED) | | $I_{DD}$ | $V_{DD}$=3.3V; $V_{LCD}$=6.0V,$T_{amb}$=25℃; | --- | --- | 1.2 | mA |
| LCD Driving Voltage | | $V_{LCD}$ | Bias=1/6 VLCD=V0-Vss | --- | 6.0 | --- | V |
| Current Consumption (LCM:WITH LED) | | $I_{LED}$ | VDD=3.3V $V_{LED}$=3.5V,$T_{amb}$=25℃; | --- | --- | TBD | mA |

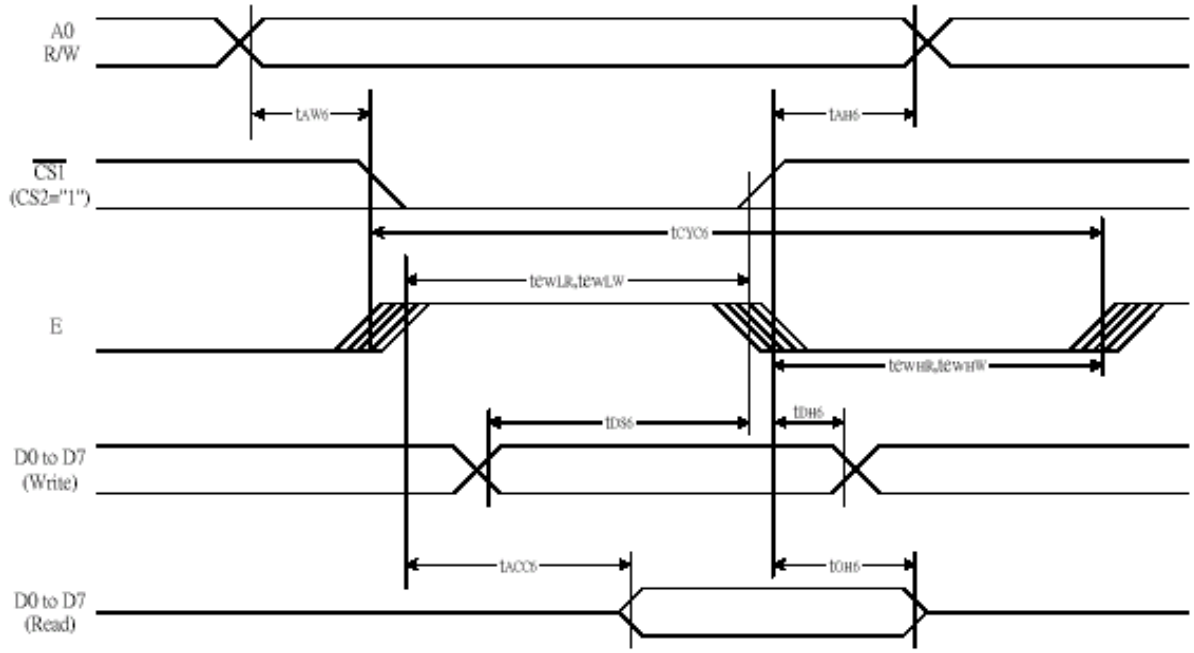
# 7. MODULE FUNCTION DESCRIPTION

## 7.1. PIN DESCRIPTION

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | V0 | LCD Bias Voltage;<br>The Must Maintain the Relative Shown Below:<br>V0≥V1≥V2≥V3≥V4≥VSS |
| 2 | V1 | |
| 3 | V2 | |
| 4 | V3 | |
| 5 | V4 | |
| 6 | CAP2N | DC-DC Voltage Converter, Connect a Capacitor with Together |
| 7 | CAP2P | |
| 8 | CAP1P | DC-DC Voltage Converter , Connect a Capacitor with Together |
| 9 | CAP1N | |
| 10 | CAP3P | DC-DC Voltage Converter,<br>Connect to VOUT when Used 3-step Voltage Circuit |
| 11 | VOUT | DC-DC Voltage Output terminal |
| 12 | VSS | Power Supply for Ground(0V) |
| 13 | VDD | Power Supply for Positive(3.3V) |
| 14-21 | DB7-DB0 | 8-bit Bi-directional Data Bus for 6800-timing |
| 22 | E | Read/Write Enable Signal |
| 23 | R/W | Read/Write Selection Signal |
| 24 | A0 | Data/Command Register Selection |
| 25 | /RES | Reset Signal |
| 26 | /CS1 | Chip Selection Signal |

# 7.2 TIMING CHARACTERISTICS

## 1.SYSTEM BUS READ/WRITE CHARACTERISTIC




System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)

Figure 38

Table 27

(VDD = 3.3 V , Ta = 25°C )

| Item | Signal | Symbol | Condition | Rating | | Units |
|---|---|---|---|---|---|---|
| | | | | Min. | Max. | |
| Address hold time | A0 | tAH6 | | 0 | — | ns |
| Address setup time | | tAW6 | | 0 | — | |
| System cycle time | | tCYC6 | | 240 | — | |
| Enable L pulse width (WRITE) | WR | tEWLW | | 80 | — | |
| Enable H pulse width (WRITE) | | tEWHW | | 80 | — | |
| Enable L pulse width (READ) | RD | tEWLR | | 80 | — | |
| Enable H pulse width (READ) | | tEWHR | | 140 | | |
| WRITE Data setup time | D0 to D7 | tDS6 | | 40 | — | |
| WRITE Address hold time | | tDH6 | | 0 | — | |
| READ access time | | tACC6 | CL = 100 pF | — | 70 | |
| READ Output disable time | | tOH6 | CL = 100 pF | 5 | 50 | |

Table 28

($V_{DD}$ = 2.7V , Ta =25°C )

| Item | Signal | Symbol | Condition | Rating | | Units |
|---|---|---|---|---|---|---|
| | | | | Min. | Max. | |
| Address hold time | A0 | $t_{AH6}$ | | 0 | — | ns |
| Address setup time | | $t_{AW6}$ | | 0 | — | |
| System cycle time | | $t_{CYC6}$ | | 400 | — | |
| Enable L pulse width (WRITE) | WR | $t_{EWLW}$ | | 220 | — | |
| Enable H pulse width (WRITE) | | $t_{EWHW}$ | | 180 | — | |
| Enable L pulse width (READ) | RD | $t_{EWLR}$ | | 220 | — | |
| Enable H pulse width (READ) | | $t_{EWHR}$ | | 180 | — | |
| WRITE Data setup time | D0 to D7 | $t_{DS6}$ | | 40 | — | |
| WRITE Address hold time | | $t_{DH6}$ | | 0 | — | |
| READ access time | | $t_{ACC6}$ | $C_L$ = 100 pF | — | 140 | |
| READ Output disable time | | $t_{OH6}$ | $C_L$ = 100 pF | 10 | 100 | |

Table 29

($V_{DD}$ =1.8V , Ta =25°C )

| Item | Signal | Symbol | Condition | Rating | | Units |
|---|---|---|---|---|---|---|
| | | | | Min. | Max. | |
| Address hold time | A0 | $t_{AH6}$ | | 0 | — | ns |
| Address setup time | | $t_{AW6}$ | | 0 | — | |
| System cycle time | | $t_{CYC6}$ | | 640 | — | |
| Enable L pulse width (WRITE) | WR | $t_{EWLW}$ | | 360 | — | |
| Enable H pulse width (WRITE) | | $t_{EWHW}$ | | 280 | — | |
| Enable L pulse width (READ) | RD | $t_{EWLR}$ | | 360 | — | |
| Enable H pulse width (READ) | | $t_{EWHR}$ | | 280 | — | |
| WRITE Data setup time | D0 to D7 | $t_{DS6}$ | | 80 | — | |
| WRITE Address hold time | | $t_{DH6}$ | | 0 | — | |
| READ access time | | $t_{ACC6}$ | $C_L$ = 100 pF | — | 240 | |
| READ Output disable time | | $t_{OH6}$ | $C_L$ = 100 pF | 10 | 200 | |

*1 The input signal rise time and fall time ($t_r$, $t_f$) is specified at 15 ns or less. When the system cycle time is extremely fast, ($t_r + t_f$) ≦ ($t_{CYC6} - t_{EWLW} - t_{EWHW}$) for ($t_r + t_f$) ≦ ($t_{CYC6} - t_{EWLR} - t_{EWHR}$) are specified.
*2 All timing is specified using 20% and 80% of $V_{DD}$ as the reference.
*3 $t_{EWLW}$ and $t_{EWLR}$ are specified as the overlap between $\overline{CS1}$ being "L" (CS2 = "H") and E.

## 2. RESET TIMING

Reset Timing

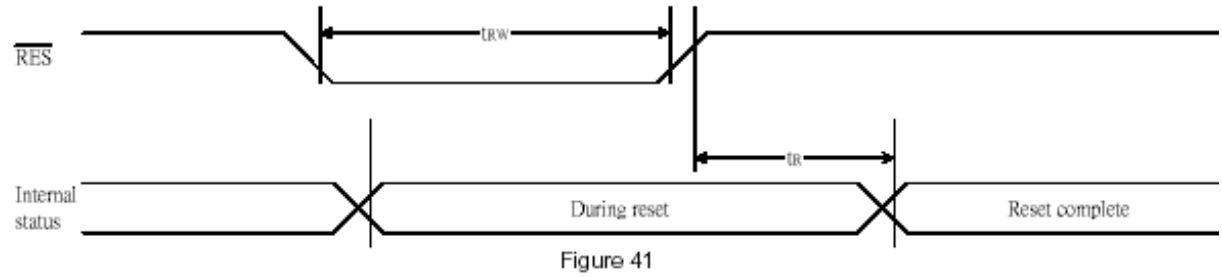



Figure 41

Table 36

(VDD = 3.3V , Ta = –40 to 85°C )

| Item | Signal | Symbol | Condition | Rating | | | Units |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Reset time | | tR | | — | — | 1.0 | us |
| Reset "L" pulse width | /RES | tRW | | 1.0 | — | — | us |

Table 37

(VDD = 2.7V , Ta = –40 to 85°C )

| Item | Signal | Symbol | Condition | Rating | | | Units |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Reset time | | tR | | — | — | 2.0 | us |
| Reset "L" pulse width | /RES | tRW | | 2.0 | — | — | us |

Table 38

(VDD = 1.8V , Ta = –40 to 85°C )

| Item | Signal | Symbol | Condition | Rating | | | Units |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Reset time | | tR | | — | — | 3.0 | us |
| Reset "L" pulse width | /RES | tRW | | 3.0 | — | — | us |

*1 All timing is specified with 20% and 80% of VDD as the standard.

## 7.3 APPLICATION OF LCM

■Reference circuit

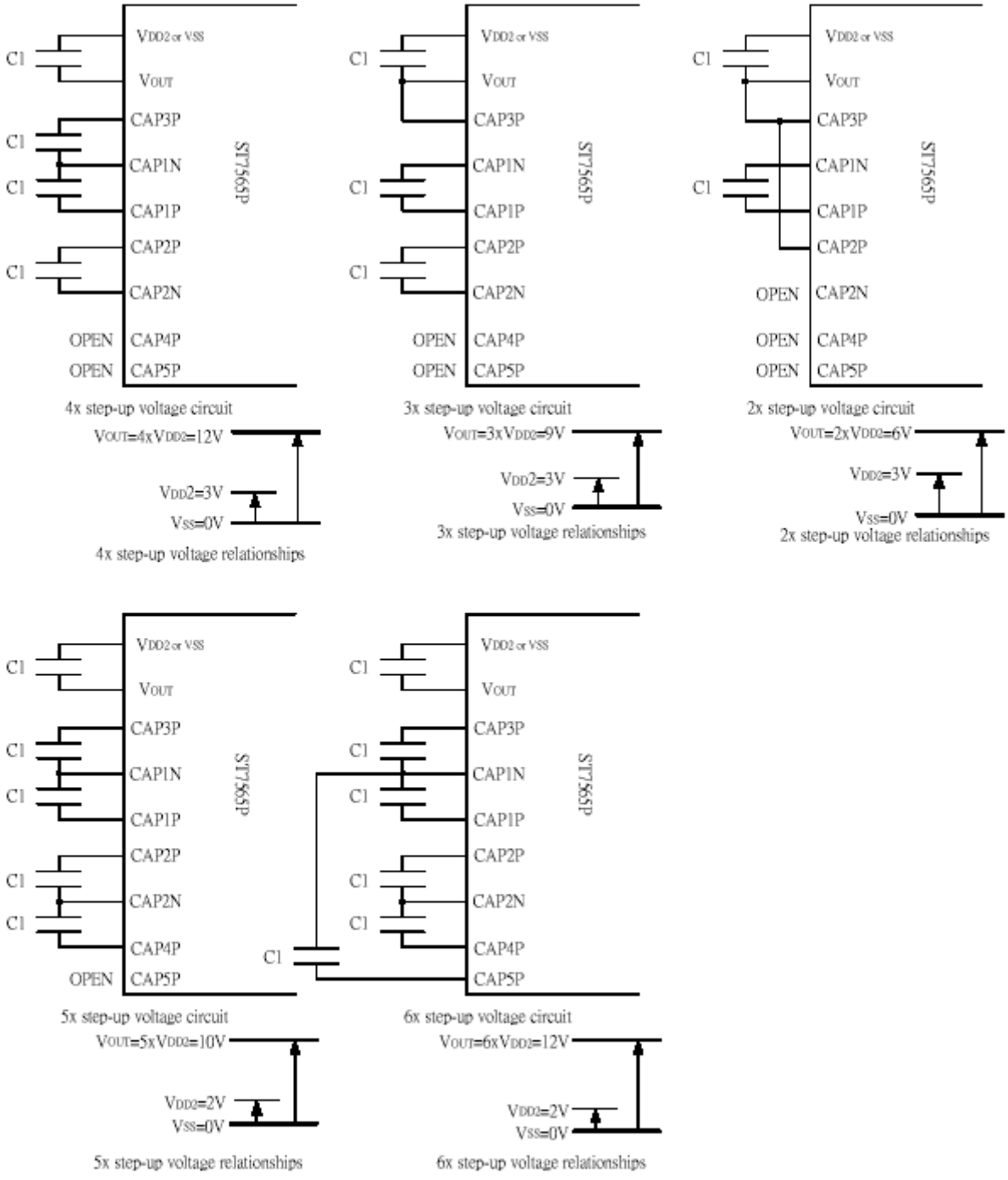
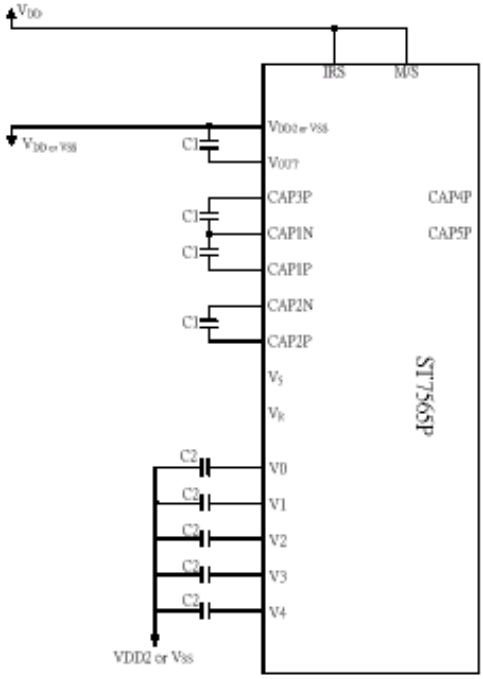



Figure 7

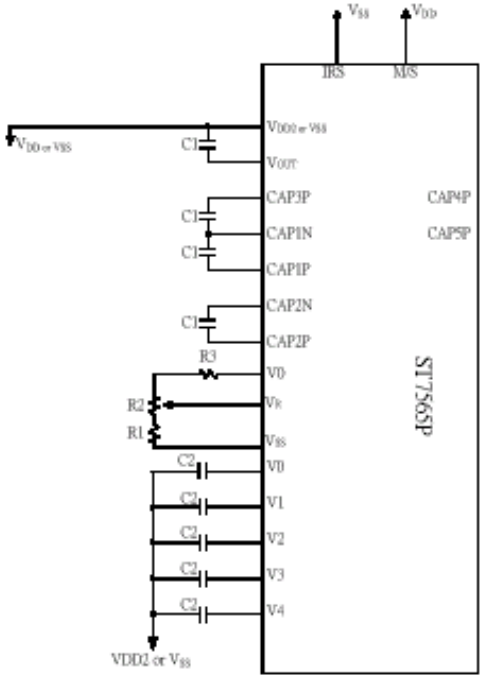
**Reference Circuit Examples**

1. When used all of the step-up circuit, voltage regulating circuit and V/F circuit

(1) When the voltage regulator internal resistor is used.
(Example where VDD2 = VDD, with 4x step-up)

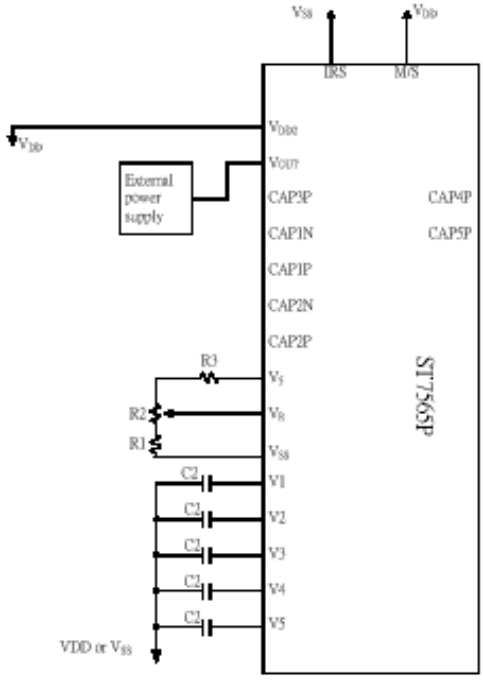



(2) When the voltage regulator internal resistor is not used.
(Example where VDD2 = VDD, with 4x step-up)

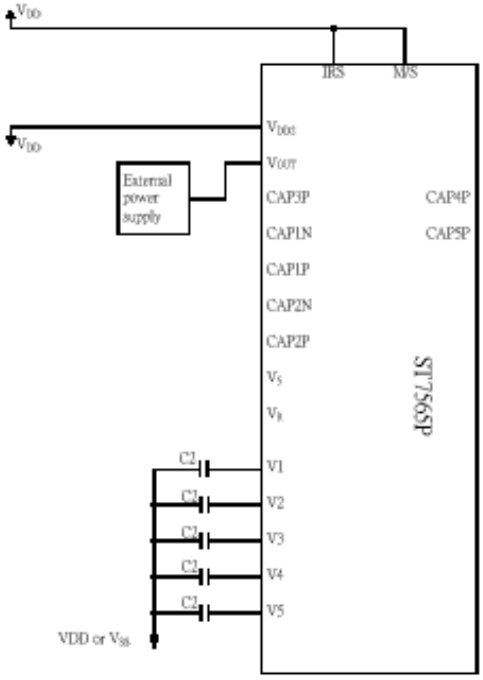



2. When the voltage regulator circuit and V/F circuit alone are used

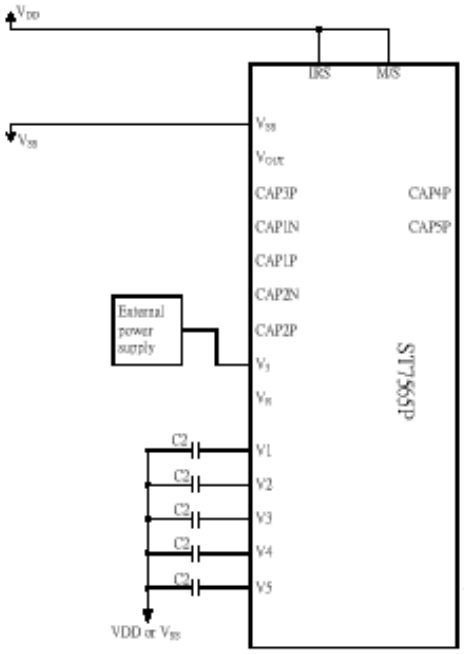
(1) When the Vs voltage regulator internal resistor is not used.



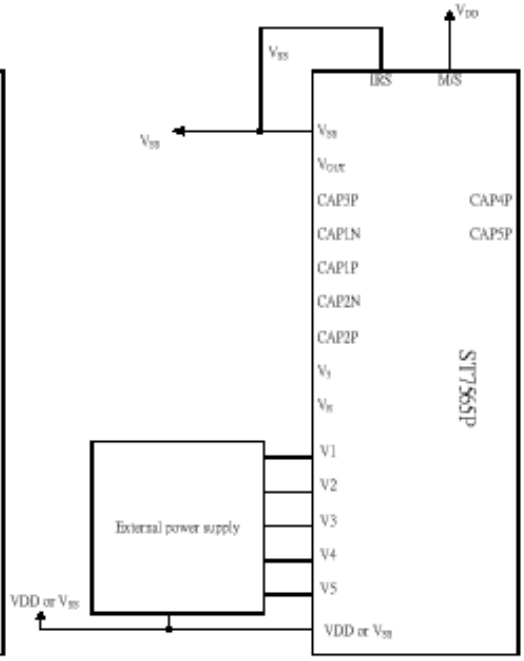

(2) When the Vs voltage regulator internal resistor is used.



(3) When the V/F circuit alone is used




(4) When the built-in power is not used




| Item | Set value | units |
|---|---|---|
| c1 | 1.0 to 4.7 | uF |
| c2 | 0.1 to 4.7 | uF |

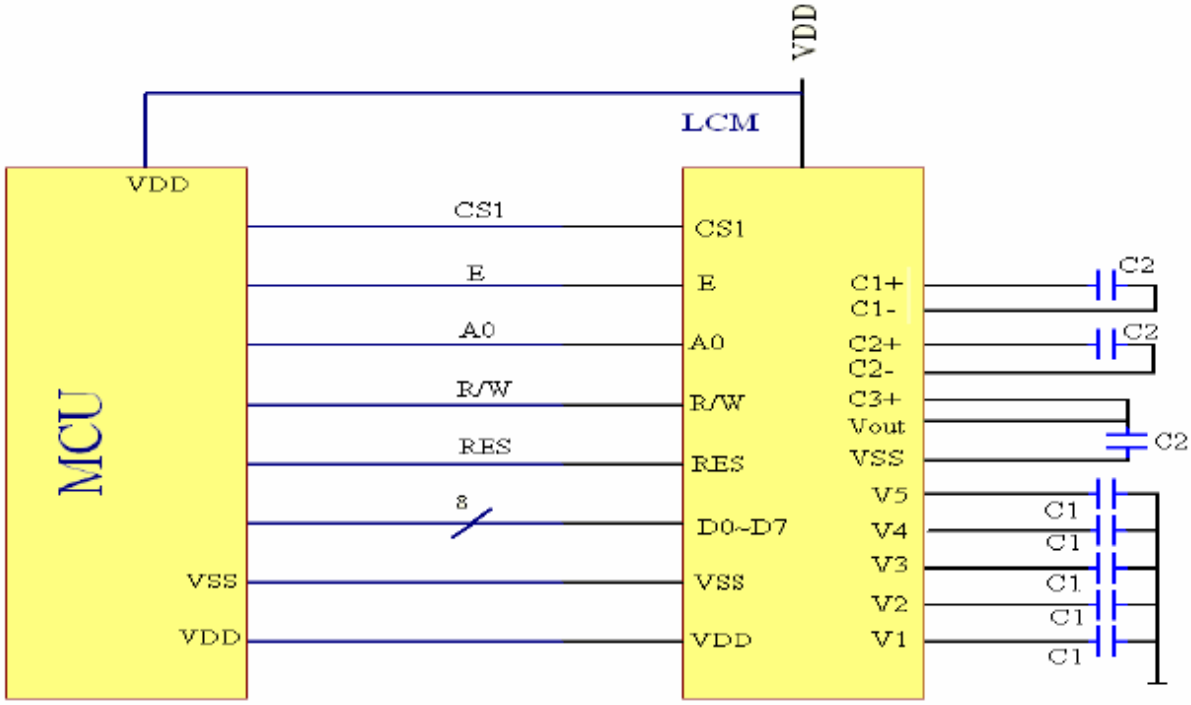
C1 and C2 are determined by the size of the LCD being driven

* 1. Because the VR terminal input impedance is high, use short leads and shielded lines.
* 2. C1 and C2 are determined by the size of the LCD being driven. Select a value that will stabilize the liquid crystal drive voltage.

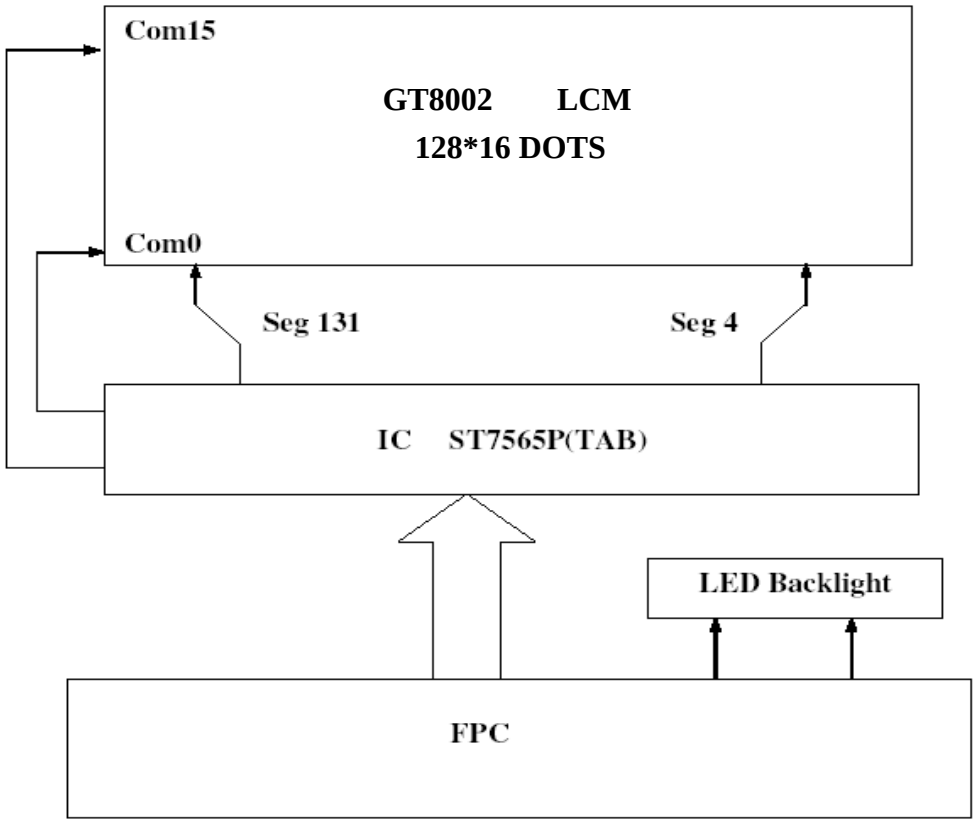
Example of the Process by which to Determine the Settings:

- Turn the voltage regulator circuit and voltage follower circuit ON and supply a voltage to VOUT from the outside.
- Determine C2 by displaying an LCD pattern with a heavy load (such as horizontal stripes) and selecting a C2 that stabilizes the liquid crystal drive voltages (V1 to V5). Note that all C2 capacitors must have the same capacitance value.
- Next turn all the power supplies ON and determine C1.

■ Application Example for LCD Module




■ Block Diagram



## 7.4 TABLE OF COMMAND

Table 16: Table of ST7565P Commands (Note) *: disabled data

| Command | Command Code | | | | | | | | | | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A0 | /RD | /WR | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| (1) Display ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0<br>1 | LCD display ON/OFF<br>0: OFF, 1: ON |
| (2) Display start line set | 0 | 1 | 0 | 0 | 1 | Display start address | | | | | | Sets the display RAM display start line address |
| (3) Page address set | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page address | | | | Sets the display RAM page address |
| (4) Column address set upper bit<br>Column address set lower bit | 0<br>0 | 1<br>1 | 0<br>0 | 0<br>0 | 0<br>0 | 0<br>0 | 1<br>0 | Most significant column address<br>Least significant column address | | | | Sets the most significant 4 bits of the display RAM column address.<br>Sets the least significant 4 bits of the display RAM column address. |
| (5) Status read | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | Reads the status data |
| (6) Display data write | 1 | 1 | 0 | Write data | | | | | | | | Writes to the display RAM |
| (7) Display data read | 1 | 0 | 1 | Read data | | | | | | | | Reads from the display RAM |
| (8) ADC select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0<br>1 | Sets the display RAM address SEG output correspondence<br>0: normal, 1: reverse |
| (9) Display normal/ reverse | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0<br>1 | Sets the LCD display normal/ reverse<br>0: normal, 1: reverse |
| (10) Display all points ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0<br>1 | Display all points<br>0: normal display<br>1: all points ON |
| (11) LCD bias set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0<br>1 | Sets the LCD drive voltage bias ratio<br>0: 1/9 bias, 1: 1/7 bias (ST7565P) |
| (12) Read/modify/write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Column address increment<br>At write: +1<br>At read: 0 |
| (13) End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | Clear read/modify/write |
| (14) Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | Internal reset |
| (15) Common output mode select | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0<br>1 | * | * | * | Select COM output scan direction<br>0: normal direction<br>1: reverse direction |
| (16) Power control set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operating mode | | | Select internal power supply operating mode |
| (17) V0 voltage regulator internal resistor ratio set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Resistor ratio | | | Select internal resistor ratio(Rb/Ra) mode |
| (18) Electronic volume mode set<br>Electronic volume register set | 0 | 1 | 0 | 1<br>0 | 0<br>0 | 0<br>Electronic volume value | 0 | 0 | 0 | 0 | 1 | Set the V0 output voltage electronic volume register |
| (19) Static indicator ON/OFF<br>Static indicator register set | 0 | 1 | 0 | 1<br>0 | 0<br>0 | 1<br>0 | 0<br>0 | 1<br>0 | 1<br>0 | 0<br>0 | 0<br>1<br>Mode | 0: OFF, 1: ON<br>Set the flashing mode |
| (20) Booster ratio set | 0 | 1 | 0 | 1<br>0 | 1<br>0 | 1<br>0 | 1<br>0 | 1<br>0 | 0<br>0 | 0<br>step-up value | 0 | select booster ratio<br>00: 2x,3x,4x<br>01: 5x<br>11: 6x |
| (21) Power saver | | | | | | | | | | | | Display OFF and display all points ON compound command |
| (22) NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | Command for non-operation |
| (23) Test | 0 | 1 | 0 | 1 | 1 | 1 | 1 | * | * | * | * | Command for IC test. Do not use this command |

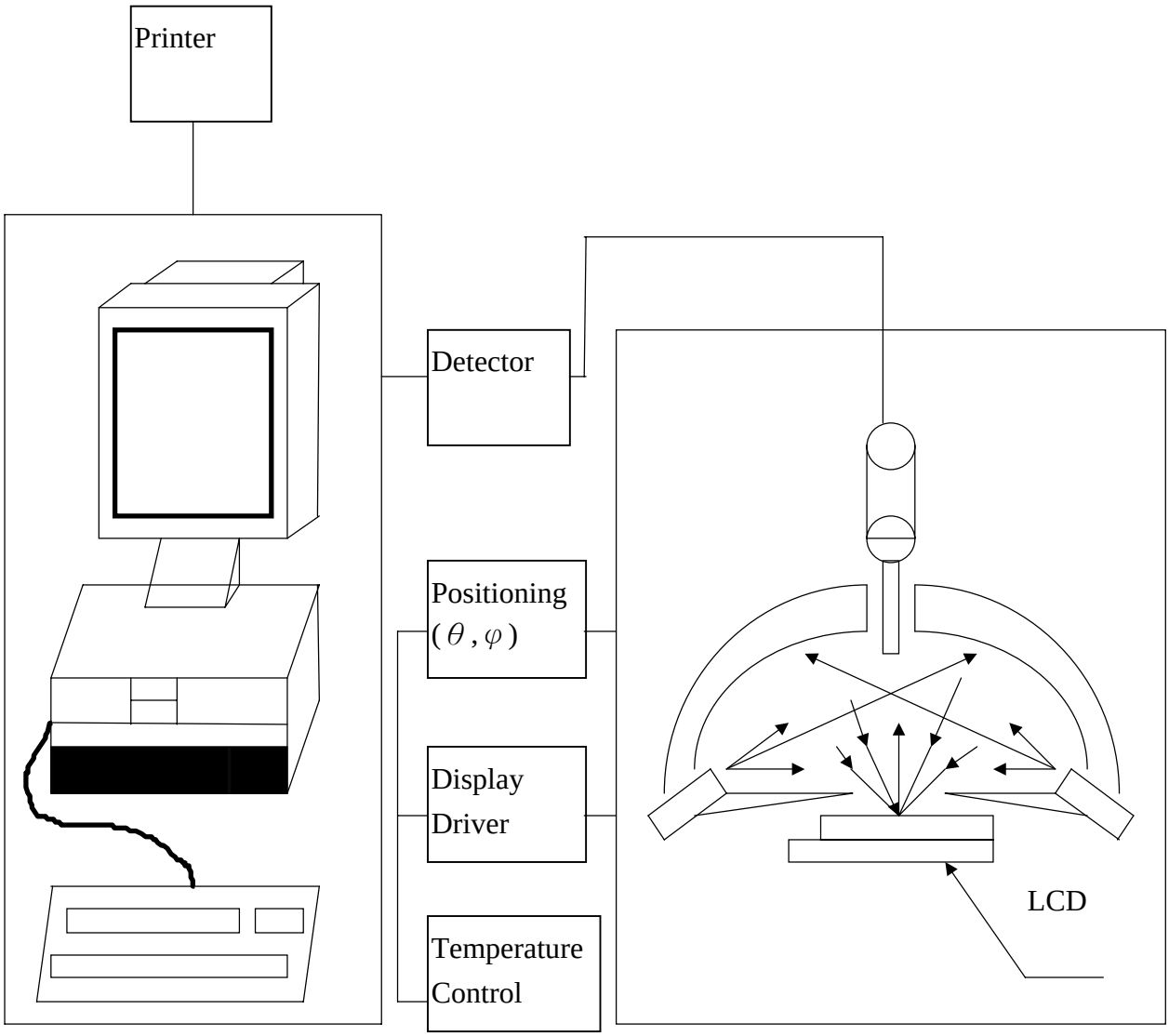
# 8. ELECTRO-OPTICAL CHARACTERISTICS

| Item | Symbol | Condition | Temp | Min | Typ. | Max | Units | Note |
|---|---|---|---|---|---|---|---|---|
| LCD driving voltage | $V_{LCD}$ | $\theta = \phi = 0$ | 0℃ | --- | 6.2 | --- | V | NOTE1 |
| | | | 25℃ | 5.7 | 6.0 | 6.3 | | |
| | | | 50℃ | --- | 5.8 | --- | | |
| Response Time | Rise Time (Tr) | $\theta = \phi = 0$ | 0℃ | --- | --- | -- | msec | NOTE2 |
| | Decay Time (Tf) | | | --- | ---- | --- | | |
| | Rise Time (Tr) | | 25℃ | --- | 225 | 340 | | |
| | Decay Time (Tf) | | | --- | 240 | 360 | | |
| | Rise Time (Tr) | | 50℃ | --- | --- | -- | | |
| | Decay Time (Tf) | | | --- | --- | -- | | |
| Contrast Ratio | Cr | $\theta = \phi = 0$ | 25℃ | 5 | 10 | --- | --- | NOTE4 |

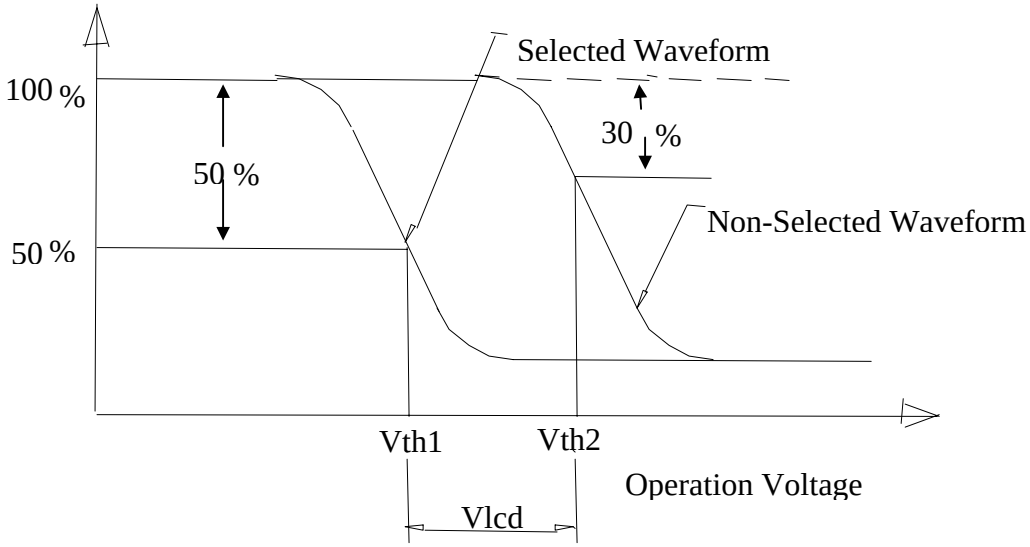
| Viewing Angle Range | $\theta$ ( $\phi$ = 0°) (6”) | $\phi$ = 90° (3”) | $\phi$ =180° (12”) | $\phi$ =270° (9”) | 備註 |
|---|---|---|---|---|---|
| $\theta$ (25℃) CR≥2 | 50 | 30 | 30 | 25 | Deg NOTE3 |

● For panel only

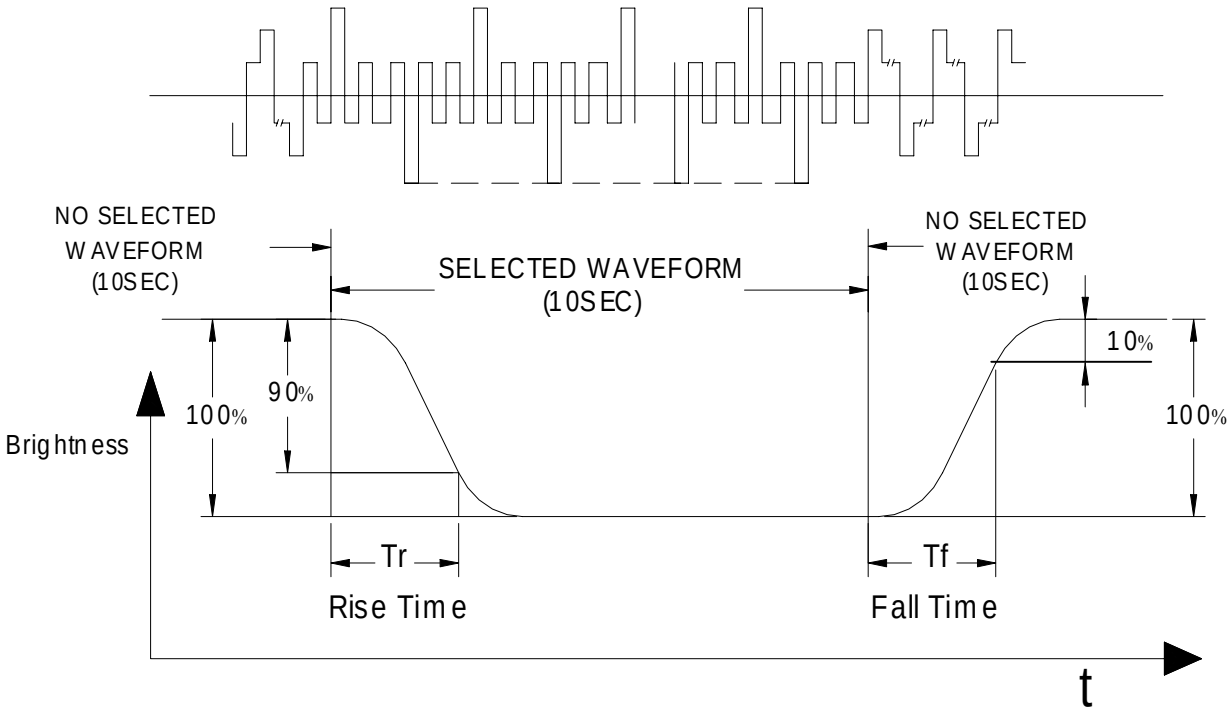
- **Electro-Optical Characteristics Measuring Equipment(DMS501)**



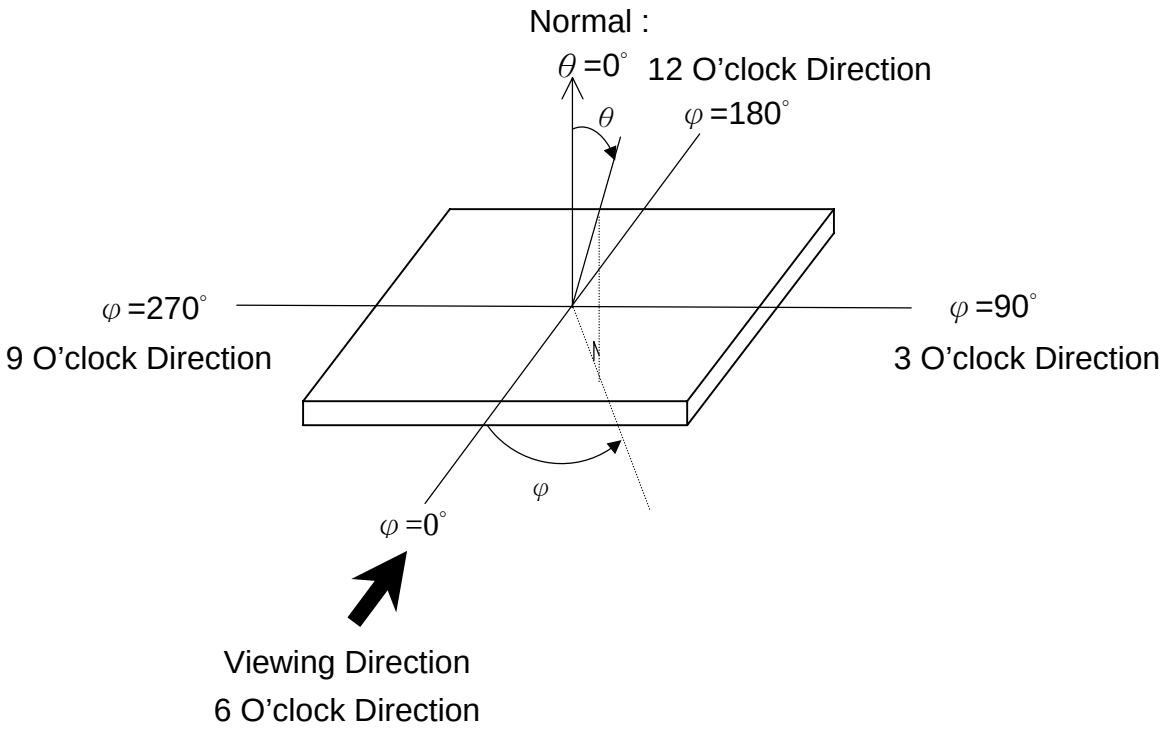
- **Note 1. Definition of Driving Voltage( Vlcd) :**




- **Note 2. Definition of Optical Response Time :**

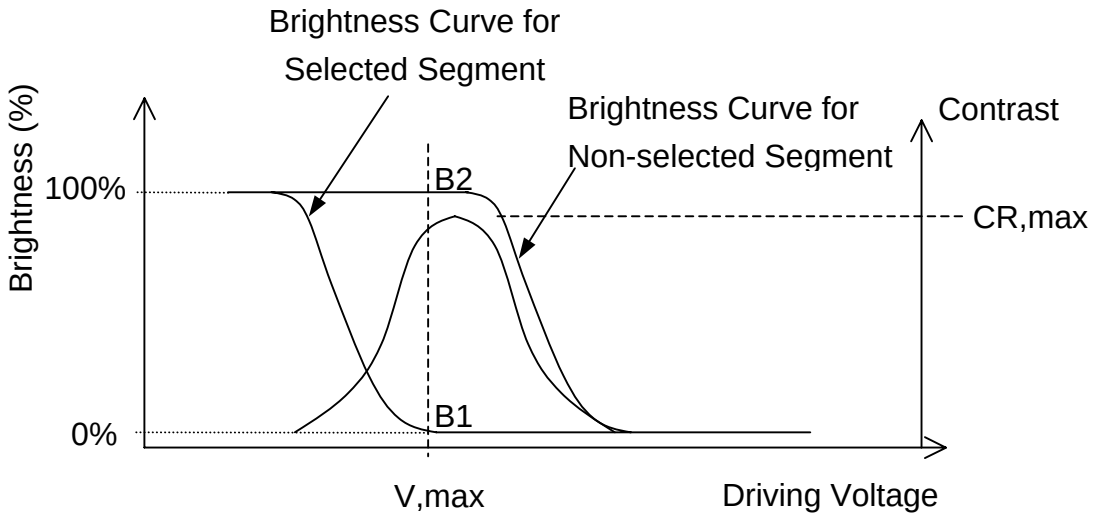


## • Note 3. Definition of Viewing Angle $\theta$ and $\phi$ :




## • Note 4. Definition of Contrast ratio( CR) :

$$CR = \frac{\text{Brightness of Non-selected Segment (B2)}}{\text{Brightness of Selected Segment (B1)}}$$



# 9. RELIABILITY

## 9.1. MTBF

The LCD module shall be designed to meet a minimum MTBF value of 50000 hours with normal. (25°C in the room without sunlight)

## 9.2. TESTS

| NO. | ITEM | CONDITION | CRITERION |
|---|---|---|---|
| 1 | High Temperature Operating | 70°C 120Hrs | 。No Defect Of Operational Function In Room Temperature Are Allowable.<br>。IDD of LCM in Pre-and post-test should follow specification |
| 2 | Low Temperature Operating | -25°C 120Hrs | |
| 3 | High Temperature/ Humidity Non-Operating | 60°C ,90%RH ,120 Hrs | |
| 4 | High Temperature Non-Operating | 85°C 120Hrs | |
| 5 | Low Temperature Non-Operating | -40°C 120Hrs | |
| 6 | Temperature Cycling Non-Operating | -40°C(30Min )↔ 85°C(30Min) 10 CYCLES | |

Notes: Judgments should be mode after exposure in room temperature for two hours.

| | | | |
|---|---|---|---|
| 7 | ESD Test | Contact Discharges : ±4KV;<br>Air Discharges : ±8KV;<br>2 pcs | 。When turning on power again, No abnormalities in functions |

# 10. PRECAUTIONS FOR USING LCD MODULES

## 10.1. HANDLING PRECAUTIONS

(1) The display panel is made of glass. Do not subject it to a mechanical shock or impact by dropping it.

(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 a 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) Extra care to minimize corrosion of the electrode. Water droplets, moisture condensation or a current flow in a high-humidity environment accelerates corrosion of the electrode.

(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 I/O 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 he LCD Module.
- 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.

## 10.2. STORAGE CONDITIONS

When storing, avoid the LCD module to be exposed to direct sunlight of fluorescent lamps. For stability, to keep it away form high temperature and high humidity environment (The best condition is : 23±5°C, 45±20%RH). ESD protection is necessary for long-term storage also.

## 10.3. 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 Module 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 recovered 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 Module 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.

# 11. Using LCD modules

## 11.1 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 a 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, toluene, ethanol and isopropyl alcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum ether. 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 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 determinate 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.

## 11.2 INSTALLING LCD MODULE

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.

## 11.3 ELECTRO-STATIC DISCHARGE CONTROL

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

(1) Make certain that you are grounded when handing LCM.
(2) Before removing 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 workbenches to the ground potential.
(6) To reduce the generation of electro-static discharge, be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

## 11.4 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 will shorten its lifetime.
(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 on.
(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, this product must be used and stored within the specified condition of 23±5°C, 45±20%RH.
(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.

## 11.5 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.

# 12. REVISION HISTORY

| Version | Revise record | Date |
|---|---|---|
| 1.0 | Original version | 06-02-01 |
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# SAMPLE APPROVED REPORT

## (样品确认单)

| | |
|---|---|
| SAMPLE MODEL NO. (样品型号) | GT8002 |
| SAMPLE SERIES NUMBER NO. (样品序号) | |
| SAMPLE QUANTITY (样品数量) | |
| COLOR/TYPE (底色/类型) | FSTN/POSITIVE |
| VIEWING DIRECTION (视角) | 6:00 |
| DRIVING METHOD (驱动参数) | 1/33Duty, 1/6Bias |
| LOGIC VOLTAGE (IC 工作电压) | 3.3V |
| LCD VOP (LCD 驱动电压) | 6.0V |
| OPERATING TEMP. (操作温度) ℃ | -25~70 |
| STORAGE TEMP. (储存温度) ℃ | -40~85 |
| POLARIZER----FRONT (首偏光片) | TRANSMISSIVE |
| POLARIZER----BACK (后偏光片) | TRANSFLECTIVE |
| CONTROLLER/DRIVER IC(控制/驱动 IC) | ST7565P |
| BACKLIGHT COLOR/TYPE (背光源类型/颜色) | LED/White |
| DRAWING REV/NO./QUANTITY (图纸版本/数量) | REV: 1 / BETB: 1 |
| SPECIFICATION (规格书 份数) | BETB: 1 |

REMARKS：
(备注)
WRIT BY：_____ DATE：_____ APROV BY：_____ DATE：_____

CUSTOMER'S APPROVAL (客户确认)：

1） FUNCTION （功能）： ☐ OK ☐ N.G.

2） DRIVER CONDITION （驱动条件）： ☐ OK ☐ N.G.

3） DISPLAY MODE （显示模式）： ☐ OK ☐ N.G.

4） VIEWING ANGLE （视角）： ☐ OK ☐ N.G.

5） BACKLIGHT （背光源）： ☐ OK ☐ N.G.

6） DISPLAYING PATTERN （显示效果）： ☐ OK ☐ N.G.

CUSTOMER'S CONCLUSIONS (客户意见)：_____

_____

_____

CUSTOMER'S SIGNATURE（客户签名）：_____ DATE (日期)：_____