# Graphic Display Module

## Part Number

G126FLGFGS164T33XAR

## Overview

128x64(80x54), FSTN, Gray background, RGB edge light, Bottom view, Super wide Temp (-30°C ~ +80°C), Transflective (positive), 3.3V LCD, 3.3V LED, Controller=ST7565P, RoHS Compliant
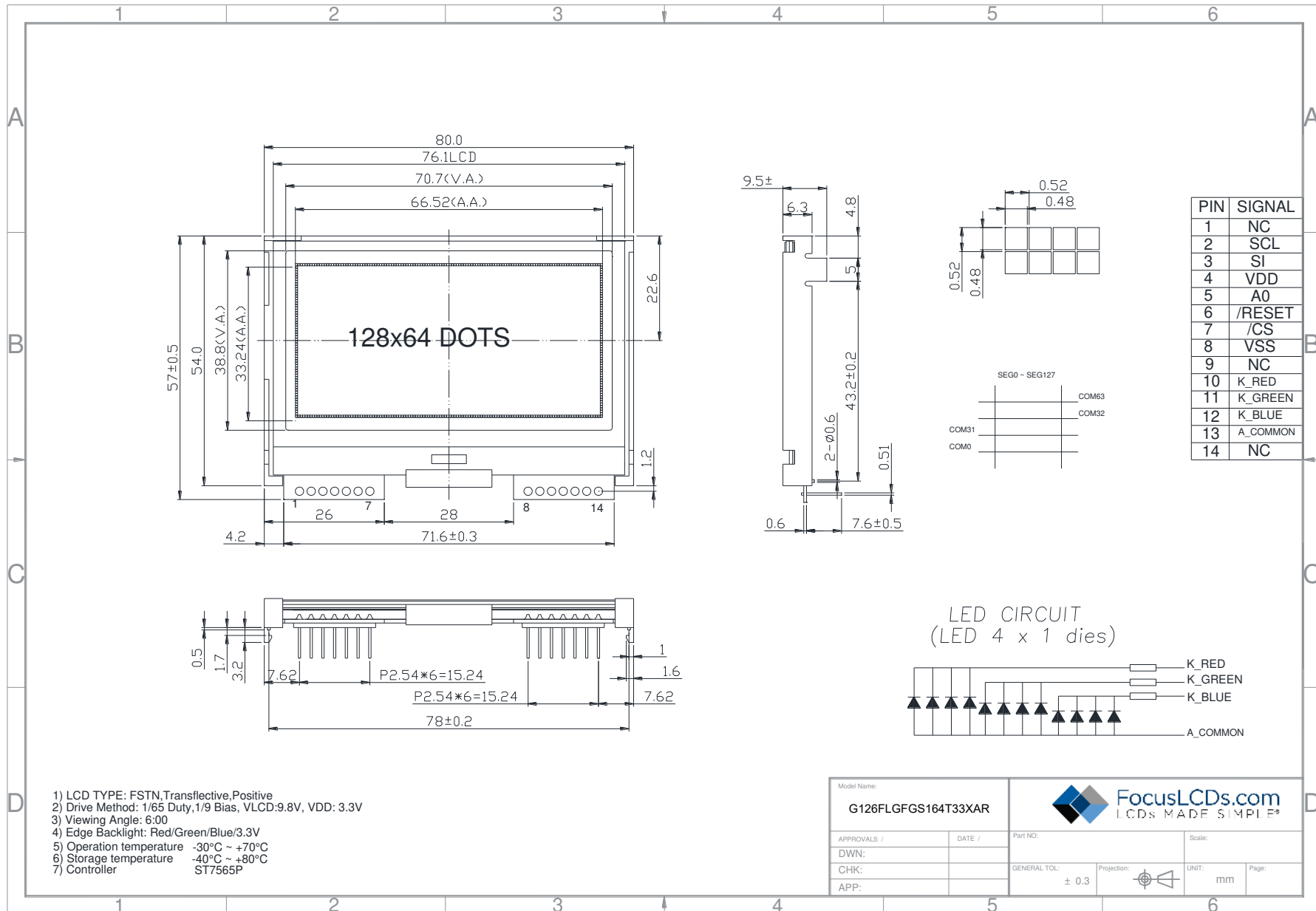
# 1.Features

1.  128X64 dots
2.  Built-in controller (ST7565P)
3.  +3.3V power supply
4.  1/64 duty cycle;1/9bias
5.  BKL to be driven by A, K.

| LCD type | ☑FSTN positive | | ☐FSTN Negative | |
|---|---|---|---|---|
| | ☐STN Yellow Green | | ☐STN Gray | ☐STN-Blue |
| View direction | ☑6 O'clock | | ☐12 O'clock | |
| Rear Polarizer | ☐Reflective | | ☑Transflective | ☐Transmissive |
| Backlight Type | ☑ LED Edge | ☐EL | ☐Internal Power | ☑3.3V input |
| | ☐LED Array | ☐CCFL | ☑External Power | ☐4.2V input |
| Backlight Color | ☑RGB | ☐Amber | ☐Blue-Green | ☐Yellow-Green |
| Temperature Range | ☐Normal | | ☑Wide | ☐Super Wide |
| DC to DC circuit | ☑Build-in | | ☐Not Build-in | |
| El Driver IC | ☐Build-in | | ☑Not Build-in | |
| Touch screen | ☐With | | ☐Without | |
| Font type | ☑English-Japanese | ☐English-European | ☐English-Russian | ☐other |

# 2. MECHANICAL SPECIFICATIONS

| | |
|---|---|
| Module size | 80.0mm(L)*54.0mm(W)* Max9.5(H)mm |
| Viewing area | 70.7mm(L)*38.8mm(W) |
| Dots size | 0.48mm(L)*0.48mm(W) |
| Dots pitch | 0.52mm(L)*0.52mm(W) |
| Weight | Approx. |

# 3. **Outline dimension**

80.0
76.1LCD
70.7(V.A.)
66.52(A.A.)

22.6

57±0.5
54.0
38.8(V.A.)
33.24(A.A.)

128x64 DOTS

1.2

1 26 7
28
8 14

4.2
71.6±0.3

9.5±
6.3
4.8
5

43.2±0.2
2-∅0.6
0.51
0.6
7.6±0.5

0.52
0.48
0.52
0.48

SEG0 ~ SEG127
COM63
COM32
COM31
COM32
COM0

| PIN | SIGNAL |
|-----|--------|
| 1 | NC |
| 2 | SCL |
| 3 | SI |
| 4 | VDD |
| 5 | A0 |
| 6 | /RESET |
| 7 | /CS |
| 8 | VSS |
| 9 | NC |
| 10 | K_RED |
| 11 | K_GREEN |
| 12 | K_BLUE |
| 13 | A_COMMON |
| 14 | NC |

0.5
1.7
3.2
7.62
P2.54*6=15.24
P2.54*6=15.24
1
1.6
7.62
78±0.2

LED CIRCUIT
(LED 4 x 1 dies)

K_RED
K_GREEN
K_BLUE
A_COMMON

1) LCD TYPE: FSTN,Transflective,Positive
2) Drive Method: 1/65 Duty,1/9 Bias, VLCD:9.8V, VDD: 3.3V
3) Viewing Angle: 6:00
4) Edge Backlight: Red/Green/Blue/3.3V
5) Operation temperature  -30°C ~ +70°C
6) Storage temperature    -40°C ~ +80°C
7) Controller             ST7565P

Model Name:

G126FLGFGS164T33XAR

FocusLCDs.com
LCDs MADE SIMPLE®

| APPROVALS / | | DATE / | Part NO: | | | Scale: | |
|-------------|--|--------|----------|--|--|--------|--|
| DWN: | | | | | | | |
| CHK: | | | GENERAL TOL: | Projection: | | UNIT: | Page: |
| APP: | | | ± 0.3 | | | mm | |

# 4. Absolute maximum ratings

| Item | Symbol | Standard | | | Unit |
|---|---|---|---|---|---|
| Power voltage | $V_{DD}$-$V_{SS}$ | 0 | - | 3.5 | V |
| Input voltage | $V_{IN}$ | VSS | - | VDD | |
| Operating temperature range | $V_{OP}$ | -30 | - | +70 | ℃ |
| Storage temperature range | $V_{ST}$ | -40 | - | +80 | |

# 5.Interface pin description

| Pin no. | Symbol | External connection | Function |
|---|---|---|---|
| 1 | NC | | NC |
| 2 | SCL | MPU | Serial clock input |
| 3 | SI | MPU | Serial data input |
| 4 | $V_{DD}$ | Power supply | Signal ground for logic (+3.3V) |
| 5 | A0 | MPU | Register select signal |
| 6 | /RESET | MPU | Controller reset (module reset) |
| 7 | /CS | MPU | Used to enter chip select signal |
| 8 | $V_{SS}$ | Power supply | Power supply for LCM (GND) |
| 9 | NC | | |
| 10 | K-RED | Power supply for BKL | LED red K |
| 11 | K-GREEN | | LED green K |
| 12 | K-BLUE | | LED blue K |
| 13 | A_COMMON | | Common cathode |
| 14 | NC | | NC |

# 6. Optical characteristics

STN type display module (Ta=25℃, VDD=3.3V)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Viewing angle | $\theta$ | $C_r \geqslant 2$ | -60 | - | 35 | deg |
| | $\Phi$ | | -40 | - | 40 | |
| Contrast ratio | $C_r$ | | - | 6 | - | - |
| Response time (rise) | $T_r$ | - | - | 150 | 250 | ms |
| Response time (fall) | $T_r$ | - | - | 150 | 250 | |

# 7. Electrical characteristics

DC characteristics

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|-----------|--------|-----------|------|------|------|------|
| Supply voltage for LCD | $V_{DD}-V_0$ | Ta =25℃ | - | 9.8 | - | V |
| Input voltage | $V_{DD}$ | | 2.4 | - | 3.3 | |
| Supply current | $I_{DD}$ | Ta=25℃, $V_{DD}$=3.3V | - | - | 147 | uA |
| Input leakage current | $I_{LKG}$ | | - | - | 1.0 | uA |
| "H" level input voltage | $V_{IH}$ | | 2.2 | - | $V_{DD}$ | |
| "L" level input voltage | $V_{IL}$ | Twice initial value or less | 0 | - | 0.6 | |
| "H" level output voltage | $V_{OH}$ | LOH=-0.5mA | 2.4 | - | - | |
| "L" level output voltage | $V_{OL}$ | LOH=0.5mA | - | - | 0.4 | V |
| Forward voltage | Red $V_F$ | Ta =25℃  If=40mA | 1.8 | - | 2.4 | |
| | Green $V_F$ | Ta =25℃  If=60mA | 2.8 | - | 3.4 | |
| | Blue $V_F$ | Ta =25℃  If=60mA | 2.8 | - | 3.4 | |

# 8. Absolute Maximum Ratings

(Unless otherwise noted, VSS=0V)

| Parameter | | Symbol | Conditions | Unit |
|-----------|---|--------|-----------|------|
| Power Supply Voltage | | VDD | -0.3 to +3.6 | V |
| Power supply voltage (3) (VDD standard) | | V5, Vout | -13.0 to +0.3 | V |
| Power supply voltage (4) (VDD standard) | | V1,V2,V3,V4 | V5 to +0.3 | V |
| Input Voltage | | Vin | -0.3 to VDD+0.3 | V |
| Output voltage | | Vo | -0.3 to VDD+0.3 | V |
| Operating Temp. | | Topr | -40 to 80 | C |
| Storage Temp. | Bare chip | Tstr | -40 to +80 | C |



VDD — VDD — VDD

GND — VSS — VSS2, V1 to V4

V5, Vout

System MPU) side     ST7565 chip side
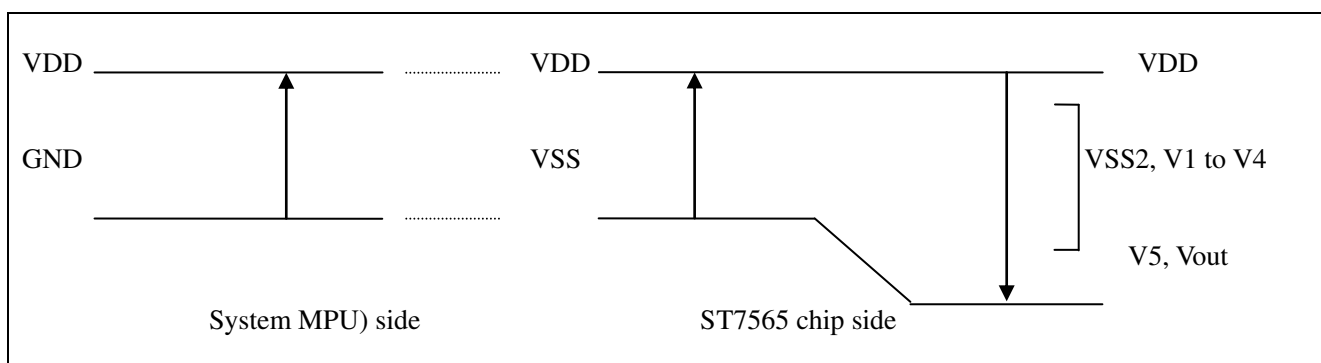
# 9. Timing Characteristics

**The Serial Interface**
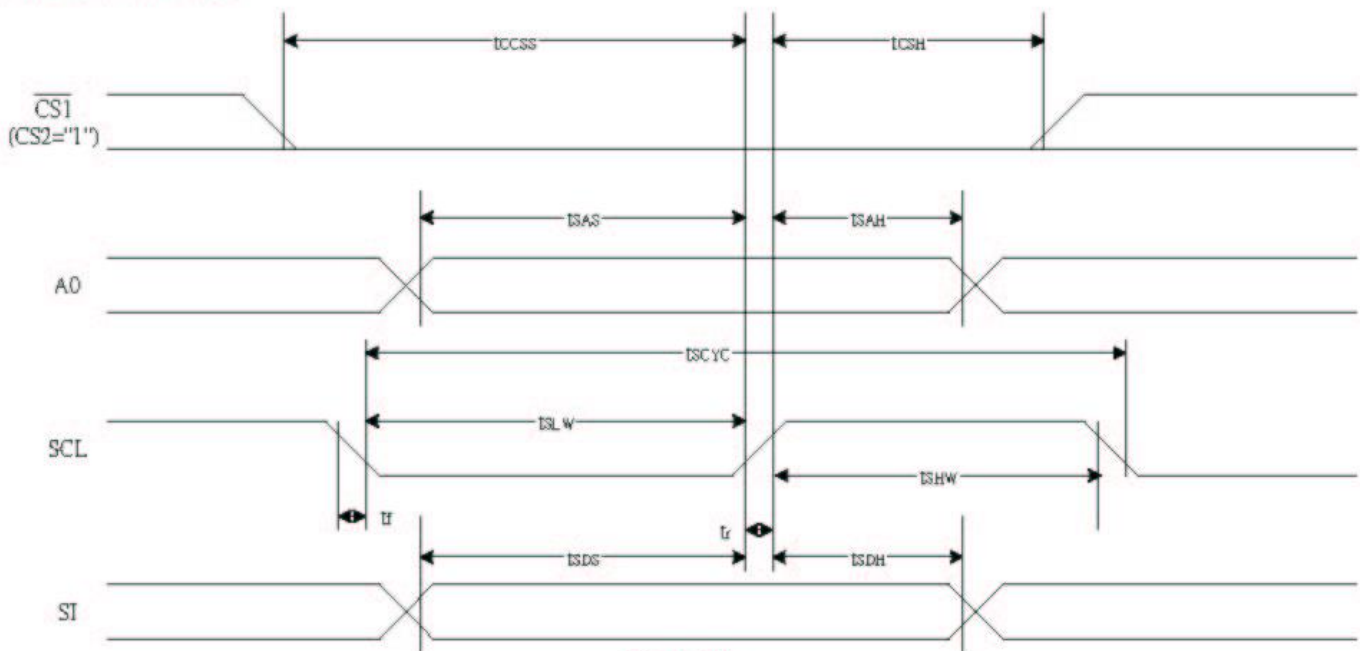


Figure 39

### Table 30

(VDD = 3.3V, Ta = −30 to 85°C)

| Item | Signal | Symbol | Condition | Rating Min. | Rating Max. | Units |
|------|--------|--------|-----------|------|------|-------|
| Serial Clock Period | | $T_{scyc}$ | | 50 | — | |
| SCL "H" pulse width | SCL | $T_{shw}$ | | 25 | — | |
| SCL "L" pulse width | | $T_{SLW}$ | | 25 | — | |
| Address setup time | A0 | $T_{SAS}$ | | 20 | — | |
| Address hold time | | $T_{sah}$ | | 10 | — | ns |
| Data setup time | SI | $T_{sds}$ | | 20 | — | |
| Data hold time | | $T_{SDH}$ | | 10 | — | |
| CS-SCL time | CS | $T_{css}$ | | 20 | — | |
| CS-SCL time | | $T_{csh}$ | | 40 | — | |

### Table 31

(VDD = 2.7V, Ta = −30 to 85°C)

| Item | Signal | Symbol | Condition | Rating Min. | Rating Max. | Units |
|------|--------|--------|-----------|------|------|-------|
| Serial Clock Period | | $T_{scyc}$ | | 100 | — | |
| SCL "H" pulse width | SCL | $T_{SHW}$ | | 50 | — | |
| SCL "L" pulse width | | $T_{SLW}$ | | 50 | — | |
| Address setup time | A0 | $T_{SAS}$ | | 30 | — | |
| Address hold time | | $T_{SAH}$ | | 20 | — | ns |
| Data setup time | SI | $T_{SDS}$ | | 30 | — | |
| Data hold time | | $T_{SDH}$ | | 20 | — | |
| CS-SCL time | CS | $T_{CSS}$ | | 30 | — | |
| CS-SCL time | | $T_{CSH}$ | | 60 | — | |

# 10. Table of LCM commands

| Command | A0 | /RD | /WR | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Display ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0/1 | LCD display ON/OFF 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 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Most significant column address | | | | Sets the most significant 4 bits of the display RAM column address. |
| Column address set lower bit | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Least significant column address | | | | 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 | 0/1 | Sets the display RAM address SEG output correspondence 0: normal, 1: reverse |
| (9) Display normal/reverse | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0/1 | Sets the LCD display normal/reverse 0: normal, 1: reverse |
| (10) Display all points ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0/1 | Display all points 0: normal display 1: all points ON |
| (11) LCD bias set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0/1 | Sets the LCD drive voltage bias ratio 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 At write: +1 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 | 0/1 | * | * | * | Select COM output scan direction 0: normal direction 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 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set the V0 output voltage electronic volume register |
| Electronic volume register set | | | | 0 | 0 | Electronic volume value | | | | | | |
| (19) Static indicator ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0/1 | 0: OFF, 1: ON |
| Static indicator register set | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mode | Set the flashing mode |
| (20) Booster ratio set | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | step-up value | | |
| (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 |

# 11.QUALITY SPECIFICATIONS

## 11.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps. Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.

Fluorescent Lamps

30cm min

100cm min

45° 45°

LCM    LCD
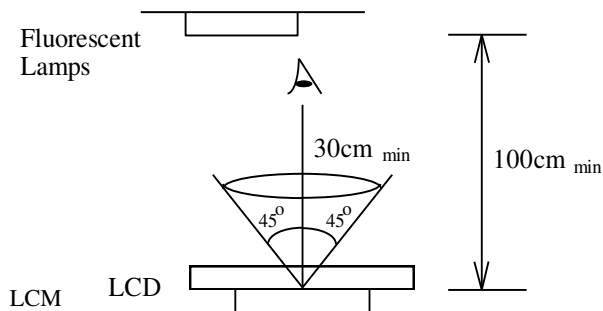
Definition of zone:
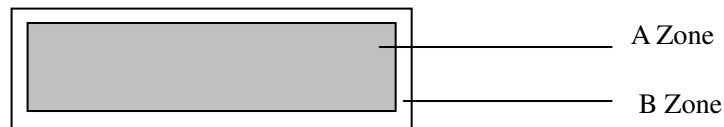
A Zone

B Zone

A Zone:   Active display area (minimum viewing area).
B Zone:   Non-active display area (outside viewing area).

## 11.2 Specification of quality assurance
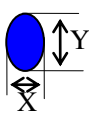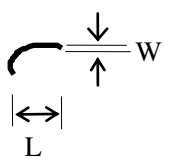
AQL inspection standard
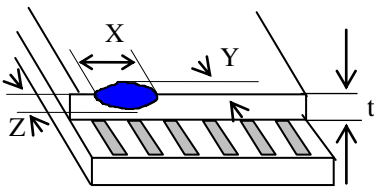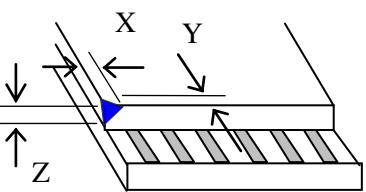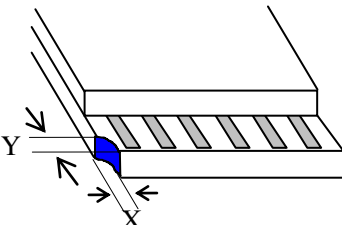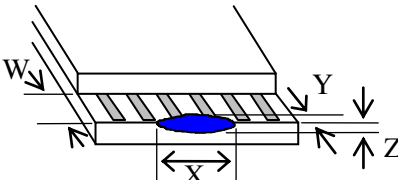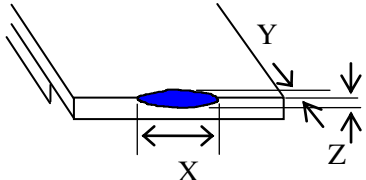
Sampling method: MIL-STD-105E, Level II, single sampling
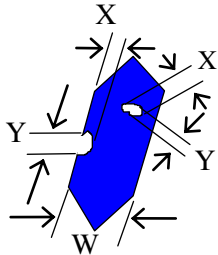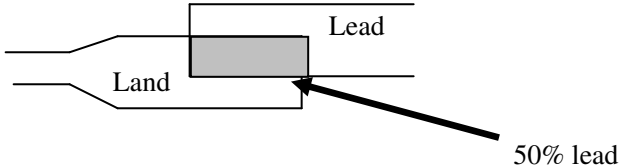
Defect classification   **(Note: * is not including)**
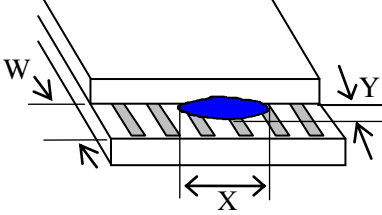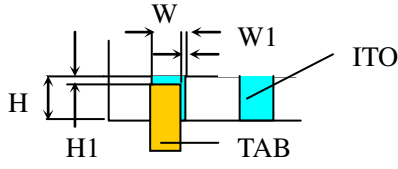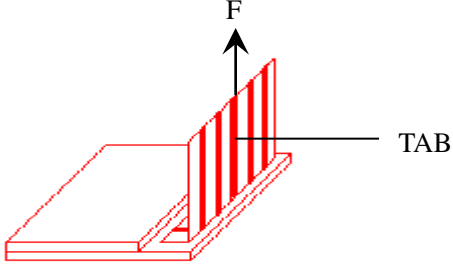
| Classify | Item | | Note | AQL |
|---|---|---|---|---|
| Major | Display state | Short or open circuit | 1 | 0.65 |
| | | LC leakage | | |
| | | Flickering | | |
| | | No display | | |
| | | Wrong viewing direction | | |
| | | Contrast defect (dim, ghost) | 2 | |
| | | Back-light | 1,8 | |
| | Non-display | Flat cable or pin reverse | 10 | |
| | | Wrong or missing component | 11 | |
| Minor | Display state | Background color deviation | 2 | 1.0 |
| | | Black spot and dust | 3 | |
| | | Line defect, Scratch | 4 | |
| | | Rainbow | 5 | |
| | | Chip | 6 | |
| | | Pin hole | 7 | |
| | | Protruded | 12 | |
| | Polarizer | Bubble and foreign material | 3 | |
| | Soldering | Poor connection | 9 | |
| | Wire | Poor connection | 10 | |
| | TAB | Position, Bonding strength | 13 | |

**Note on defect classification**

| No. | Item | Criterion |
|-----|------|-----------|
| 1 | Short or open circuit | Not allow |
| | LC leakage | |
| | Flickering | |
| | No display | |
| | Wrong viewing direction | |
| | Wrong Back-light | |
| 2 | Contrast defect | Refer to approval sample |
| | Background color deviation | |
| 3 | Point defect, Black spot, dust (including Polarizer)  $\phi = (X+Y)/2$ |  |
| 4 | Line defect, Scratch |  |
| 5 | Rainbow | Not more than two color changes across the viewing area. |

For item 3:

| Point Size | Acceptable Qty. |
|-----------|-----------------|
| $\phi < 0.10$ | Disregard |
| $0.10 < \phi \leq 0.20$ | 3 |
| $0.20 < \phi \leq 0.25$ | 2 |
| $0.25 < \phi \leq 0.30$ | 1 |
| $\phi > 0.30$ | 0 |

Unit: mm

For item 4:

| Line | | Acceptable Qty. |
|------|------|-----------------|
| L | W | |
| --- | $0.015 \geq W$ | Disregard |
| $3.0 \geq L$ | $0.03 \geq W$ | 2 |
| $2.0 \geq L$ | $0.05 \geq W$ | |
| $1.0 \geq L$ | $0.1 > W$ | 1 |
| --- | $0.05 < W$ | Applied as point defect |

Unit: mm

| No | Item | Criterion |
|---|---|---|
| 6 | Chip<br><br>Remark:<br>  X: Length direction<br>  Y: Short direction<br>  Z: Thickness direction<br>  t: Glass thickness<br>  W: Terminal Width | Acceptable criterion<br><br>Acceptable criterion<br><br>Acceptable criterion<br><br>Acceptable criterion<br><br>Acceptable criterion |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| ≤2 | 0.5mm | ≤t/2 |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| ≤2 | 0.5mm | ≤t |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| ≤3 | ≤2 | ≤t |
| shall not reach to ITO | | |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| Disregard | ≤0.2 | ≤t |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| ≤5 | ≤2 | ≤t/3 |

| No. | Item | Criterion |
|---|---|---|
| 7 | Segment pattern<br>W = Segment width<br>$\phi = (X+Y)/2$ | (1) Pin hole<br><br>$\phi < 0.10mm$ is acceptable.<br><br>X X Y Y W<br><br>| Point Size | Acceptable Qty |<br>|---|---|<br>| $\phi \leqslant 1/4W$ | Disregard |<br>| $1/4W < \phi \leqslant 1/2W$ | 1 |<br>| $\phi > 1/2W$ | 0 |<br><br>Unit: mm |
| 8 | Back-light | (1)  The color of backlight should correspond its specification.<br>(2)  Not allow flickering |
| 9 | Soldering | (1)  Not allow heavy dirty and solder ball on PCB.<br>(The size of dirty refer to point and dust defect)<br>(2)  Over 50% of lead should be soldered on Land.<br><br>Lead<br>Land<br>50% lead |
| 10 | Wire | (1)  Copper wire should not be rusted<br>(2)  Not allow crack on copper wire connection.<br>(3)  Not allow reversing the position of the flat cable.<br>(4)  Not allow exposed copper wire inside the flat cable. |
| 11* | PCB | (1)  Not allow screw rust or damage.<br>(2)  Not allow missing or wrong putting of component. |

| No | Item | Criterion |
|----|------|-----------|
| 12 | Protruded<br><br>W: Terminal Width | <br>Acceptable criteria:<br>$Y \leq 0.4$ |
| 13 | TAB | 1. Position<br><br><br>$W1 \leq 1/3W$<br>$H1 \leq 1/3H$<br><br>2  TAB bonding strength test<br><br><br><br>P (=F/TAB bonding width)  $\geq 650$gf/cm ,(speed rate: 1mm/min)<br>5pcs per SOA (shipment) |
| 14 | Total no. of acceptable Defect | A. Zone<br><br>  Maximum 2 minor non-conformities per one unit.<br><br>  Defect distance: each point to be separated over 10mm<br><br>B. Zone<br><br>  It is acceptable when it is no trouble for quality and assembly<br><br>  in customer's end product. |

## 11.3 Reliability of LCM

Reliability test condition:

| Item | Condition | Time (hrs) | Assessment |
|---|---|---|---|
| High temp. Storage | 80°C | 48 | |
| High temp. Operating | 70°C | 48 | |
| Low temp. Storage | -30°C | 48 | No abnormalities in functions and appearance |
| Low temp. Operating | -20°C | 48 | |
| Humidity | 40°C/ 90%RH | 48 | |
| Temp. Cycle | 0°C ← 25°C →50°C (30 min ← 5 min → 30min) | 10cycles | |

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20$\pm$8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

## 11.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

**General Precautions:**
1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting Focus LCDs
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

**Static Electricity Precautions:**
1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and

the interface terminals with any parts of the human body.

3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

## Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: $280°C\pm10°C$
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

## Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%,and avoid direct sunlight.