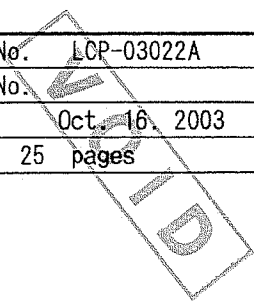


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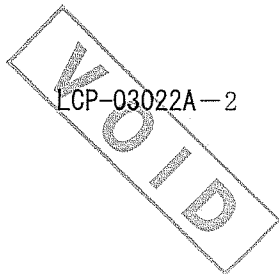
**SPECIFICATION**

DEVICE SPECIFICATION FOR  
**CG-Silicon TFT-LCD module**  
MODEL No. LS040V7DD92

CUSTOMER'S APPROVAL

DATA \_\_\_\_\_

BY \_\_\_\_\_



(1) Application

This literature applies to L S O 4 0 V 7 D D 9 2

(2) Overview

This module is a color transfective and active matrix LCD module incorporating CG-Silicon TFT (Continuous Grain-Silicon Thin Film Transistor), named AD-TFT (Advanced TFT). It is composed of a color TFT-LCD panel, driver ICs, an FPC, a back light, a touch panel and a back sealed casing. It isn't composed control circuit. Graphics and texts can be displayed on a 480×3×640 dots panel with 262,144 colors by supplying.

This LCD module has multi resolution and multi colors functions. A resolution mode is selective in VGA (480H×640V) or QVGA(240H×320V). A Color mode is selective in 262,144 colors (18bit RGB) or 8 colors (3bit RGB).

Optimum view angle is 6 o'clock. An inverted display mode is selective in the vertical and the horizontal direction.

(3) Mechanical specifications

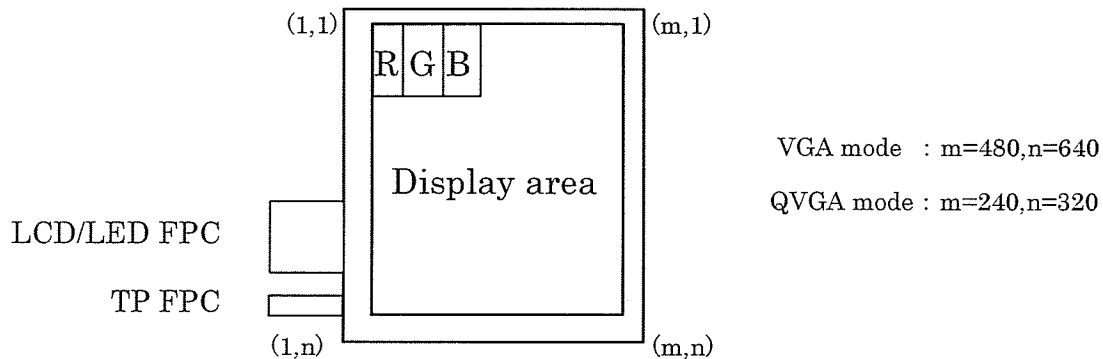
Table 1

| Parameter                         | Specifications                          | Units  | Remarks   |
|-----------------------------------|---|--------|-----------|
| Screen size (Diagonal)            | 10.0 [4.0" ] Diagonal                   | cm     |           |
| Display active area               | 60.48 (H) × 80.64 (V)                   | mm     |           |
| Touch panel active area           | 61.50×81.60                             | mm     |           |
| Pixel format                      | 480(H)×640(V)<br>(1 pixel = R+G+B dots) | pixels |           |
| Pixel pitch                       | 0.042 (H) × 0.126 (V)                   | mm     |           |
| Pixel configuration               | R,G,B vertical stripe                   |        |           |
| Unit outline dimension            | 69.3(W)×96.0(H)×4.2(D)                  | mm     | 【Note3-1】 |
| Mass                              | Typ.57, Max.62                          | g      |           |
| Surface hardness<br>(Touch panel) | 3H                                      |        |           |

【Note 3-1】

Excluding protrusion. For detailed measurements and tolerances, please refer to Fig. 1.

(4)Pixel configuration



## (5)Input/Output terminal

## 5-1)TFT-LCD panel and Touch panel driving section

Table2

| Pin No. | Symbol | I/O | Description   | Remarks   |
|---------|--------|-----|---|-----------|
| 1       | GVSS   | —   | Power supply of driver (low level2)                     |           |
| 2       | GND    | —   | Ground  |           |
| 3       | GND    | —   | Ground  |           |
| 4       | INI    | I   | Control signal of driver                                | 【Note5-1】 |
| 5       | SPS    | I   | Start signal of gate driver                             |           |
| 6       | CLS    | I   | Clock signal of gate driver                             |           |
| 7       | MO     | I   | Selection for resolution (VGA or QVGA)                  | 【Note5-2】 |
| 8       | U/L    | I   | Selection for vertical scanning direction               | 【Note5-3】 |
| 9       | R0     | I   | RED data signal (LSB)                                   |           |
| 10      | R1     | I   | RED data signal   |           |
| 11      | R2     | I   | RED data signal   |           |
| 12      | R3     | I   | RED data signal   |           |
| 13      | R4     | I   | RED data signal   |           |
| 14      | R5     | I   | RED data signal (MSB)                                   |           |
| 15      | G0     | I   | GREEN data signal (LSB)                                 |           |
| 16      | G1     | I   | GREEN data signal                                       |           |
| 17      | G2     | I   | GREEN data signal                                       |           |
| 18      | G3     | I   | GREEN data signal                                       |           |
| 19      | G4     | I   | GREEN data signal                                       |           |
| 20      | G5     | I   | GREEN data signal (MSB)                                 |           |
| 21      | B0     | I   | BLUE data signal (LSB)                                  |           |
| 22      | B1     | I   | BLUE data signal  |           |
| 23      | B2     | I   | BLUE data signal  |           |
| 24      | B3     | I   | BLUE data signal  |           |
| 25      | B4     | I   | BLUE data signal  |           |
| 26      | B5     | I   | BLUE data signal (MSB)                                  |           |
| 27      | VSSD   | —   | Power supply of driver (low level1)                     | 【Note5-4】 |
| 28      | GND    | —   | Ground  |           |
| 29      | DCLK   | I   | Data sampling clock signal                              |           |
| 30      | VSHD   | —   | Power supply (digital)                                  | 【Note5-4】 |
| 31      | VCOM   | I   | Common electrode driving signal                         |           |
| 32      | VDD    | —   | Power supply of driver (High level)                     | 【Note5-4】 |
| 33      | CsCOM  | I   | Cs electrode driving signal                             | 【Note5-4】 |
| 34      | VSHA   | —   | Power supply (analog)                                   | 【Note5-4】 |
| 35      | V4     | I   | Standard voltage to generate gray scale voltage :option |           |
| 36      | V3     | I   | Standard voltage to generate gray scale voltage :option |           |

| Pin No. | Symbol | I/O | Description  | Remarks   |
|---------|--------|-----|--|-----------|
| 37      | V2     | I   | Standard voltage to generate gray scale voltage :option      |           |
| 38      | V1     | I   | Standard voltage to generate gray scale voltage :option      |           |
| 39      | V0     | I   | Standard voltage to generate gray scale voltage :option      |           |
| 40      | SPL    | I/O | Sampling start signal  | [Note5-5] |
| 41      | SPR    | I/O | Sampling start signal  | [Note5-5] |
| 42      | LP     | I   | Data latch signal of source driver                           |           |
| 43      | CO     | I   | Selection for color mode (18bit or 1bit digital RGB)         | [Note5-6] |
| 44      | REV    | I   | Reverse control signal                                       |           |
| 45      | COM    | O   | Produce REV signal with the amplitude of AGND - VSHA :option |           |
| 46      | LBR    | I   | Selection for horizontal scanning direction                  | [Note5-5] |
| 47      | ASC    | I   | Analog switch control signal                                 |           |
| 48      | SSC    | I   | Source signal control  |           |
| 49      | GND    | -   | Ground   |           |
| 50      | LED+   | -   | Power supply for LED (High voltage)                          | [Note5-4] |
| 51      | LED-   | -   | Power supply for LED (Low voltage)                           |           |

[Note5-1] See section(7-1)-(A) "※Cautions when you turn on or off the power supply".

[Note5-2] Selection for resolution mode

| MO   | Resolution |
|------|------------|
| High | VGA        |
| Low  | QVGA       |

[Note5-3] Selection for vertical scanning direction

| U/L  | Scanning direction (Pixel configuration)    |
|------|---|
| High | Conventional scanning (X, 1)<br>↓<br>(X, Y) |
| Low  | Inverted scanning (X, 1)<br>↑<br>(X, Y)     |

VGA mode: Y=640, QVGA mode: Y=320

[Note5-4] When superfluous current flows, please intercept current with a fuse etc.

[Note5-5] Selection for horizontal scanning direction

| LBR  | SPL    | SPR    | Scanning direction (Pixel configuration) |
|------|--------|--------|--|
| High | Input  | Output | Normal scanning (1,Y) → (X,Y)            |
| Low  | Output | Input  | Inverted scanning (1,Y) ← (X,Y)          |

VGA mode: X=480, QVGA mode: X=240

[Note5-6] Selection for color mode

| CO   | Color variation                   |
|------|-----------------------------------|
| High | 262,144 colors (18bit RGB colors) |
| Low  | 8 colors (3bit RGB colors)        |

## 5-2) Touch panel driving section

Table 3

| Pin No. | Symbol | I/O | Description                         | Remark |
|---------|--------|-----|-------------------------------------|--------|
| T1      | Y1     | -   | Upper electrode Y (12 o'clock side) |        |
| T2      | X1     | -   | Lower electrode X (Left side)       |        |
| T3      | Y2     | -   | Upper electrode Y (6 o'clock side)  |        |
| T4      | X2     | -   | Lower electrode X (Right side)      |        |

## (6) Absolute Maximum Ratings

Table 4

| Parameter                             | Symbol | Condition | Ratings       | Unit | Remark      |
|---------------------------------------|--------|-----------|---------------|------|-------------|
| Power supply (COG driver / Analog)    | VSHA   | Ta=25°C   | -0.3~+6.0     | V    |             |
| Power supply (COG driver / Digital)   | VSHD   | Ta=25°C   | -0.3~+4.0     | V    |             |
| Power supply (monolithic driver)      | VDD    | Ta=25°C   | -0.3~+9.0     | V    |             |
| Power supply (monolithic driver)      | VSSD   | Ta=25°C   | -5.0~+0.3     | V    |             |
| Power supply (monolithic driver)      | GVSS   | Ta=25°C   | -9.0~+0.3     | V    |             |
| Input voltage (Analog)                | VIA    | Ta=25°C   | -0.3~VSHA+0.3 |      | [Terminal①] |
| Input voltage (Digital)               | VID    | Ta=25°C   | -0.3~VSHD+0.3 | V    | [Terminal②] |
| Input voltage (VCOM, CsCOM)           | VCOM   | Ta=25°C   | -2.0~+4.5V    | V    |             |
|                                       | CsCOM  | Ta=25°C   | -0.3~+14.0V   | V    |             |
| Input voltage (Touch panel)           | VIT    | Ta=25°C   | 24            | V    | [Note6-1]   |
| Input current (Touch panel)           | IIT    | Ta=25°C   | 90            | mA   | [Note6-1]   |
| Operating temperature (Panel surface) | T opp  | —         | -10~60        | °C   | [Note6-2]   |
| Storage temperature                   | T stg  | —         | -20~70        | °C   | [Note6-2]   |

[Terminal①] V0~V4

[Terminal②] SSC,ASC,LBR,REV,CO,LP,SPR,SPL,DCLK,R0~R5,G0~G5,B0~B5,U/L,MO,CLS,SPS,INI

[Note6-1] Terminals of touch panel(X1,X2,Y1,Y2) are applied(within 1 minute).

When power supply is over 5V(within 1-minute),please don't touch the touch panel.

If you touch it, some problem may occur.

[Note6-2] Humidity: 95%RH Max.(at Ta ≤ 40°C). Maximum wet-bulb temperature is less than 39°C (at Ta > 40°C). Condensation of dew must be avoided.

## (7)Electrical characteristics

## 7-1) Recommended operating conditions

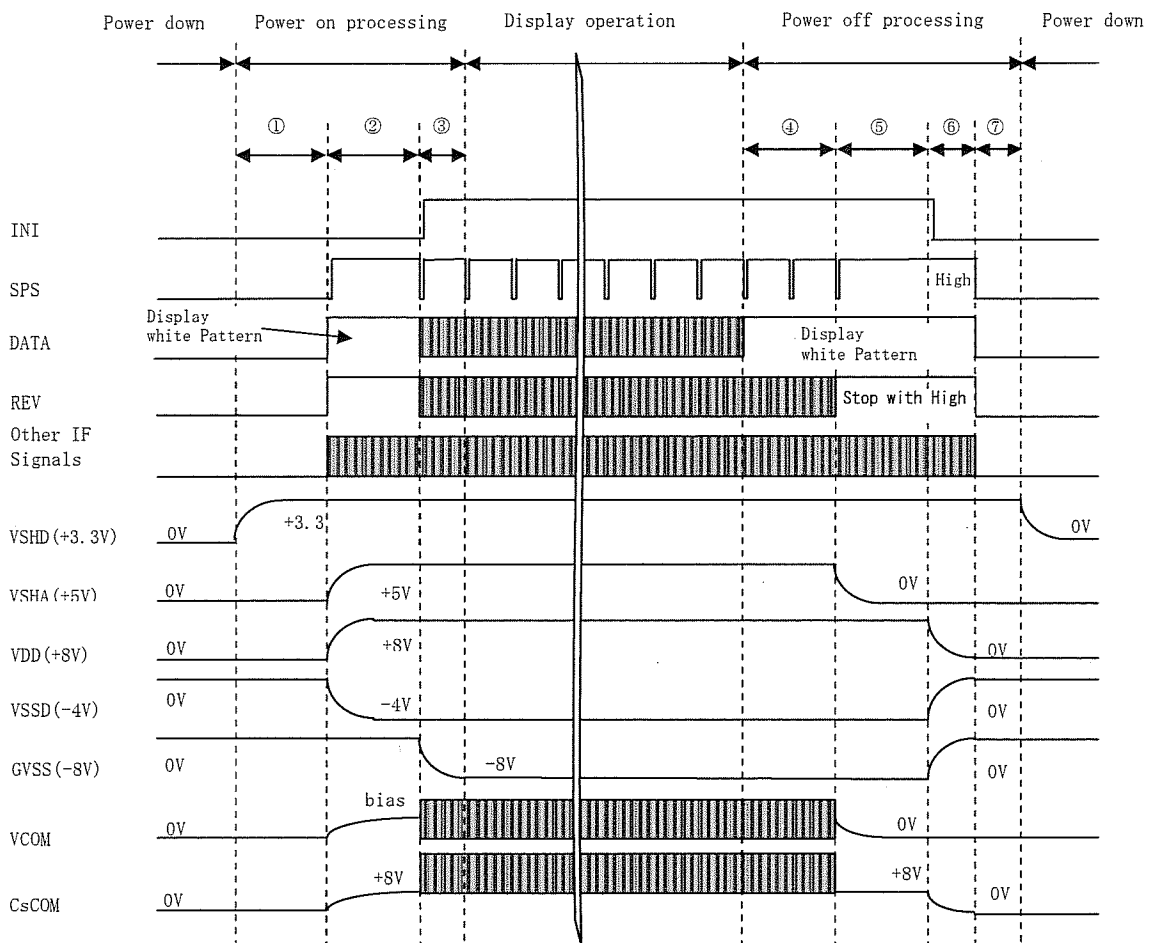
## A) TFT-LCD panel driving section

Table 5

GND=0V

| Parameter                            |              | Symbol  | Min.    | Typ.      | Max.      | Unit             | Remarks    |
|--------------------------------------|--------------|---------|---------|-----------|-----------|------------------|------------|
| Supply voltage for COG driver        | Analog       | VSHA    | +4.8    | +5.0      | +5.2      | V                |            |
|                                      | Digital      | VSHD    | +3.0    | +3.3      | +3.6      | V                |            |
| Supply voltage for monolithic driver | High voltage | VDD     | +7.6    | +8.0      | +8.4      | V                |            |
|                                      | Low voltage  | VSSD    | -4.4    | -4.0      | -3.6      | V                |            |
|                                      | Low voltage  | GVSS    | -8.4    | -8.0      | -7.6      | V                |            |
| Gray scale voltage                   |              | V0~V4   | GND     |           | VSHA      | V                | [Note 7-1] |
| Input voltage (Low)                  |              | VILS    | GND     | -         | 0.2VSHD   | V                | [Note 7-2] |
| Input voltage (High)                 |              | VIHS    | 0.8VSHD | -         | VSHD      | V                | [Note 7-2] |
| Input current (Low)                  |              | IILS    | -       | -         | 1         | $\mu$ A          | [Note 7-2] |
| Input current (High)                 |              | IHS     | -       | -         | 1         | $\mu$ A          | [Note 7-2] |
| Common electrode driving signal      | AC component | VCOMAC  | -       | $\pm 2.5$ | $\pm 2.6$ | V <sub>p-p</sub> | [Note 7-3] |
|                                      | DC component | VCOMDC  | +0.1    | +1.1      | +2.1      | V                | [Note 7-3] |
| Cs electrode driving signal          | AC component | CsCOMAC | -       | 5.0       | 5.2       | V <sub>p-p</sub> | [Note 7-4] |
|                                      | DC component | CsCOMDC | +7.6    | +8.0      | +8.4      | V                | [Note 7-4] |

※Cautions when you turn on or off the power supply



- ① Stabilize VSHD(3.3V) within double vertical periods second.
- ② Supply SPS, DATA(White pattern), REV(with High), and other signals. Stabilize VSHA(+5V), VDD(+8V), VSSD(-4V) within double vertical periods.
- ③ INI signal and GVSS(-8V) are supplied. Stabilize GVSS(-8V) within single vertical period.
- ④ White pattern is displayed during double or more vertical periods.
- ⑤ REV signal is stopped with High level. VSHA(+5V) supply is stopped, which is stabilized within double vertical periods.
- ⑥ VDD(+8V), VSSD(-4V) and GVSS(-8V) supplies are stopped, which are stabilized within double vertical periods.
- ⑦ SPS, DATA, REV and other IF signals are stopped with Low level. Then VSHD(+3.3V) supply is stopped.

【Note 7-1】 These are standard input voltages for gray scale. When VCOM is alternated polarity, these voltage should be alternated polarity. V0(black) is different polarity alternating signal of VCOM. V4(white) is the same polarity alternating signal of VCOM. Center voltage of each standard input voltage shift positive way for LCD characteristics (V0→V1→V2→V3→V4). This shift amount is adjusted so as to no flicker of each standard input voltage after DC bias voltage of VCOM and V0 is adjusted.

【Note 7-2】 SSC, ASC, LBR, REV, CO, LP, SPR, SPL, DCLK, U/L, MO, CLS, SPS, INI, R0~R5, G0~G5, B0~B5 terminals are applied.

【Note 7-3】 VCOMAC should be alternated on VCOMDC every 1 horizontal period and 1 vertical period. VCOMDC bias is adjusted so as to minimize flicker or maximum contrast every each module.  $VCOM = VCOMAC + VCOMDC$

【Note 7-4】 CsCOMAC should be alternated on CsCOMDC every 1 horizontal period and 1 vertical period. CsCOM's phase is as same as VCOM's.  $CsCOM = CsCOMAC + CsCOMDC$

## B) Back light driving section

Table 6

Ta=25°C

| Parameter         | Symbol | MIN | TYP  | MAX  | Units | Remarks terminal |
|-------------------|--------|-----|------|------|-------|------------------|
| LED voltage       | VL     | —   | 32.4 | 37.8 | V     | 【Note 7-5】       |
| LED current       | IL     | —   | 15.0 | 20.0 | mA    |                  |
| Power consumption | WL     | —   | 486  | —    | mW    | 【Note 7-6】       |

【Note 7-5】 VL(TYP) at IL=15mA. VL(MAX) at IL=20mA.

【Note 7-6】 Calculated reference value(IL(TYP)×VL(TYP))

## 7-2) Timing Characteristics of input signals

Table 7 AC Characteristics

(VSHA=+5.0V, VSHD=+3.3V, VDD=+8.0, VSSD=-4V GVSS=-8.0Ta=25°C)

| Terminal                                    | Parameter                                   | Symbol   | Mode | Min. | Typ. | Max.    | Unit |    |
|---|---|----------|------|------|------|---------|------|----|
| DCK   | Clock frequency of source driver            | fck      | VGA  | 19.4 | —    | 28      | MHz  |    |
|   |   |          | QVGA | 5.0  | —    | 6.8     |      |    |
|   | Rising time of clock                        | Tcr      |      | —    | —    | 6       | ns   |    |
|   | Falling time of clock                       | Tcf      |      | —    | —    | 6       | ns   |    |
|   | Pulse width (High level)                    | Tcwh     |      | 12   | —    | —       | ns   |    |
|   | Pulse width (Low level)                     | Tcwl     |      | 12   | —    | —       | ns   |    |
| SPL,SPR                                     | Frequency of start pulse                    | fsp      | VGA  | 35.5 |      | 39.5    | kHz  |    |
|   |   |          | QVGA | 17.9 |      | 19.9    |      |    |
|   | Rising time of start pulse                  | Trsp     |      |      |      | 10      | ns   |    |
|   | Falling time of start pulse                 | Tfsp     |      |      |      | 10      | ns   |    |
|   | Setup time of start pulse                   | Tsusp    |      | 10   |      |         | ns   |    |
|   | Hold time of start pulse                    | Thsp     |      | 10   |      |         | ns   |    |
|   | Pulse width of start pulse 【Note 7-7】       | Twsp     |      |      |      | 1.5/fck | ns   |    |
| LP  | Rising time of latch pulse                  | Trlp     |      |      |      | 50      | ns   |    |
|   | Falling time of latch pulse                 | Tflp     |      |      |      | 50      | ns   |    |
|   | Setup time of latch pulse                   | Tsulp    |      | 100  |      |         | ns   |    |
|   | Hold time of latch pulse                    | Thlp     |      | 50   |      |         | ns   |    |
|   | Pulse width of latch pulse                  | Twlp     |      | 50   |      |         | ns   |    |
|   | Phase COM—latch pulse                       | Tcom·lp  |      | 100  |      |         | ns   |    |
| SSC   | Rising time of Source signal control        | Trssc    |      |      |      | 10      | ns   |    |
|   | Falling time of Source signal control       | Tfssc    |      |      |      | 10      | ns   |    |
|   | Pulse width of Source signal control        | Twssc    |      | 50   |      |         | ns   |    |
|   | Pulse period of SSC                         | Tpssc    | VGA  | 7.3  |      |         |      | μs |
|   |   |          | QVGA | 14.6 |      |         |      |    |
|   | Phase of SSC—ASC                            | Tssc·asc |      |      | 0    |         | ns   |    |
| R0~R5                                       | Setup time of data                          | Tsud     |      | 10   |      |         | ns   |    |
| G0~G5                                       | Hold time of data                           | Thd      |      | 10   |      |         | ns   |    |
| B0~B5                                       |   |          |      |      |      |         |      |    |
| ASC   | Rising time of Analog SW control signal     | Trasc    |      |      |      | 10      | ns   |    |
|   | Falling time of Analog SW control signal    | Tfasc    |      |      |      | 10      | ns   |    |
|   | Pulse width of Analog SW control signal     | Twasc    |      | 50   |      |         | ns   |    |
|   | Setup time of Analog SW control signal      | Tsuasc   |      | 1    |      |         | μs   |    |
|   | Hold time of Analog SW control signal       | Thasc    | VGA  | 1.5  |      |         |      | μs |
|   |   |          | QVGA | 3.0  |      |         |      |    |
|   | Pulse period<br>of Analog SW control signal | Tpasc1   | VGA  | 5.95 |      |         |      | μs |
| QVGA  |   |          | 11.9 |      |      |         |      |    |
| Pulse period<br>of Analog SW control signal | Tpasc2                                      | VGA      | 1.35 |      |      |         | μs   |    |
|   |   | QVGA     | 2.7  |      |      |         |      |    |

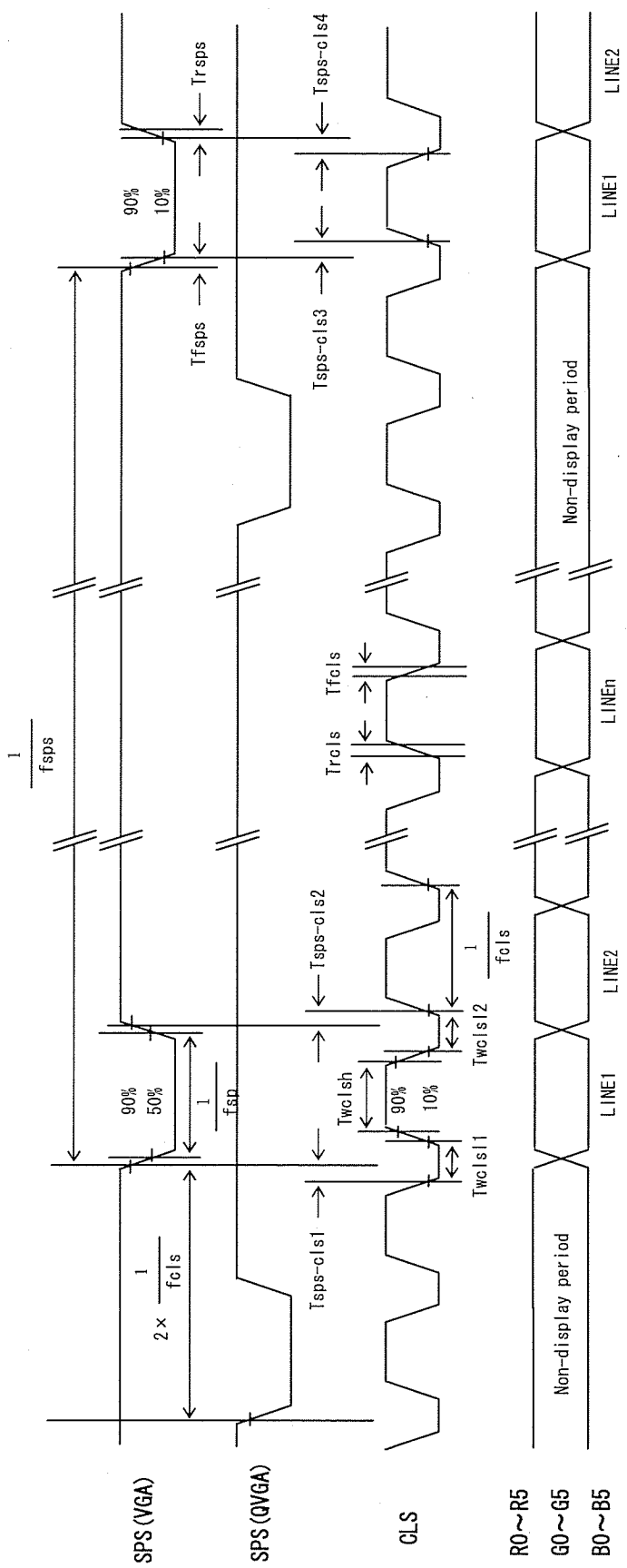


| Terminal      | Parameter                    | Symbol    |             | Min.         | Typ.     | Max.         | Unit    |
|---------------|------------------------------|-----------|-------------|--------------|----------|--------------|---------|
| CLS           | Clock frequency              | fcls      | VGA<br>QVGA | 35.5<br>17.9 |          | 39.5<br>19.9 | kHz     |
|               | Rising time of clock         | Trcls     |             |              |          | 50           | ns      |
|               | Falling time of clock        | Tfcls     |             |              |          | 50           | ns      |
|               | Setup time of clock          | Tsucls    |             | 100          |          |              | ns      |
|               | Pulse width of clock (Low1)  | Twcls1    | VGA<br>QVGA | 2<br>3       |          | 4.5<br>9     | $\mu$ s |
|               | Pulse width of clock (Low2)  | Twcls2    | VGA<br>QVGA | 2<br>3       |          | 4.5<br>9     | $\mu$ s |
|               | Pulse width of clock(High)   | Twclsh    | VGA<br>QVGA | 23<br>46.1   |          |              | $\mu$ s |
|               | Phase SPS-CLS                | Tsps-cls1 |             | 1            |          |              | $\mu$ s |
|               | Phase SPS-CLS                | Tsps-cls2 |             | 1            |          |              | $\mu$ s |
|               | Phase SPS-CLS                | Tsps-cls3 |             | 1            |          |              | $\mu$ s |
|               | Phase SPS-CLS                | Tsps-cls4 |             | 1            |          |              | $\mu$ s |
| SPS           | Rising time of start pulse   | Trsps     |             |              |          | 50           | ns      |
|               | Falling time of start pulse  | Tfsps     |             |              |          | 50           | ns      |
|               | Frequency of start pulse     | fsps      | VGA<br>QVGA | 55<br>55     | 60<br>60 | 61.3<br>61.6 | Hz      |
| VCOM<br>CsCOM | Setup time of VCOM and CsCOM | Tsucom    | VGA<br>QVGA | 2<br>4       |          |              | $\mu$ s |
|               | Hold time of VOM and CsCOM   | Thcom     | VGA<br>QVGA | 1<br>2       |          |              | $\mu$ s |

【Note 7-7】 There must be only one up-edge of DCLK(includes Tsusp and Thsp time) in the period SPL(orSPR)=" High

VOID

LCP-0302A-10

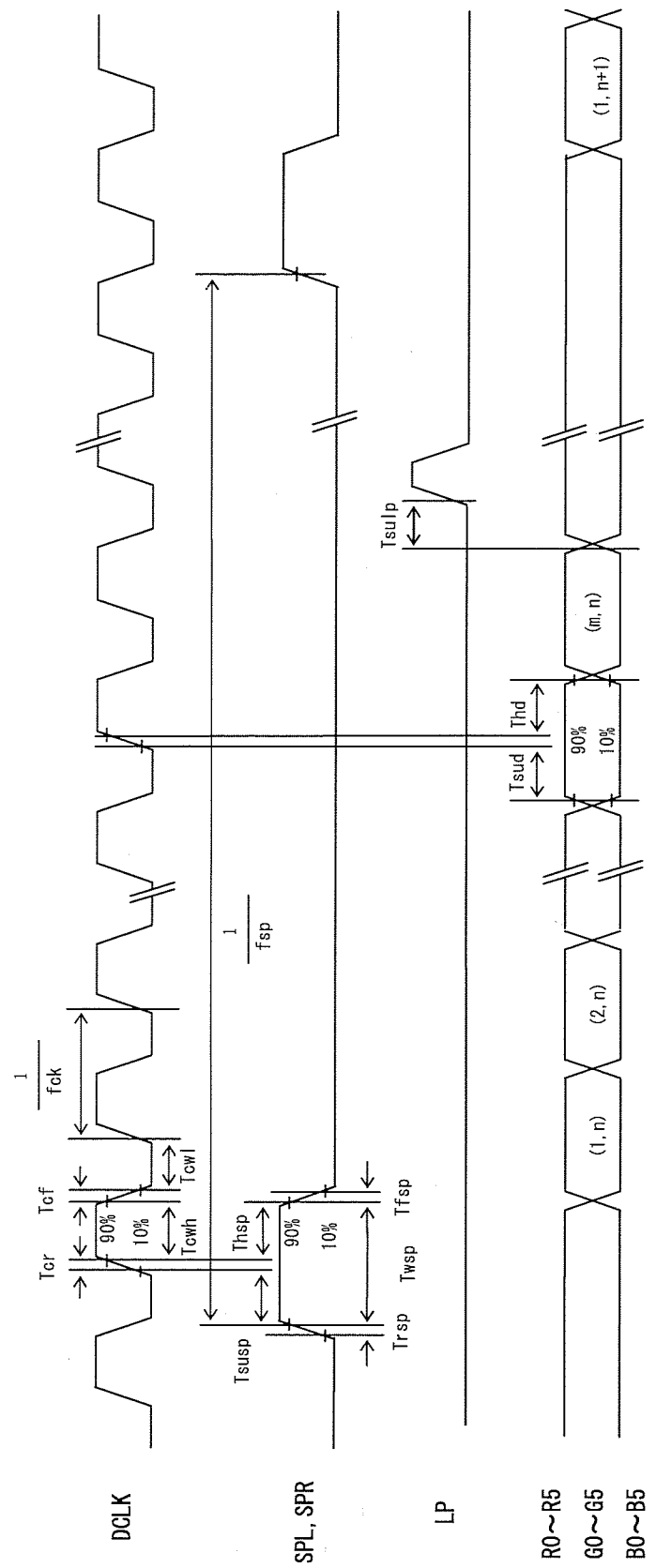


VGA mode : n=640  
 QVGA mode : n=320

Fig.(a) Vertical timing chart

VOID

LCP-03022A-11



VGA mode : m=480  
 QVGA mode : m=240

Fig.(b) Horizontal timing chart



## 7-3) Power consumption

Measurement condition : SPS=60Hz, CLS=38.85kHz, SPL=38.85kHz, DCLK=25.175MHz, Ta=25°C

Table 8

when conventional scan mode

| Parameter                 |         | Sym   | Conditions | MIN | TYP  | MAX  | Unit | Remarks   |
|---------------------------|---------|-------|------------|-----|------|------|------|-----------|
| COG driver current        | Analog  | ISHA  | VSHA=+5.0V | —   | 5.5  | 11.0 | mA   | 【Note7-8】 |
|                           | Digital | ISHD  | VSHD=+3.3V | —   | 2.3  | 4.6  | mA   | 【Note7-8】 |
| Monolithic driver current | High    | IVDD  | VDD=+8.0V  | —   | 0.7  | 2.0  | mA   | 【Note7-9】 |
|                           | Low     | IVSSD | VSSD=-4.0V | —   | -0.6 | -1.7 | mA   | 【Note7-9】 |
|                           | Low     | IGVSS | GVSS=-8.0V | —   | -0.1 | -0.3 | mA   | 【Note7-9】 |

【Note 7-8】 Vertical stripe pattern alternating 21 gray scale (GS21) with 42 gray scale (GS42) every 1 dot.

【Note 7-9】 64-Gray-bar vertical pattern (GS0 ~ GS63 for horizontal way)

8. Input Signals, Basic Display Color and Gray Scale of Each Color (TBD)

Table 9 18bit RGB color display mode (CO=High)

| Colors &<br>Gray scale | Data signal |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------------------------|-------------|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                        | Gray Scale  | R0   | R1 | R2 | R3 | R4 | R5 | G0 | G1 | G2 | G3 | G4 | G5 | B0 | B1 | B2 | B3 | B4 | B5 |
| Basic color            | Black       | —    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | Blue        | —    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
|                        | Green       | —    | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  |
|                        | Cyan        | —    | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                        | Red         | —    | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | Magenta     | —    | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  |
|                        | Yellow      | —    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
|                        | White       | —    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Gray Scale of red      | Black       | GS0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | ↑           | GS1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | Darker      | GS2  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | ↑           | ↓    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    | ↓  |    |    |
|                        | ↓           | ↓    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    | ↓  |    |    |
|                        | Brighter    | GS61 | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | ↓           | GS62 | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | Red         | GS63 | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale of green    | Black       | GS0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | ↑           | GS1  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | Darker      | GS2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | ↑           | ↓    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    | ↓  |    |    |
|                        | ↓           | ↓    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    | ↓  |    |    |
|                        | Brighter    | GS61 | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
|                        | ↓           | GS62 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
|                        | Green       | GS63 | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale of bleu     | Black       | GS0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                        | ↑           | GS1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  |
|                        | Darker      | GS2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  |
|                        | ↑           | ↓    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    | ↓  |    |    |
|                        | ↓           | ↓    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    | ↓  |    |    |
|                        | Brighter    | GS61 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 1  |
|                        | ↓           | GS62 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  |
|                        | Bleu        | GS63 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  |

0 : Low level voltage    1 : High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. According to the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

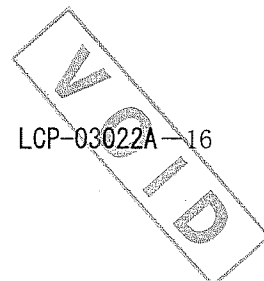
Table 10 3bit RGB color display mode (CO=Low)

| Colors &<br>Gray scale | Gray<br>Scale | Data signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------------------------|---------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                        |               | R0          | R1 | R2 | R3 | R4 | R5 | G0 | G1 | G2 | G3 | G4 | G5 | B0 | B1 | B2 | B3 | B4 | B5 |
| Basic color            | Black         | —           | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 0  |
|                        | Blue          | —           | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 1  |
|                        | Green         | —           | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 0  |
|                        | Cyan          | —           | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 1  |
|                        | Red           | —           | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 0  |
|                        | Magenta       | —           | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 0  | —  | —  | —  | —  | —  | 1  |
|                        | Yellow        | —           | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 0  |
|                        | White         | —           | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 1  | —  | —  | —  | —  | —  | 1  |

0 :Low level voltage

1 :High level voltage

—:High or Low level voltage constant



(9)Optical characteristics

9-1) Not driving the Back light condition

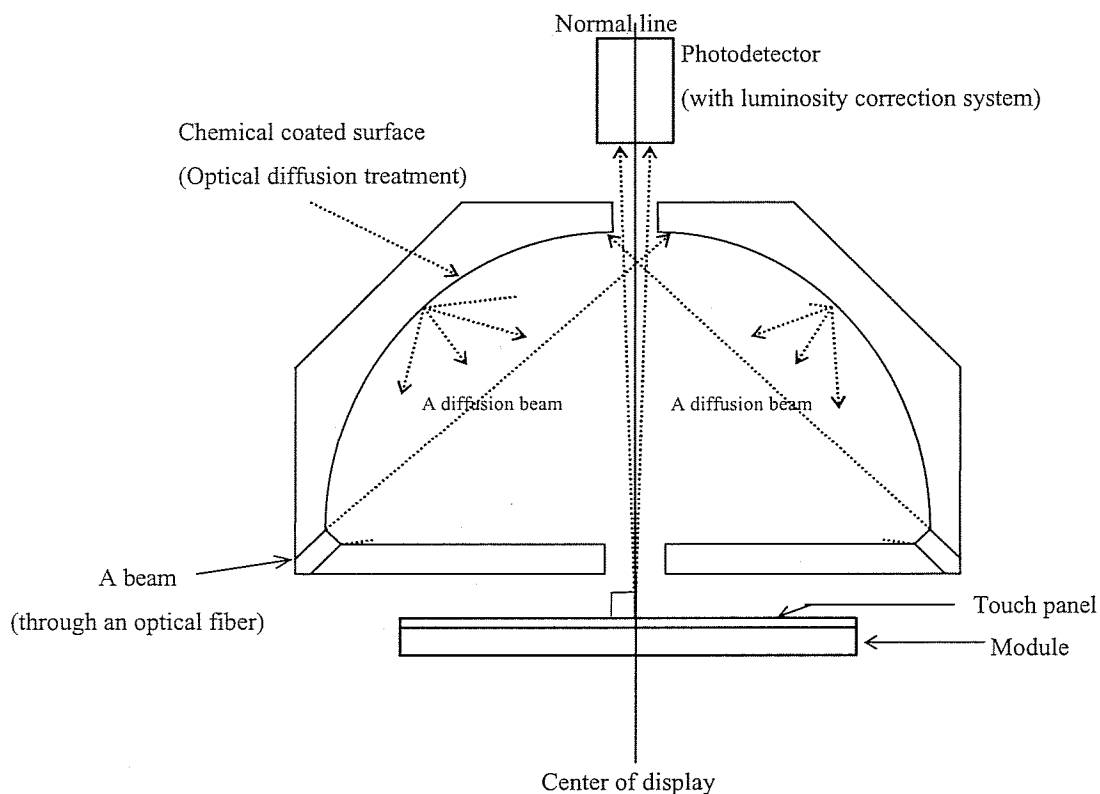
Table 11

Ta=25°C

| Parameter           | Symbol           | Condition          | Min  | Typ  | Max  | Unit   | Remarks      |
|---------------------|------------------|--------------------|------|------|------|--------|--------------|
| Viewing angle range | $\theta_{21,22}$ | CR $\geq$ 2        | 20   | 30   | -    | degree | [Note 9-1,2] |
|                     | $\theta_{11}$    |                    | 20   | 30   | -    | degree |              |
|                     | $\theta_{12}$    |                    | 20   | 30   | -    | degree |              |
| Contrast ratio      | CRmax            | $\theta = 0^\circ$ | 3    | 5    | -    |        | [Note 9-2,4] |
| Response time       | Rise             | $\theta = 0^\circ$ | -    | 30   | 60   | ms     | [Note 9-3]   |
|                     | Fall             |                    | -    | 50   | 100  | ms     |              |
| White chromaticity  | x                | $\theta = 0^\circ$ | 0.24 | 0.29 | 0.34 |        | [Note 9-4]   |
|                     | y                |                    | 0.28 | 0.33 | 0.38 |        |              |
| Reflection ratio    | R                | $\theta = 0^\circ$ | 4    | 6    | -    | %      | [Note 9-5]   |

\* The measuring method of the optical characteristics is shown by the following figure.

\* A measurement device is Otsuka luminance meter LCD5200.(With the diffusion reflection unit.)



Measuring method (a) for optical characteristics



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LCP-03022A-17

9-2) Driving the Back light condition

Table 12

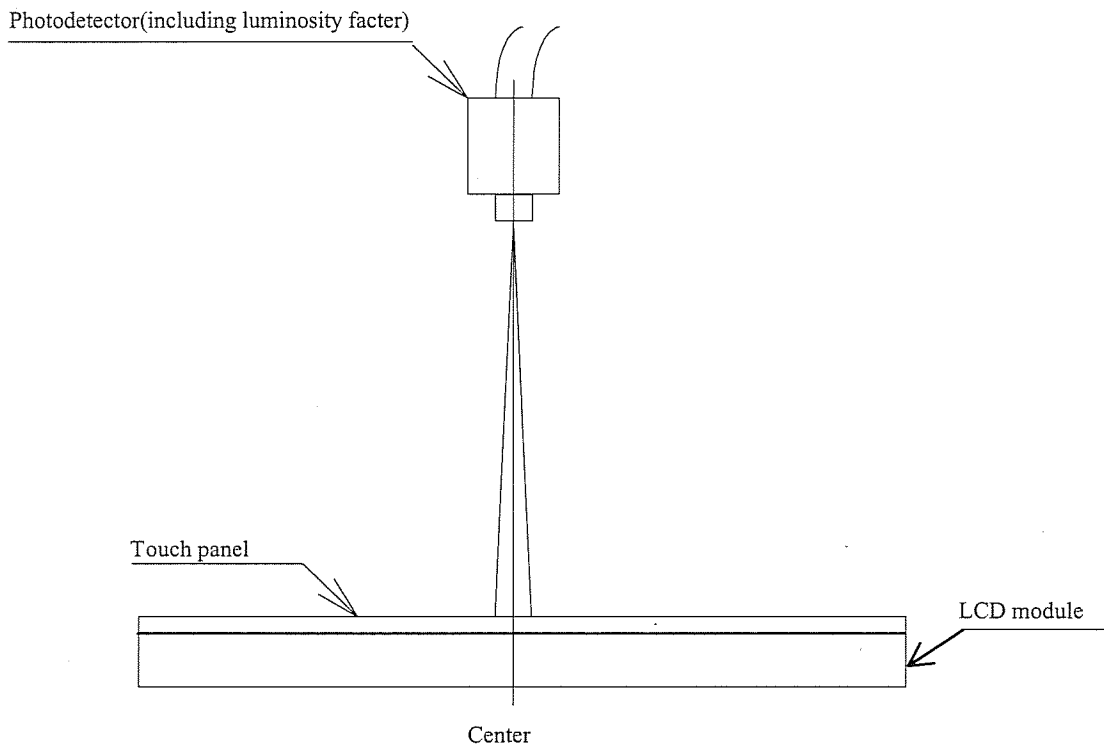
Ta=25°C

| Parameter           | Symbol          | Condition          | Min      | Typ  | Max  | Unit                 | Remarks        |
|---------------------|-----------------|--------------------|----------|------|------|----------------------|----------------|
| Viewing angle range | $\theta_{1,22}$ | CR $\geq$ 2        | 30       | 40   | -    | degree               | [Note 9-1,2,6] |
|                     | $\theta_{11}$   |                    | 30       | 40   | -    | degree               |                |
|                     | $\theta_{12}$   |                    | 30       | 40   | -    | degree               |                |
| Contrast ratio      | Crmax           | $\theta = 0^\circ$ | 70       | 100  | -    |                      | [Note 9-2]     |
| Response time       | Rise            | $\tau_r$           | -        | 30   | 60   | ms                   | [Note 9-3]     |
|                     | Fall            |                    | $\tau_d$ | -    | 50   | 100                  |                |
| White chromaticity  | x               | $\theta = 0^\circ$ | 0.24     | 0.30 | 0.35 |                      |                |
|                     | y               |                    | 0.26     | 0.32 | 0.37 |                      |                |
| Uniformity          | U               | $\theta = 0^\circ$ | 70       | -    | -    | %                    | [Note 9-7]     |
| Brightness          | Y               | $\theta = 0^\circ$ | 55       | 70   | -    | (cd/m <sup>2</sup> ) | IL=15mA        |

△

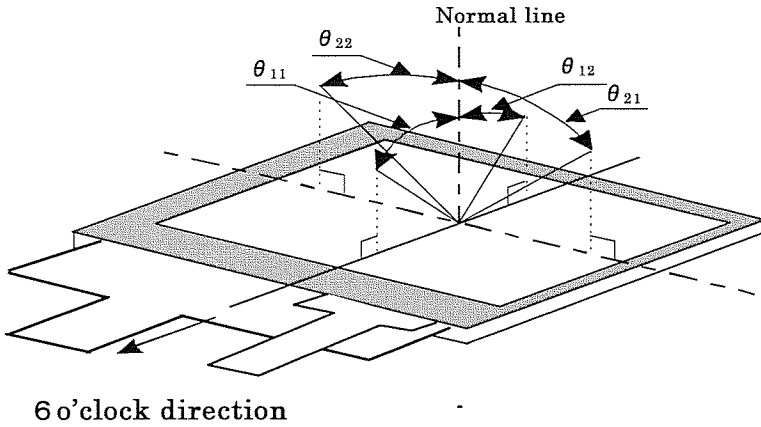
\* The measuring method of the optical characteristics is shown by the following figure.

\* A measurement device is TOPCON luminance meter BM-5(A).(Viewing cone 1)



**Measuring method (b) for optical characteristics**

[Note 9-1] Viewing angle range is defined as follows.



**Definition for viewing angle**

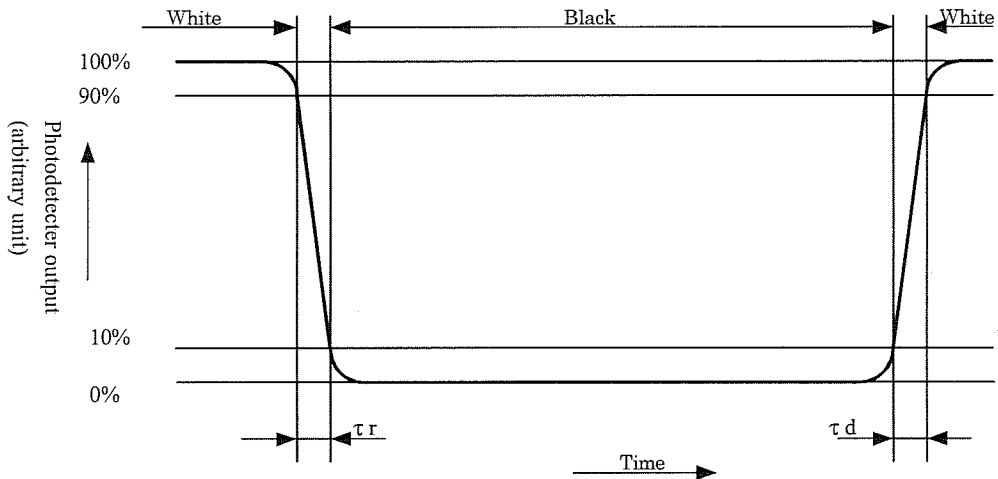
[Note 9-2] Definition of contrast ratio:

The contrast ratio is defined as follows:

$$\text{Contrast ratio(CR)} = \frac{\text{Photodetector output with all pixels white(GS63)}}{\text{Photodetector output with all pixels black(GS0)}} \times \text{VCOMAC} = 5.0V_{p-p}$$

[Note 9-3] Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



[Note 9-4] A measurement device is Minolta CM-2002.

[Note 9-5] Definition of reflection ratio

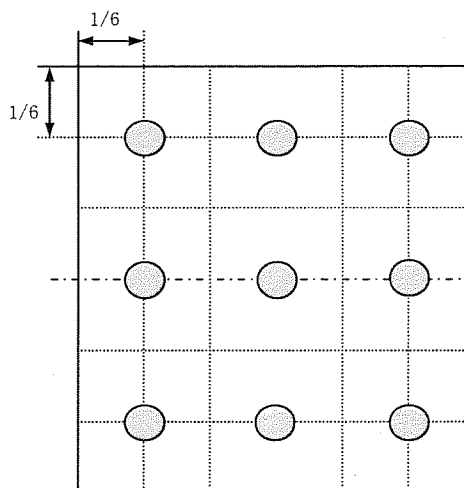
$$\text{Reflection ratio} = \frac{\text{Light detected level of the reflection by the LCD module}}{\text{Light detected level of the reflection by the standard white board}}$$

[Note 9-6] A measurement device is ELDIM EZContrast

[Note 9-7] Definition of Uniformity  $\triangle$

$$\text{Uniformity} = \frac{\text{Minimum Brightness}}{\text{Maximum Brightness}} \times 100 (\%)$$

The brightness should be measured on the 9-point as shown in the right figure.



(10) Touch panel characteristics

Table 13

| Parameter                         | Min. | Typ. | Max.      | Unit       | Remark                    |
|-----------------------------------|------|------|-----------|------------|---------------------------|
| Input voltage                     | -    | 5    | 7         | V          |                           |
| Resistor between terminals(X1-X2) | 190  |      | 620       | $\Omega$   | Provisional specification |
| Resistor between terminals(Y1-Y2) | 150  |      | 570       | $\Omega$   |                           |
| Accuracy of detecting dimension   | -    |      | $\pm 1.5$ | %          |                           |
| Line linearity(X direction)       | -    | -    | $\pm 1.5$ | %          |                           |
| Line linearity(Y direction)       | -    | -    | $\pm 1.5$ | %          |                           |
| Insuration resistance             | 20   | -    | -         | M $\Omega$ |                           |
| Activation force                  | 10   | -    | 80        | gf         | [Note 10-1]               |

[Note 10-1] Test condition : End shape:R0.8mm,Resistance Between X and Y axis must be equal or lower than 2k $\Omega$ , the test voltage=DC5V

(11) Display quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standards for TFT-LCD..

(12) Mechanical characteristics

12-1) External appearance

See Fig. 1

12-2) FPC (for LCD panel) characteristics

(1) Specific connector

LCD-FPC : JAE FF0251SS1 (Bottom contact only)

T.P-FPC : JST 04(1.0)9FLH-RSM1-TB

(2) Bending endurance of the bending slits portion

No line of the FPC is broken for the bending test (Bending radius=0.6mm and angle=90°) in 30 cycles.

## 12-3) Design guidance for touchpanel(T/P)

## 12-3-1) Example of housing design

- (1) If a consumer will put a palm on housing in normal usage, care should be taken as follows.
- (2) Keep the gap, for example 0.3 to 0.7mm, between bezel edge and T/P surface.  
The reason is to avoid the bezel edge from contacting T/P surface that may cause a "short" with bottom layer (See Fig.2)
- (3) Insertion of a cushion material is recommended.
- (4) The cushion material should be limited just on the busbar insulation paste area.  
If it is over the transparent insulation paste area, a "short" may be occurred.
- (5) There is one where a resistance film is left in the T/P part of the end of the pole.  
Design to keep insulation from the perimeter to prevent from mis-operation and so on.

## 12-3-2) Mounting on display and housing bezel

- (1) In all cases, the T/P should be supported from the backside of the glass.
- (2) Do not use an adhesive tape to bond it on the front of T/P and hang it to the housing bezel.
- (3) Never expand the T/P top layer (PET-film) like a balloon by internal air pressure.  
The life of the T/P will be extremely short.
- (4) Top layer, PET, dimension is changing with environmental temperature and humidity.  
Avoid a stress from housing bezel to top layer, because it may cause "waving".
- (5) The input to the Touchpanel sometimes distorts touch panel itself.

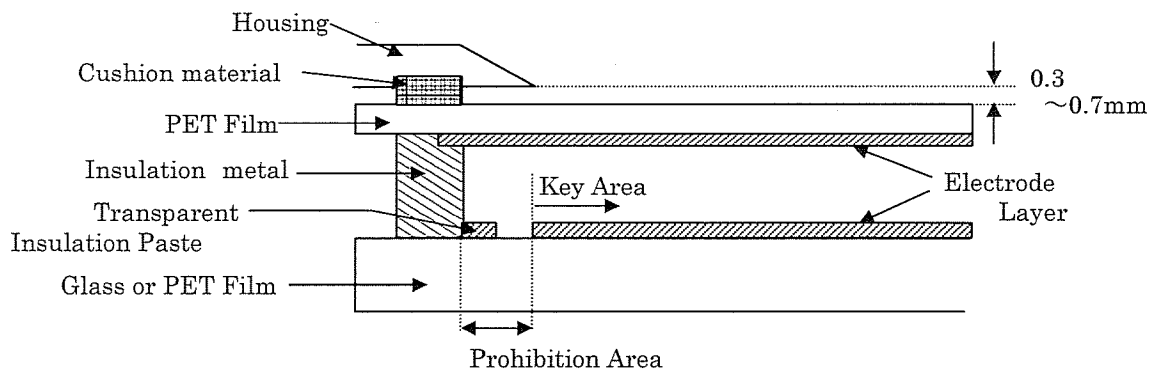
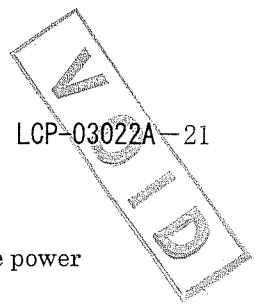


Fig.2



### (13) Handling Precautions

#### 13-1) Insertion and taking out of FPCs

Be sure insert and take out of the FPC into the connector of the set after turning off the power supply on the set side.

#### 13-2) Handling of FPCs

The FPC for LCD panel shall be bent only slit portion. The bending slit shall be bent uniformly on the whole slit portion with bending radius larger than 0.6mm, and only inner side (back side of the module). Don't bend it outer side (display surface side).

Don't give the FPCs too large force, for example, hanging the module with holding FPC.

#### 13-3) Installation of the module

On mounting the module, be sure to fix the module on the same plane. Taking care not to warp or twist the module.

#### 13-4) Precaution when mounting

- (1) If water droplets and oil attaches to it for a long time, discoloration and staining occurs. Wipe them off immediately.
- (2) Glass is used for the TFT-LCD panel or touch panel. If it is dropped or bumped against a hard object, it may be broken. Handle it with sufficient care.
- (3) As the CMOS IC is used in this module, pay attention to static electricity when handling it. Take a measure for grounding on the human body.

#### 13-5) Others

- (1) The liquid-crystal is deteriorated by ultraviolet rays. Do not leave it in direct sunlight and strong ultraviolet rays for many hours.
- (2) If it is kept at a temperature below the rated storage temperature, it becomes coagulated and the panel may be broken. Also, if it is kept at a temperature above the rated storage temperature, it becomes isotropic liquid and does not return to its original state. Therefore, it is desirable to keep it at room temperature as much as possible.
- (3) If the LCD breaks, don't put internal liquid crystal into the mouth. When the liquid crystal sticks to the hands, feet and clothes, wash it out immediately.
- (4) Wipe off water drop or finger grease immediately. Long contact with water may cause discoloration or spots.
- (5) Observe general precautions for all electronic components.
- (6) VCOM must be adjusted on condition of your final product. No adjustment causes the deterioration for display quality.
- (7) Static image should not be displayed more than 5 minutes in order to prevent from occurrence of residual image.

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## (14) Reliability Test Conditions for TFT-LCD Module

Table 14

| No. | Test items  | Test conditions  |
|-----|---|--|
| 1   | High temperature storage test                     | Ta=+70°C 240h  |
| 2   | Low temperature storage test                      | Ta=-20°C 240h  |
| 3   | High temperature and high humidity operating test | Tp=+40°C , 95%RH 240h<br>(But no condensation of dew)  |
| 4   | High temperature operating test                   | Tp=+60°C 240h  |
| 5   | Low temperature operating test                    | Tp=-10°C 240h  |
| 6   | Electro static discharge test                     | ±200V · 200pF(0Ω) 1 time for each terminals  |
| 7   | Shock test  | 980 m/s <sup>2</sup> , 6 ms<br>±X, ±Y, ±Z 3 times for each direction<br>(JIS C0041, A-7 Condition C)   |
| 8   | Vibration test                                    | Frequency range: 10Hz~55Hz<br>Stroke: 1.5 mm Sweep: 10Hz~55Hz<br>X,Y,Z 2 hours for each direction (total 6 hours)<br>(JIS C0040,A-10 Condition A)  |
| 9   | Heat shock test                                   | Ta=-20°C~+70°C / 5 cycles<br>(1h) (1h)   |
| 10  | Point activation test<br>(Touch panel)            | Hit it (1,000,000) times with a silicon rubber of R8 HS 60.<br>Hitting force : 250g<br>Hitting speed : 3 times per second  |
| 11  | Writing friction resistance test<br>(Touch panel) | Write according to the right illustration in the under-mentioned conditions:<br>Pen : 0.8R Polyacetal stylus<br>Load : 250gf<br>Speed : 3 strokes per second<br>Stroke : 35mm<br>Frequency : (50,000) times × 4 pieces<br>Testing apparatus : shown in Fig 3 |

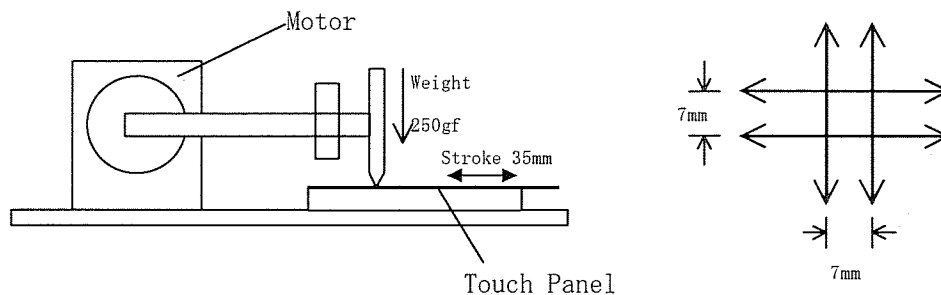


Fig.3

【Note】 Ta = Ambient temperature, Tp = Panel temperature.

【Check items】

- Test No.1~9

In the standard condition, there shall be no practical problems that may affect the display function.

- Test No.10~No.11

The measurements after the tests are satisfied (10)-Table 13 (Touch panel characteristics)

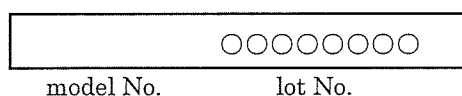
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(15) Others

15-1) Indication of lot number

The lot number is shown on a label. Attached location is shown in Fig.1 (Outline Dimensions).

Indicated contents of the label



15-2) Used Regulation of Chemical Substances Breaking Ozone Stratum

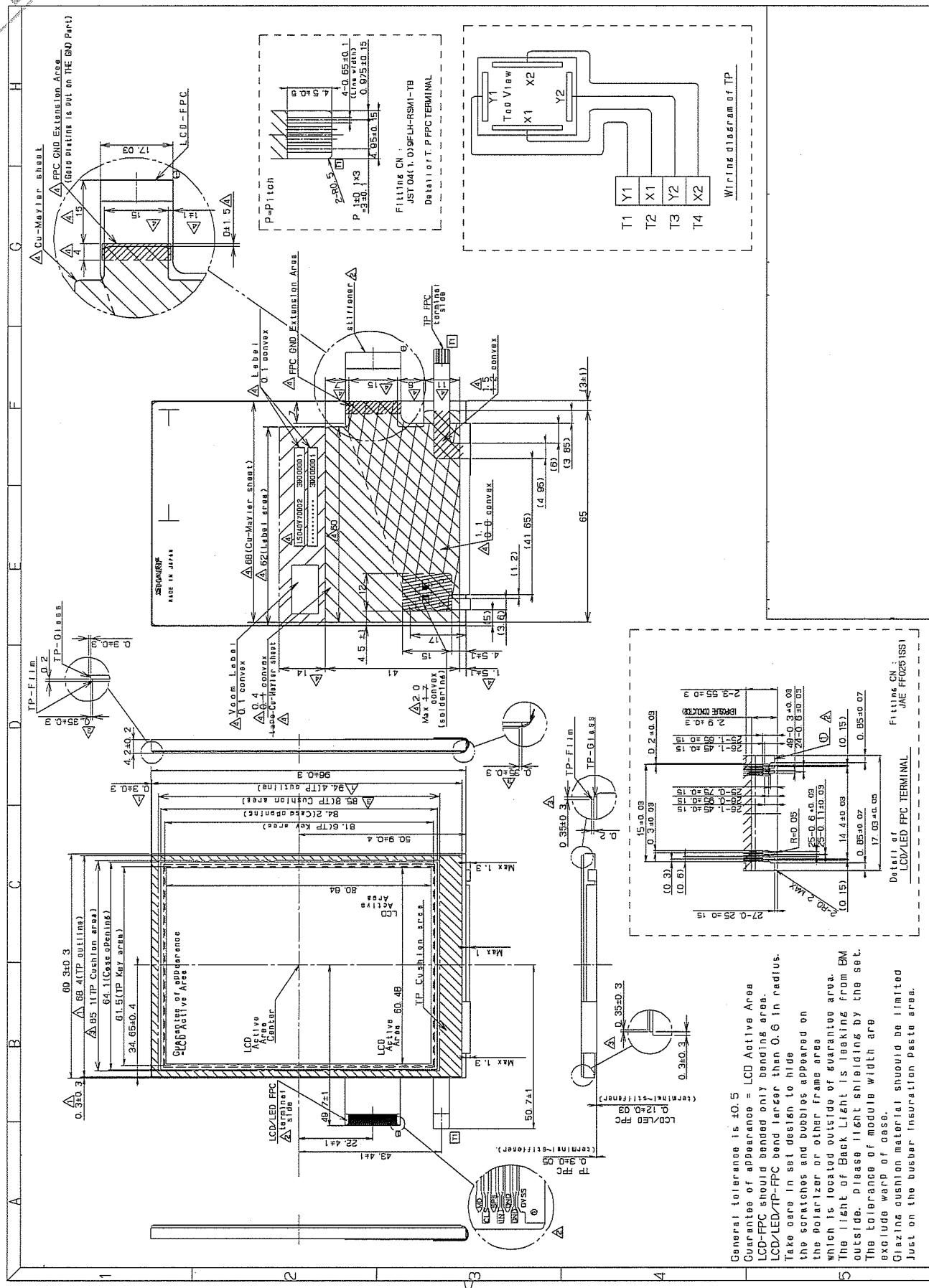
Substances with the object of regulating : CFCS, Carbon tetrachloride, Halon

1,1,1-Trichloro ethane (Methyl chloroform)

- (a) This LCD module, Constructed part and Parts don't contain the above substances.
- (b) This LCD module, Constructed part and Parts don't contain the above substances in processes of manufacture.

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LCP-03022A-24



General tolerance is  $\pm 0.5$   
 Guarantee of appearance = LCD Active Area  
 LCD-FPC should be banded only banding area.  
 LCD/LED/TP-FPC bend larger than 0.6 in radius.  
 Take care in set design to hide the scratches and bubbles appeared on the polarizer or other frame area which is located outside of guarantee area.  
 The light of Back Light is leaking from BM outside. Please light shielding by the set.  
 The tolerance of module width are exclude warp of case.  
 Glazing cushion material should be limited Just on the busbar insulation paste area.

Fig.1 Outline Dimensions