

# LTPS TFT LCD Paper-machine

## ALR333RGT

8.8cm(3.5inch) 480 x RGB x 640 dot

\*This specification is tentative, and is subject to change without notice.

This 3.5 inch low temperature poly- silicon TFT-LCD module is suitable for PDA.

### <Features>

- Display size : 8.8cm diagonal (3.5inch)
- 921,600 dot (480 x RGB x 640)(232ppi)
- Transflective type
- RGB stripe color arrangement.
- Preferred viewing angle ; 12 o'clock
- Polarizer : AR coat
- Slim design, light weight and narrow frame.
- Operating temperature is -20 to +60 °C.
- Storage temperature is - 30 to +70 °C.

### <Specifications>

| Item                                     | Specifications          | Unit |
|--|-------------------------|------|
| Dot count (H)x(V)                        | 480 x RGB x 640         | dot  |
| Effective display dimensions (H)x(V)     | 52.56 x 70.08           | mm   |
| Display size (diagonal)                  | 8.76 (3.5inch)          | cm   |
| Dot pitch (H)x(V)                        | 0.0365 x 0.1095         | mm   |
| Color arrangement                        | RGB Stripe              | -    |
| Module external dimensions (W)x(H)x(D) * | TYP. 59.6 x 89.8 x 3.81 | mm   |
| FPC length                               | TYP. 16.0               | mm   |
| Weight                                   | T.B.D.                  | g    |

\* : Without Projection

(1)No products described or contained herein are intended for use in surgical implants,life-support systems,aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury,death or property loss.

(2)Anyone purchasing any products described or contained herein for an above-mensioned use shall:

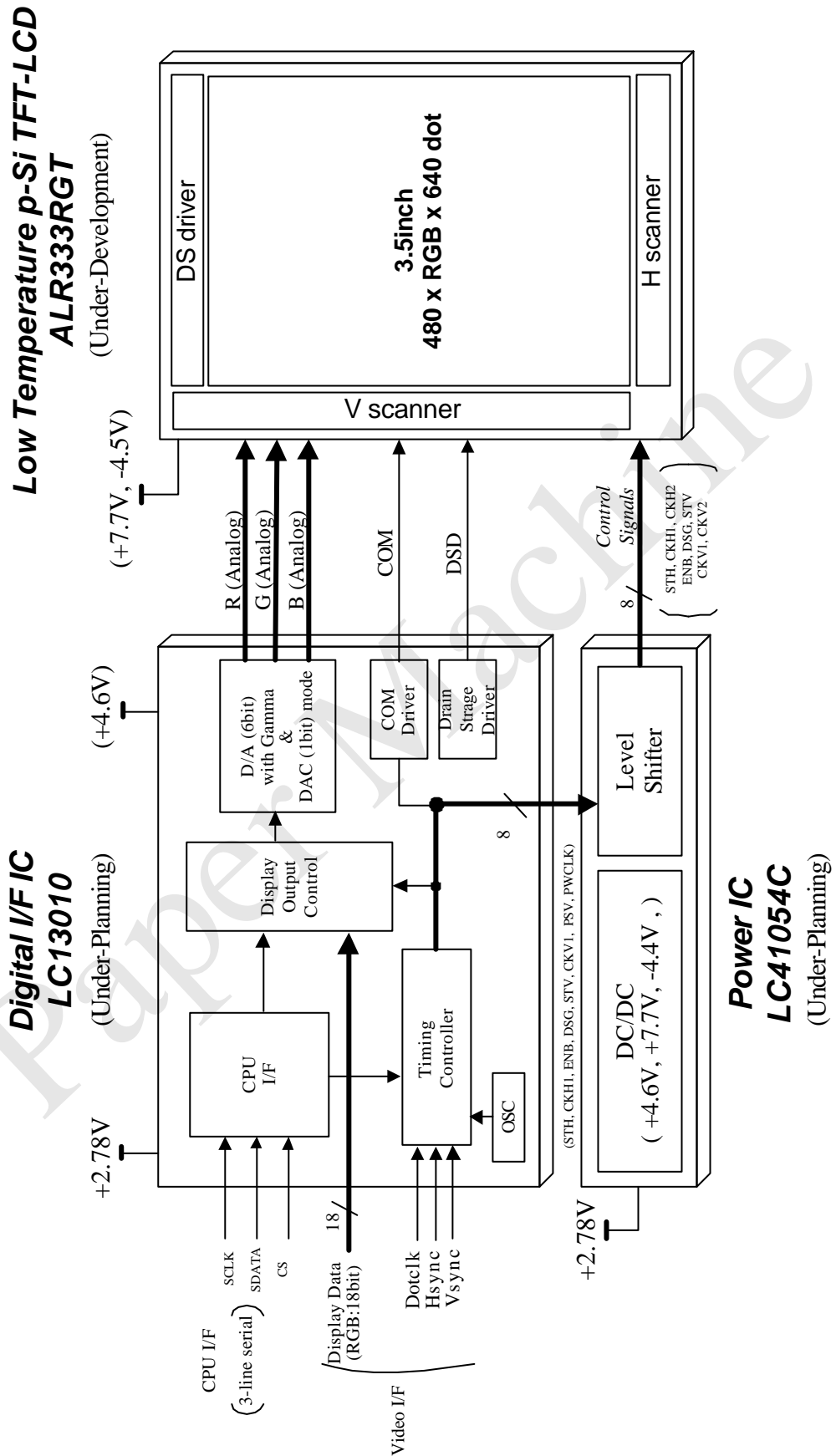
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•Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO.,LTD.,its affiliates,subsidiaries and distributors or any of their officers and employees, jointly or severally

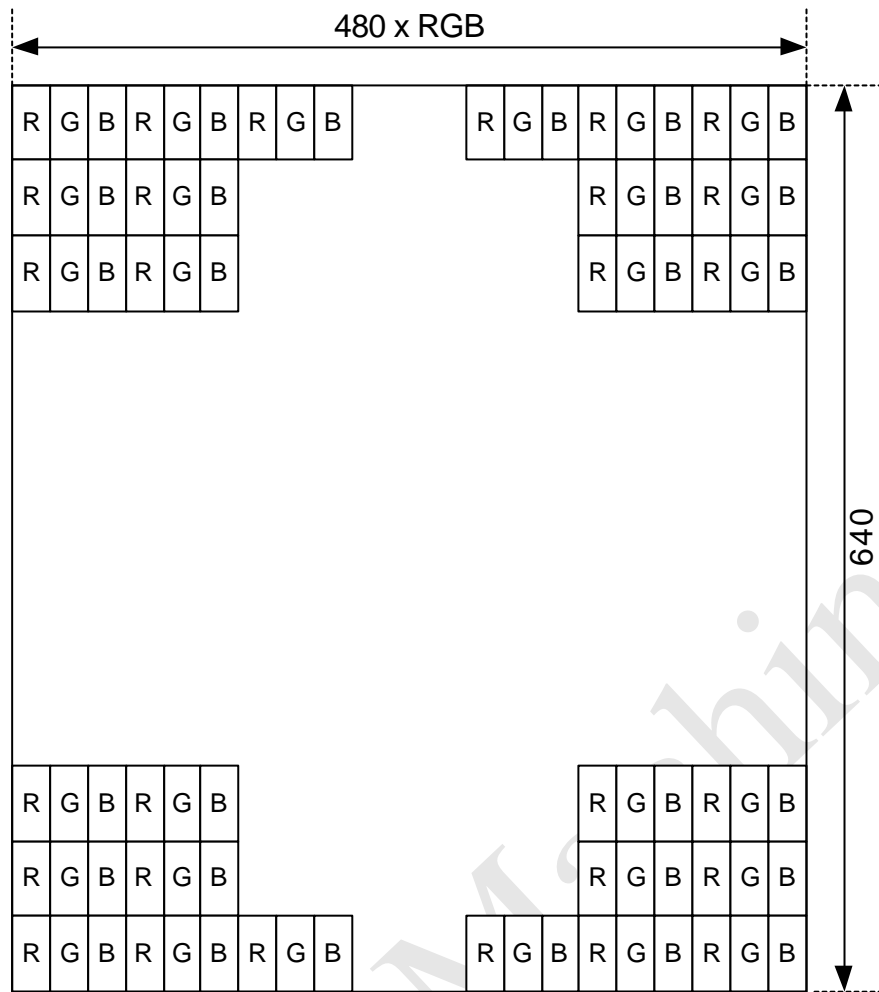
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[Block diagram]

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[Color arrangement]



[Input pin arrangement]

| No. | Pin Name | No. | Pin Name |
|-----|----------|-----|----------|
| 1   | DGND     | 19  | RD2      |
| 2   | DGND     | 20  | RD3      |
| 3   | VDD      | 21  | RD4      |
| 4   | VDD      | 22  | RD5      |
| 5   | AGND     | 23  | DGND     |
| 6   | EN16     | 24  | GB0      |
| 7   | VDD      | 25  | GB1      |
| 8   | TERST    | 26  | GB2      |
| 9   | CS       | 27  | GB3      |
| 10  | DIN      | 28  | GB4      |
| 11  | DOUT     | 29  | GB5      |
| 12  | SCLK     | 30  | DGND     |
| 13  | VSYNC    | 31  | BD0      |
| 14  | HSYNC    | 32  | BD1      |
| 15  | DCLK     | 33  | BD2      |
| 16  | DGND     | 34  | BD3      |
| 17  | RD0      | 35  | BD4      |
| 18  | RD1      | 36  | BD5      |

## [Electrical characteristics]

Absolute Maximum Ratings:(VSS standard, Ta=25deg. ± 2deg.)

| Item                  | Symbol | Condition | Min. | Typ. | Max.    | Unit |
|-----------------------|--------|-----------|------|------|---------|------|
| Power Supply Voltage  | VDD    |           | -0.3 | -    | +4.0    | V    |
| Power Supply Voltage  | VSS    |           | -0.3 | -    | 0.3     | V    |
| Input Voltage (Logic) | Vin    |           | -0.5 | -    | VDD+0.5 | V    |
| Storage Temperature   | Tstg   |           | -30  | -    | 70      | deg. |
| Operating Temperature | Topr   |           | -20  | -    | 60      | deg. |

Allowable Operating Ranges ( VSS standard )

| Item                  | Symbol | Condition | Min.   | Typ.  | Max.   | Unit |
|-----------------------|--------|-----------|--------|-------|--------|------|
| Power Supply Voltage  | VDD    |           | +2.58  | +2.78 | +2.98  | V    |
| Power Supply Voltage  | VSS    |           | -      | 0     | -      | V    |
| Operating Temperature | Topr   |           | -20    | -     | +60    | deg. |
| H-Level Input Voltage | Vih    |           | 0.7VDD | -     | VDD    | V    |
| L-Level Input Voltage | Vil    |           | 0      | -     | 0.3VDD | V    |

## [AC characteristics]

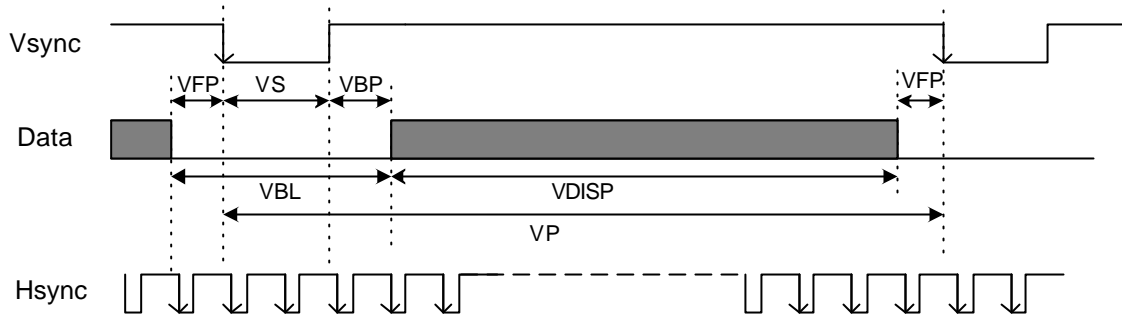
VDD=2.58 to 2.98V

| Item   | Symbol | Condition | Min. | Typ.   | Max. | Unit  |
|--|--------|-----------|------|--------|------|-------|
| Vertical Sync. Set-up Time                       | tvsys  |           | 10   | -      | -    | ns    |
| Vertical Sync. Hold Time                         | tvsyh  |           | 10   | -      | -    | ns    |
| Horizontal Sync. Set-up Time                     | thsys  |           | 10   | -      | -    | ns    |
| Horizontal Sync. Hold Time                       | thsyh  |           | 10   | -      | -    | ns    |
| Phase difference of Sync.<br>Signal Falling edge | thv    |           | 0    | -      | -    | clk   |
| Clock Cycle                                      | tclk   |           | -    | 39.7   | -    | ns    |
|  | fclk   |           | -    | 25.175 | -    | (MHz) |
| Clock "L" Period                                 | tckl   |           | 15   | -      | -    | ns    |
| Clock "H" Period                                 | tckh   |           | 15   | -      | -    | ns    |
| Data Set-up Time                                 | tds    |           | 10   | -      | -    | ns    |
| Data Hold Time                                   | tdh    |           | 10   | -      | -    | ns    |

# [Input Timing]

## Video I/F

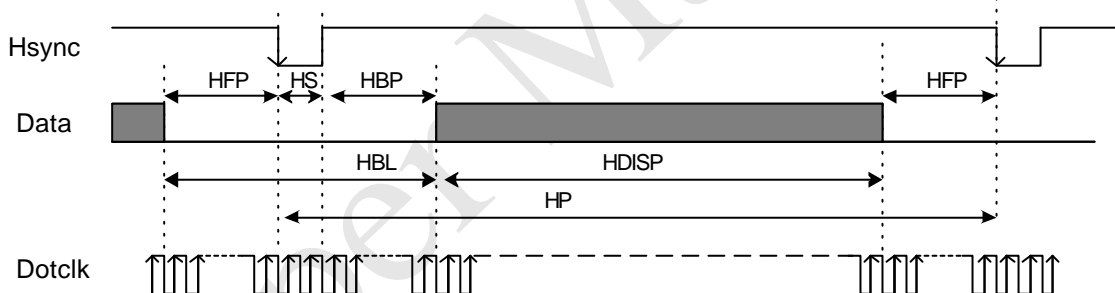
### <Vertical Timing Chart>



(VDD=2.58 to 2.98V)

| Item                       | Symbol | Condition  | Min. | Typ. | Max. | Unit |
|----------------------------|--------|------------|------|------|------|------|
| Vertical Cycle             | VP     |            | -    | 644  | -    | line |
| Vertical Sync. Pulse Width | VS     |            | -    | 2    | -    | line |
| Vertical Back Porch        | VBP    |            | -    | 1    | -    | line |
| Vertical Data Start Point  |        | VS+VBP     | -    | 3    | -    | line |
| Vertical Front Porch       | VFP    |            | -    | 1    | -    | line |
| Vertical Blanking Period   | VBL    | VS+VBP+VFL | -    | 4    | -    | line |
| Vertical Active Area       | VDISP  |            | -    | 640  | -    | line |

### <Horizontal Timing Chart>



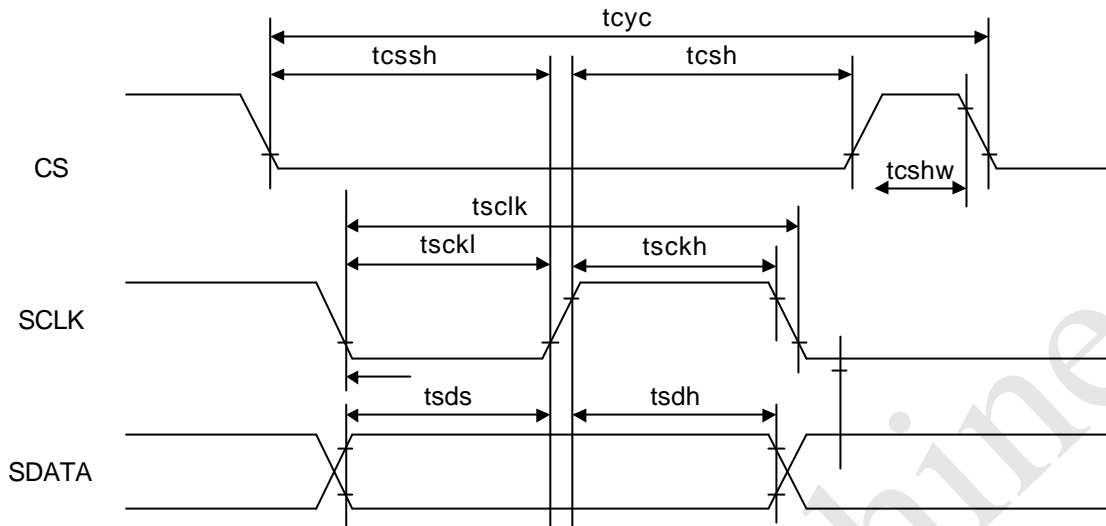
(VDD=2.58 to 2.98V)

| Item                         | Symbol | Condition  | Min. | Typ.   | Max. | Unit  |
|------------------------------|--------|------------|------|--------|------|-------|
| Horizontal Cycle             | HP     |            | -    | 660    | -    | dot   |
|                              |        |            | -    | 26.2   | -    | (us)  |
| Horizontal Sync. Pulse Width | HS     |            | -    | 96     | -    | dot   |
|                              |        |            | -    | 3.8    | -    | (us)  |
| Horizontal Back Porch        | HBP    |            | -    | 43     | -    | dot   |
|                              |        |            | -    | 1.7    | -    | (us)  |
| Horizontal Data Start Point  |        | HS+HBP     | -    | 139    | -    | dot   |
|                              |        |            | -    | 5.5    | -    | (us)  |
| Horizontal Front Porch       | HFP    |            | -    | 41     | -    | dot   |
|                              |        |            | -    | 1.6    | -    | (us)  |
| Horizontal Blanking Period   | HBL    | HS+HBP+HFP | -    | 180    | -    | dot   |
|                              |        |            | -    | 7.1    | -    | (us)  |
| Horizontal Active Area       | HDISP  |            | -    | 480    | -    | dot   |
|                              |        |            | -    | 19.1   | -    | (us)  |
| Clock Frequency              | tclk   |            | -    | 39.7   | 36   | ns    |
|                              | fclk   |            | -    | 25.175 | 27.7 | (MHz) |

# [ Timing Chart ]

CPU I/F

< Serial I/F >



(VDD=2.58 to 2.98V)

| Item                 | Symbol | Condition  | Min. | Typ. | Max. | Unit |
|----------------------|--------|--|------|------|------|------|
| CS Cycle Time        | tcyc   | Fast OSC Operating<br>Normal Command &<br>FD Write Command | 1000 | -    | -    | ns   |
| Serial Clock Cycle   | tsclk  |  | 50   | -    | -    | ns   |
| CS Cycle Time        | tcyc   | Fast OSC Operating<br>PD Write Command                     | 4000 | -    | -    | ns   |
| Serial Clock Cycle   | tsclk  |  | 50   | -    | -    | ns   |
| CS-SCLK Time         | tcssh  | CS   | 60   | -    | -    | ns   |
|                      | tcsh   | CS   | 40   | -    | -    | ns   |
| CS "H" Pulse Width   | tschw  | CS   | 50   | -    | -    | ns   |
| SCLK "L" Pulse Width | tsckl  | SCLK   | 20   | -    | -    | ns   |
| SCLK "H" Pulse Width | tsckh  | SCLK   | 20   | -    | -    | ns   |
| Data Set up Time     | tsds   | SDATA  | 15   | -    | -    | ns   |
| Data Hold Time       | tsdh   | SDATA  | 15   | -    | -    | ns   |

## [Electro-optical specifications]

Electro-optical characteristics (Ta = 25 deg., VDD = 2.78 V)

### <Backlight OFF>

| Measurement Items |                  | Symbol         | Method | MIN | TYP  | MAX | Unit |
|-------------------|------------------|----------------|--------|-----|------|-----|------|
| Reflectance       |                  | R              | (1)    | -   | 3    | -   | %    |
| Contrast ratio    |                  | CR             | (2)    | -   | 12   | -   | -    |
| Viewing angle     | CR <sub>≥5</sub> | θ (φ= 90 deg.) | (4)    | -   | 30   | -   | deg. |
|                   |                  | θ (φ=270 deg.) |        | -   | 30   | -   |      |
|                   |                  | θ (φ= 0 deg.)  |        | -   | 50   | -   |      |
|                   |                  | θ (φ=180 deg.) |        | -   | 50   | -   |      |
| Chromaticity      | White            | x <sub>W</sub> | (5)    | -   | 0.33 | -   | -    |
|                   |                  | y <sub>W</sub> |        | -   | 0.37 | -   |      |
|                   | Red              | x <sub>R</sub> |        | -   | 0.48 | -   | -    |
|                   |                  | y <sub>R</sub> |        | -   | 0.35 | -   |      |
|                   | Green            | x <sub>G</sub> |        | -   | 0.32 | -   | -    |
|                   |                  | y <sub>G</sub> |        | -   | 0.48 | -   |      |
|                   | Bule             | x <sub>B</sub> |        | -   | 0.24 | -   | -    |
|                   |                  | y <sub>B</sub> |        | -   | 0.25 | -   |      |

### <Backlight ON>

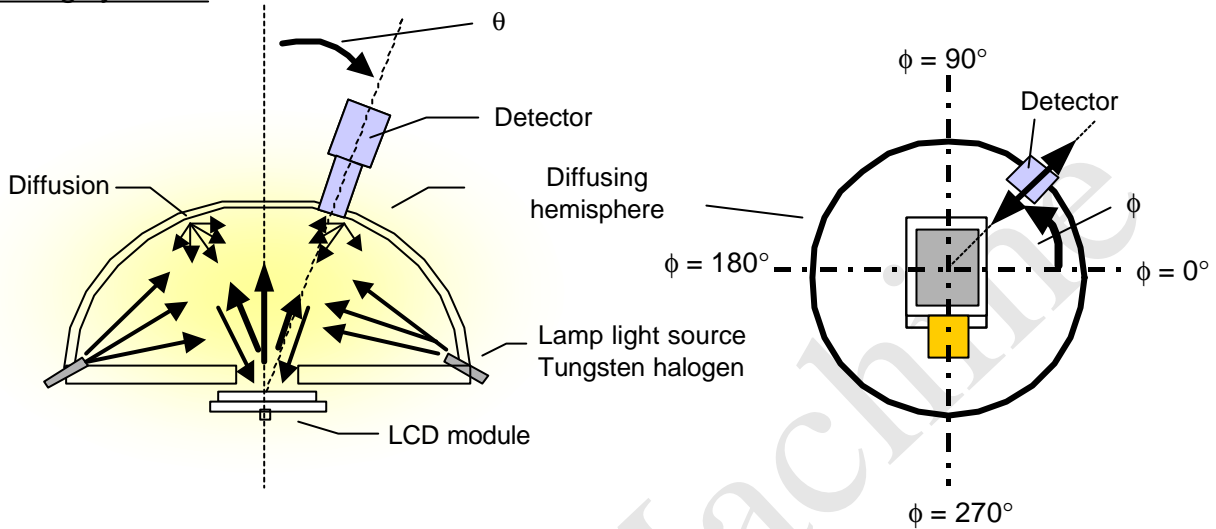
| Measurement Items         |                  | Symbol         | Method | MIN | TYP  | MAX | Unit              |
|---------------------------|------------------|----------------|--------|-----|------|-----|-------------------|
| Contrast ratio            |                  | CR             | (2)    | -   | 80   | -   | -                 |
| Response Time             |                  | ton + toff     | (3)    | -   | 40   | -   | ms                |
| Display surface luminance | θ=0              | L              | (6)    | -   | 80   | -   | cd/m <sup>2</sup> |
| Viewing angle             | CR <sub>≥5</sub> | θ (φ= 90 deg.) | (4)    | -   | 30   | -   | deg.              |
|                           |                  | θ (φ=270 deg.) |        | -   | 30   | -   |                   |
|                           |                  | θ (φ= 0 deg.)  |        | -   | 30   | -   |                   |
|                           |                  | θ (φ=180 deg.) |        | -   | 30   | -   |                   |
| Chromaticity              | White            | x <sub>W</sub> | (7)    | -   | 0.30 | -   | -                 |
|                           |                  | y <sub>W</sub> |        | -   | 0.33 | -   |                   |
|                           | Red              | x <sub>R</sub> |        | -   | 0.57 | -   | -                 |
|                           |                  | y <sub>R</sub> |        | -   | 0.34 | -   |                   |
|                           | Green            | x <sub>G</sub> |        | -   | 0.30 | -   | -                 |
|                           |                  | y <sub>G</sub> |        | -   | 0.49 | -   |                   |
|                           | Bule             | x <sub>B</sub> |        | -   | 0.14 | -   | -                 |
|                           |                  | y <sub>B</sub> |        | -   | 0.18 | -   |                   |
| Luminance uniformity      |                  |                | (8)    | -   | 80   | -   | %                 |

## Electro-optical characteristics measuring method

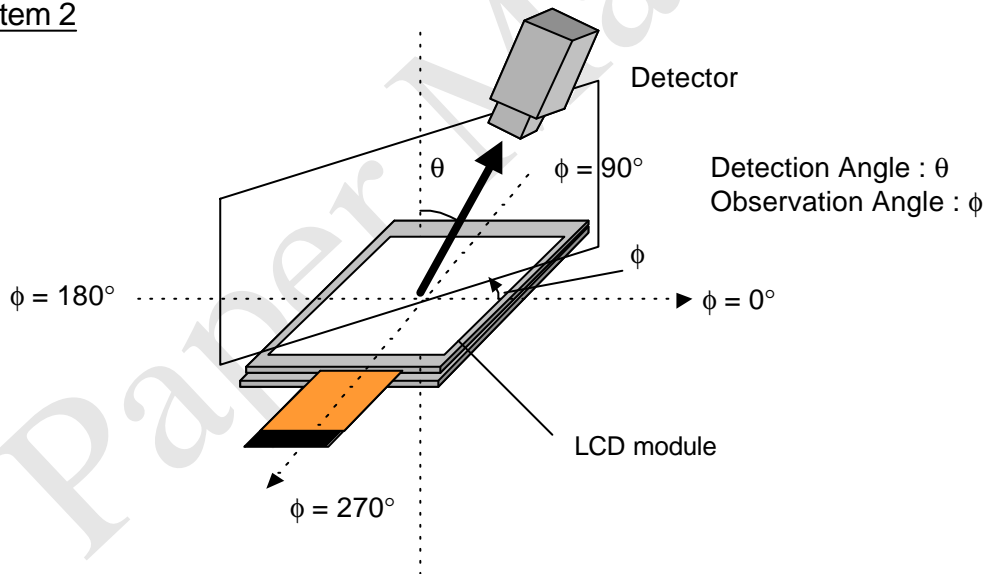
<Basic measuring condition>

- a) Drive voltage  
VDD = 2.78 V, VCOM = Optimum voltage
- b) Measuring temperature  
25°C unless otherwise specified
- c) Measuring point  
One point in the screen center, unless otherwise specified.
- d) Measuring system  
The following three system are to be used.
- e) The constant current circuit for Backlight in measuring is OFF, unless otherwise specified.

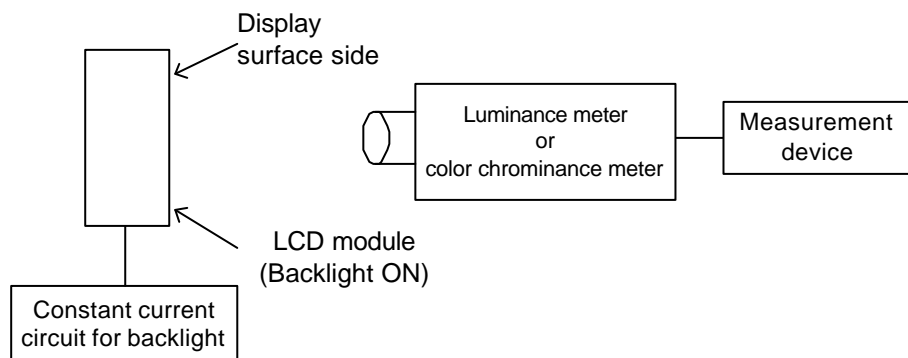
### Measuring system 1



### Measuring system 2



### Measuring system 3



(1) Reflectance

In the measuring system 1 ( $\theta = 0^\circ$ ,  $\phi = 0^\circ$ ), measure the panel surface luminance L (white) when the input data is set to 3Fh, and measure the surface luminance of the standard diffusion white board L (Ref). Then, calculate the reflectance using the following expression.

$$\text{Reflectance} = \frac{L(\text{White})}{L(\text{Ref})} \times 100(\%)$$

(2) Contrast ratio

In the measuring system 1 ( $\theta = 0^\circ$ ,  $\phi = 0^\circ$ ), measure the panel surface luminance L (white) when the input data is set to 3Fh, and measure L(Black) when the input data is set to 00h. Then, calculate the contrast ratio CR using following expression.

\* With Backlight ON, use the measuring system 2.

$$\text{CR} = \frac{L(\text{White})}{L(\text{Black})}$$

(3) Response time

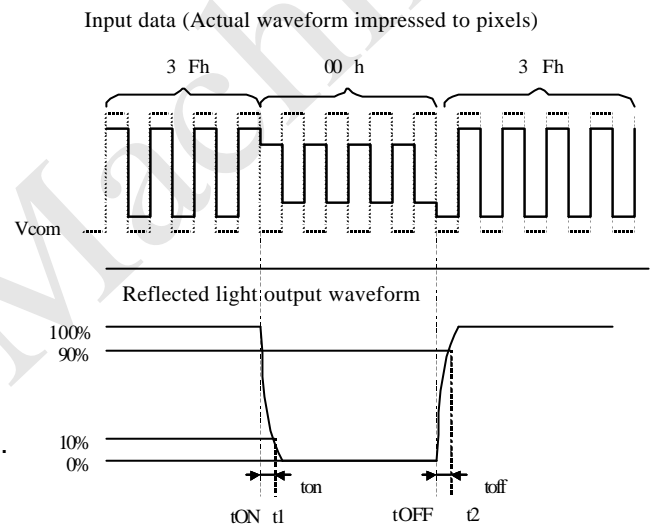
In the measuring system 2 ( $\theta = 0^\circ$ ,  $\phi = 0^\circ$ ), impress the input data shown in the right drawing to each input terminal and then measure times t on and t off:

$$t_{\text{on}} = t_1 - t_{\text{ON}}$$

where t on is the time period between t ON and t 1, where the reflected light output reduces to 10%.

$$t_{\text{off}} = t_2 - t_{\text{OFF}}$$

where t off is the time period between t OFF and t 2, where the reflected light output reaches 90%.



(4) Viewing angle

In measuring System 1, measure the contrast ratio in the  $\theta$  direction ( $0^\circ$  to  $70^\circ$ ), at the angles of  $\phi=0^\circ$ ,  $90^\circ$ ,  $180^\circ$  and  $270^\circ$ . The viewing angle is defined as the angle range which shall be the one where  $CR \geq 5$ .

(5) Display screen chromaticity (Backlight OFF)

In measuring System 1 ( $\theta = 0^\circ$ ,  $\phi = 0^\circ$ ), measure the chromaticity (White, Red, Green, Blue) with D65 light source. (conversion by the data of spectrum photometer)

Red : input 3Fh to R. (B, G is 00h.)

Green : input 3Fh to G. (R, B is 00h.)

Blue : input 3Fh to B. (R, G is 00h.)

White : input 3Fh to each R, G, B.

(6) Display surface luminance (Backlight ON)

In measuring system 3, measure the display surface luminance according to the following conditions.  
Measure without input data.

| Parameter            | Condition                            |
|----------------------|--------------------------------------|
| Ambient lighting     | Inside a darkroom 10 lux or below    |
| Ambient temperature  | 25±3°C                               |
| Measuring instrument | Luminance colorimeter (BM-5A:TOPCON) |
| Measuring diameter   | f5mm                                 |
| Measuring point      | Center area of display screen        |

(7) Display screen chromaticity (Backlight ON)

In measuring system 3, measure the chromaticity according to the same condition as for (6).

Red : input 3Fh to R. (B, G is 00h.)

Green : input 3Fh to G. (R, B is 00h.)

Blue : input 3Fh to B. (R, G is 00h.)

White : input 3Fh to each R, G, B.

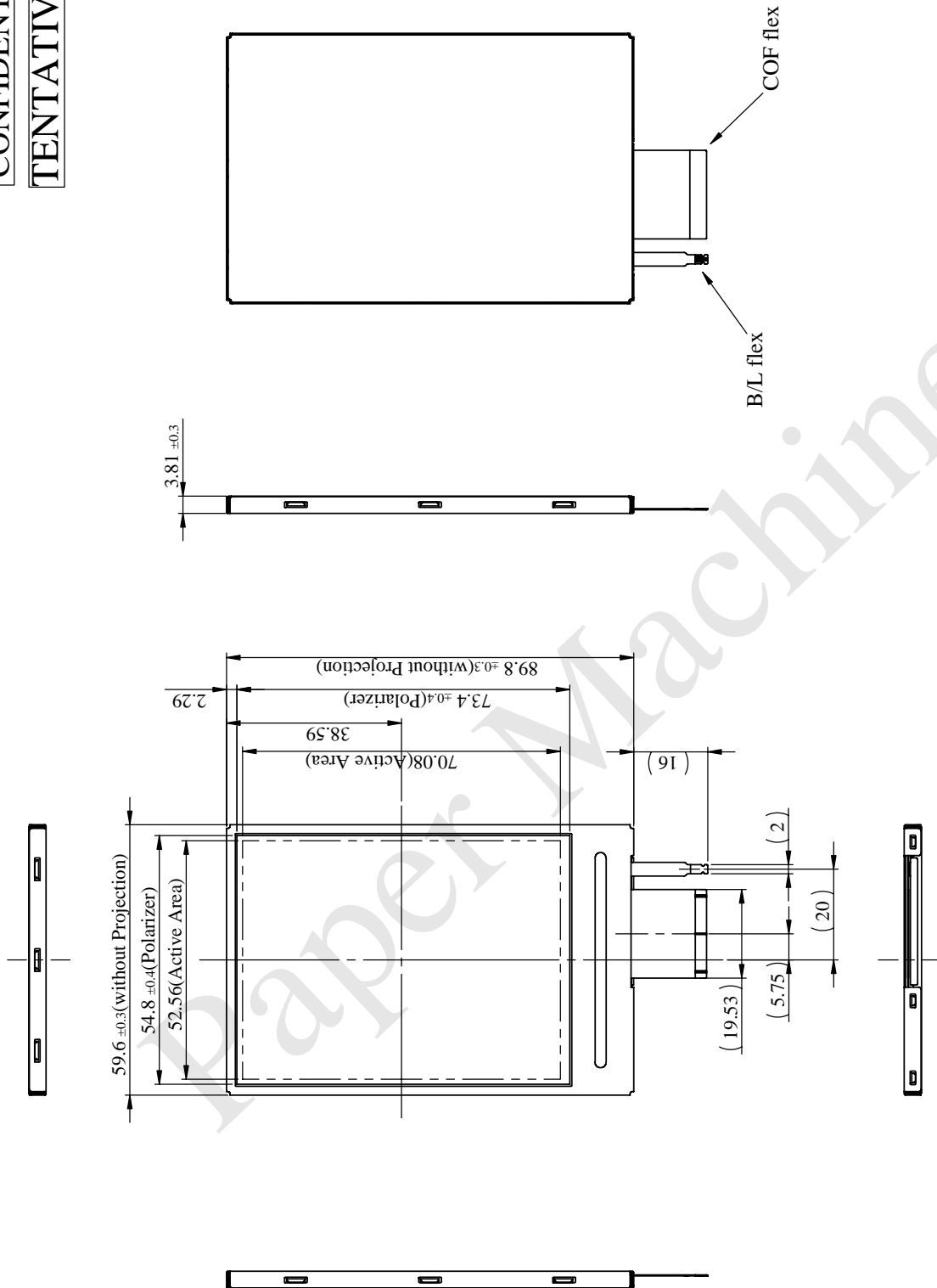
(8) Luminance uniformity (Backlight ON)

In measuring system 3, measure the luminance uniformity according to the following condition.

| Parameter            | Condition   |
|----------------------|---|
| Ambient lighting     | Inside a darkroom 10 lux or below                         |
| Ambient temperature  | 25±3°C  |
| Measuring instrument | Luminance colorimeter (BM-5A:TOPCON)                      |
| Measuring diameter   | f10mm   |
| Measuring point      | 3 row 3 line on effective area                            |
| Calculating method   | Minimum/Maximum values among measuring values on 9 points |
| Measuring signal     | Input 3Fh to each R,G, B.                                 |

[Outline dimensions]

CONFIDENTIAL  
TENTATIVE



- Note1. Unspecified dimensional tolerance shall be  $\pm 0.4$ .  
 2. When assembling into the unit, ground the case (at the ground potential).  
 3. For the LCD module positioning, avoid areas near the corners and projections.