

- ☒ Tentative Specification
- ☐ Preliminary Specification
- ☐ Approval Specification

MODEL NO.: G070ACE
SUFFIX: LH3

Customer:

APPROVED BY

SIGNATURE

Name / Title

Note

Please return 1 copy for your confirmation with your signature and comments.

| Approved By | Checked By | Prepared By |
|-------------|------------|-------------|
| | | |

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REVISION HISTORY

[illegible]

1. GENERAL DESCRIPTION

1.1 OVERVIEW

G070ACE-LH3 is a 7" TFT Liquid Crystal Display module with WLED Backlight unit and 30 pins 1ch-LVDS interface. This module supports 800xRGBx480 AAS mode and can display 262k or 16.7M colors.

The PSWG is to establish a set of displays with standard mechanical dimensions and select electrical interface requirements for an industry standard 7" WVGA LCD panel and the LED driving device for Backlight is built in PCBA.

1.2 FEATURE

- WVGA (800 x 480 pixels) resolution
- DE (Data Enable) only mode
- LVDS Interface with 1pixel/clock
- PSWG (Panel Standardization Working Group)
- Wide operating temperature.
- RoHS compliance

1.3 APPLICATION

- TFT LCD Monitor
- Factory Application
- Amusement

1.4 GENERAL SPECIFICATIONS

| Item | Specification | Unit | Note |
|--------------------------|--------------------------------------|-------|------|
| Active Area | 152.4 (H) x 91.44 (V) (7" diagonal) | mm | (1) |
| Driver Element | a-Si TFT active matrix | - | - |
| Pixel Number | 800 x R.G.B. x 480 | pixel | - |
| Pixel Pitch | 0.1905 (H) x 0.1905 (V) | mm | - |
| Pixel Arrangement | RGB vertical Stripe | - | - |
| Display Colors | 16.7M / 262K | color | - |
| Display Mode | Normally Black | - | - |
| Surface Treatment | Hard Coating (3H), Anti-Glare | - | - |
| Module Power Consumption | Total 3.15 W @ cell 0.45 W, BL 2.7 W | W | Typ. |

1.5 MECHANICAL SPECIFICATIONS

| Item | | Min. | Typ. | Max. | Unit | Note |
|-------------|----------------|-------|--------|-------|------|------|
| Module Size | Horizontal (H) | 164.5 | 165 | 165.5 | mm | (1) |
| | Vertical (V) | 103.5 | 104 | 104.5 | mm | |
| | Thickness (T) | 8.13 | 8.63 | 9.13 | mm | |
| Bezel Area | Horizontal | 154.3 | 154.60 | 154.9 | mm | |
| | Vertical | 93.34 | 93.64 | 93.94 | mm | |
| Active Area | Horizontal | - | 152.4 | - | mm | |
| | Vertical | - | 91.44 | - | mm | |
| Weight | | | (152) | | g | |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

2. ABSOLUTE MAXIMUM RATINGS

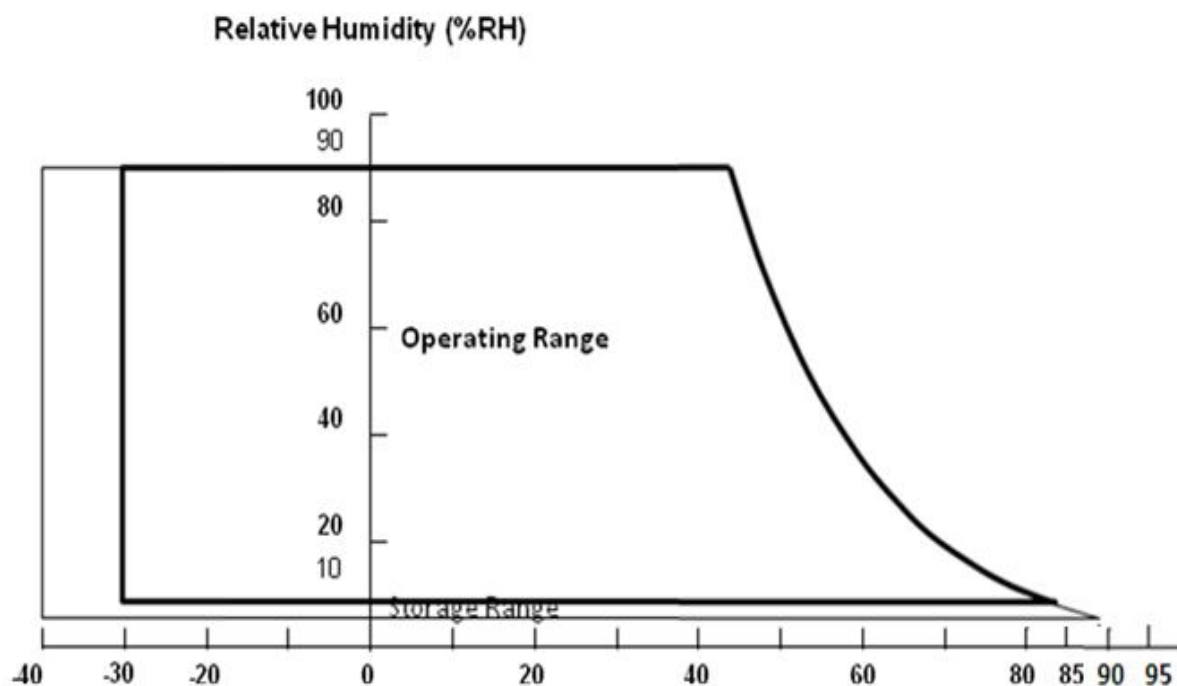
2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item | Symbol | Value | | Unit | Note |
|-------------------------------|--------|-------|------|------|--------|
| | | Min. | Max. | | |
| Storage Temperature | Tst | -40 | (85) | °C | (1)(2) |
| Operating Ambient Temperature | Top | -30 | (85) | °C | |

Note (1)

- (a) 90 %RH Max.
- (b) Wet-bulb temperature should be 39 °C Max.
- (c) No condensation.

Note (2) Panel surface temperature should be 0°C min. and 65°C max under Vcc=5.0V, fr =60Hz, typical LED string current, 25°C ambient temperature, and no humidity control . Any condition of ambient operating temperature ,the surface of active area should be keeping not higher than 65°C.



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

| Item | Symbol | Value | | Unit | Note |
|----------------------|-----------------|-------|------|------|------|
| | | Min. | Max. | | |
| Power Supply Voltage | V _{CC} | -0.3 | 3.6 | V | (1) |
| Logic Input Voltage | V _{IN} | -0.3 | 3.6 | V | |

2.2.2 BACKLIGHT UNIT

| Item | Symbol | Value | | Unit | Note |
|-------------------|----------------|-------|------|------|-----------|
| | | Min. | Max. | | |
| Converter Voltage | V _i | 0 | 18.0 | V | (1) , (2) |
| Enable Voltage | EN | --- | 7 | V | |
| Backlight Adjust | Dimming | --- | 7 | V | |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for LED (Refer to 3.2 for further information).

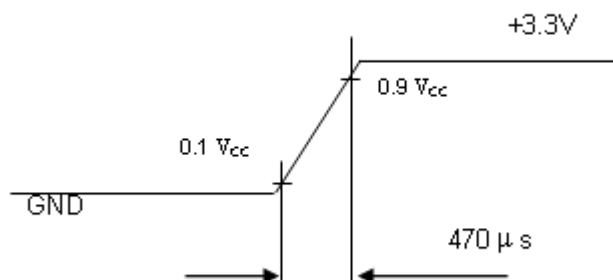
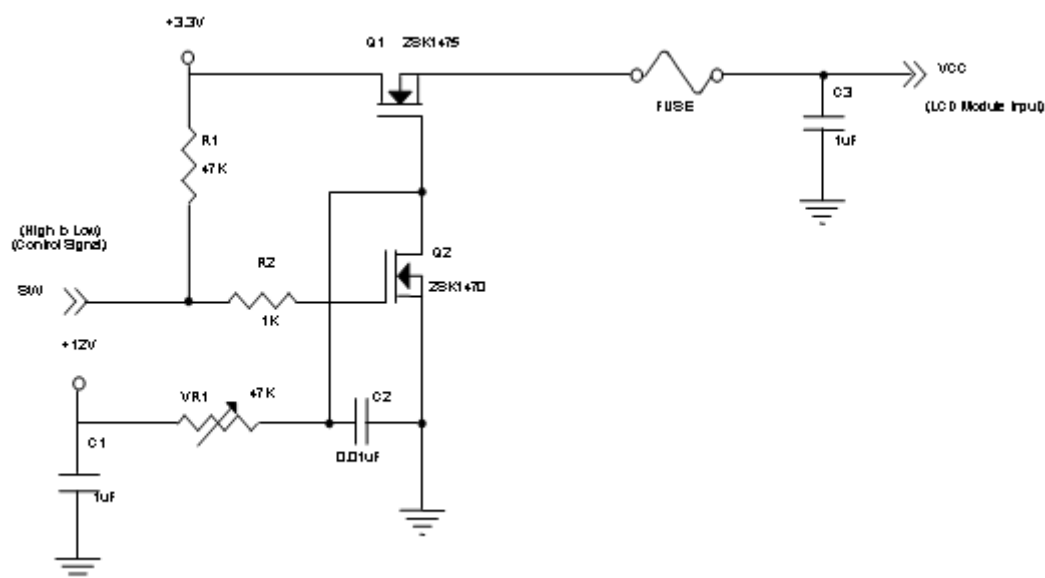
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

| Parameter | Symbol | Value | | | Unit | Note |
|--|-------------------|-----------------|------|-----------------|-------|------|
| | | Min. | Typ. | Max. | | |
| Power Supply Voltage | V _{CC} | 3.0 | 3.3 | 3.6 | V | - |
| Ripple Voltage | V _{RP} | - | - | 100 | mVp-p | - |
| Rush Current | I _{RUSH} | - | - | 2 | A | (2) |
| Power Supply Current | White | - | 135 | 200 | mA | (3)a |
| | Black | - | 85 | 135 | mA | (3)b |
| LVDS differential input voltage | V _{id} | 200 | - | 600 | mV | |
| LVDS common input voltage | V _{ic} | 1.0 | 1.2 | 1.4 | V | |
| Differential Input Voltage for LVDS Receiver Threshold | "H" Level | V _{TH} | - | +100 | mV | - |
| | "L" Level | V _{TL} | -100 | - | mV | - |
| Logic Input Voltage | "H" Level | V _{IH} | 2.6 | V _{CC} | V | |
| | "L" Level | V _{IL} | 0 | 0.7 | V | |
| Terminating Resistor | R _T | - | 100 | - | Ohm | - |

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:



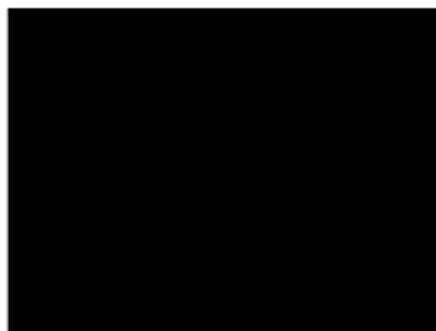
Note (3) The specified power supply current is under the conditions at $V_{CC} = 3.3V$, $T_a = 25 \pm 2^\circ C$, DC Current and $f_v = 60$ Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern

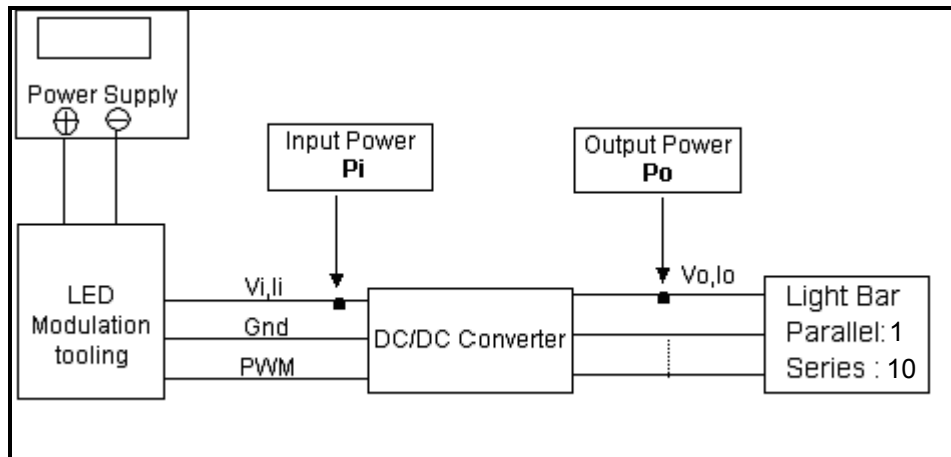


Active Area

3.2 BACKLIGHT UNIT

| Parameter | | Symbol | Value | | | Unit | Note |
|--------------------------------|----------------|--------------------|--------|------|------|------|---|
| | | | Min. | Typ. | Max. | | |
| Converter Power Supply Voltage | | LED_Vin | 10.8 | 12.0 | 13.2 | V | |
| Converter Input Ripple Voltage | | V _{IRP} | - | - | 500 | mV | |
| Converter Power Supply Current | | I _I | 0.18 | 0.22 | 0.3 | A | @LED_Vin= 12V Duty=100% |
| Converter Input Rush Current | | I _{Irsh} | | | 3 | A | @LED_Vin rising = 1mS(Vi=12V) |
| Input Power Consumption | | P _i | - | 2.7 | 3.3 | W | (1) |
| EN Control Level | Backlight on | ENLED (BLON) | 2.0 | 3.3 | 5.0 | V | EN Control Level |
| | Backlight off | | 0 | - | 0.3 | V | |
| PWM Control Level | PWM High Level | Dimming (E_PWM) | 2.0 | -- | 5.0 | V | PWM Control Level |
| | PWM Low Level | | 0 | -- | 0.15 | V | |
| PWN Noise Range | | V _{Noise} | - | - | 0.1 | V | |
| PWM Control Frequency | | f _{PWM} | 190 | 200 | 20K | Hz | (3) |
| PWM Dimming Control Duty Ratio | | - | 5 | - | 100 | % | (3), @ 190Hz < f _{PWM} < 1kHz |
| | | | 20 | - | 100 | % | (3), @ 1kHz ≤ f _{PWM} < 20kHz |
| LED Life Time | | L _{LED} | 50,000 | | - | Hrs | (2) |

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



Note (2) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2^\circ\text{C}$ and Duty 100% until the brightness becomes $\leq 50\%$ of its original value. Operating LED at high temperature condition will reduce life time and lead to color shift.

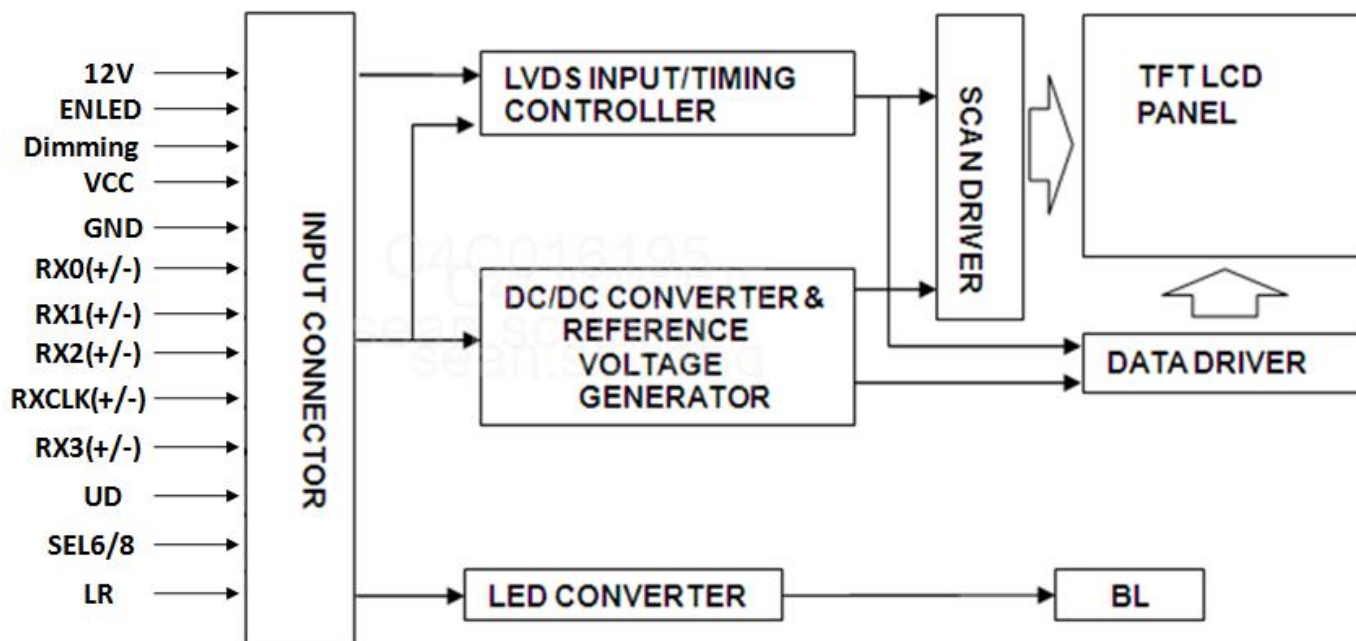
Note (3) At 190 ~1kHz PWM control frequency, duty ratio range is restricted from 5% to 100%.

1K ~20kHz PWM control frequency, duty ratio range is restricted from 20% to 100%.

If PWM control frequency is applied in the range from 1KHz to 20KHZ, The “non-linear” phenomenon on the Backlight Unit may be found. So It’ s a **suggestion** that PWM control frequency should be **less than 1KHz**.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

| Pin No. | Symbol | Function | Polarity | Note |
|---------|---------|---|----------|------|
| 1 | 12V | LED power | | - |
| 2 | 12V | LED power | | - |
| 3 | 12V | LED power | | - |
| 4 | 12V | LED power | | - |
| 5 | ENLED | Enable pin | | - |
| 6 | Dimming | Backlight Adjust | | - |
| 7 | NC | No Connction (Reserve for INX test) | | (4) |
| 8 | NC | No Connction (Reserve for INX test) | | (4) |
| 9 | VCC | Power supply: +3.3V | | - |
| 10 | VCC | Power supply: +3.3V | | - |
| 11 | GND | Ground | | - |
| 12 | GND | Ground | | - |
| 13 | RX0- | Negative transmission data of pixel 0 | Negative | - |
| 14 | RX0+ | Positive transmission data of pixel 0 | Positive | - |
| 15 | GND | Ground | | - |
| 16 | RX1- | Negative transmission data of pixel 1 | Negative | - |
| 17 | RX1+ | Positive transmission data of pixel 1 | Positive | - |
| 18 | GND | Ground | | - |
| 19 | RX2- | Negative transmission data of pixel 2 | Negative | - |
| 20 | RX2+ | Positive transmission data of pixel 2 | Positive | - |
| 21 | GND | Ground | | - |
| 22 | RXCLK- | Negative of clock | Negative | - |
| 23 | RXCLK+ | Positive of clock | Positive | - |
| 24 | GND | Ground | | - |
| 25 | RX3- | Negative transmission data of pixel 3 | Negative | - |
| 26 | RX3+ | Positive transmission data of pixel 3 | Positive | - |
| 27 | UD | Gate Driver Up/Down scan control. When UD=H, reverse scan When UD=L, normal scan | | (3) |
| 28 | SEL6/8 | LVDS 6/8 bit select function control, Low → 6 bit Input Mode High or NC → 8bit Input Mode | | (3) |
| 29 | LR | Source Driver Right/ Left scan control. When LR=H, normal scan When LR=L, reverse scan | | (3) |
| 30 | GND | Ground | | |

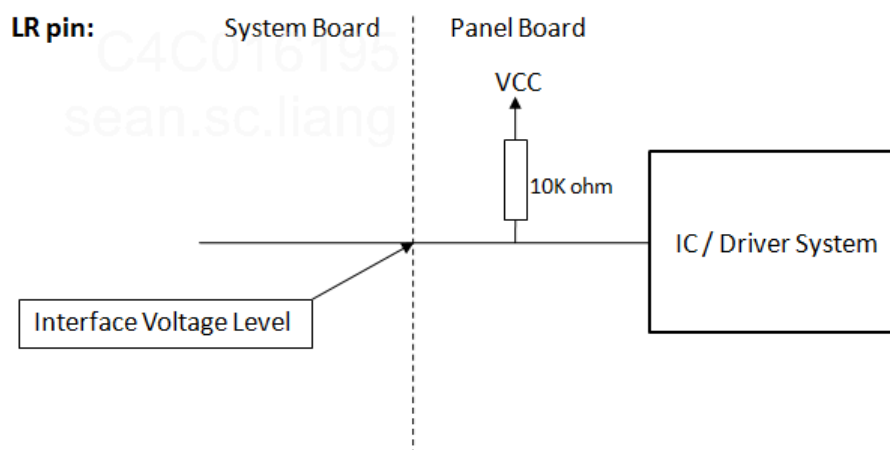
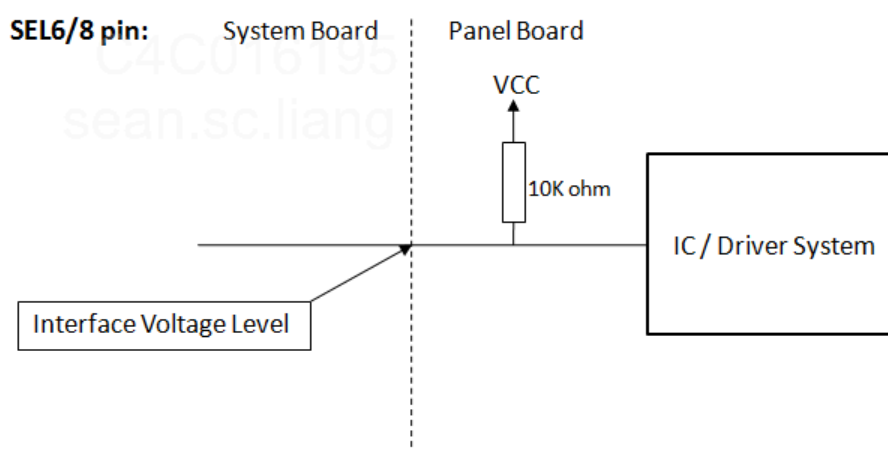
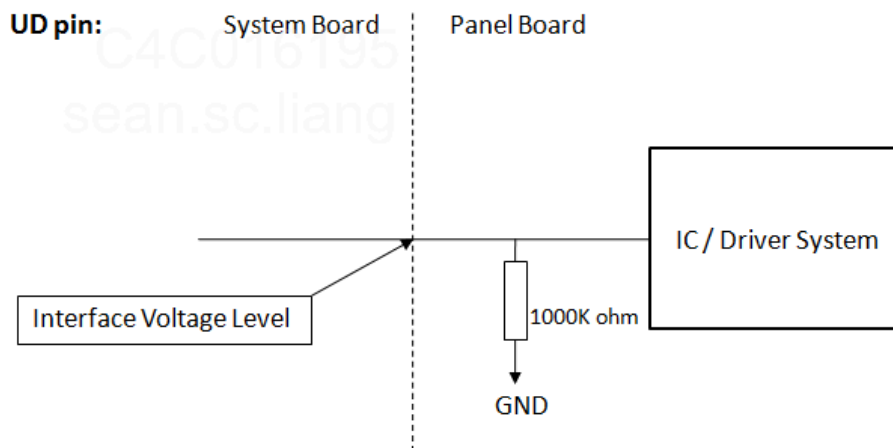
Note (1) Connector Part No.: Starconn 093G30-B0001A-G4.or P-TWO 187114-30091

Note (2) User's connector Part No:

Mating Wire Cable Connector Part No. :FI-X30H (JAE) or FI-X30HL (JAE)

Note (3) "Low" stands for 0V. "High" stands for 3.3V

Note (4) Pin7, Pin8 input signals should be set to no connection or ground, this module



5.2 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

| Color | | Data Signal | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|----------------|-------------|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|
| | | Red | | | | | | | | Green | | | | | | | | Blue | | | | | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale Of Red | Red(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| | Red(253) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Green | Green(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| | Green(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Blue | Blue(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| | Blue(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

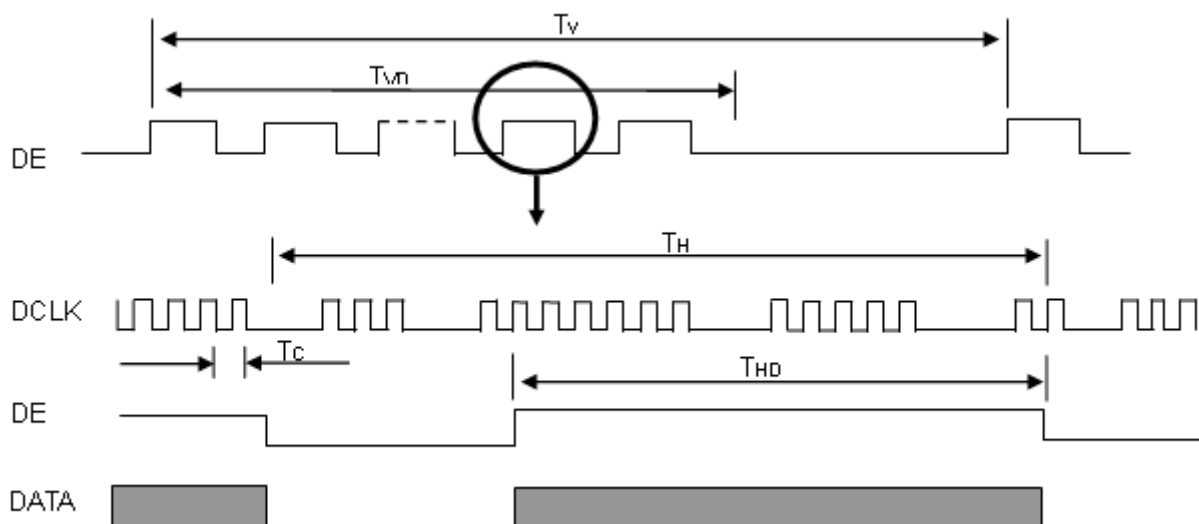
The input signal timing specifications are shown as the following table and timing diagram.

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|-------------------------|--------------------------------------|------------------|-------------------|-------|------------------|-------|-------------------------|
| LVDS Clock | Frequency | F_c | 25.2 | 25.4 | 35.7 | MHz | - |
| | Period | T_c | | 39.37 | | ns | |
| | Input cycle to cycle jitter | T_{rcj} | $-0.02 \cdot T_c$ | - | $0.02 \cdot T_c$ | ns | (a) |
| | Input Clock to data skew | TLVCCS | $-0.02 \cdot T_c$ | - | $0.02 \cdot T_c$ | ps | (b) |
| | Spread spectrum modulation range | F_{clkin_mod} | - | - | $1.02 \cdot F_c$ | MHz | (c) |
| | Spread spectrum modulation frequency | F_{SSM} | 23 | - | 93 | KHz | |
| Vertical Display Term | Frame Rate | F_r | - | 60 | - | Hz | - |
| | Total | T_v | 488 | 490 | 611 | T_h | $T_v = T_{vd} + T_{vb}$ |
| | Active Display | T_{vd} | 480 | 480 | 480 | T_h | - |
| | Blank | T_{vb} | 8 | 10 | 131 | T_h | - |
| Horizontal Display Term | Total | T_h | 860 | 864 | 974 | T_c | $T_h = T_{hd} + T_{hb}$ |
| | Active Display | T_{hd} | 800 | 800 | 800 | T_c | - |
| | Blank | T_{hb} | 60 | 64 | 174 | T_c | - |

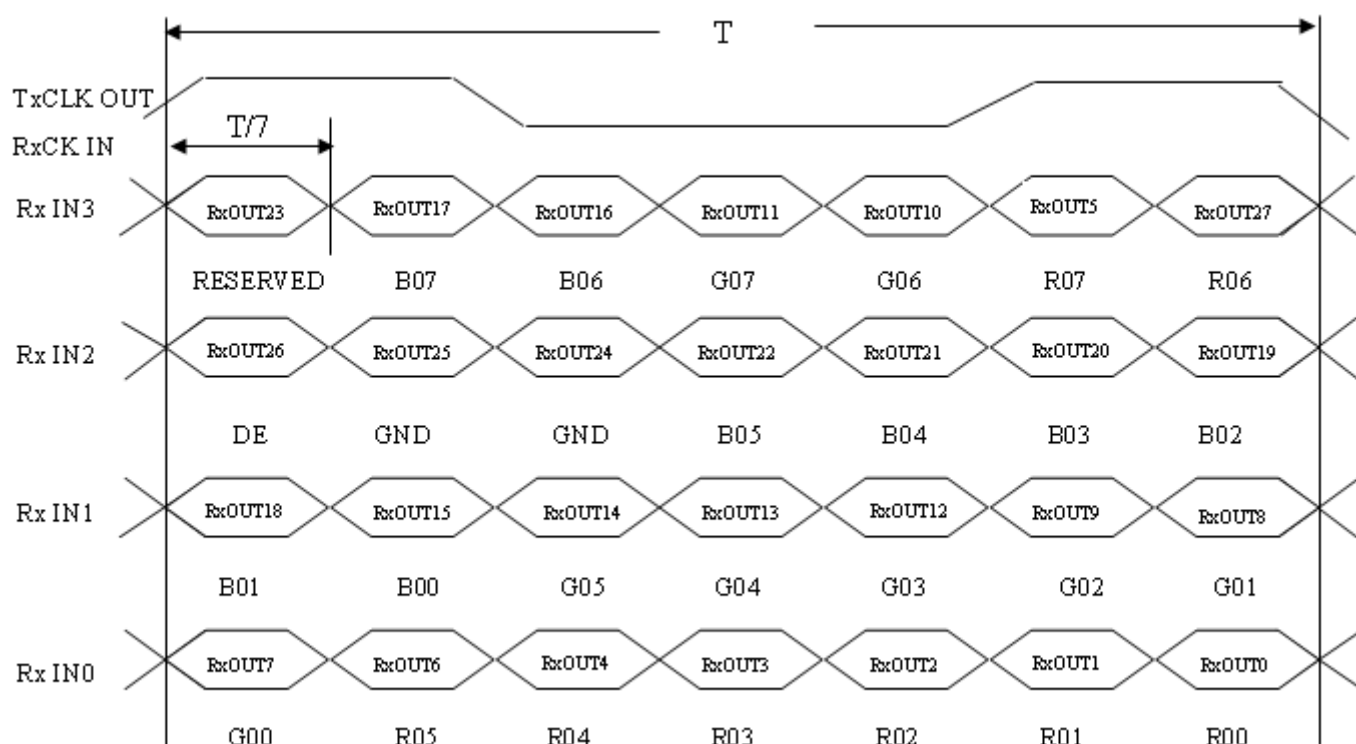
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The $T_v(T_{vd}+T_{vb})$ must be integer, otherwise, the module would operate abnormally.

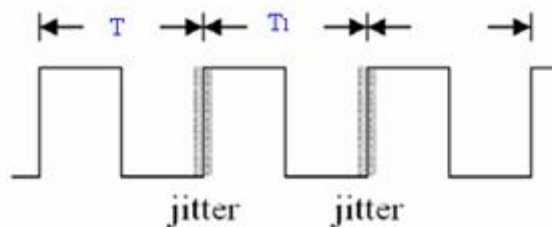
INPUT SIGNAL TIMING DIAGRAM



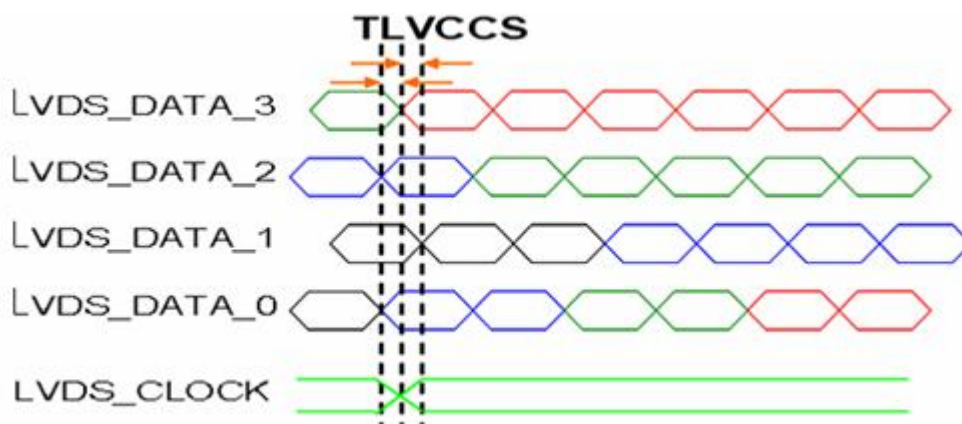
TIMING DIAGRAM of LVDS



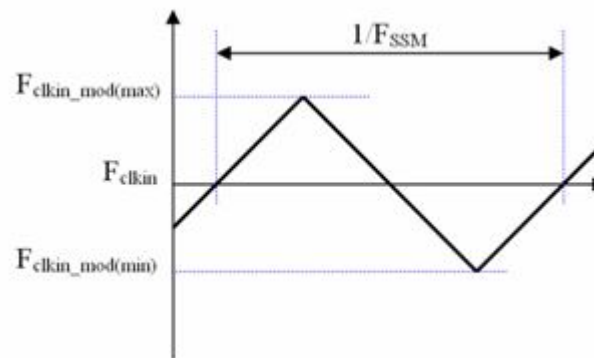
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. $T_{rc1} = |T1 - T|$



Note (b) Input Clock to data skew is defined as below figures.

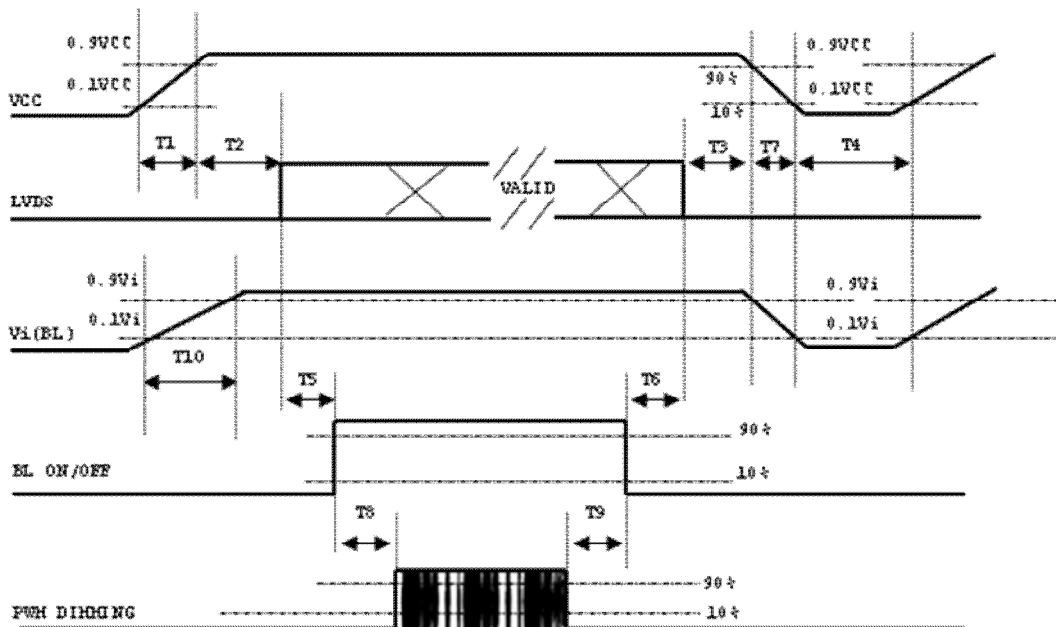


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



6.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.



| Parameter | Value | | | Units Min |
|-----------|-------|-----|-----|--------------|
| | Min | Typ | Max | |
| T1 | 0.5 | - | 10 | ms |
| T2 | 0 | - | 50 | ms |
| T3 | 0 | - | 50 | ms |
| T4 | 500 | - | - | ms |
| T5 | 450 | - | - | ms |
| T6 | 200 | - | - | ms |
| T7 | 10 | - | 100 | ms |

| | | | | |
|-----|----|---|----|----|
| T8 | 10 | - | - | ms |
| T9 | 10 | - | - | ms |
| T10 | 20 | - | 50 | ms |

Note

- (1) The supply voltage of the external system for the module input should be the same as the definition of Vcc.
- (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.
- (3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.
- (6) INX won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.

There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "T7 spec".

6.3 SCANNING DIRECTION

The following figures show the image see from the front view. The arrow indicates the direction of scan.

Fig.1 Normal Scan



PCBA on the bottom side

Fig.2 Reverse Scan



PCBA on the bottom side

Fig. 1 Normal scan (pin 27, UD = Low, pin 29 LR = High)

Fig. 2 Reverse scan (pin 27, UD = High, pin 29 LR = Low)

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

| Item | Symbol | Value | Unit |
|---------------------|--|-------|------|
| Ambient Temperature | Ta | 25±2 | °C |
| Ambient Humidity | Ha | 50±10 | %RH |
| Supply Voltage | According to typical value and tolerance in "ELECTRICAL CHARACTERISTICS" | | |
| Input Signal | | | |
| PWM Duty Ratio | D | 100 | % |

7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown here and all items are measured at the center point of screen unless otherwise noted. The following items should be measured under the test conditions described above and stable conditions shown in Note (5).

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|--------------------|---------------------------|-------------|---|------------|---------|------------|----------|----------|
| Color Chromaticity | Red | Rx | $\theta X=0^{\circ}, \theta Y=0^{\circ}$ Grayscale Maximum | Typ – 0.05 | (0.58) | Typ + 0.05 | - | (1), (5) |
| | | Ry | | | (0.330) | | | |
| | Green | Gx | | | (0.334) | | | |
| | | Gy | | | (0.600) | | | |
| | Blue | Bx | | | (0.150) | | | |
| | | By | | | (0.054) | | | |
| | White | Wx | | | 0.313 | | | |
| | | Wy | | | 0.329 | | | |
| | Center Luminance of White | | | | LC | | | |
| Contrast Ratio | | CR | 600 | 800 | | | (2), (5) | |
| Response Time | | TR | $\theta X=0^{\circ}, \theta Y=0^{\circ}$ | - | 13 | - | ms | (3) |
| | | TF | | - | 12 | - | | |
| White Variation | | δW | $\theta X=0^{\circ}, \theta Y=0^{\circ}$ | 70 | - | - | % | (5), (6) |
| Viewing Angle | Horizontal | $\theta X+$ | $CR \geq 10$ | 80 | 89 | - | Deg. | (1), (5) |
| | | $\theta X-$ | | 80 | 89 | - | | |
| | Vertical | $\theta Y+$ | | 80 | 89 | - | | |
| | | $\theta Y-$ | | 80 | 89 | - | | |

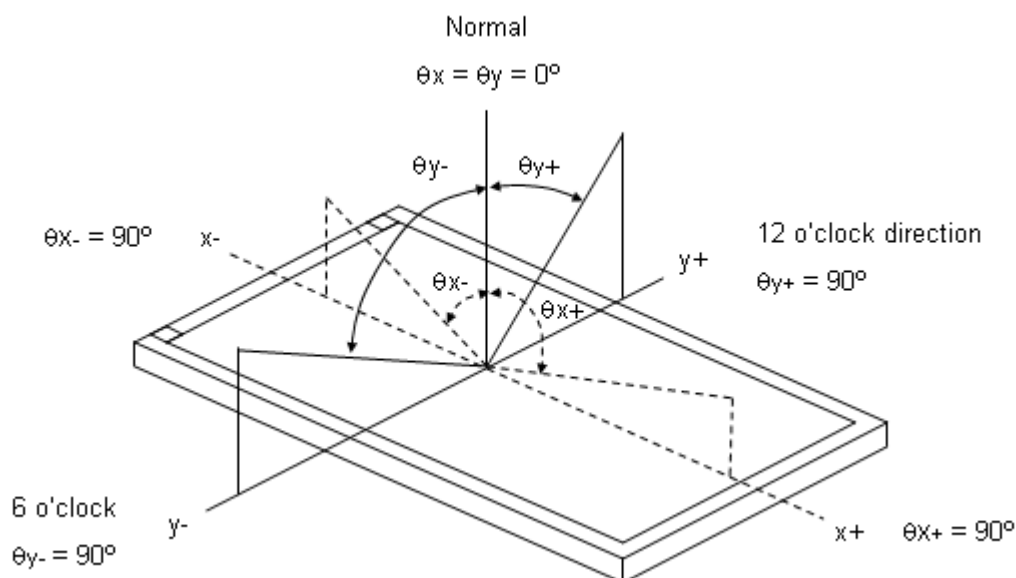
Definition :

Grayscale Maximum : Grayscale 255 (10 bits: grayscale 1023 ; 8 bits : grayscale 255 ; 6 bits: grayscale 63)

White : Luminance of Grayscale Maximum (All R,G,B)

Black : Luminance of grayscale 0 (All R,G,B)

Note (1) Definition of Viewing Angle (θ_x , θ_y):

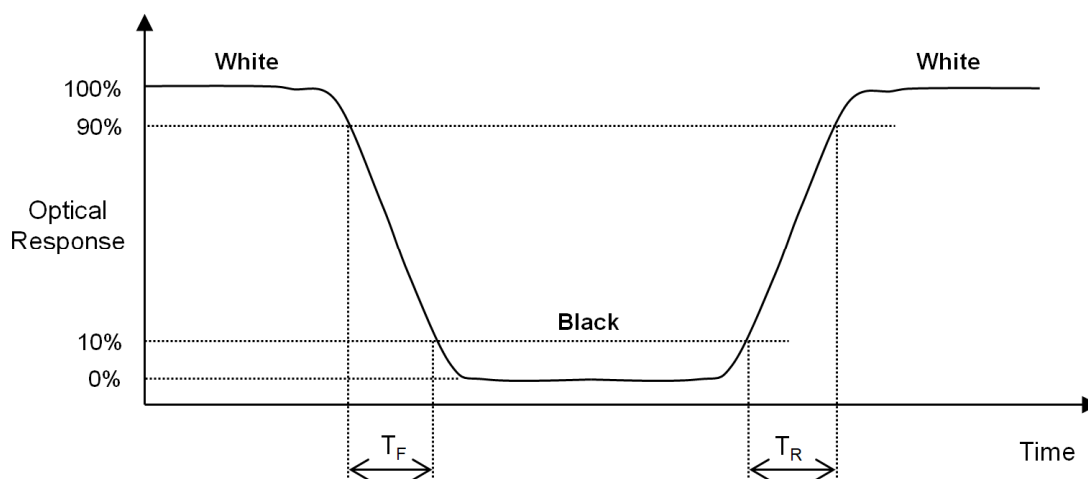


Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression at center point.

$$\text{Contrast Ratio (CR)} = \text{White} / \text{Black}$$

Note (3) Definition of Response Time (T_R , T_F):

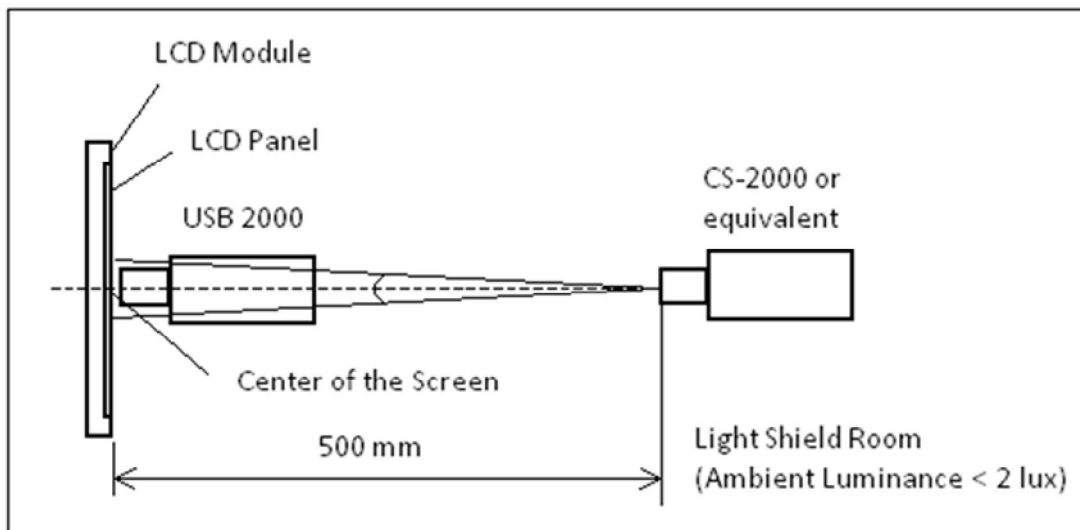


Note (4) Definition of Luminance of White (L_c):

Measure the luminance of White at center point.

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room. The measurement placement of module should be in accordance with module drawing.

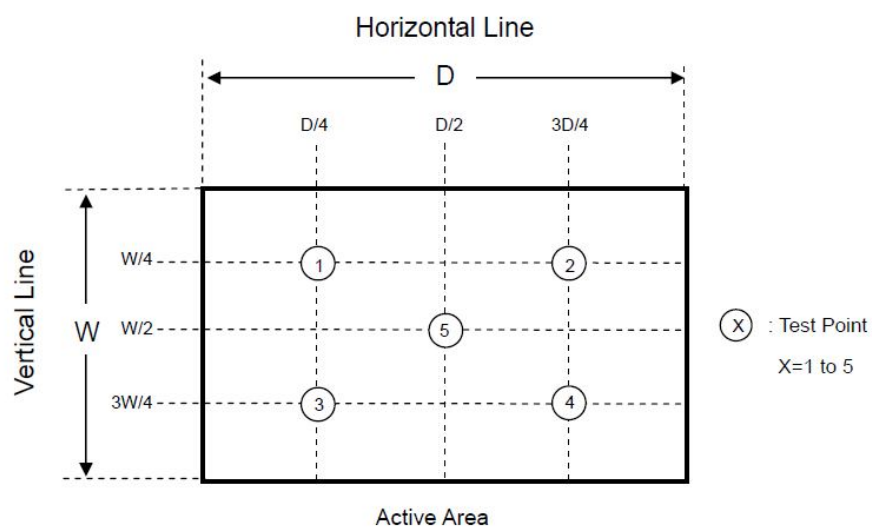


Note (6) Definition of White Variation (δW):

Measure the luminance of White at 5 points.

Luminance of White : $L(X)$, where X is from 1 to 5.

$$\delta W = \frac{\text{Minimum [} L(1) \text{ to } L(5)]}{\text{Maximum [} L(1) \text{ to } L(5)]} \times 100\%$$



8. RELIABILITY TEST CRITERIA

| Test Item | Test Condition | Note |
|---|--|--------------------|
| High Temperature Storage Test | (85°C, 240 hours) | (1),(2) (4),(5) |
| Low Temperature Storage Test | -40°C, 240 hours | |
| Thermal Shock Storage Test | -30°C, 0.5hour \longleftrightarrow 80°C, 0.5hour; 1hour/cycle, 100cycles | |
| High Temperature Operation Test | (85°C, 240 hours) | |
| Low Temperature Operation Test | -30°C, 240 hours | |
| High Temperature & High Humidity Operation Test | 60°C, RH 90%, 240 hours | (2), (3) |
| Shock (Non-Operating) | 50G, 11ms, half sine wave, 1 time for $\pm X$, $\pm Y$, $\pm Z$ | |
| Vibration (Non-Operating) | 1.5G, 10 ~ 300 Hz, 10min/cycle, 3 cycles each X, Y, Z | |

Note (1) There should be no condensation on the surface of panel during test ,

Note (2) Temperature of panel display surface area should be 85°C Max.

Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

Note (4) In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before reliability test.

Note (5) Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

9. PACKAGING

9.1 PACKING SPECIFICATIONS

- (1) 34 pcs LCD modules / 1 Box
- (2) Box dimensions: 465 (L) X 362 (W) X 314 (H) mm
- (3) Weight: approximately TBD Kg (34modules per box)

9.2 PACKING METHOD

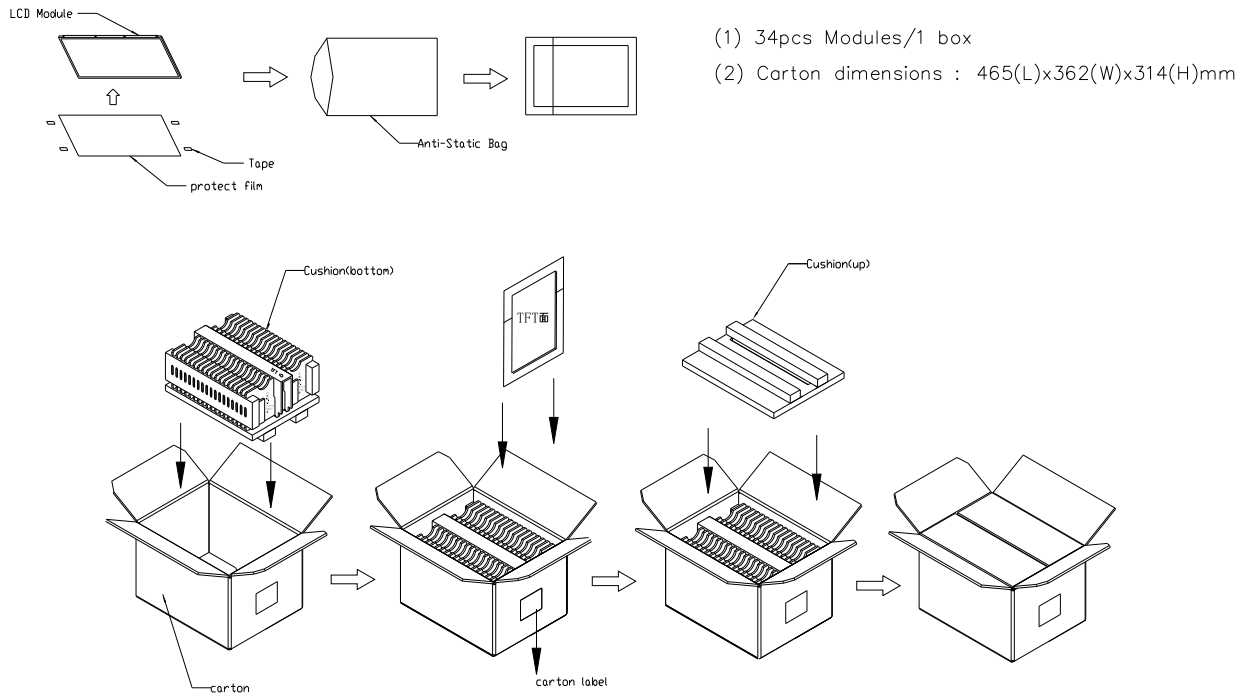
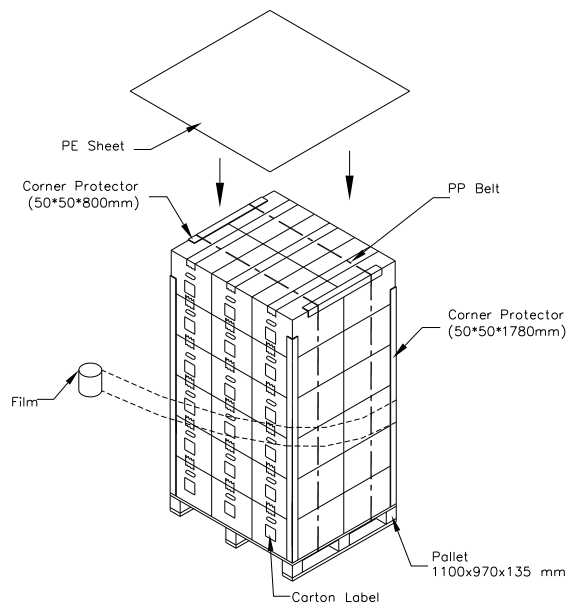


Figure. 9-1 Packing method

Sea / Land Transportation (40ft Container)



Air Transportation

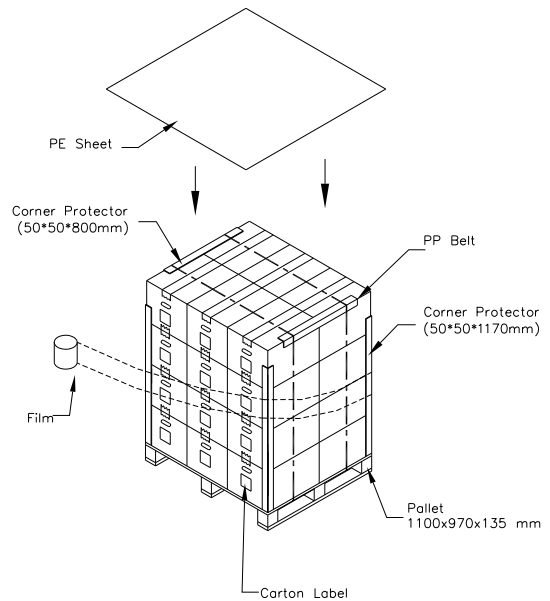


Figure. 9-2 Packing method

9.3 UN-PACKING METHOD

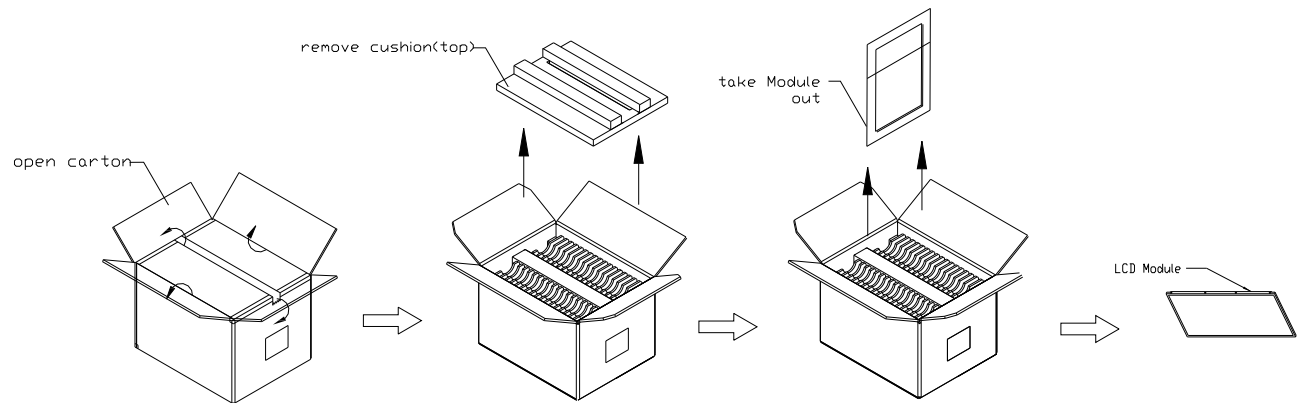
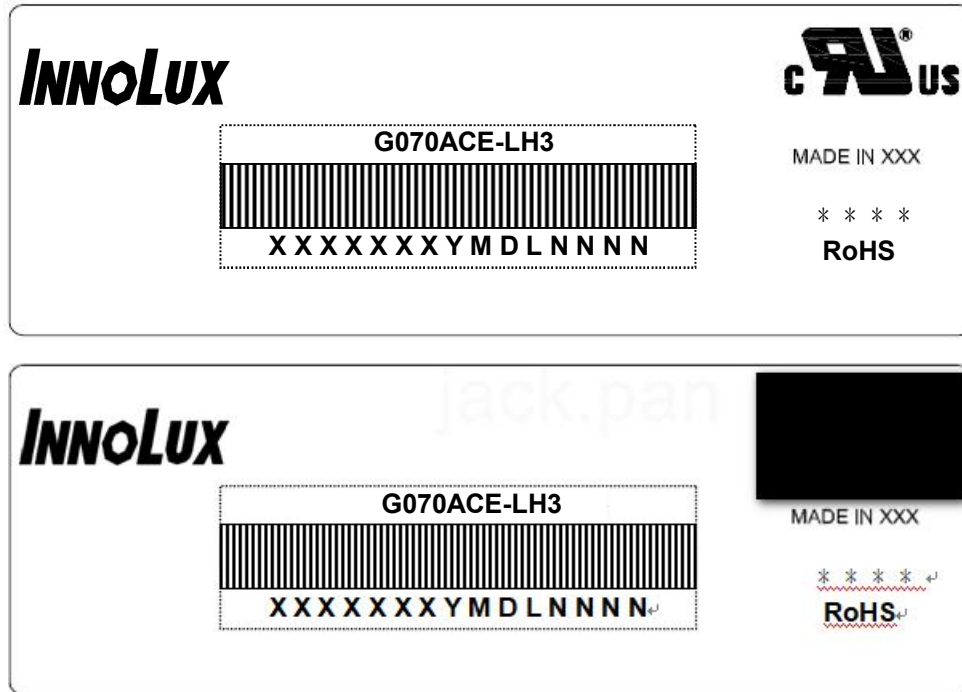


Figure. 9-3 UN-Packing method

10. DEFINITION OF LABELS

10.1 INX MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.

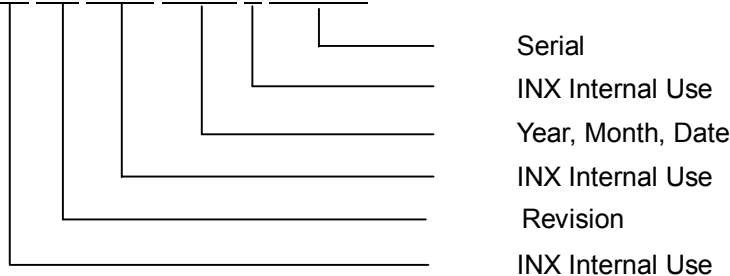


Note (1) Safety Compliance(UL logo) will open after C1 version.

(a) Model Name: G070ACE-LH3

(b) * * * * : Factory ID

(c) Serial ID: X X X X X X Y M D X N N N N



Serial ID includes the information as below:

- (a) Manufactured Date: Year: 1~9, for 2021~2029
Month: 1~9, A~C, for Jan. ~ Dec.
Day: 1~9, A~Y, for 1st to 31st, exclude I , O and U
- (b) Revision Code: cover all the change
- (c) Serial No.: Manufacturing sequence of product

11. PRECAUTIONS

11.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the lamp wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

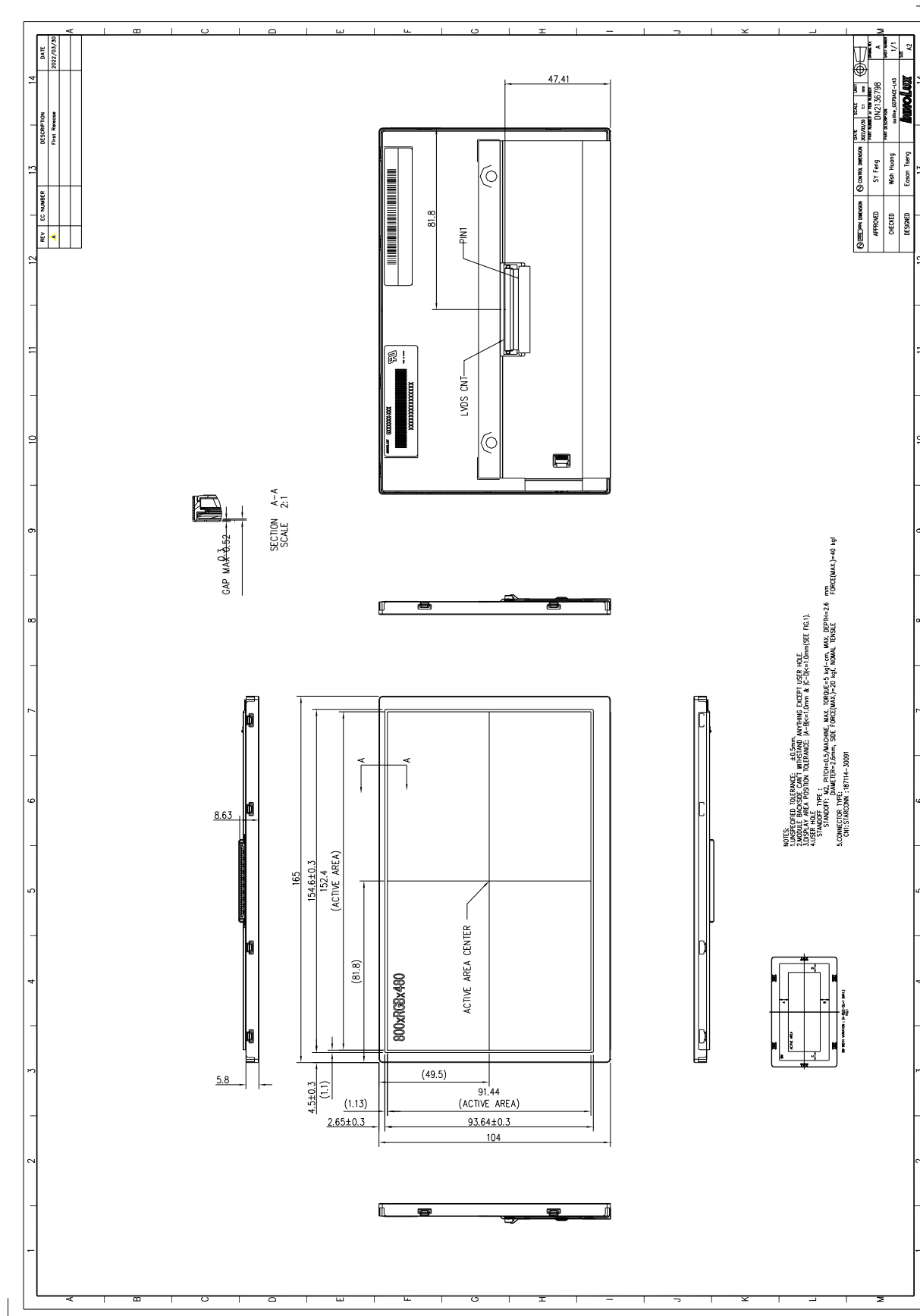
11.2 STORAGE PRECAUTIONS

- (1) When storing for a long time, the following precautions are necessary.
 - (a) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 30°C at humidity 50+-10%RH.
 - (b) The polarizer surface should not come in contact with any other object.
 - (c) It is recommended that they be stored in the container in which they were shipped.
 - (d) Storage condition is guaranteed under packing conditions.
 - (e) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition
- (2) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (3) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (4) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.


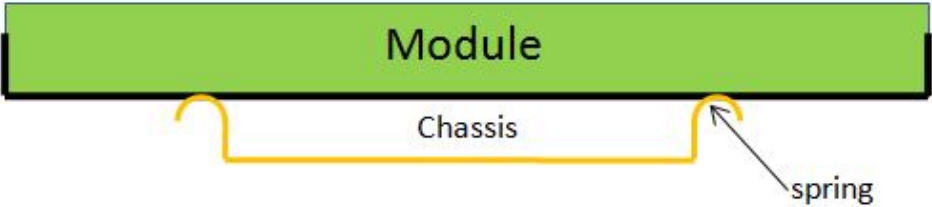

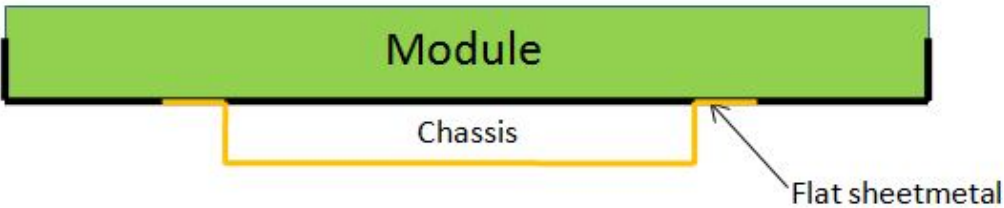

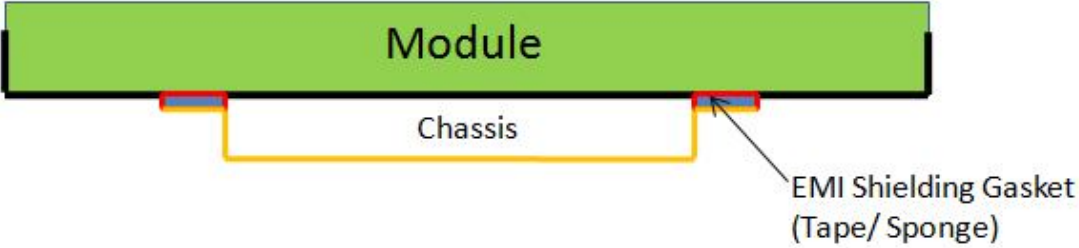
11.3 OTHER PRECAUTIONS

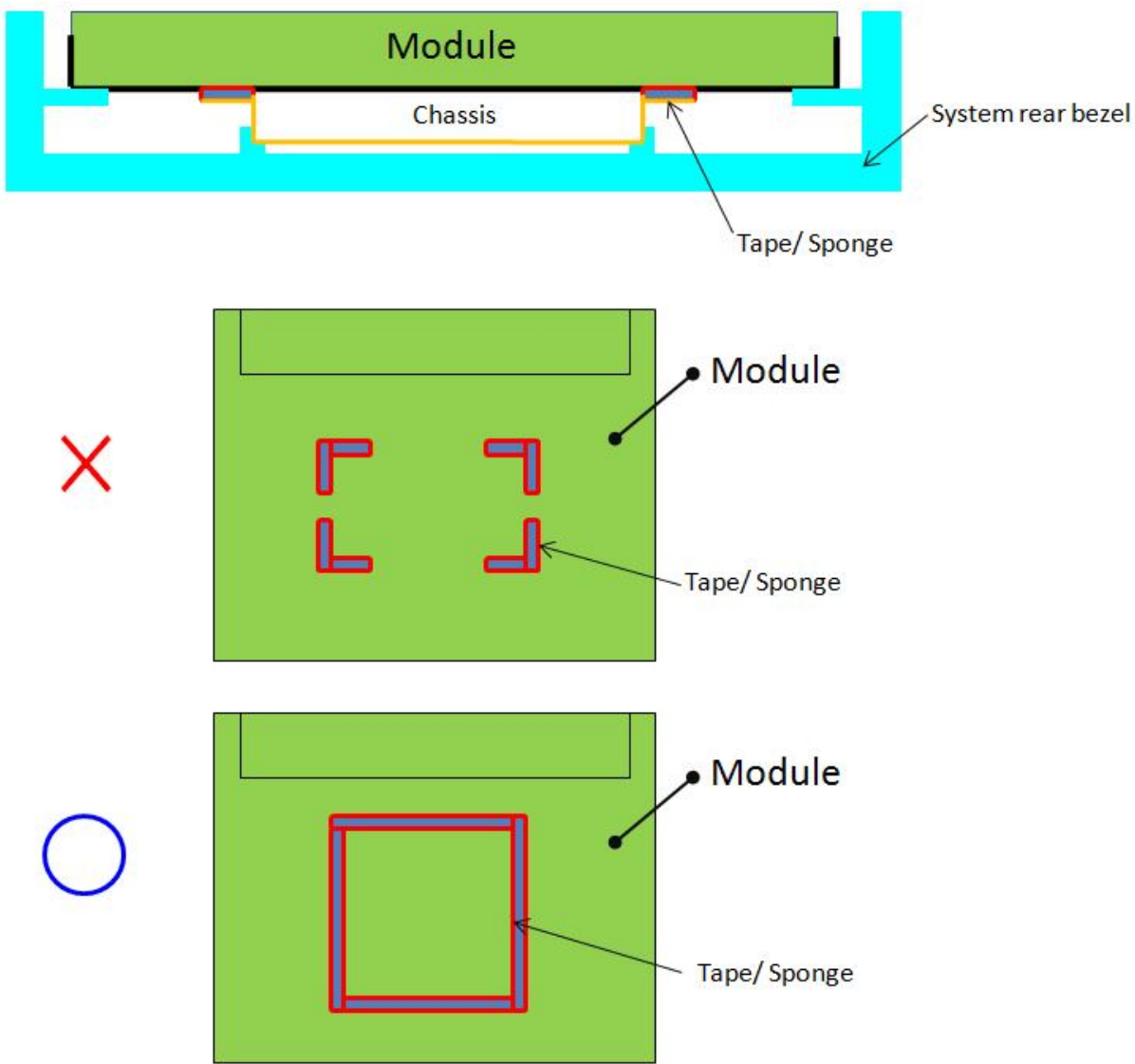
- (1) Normal operating condition
 - (a) Display pattern: dynamic pattern (Real display)
 - (Note) Long-term static display can cause image sticking.
- (2) Operating usages to protect against image sticking due to long-term static display
 - (a) Suitable operating time: under 16 hours a day.
 - (b) Static information display recommended to use with moving image.
 - (c) Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.
- (3) Abnormal condition just means conditions except normal condition.

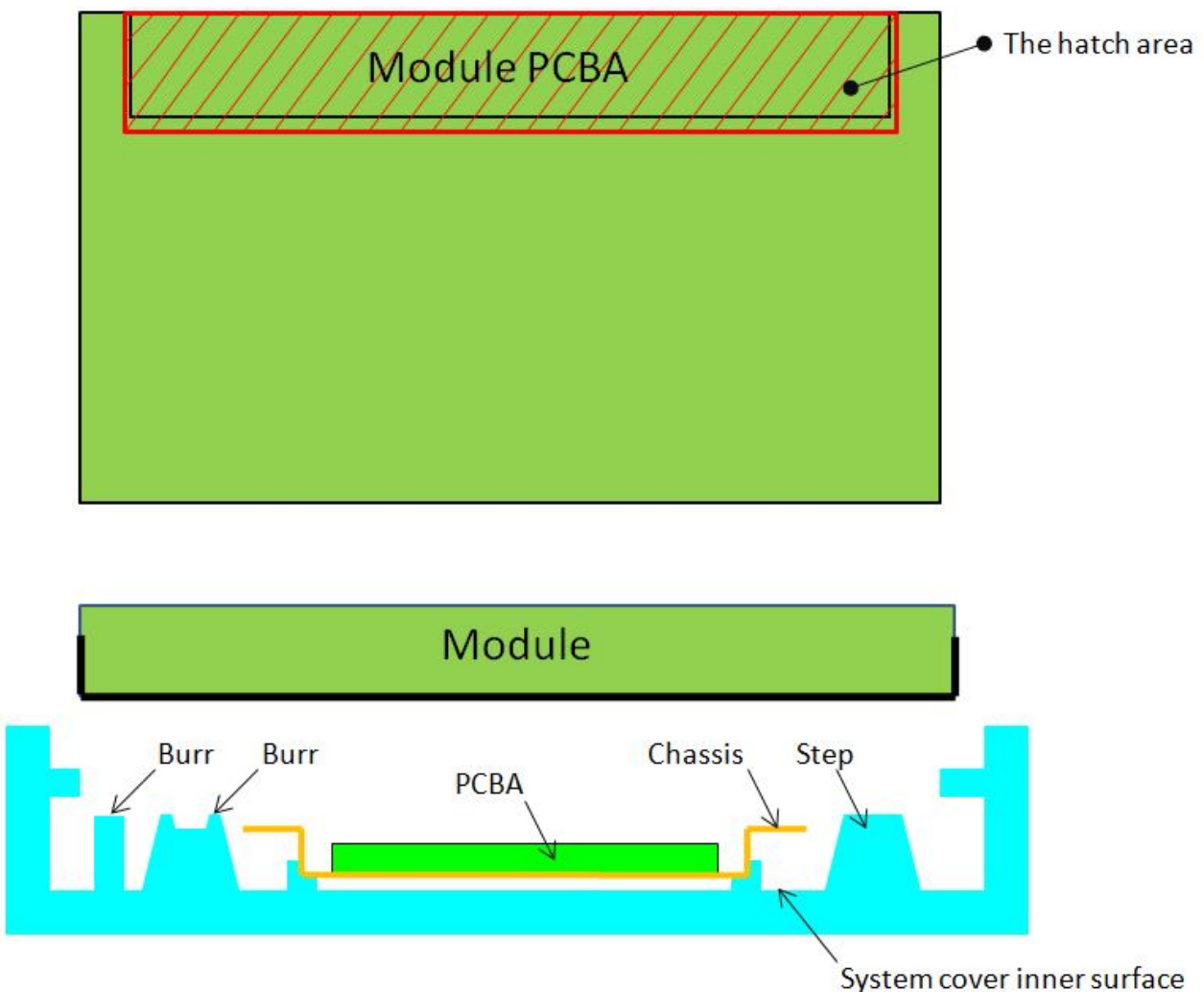
MECHANICAL CHARACTERISTICS

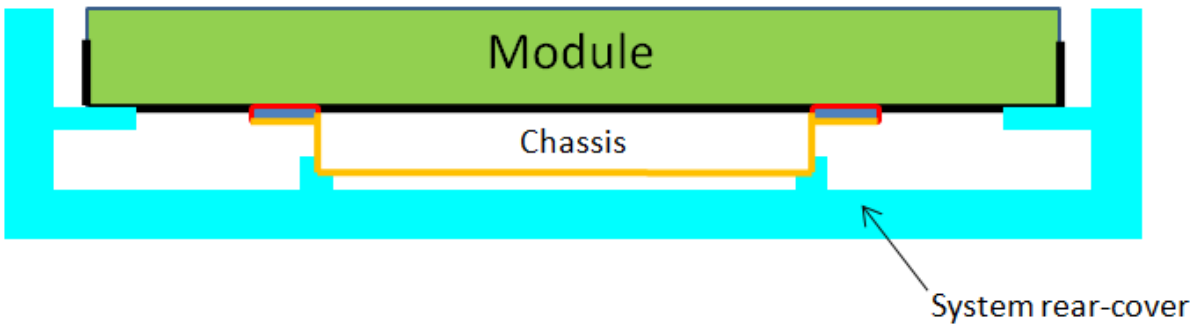


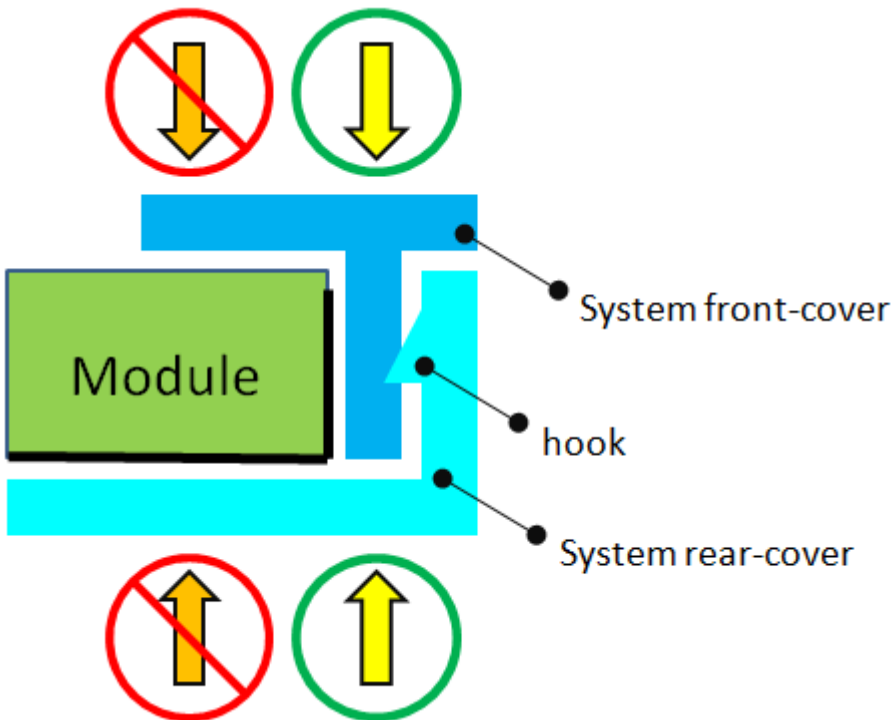
Appendix . SYSTEM COVER DESIGN NOTICE

| 1 | Set Chassis and IAVM Module touching Mode |
|---|---|
|  |  |
|  |  |
|  |  |
| Definition | <p>a. To prevent from abnormal display & white spot after mechanical test, it is not recommended to use spring type chassis.</p> <p>b. We suggest the contact mode between Chassis and Module rear cover is Tape/Sponge, second is Flat sheet metal type chassis.</p> |

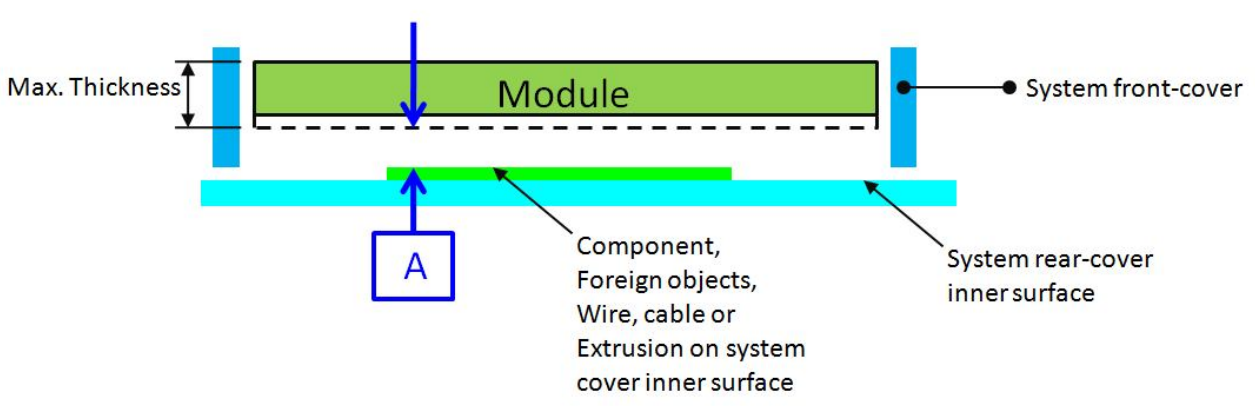
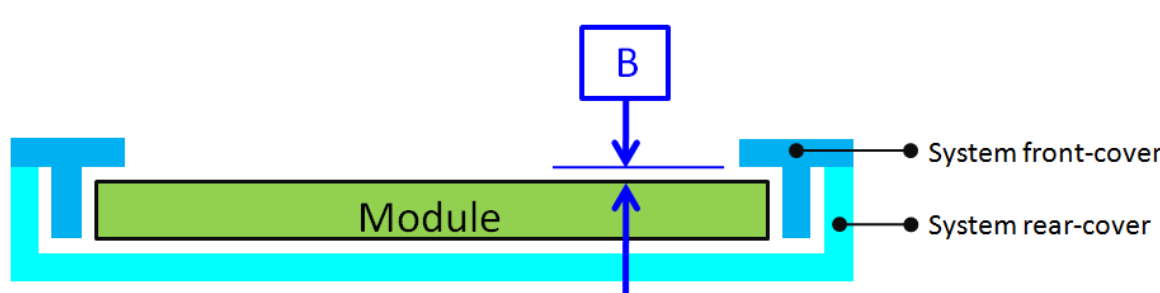
| 2 | Tape/Sponge design on system inner surface |
|------------|---|
| |  <p>The top diagram shows a cross-section of the system inner surface. A green 'Module' is mounted on a yellow 'Chassis'. A red 'Tape/Sponge' is placed between the module and the chassis. A blue 'System rear bezel' is shown on the right. The bottom two diagrams show top-down views of the module. The middle diagram, marked with a red 'X', shows four separate red 'Tape/Sponge' pieces placed at the corners of the module. The bottom diagram, marked with a blue circle, shows a single red 'Tape/Sponge' piece placed around the perimeter of the module.</p> |
| Definition | <p>a. To prevent from abnormal display & white spot after mechanical test, we suggest using Tape/Sponge as medium between chassis and Module rear cover could reduce the occurrence of white spot.</p> <p>b. When using the Tape/Sponge, we suggest it be lay over between set chassis and Module rear cover. It is not recommended to add Tape/Sponge in separate location. Since each Tape/Sponge may act as pressure concentration location.</p> |

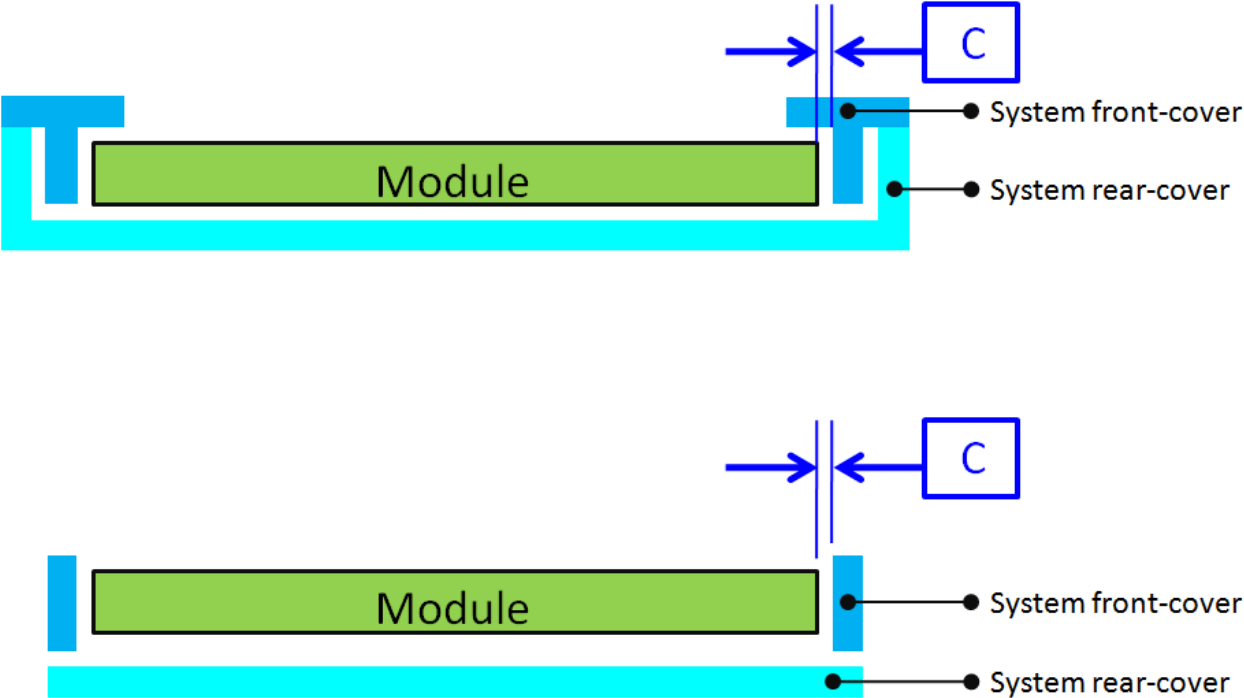
| | |
|------------|--|
| 3 | System inner surface examination |
| |  |
| Definition | <p>a. The hatch area on Module PCBA should keep at least 1mm gap(X,Y,Z direction) to any structure with system cover inner surface.</p> <p>b. Burr, Step, PCB protrusion may cause stress concentration. White spot may occur during reliability test.</p> |

| | |
|--|--|
| 4 | Material used for system rear-cover |
|  | |
| Definition | <p>System rear-cover material with high rigidity is needed to resist deformation during scuffing test, hinge test, pogo test or backpack test. Abnormal display, white spot, pooling issue may occur if low rigidity material is used. Pooling issue may occur because screw's boss position for module's bracket are deformed open-close test. Solid structure design of system rear-cover may also influence the rigidity of system rear-cover. The deformation of system rear-cover should not caused interference.</p> |

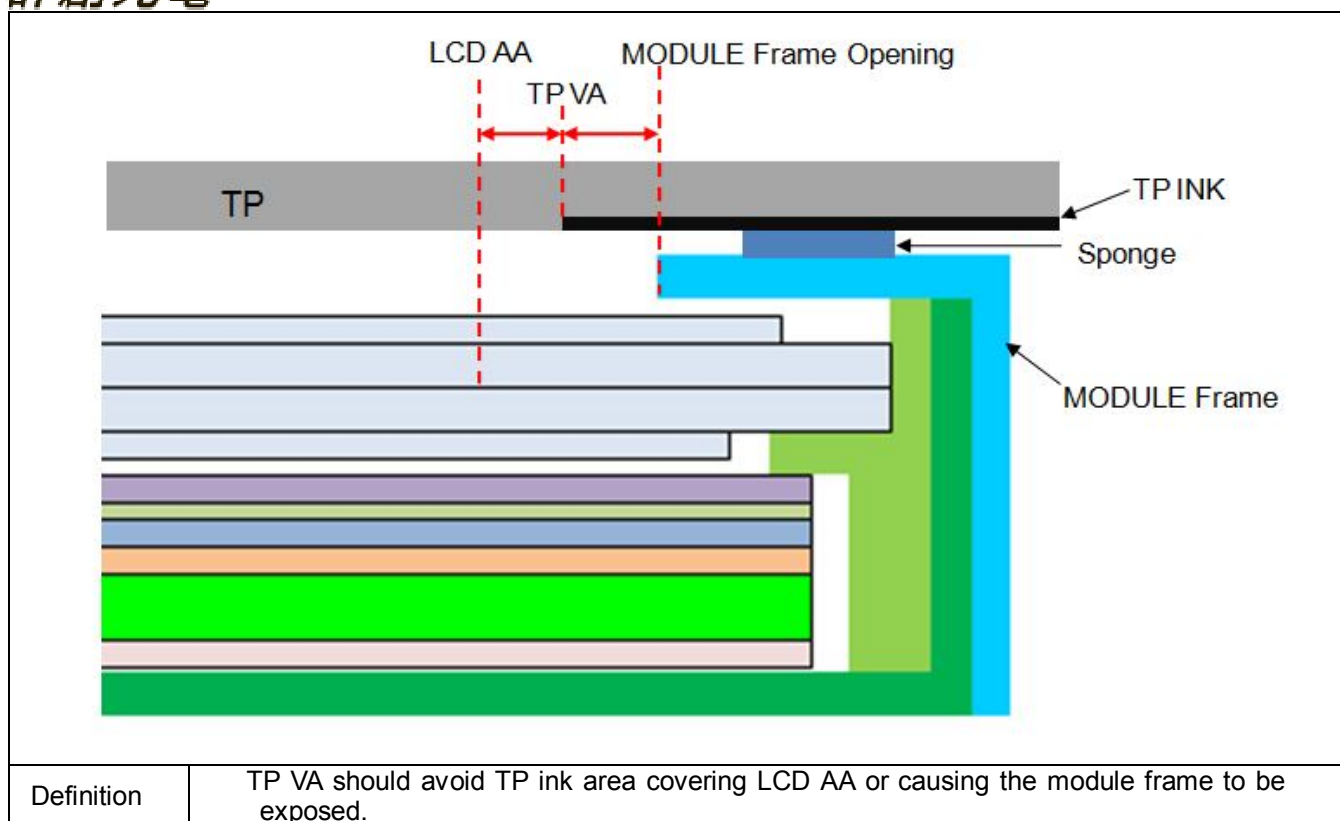
| | |
|--|---|
| 5 | Assembly SOP examination for system front-cover with hook structure |
|  | |
| Definition | <p>To prevent panel crack during system front-cover assembly process with hook structure, it is not recommended to press panel or any location that relate directly to the panel.</p> |

| 6 | Permanent deformation of system cover after reliability test |
|--|--|
| <div data-bbox="268 376 352 465">○</div> <div data-bbox="276 611 344 701">✗</div> <div data-bbox="268 779 352 869">○</div> <div data-bbox="276 981 344 1070">✗</div> <div data-bbox="276 1149 344 1238">✗</div> <div data-bbox="276 1328 344 1417">✗</div> | <p>System front-cover</p> <p>System rear-cover</p> <p>Module</p> <p>deformation</p> <p>0 gap</p> |
| Definition | <p>System cover including front cover and rear cover may deform during reliability test. Permanent deformation of system front cover and rear cover after reliability test should not interfere with panel. Because it may cause issue such as pooling, abnormal display, white spot and also cell crack.</p> <p>Note: If the interference cannot be avoided, please feel free to contract INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.</p> |

| | |
|------------|---|
| 7 | Design gap A between panel & any components on system rear-cover |
| |  |
| Definition | <p>System cover including front cover and rear cover may deform during reliability test. Permanent deformation of system front cover and rear cover after reliability test should not interfere with panel. Because it may cause issue such as pooling, abnormal display, white spot and also cell creak.</p> <p>Note: If the interference cannot be avoided, please feel free to contract INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.</p> |
| 8 | Design gap B between system front-cover & panel surface |
| |  |
| Definition | <p>Gap between system front-cover & panel surface is needed to prevent pooling or glass broken. Zero gap or interference such as burr and warpage from mold frame may cause pooling issue near system front-cover opening edge. This phenomenon is obvious during swing test, hinge test, knock test or during pooling inspection procedure.</p> <p>To remain sufficient gap, design with system rib higher than maximum panel thickness is recommended.</p> <p>Note: If the interference cannot be avoided, please feel free to contract INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.</p> |

| | |
|---|--|
| 9 | Design gap C between panel & system front-cover or protrusions |
|  <p>The diagrams show two cross-sectional views of a module assembly. In both, a green rectangular 'Module' is positioned between a blue 'System front-cover' and a cyan 'System rear-cover'. A gap 'C' is defined between the module and the front-cover. Blue arrows point towards the gap 'C' in both diagrams.</p> | |
| Definition | <p>Gap between panel & system front-cover or protrusions is needed to prevent shock test failure. Because system front-cover or protrusions with small gap may hit panel during the test. Issue such as cell crack, abnormal display may occur.</p> <p>The gap should be large enough to absorb the maximum displacement during the test.</p> <p>Note: If the interference cannot be avoided, please feel free to contract INX FAE Engineer for collaboration design. We can help to verify and pass risk assessment for customer reference.</p> |

| | |
|----|---|
| 10 | Design distance between TP AA to LCD AA |
|----|---|



| | |
|----|--------------------|
| 11 | Use OCR Lamination |
|----|--------------------|

