

INNOLUX DISPLAY CORPORATION

BT141XG01 LCD MODULE SPECIFICATION

Preliminary

Version 08

| | |
|----------|-----------------------|
| Customer | Checked & Approved by |
| | |

| Approved by | Checked by | | Prepared by |
|-------------|------------|----|-------------|
| MKT | QRA | PD | MKT |
| | | | |

Date: _____

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Record of Revision

| Version | Revise Date | Page | Content |
|---------|-------------|------|---|
| 01 | 2004-06-04 | | First edition to all |
| 02 | 2004-07-14 | 7 | LVDS Macro AC characteristics |
| | | 7 | AC Timing Diagram |
| | | 9 | Timing characteristics of input signals |
| | | 15 | Reliability test items |
| 03 | 2004-07-15 | 12 | Add optical specification measurement method |
| | | 15 | Remove reliability test item (2) Shock & Vibration |
| 04 | 2004-09-09 | | Revise format |
| | | 17 | Add Module Label description |
| | | 18 | Add Product Number |
| 05 | 2004-10-15 | 5 | Update connector |
| | | 6 | Update CCFL Current. Add CCFL Voltage |
| | | 10 | Update backlight driving conditions- Lamp voltage, Lamp current, power consumption, Lamp stating voltage, Frequency. Add Burst mode, Duty cycle |
| | | 12 | Update Clolor chormaticity R, G, B |
| | | 20 | Update cable length |
| 06 | 2004-12-01 | 7 | Add CCFL voltage, Re-screw, Assured Torque at Side Mount |
| | | 8 | Add Power consumption, Rush current |
| | | 11 | Update Lamp voltage from 725 to 705 (max), Power consumption from 4.72 to 4.58 (max), Add Bust mode, Duty cycle |
| | | 13 | Add view angle 15/35/45/45 (U/D/L/R) (Typ.) |
| | | 15 | Update note 8 graph from 1/10 to 10mm |

| | | | |
|----|------------|---------|---|
| | | 16 | Update Electrostatic discharge from 150 pF,330Ω, Contact: ±8kV,Air: ±15kV (operation) Contact: ±10kV,Air: ±20kV (non-operation) to 150 pF,330Ω, Contact: ±8kV,Air: ±15kV (non-operation) |
| | | 20 | Add packing form |
| 07 | 2004-12-07 | 8 | Add mosaic pattern explanation. Update power consumption pattern from mosaic pattern to all black pattern. |
| | | 12 | Add panel power sequence |
| | | 21 | Update front view drawing (from 15.52 to 15) |
| | | 22 | Update back view drawing (from 70.75 to 70.82) |
| | | 16 | Update reliability from 300Hrs to 240Hrs Update random vibration from 2Hrs to 1Hr Update mechanical shock from 3 times to one time Update Electrostatic discharge from non-operation to operation Update Temperature cycling to Thermal Shock Add humidity test to high tempetaure storage and operation |
| | | 7 | Add environment range for operation and storage drawing |
| 08 | 2005-01-17 | 8 | Add CCFL current min. value |
| | | 9,10,11 | Add Note 3 for rush current Add Note 4 for power sequence |
| | | 14,15 | Add Note 2,3,4 for lamp starting voltage Revise power consumption min. from 1.72 to “-“, max.from 4.58 to 4.4 Revise starting voltage from 1200 to 1300 at 25°C |
| | | 16 | Add respond time max. value Add color chromaticity (CIE) min. and max. value |

| | | | |
|--|--|----|---|
| | | 19 | Revise mechanical shock from 240G/2ms to 220G/2ms |
| | | 22 | Add carton lable description |
| | | 23 | Revise packing form |
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A. General specification

| NO. | Item | Specification | Remark |
|-----|----------------------------|---|--------|
| 1 | Display resolution (pixel) | 1024(H) X 768(V), XGA resolution | |
| 2 | Active area (mm) | 285.7(H) X 214.3(V) | |
| 3 | Screen size (inch) | 14.1 inches diagonal | |
| 4 | Pixel pitch (mm) | 0.279(H) X 0.279(V) | |
| 5 | Color configuration | R, G, B vertical stripe | |
| 6 | Overall dimension (mm) | 299(W) X 228(H) X 5.2(D) Typ. | |
| 7 | Weight (g) | 410 Typ. (w/o Inverter) | |
| 8 | Surface treatment | Anti-glare, Haze = 25%, Hard coating (3H) | |
| 9 | Input color signal | 6 bit LVDS | |
| 10 | Color saturation | 45% NTSC | |
| 11 | Display colors | 262K (6 bit) | |
| 12 | Optimum viewing direction | 6 o'clock | |
| 13 | Backlight | 1 CCFL | |

B. Electrical specifications

1.Pin assignment

Connector FI-XB30SL-HF10 or compatible

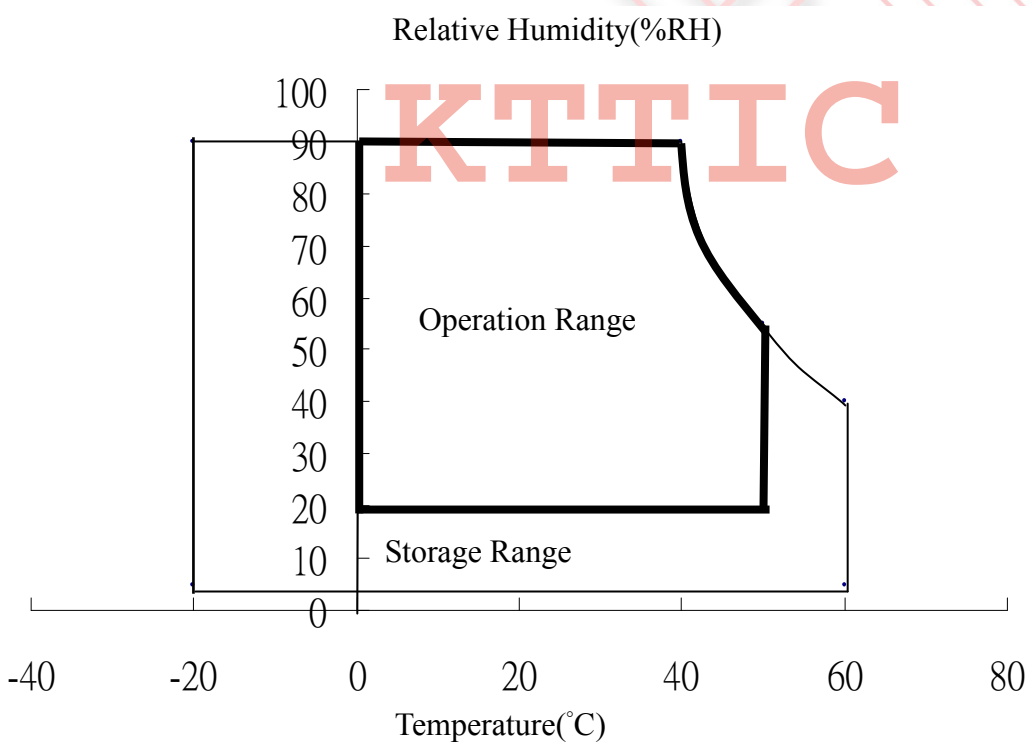
| Pin No | Symbol | Description |
|--------|----------------------|--|
| 1 | GND | Ground |
| 2 | VDD | +3.3V power supply |
| 3 | VDD | +3.3V power supply |
| 4 | V _{EDID} | +3.3V EDID power |
| 5 | NC | |
| 6 | CLK _{EDID} | EDID clock input |
| 7 | DATA _{EDID} | EDID data input |
| 8 | RxIN0- | LVDS differential data input (Red0-Red5, Green0) |
| 9 | RxIN0+ | LVDS differential data input (Red0-Red5, Green0) |
| 10 | GND | Ground |
| 11 | RxIN1- | LVDS differential data input (Green1-Green5, Blue0-Blue1) |
| 12 | RxIN1+ | LVDS differential data input (Green1-Green5, Blue0-Blue1) |
| 13 | GND | Ground |
| 14 | RxIN2- | LVDS differential data input (Blue2-Blue5, Hsync, Vsync, DSPTMG) |
| 15 | RxIN2+ | LVDS differential data input (Blue2-Blue5, Hsync, Vsync, DSPTMG) |
| 16 | GND | Ground |
| 17 | RxCLKIN- | LVDS differential clock input |
| 18 | RxCLKIN+ | LVDS differential clock input |
| 19 | GND | Ground |
| 20~30 | NC | |

2. Absolute maximum ratings

| Parameter | Symbol | Values | | Unit | Remark |
|------------------------------|----------|--------|------|----------|---------|
| | | Min. | Max. | | |
| Power voltage | V_{DD} | - 0.3 | 4.0 | V | At 25°C |
| Input signal voltage | V_{LH} | - 0.3 | 4.3 | V | At 25°C |
| Operating temperature | T_{op} | 0 | 50 | °C | Note 1 |
| Storage temperature | T_{ST} | - 20 | 60 | °C | Note 2 |
| CCFL Current | ICFL | 2 | 6.5 | [mA] rms | |
| CCFL Voltage | | - | 2.5 | KV | |
| Re-screw | | - | 5 | Times | |
| Assured Torque at Side Mount | | - | 2.5 | [kgf.cm] | |

Note 1: The relative humidity must not exceed 90% non-condensing at temperatures of 40°C or less. At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C.

Note 2: The unit should not be exposed to corrosive chemicals.



3. Electrical characteristics

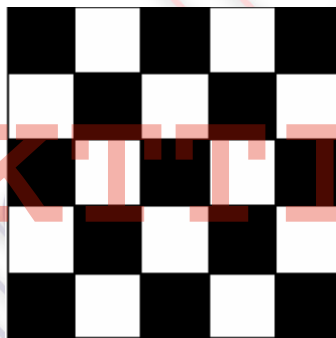
a. Typical operating conditions

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|----------------------------------|------------|------|------|------|-------|--------|
| Input voltage | V_{DD} | 3 | 3.3 | 3.6 | V | |
| Permissive Power Input Ripple | V_{RF} | - | - | 0.1 | V | |
| Input Current | I_{DD} | - | 0.35 | 0.45 | A | Note 1 |
| Power Consumption | P_C | - | 1.4 | 1.65 | Watts | Note 2 |
| Rush Current | I_{Rush} | - | - | 1.5 | A | Note 3 |

Note 1: The specified input current is under the $V_{cc} = 3.3$ V, 25 °C, $fV=60$ Hz (frame frequency) condition whereas mosaic pattern (black & white [5*5]) is displayed.

White : 63 Gray

Black : 0Gray

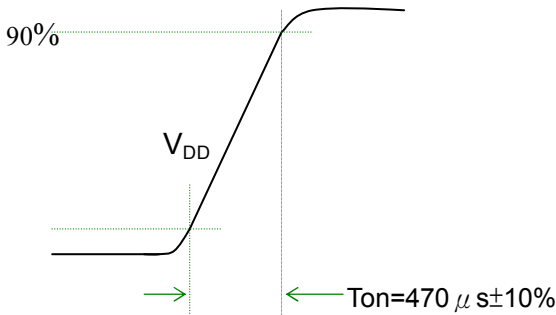


mosaic pattern (black & white [5*5])

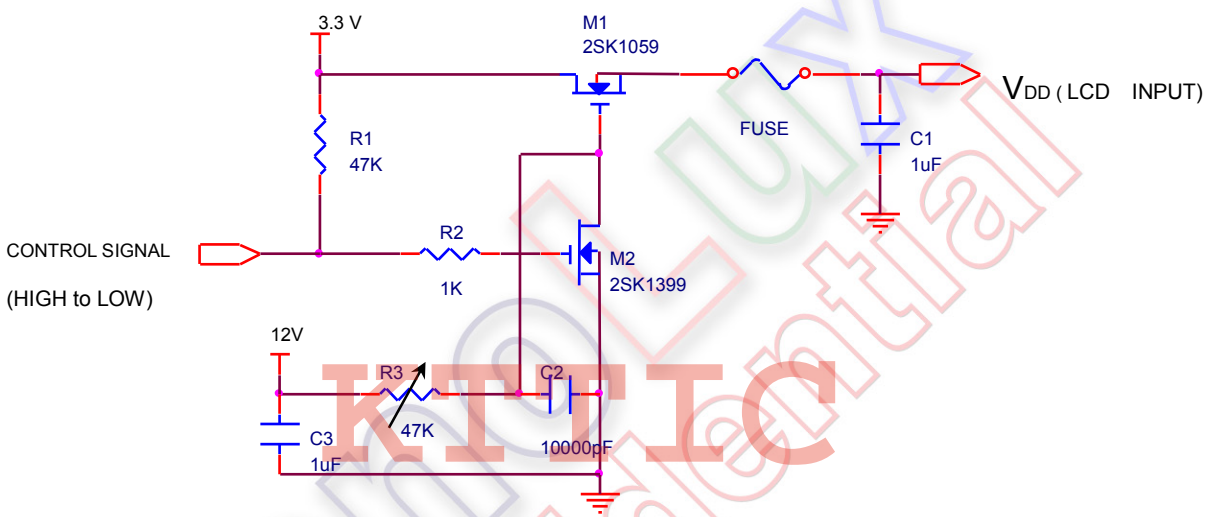
Note 2 : The specified power consumption is under the $V_{cc} = 3.3$ V, 25 °C, $fV=60$ Hz (frame frequency) condition whereas all black pattern is displayed.

Note 3 : test condition :

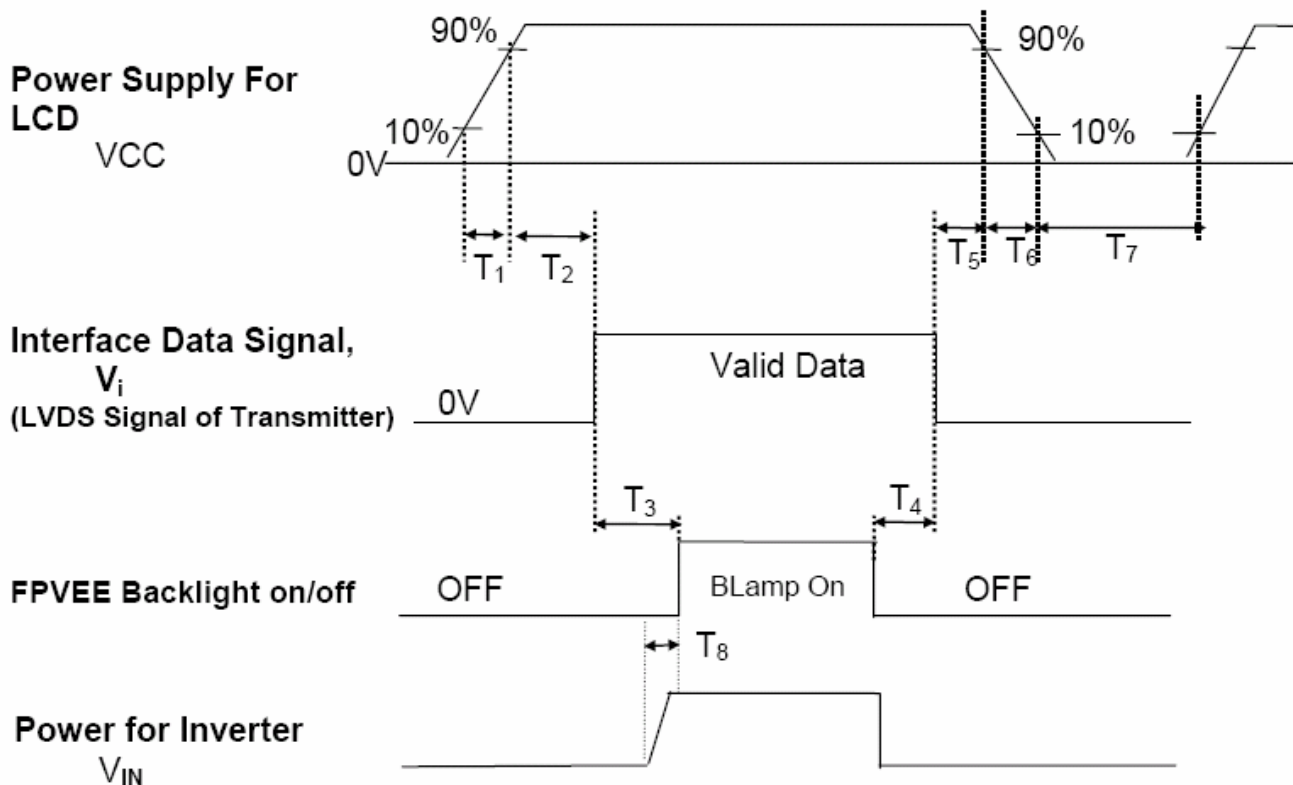
- (1) $V_{DD} = 3.3\text{ V}$, V_{DD} rising time = $470\text{ us} \pm 10\%$
- (2) Pattern: Mosaic pattern



(3) Test circuit



Note 4 : Power on sequence for LCD V_{DD}



Power Sequence Timing

| Parameter | Value | | | Units |
|-----------|-------|------|------|-------|
| | Min. | Typ. | Max. | |
| T1 | 0.5 | - | 10 | (ms) |
| T2 | 0 | - | 50 | (ms) |
| T3 | 200 | - | - | (ms) |
| T4 | 200 | - | - | (ms) |
| T5 | 0 | - | 50 | (ms) |
| T6 | 0 | - | 10 | (ms) |
| T7 | 200 | - | - | (ms) |
| T8 | 10 | - | - | (ms) |

b. Display color v.s. input data signals

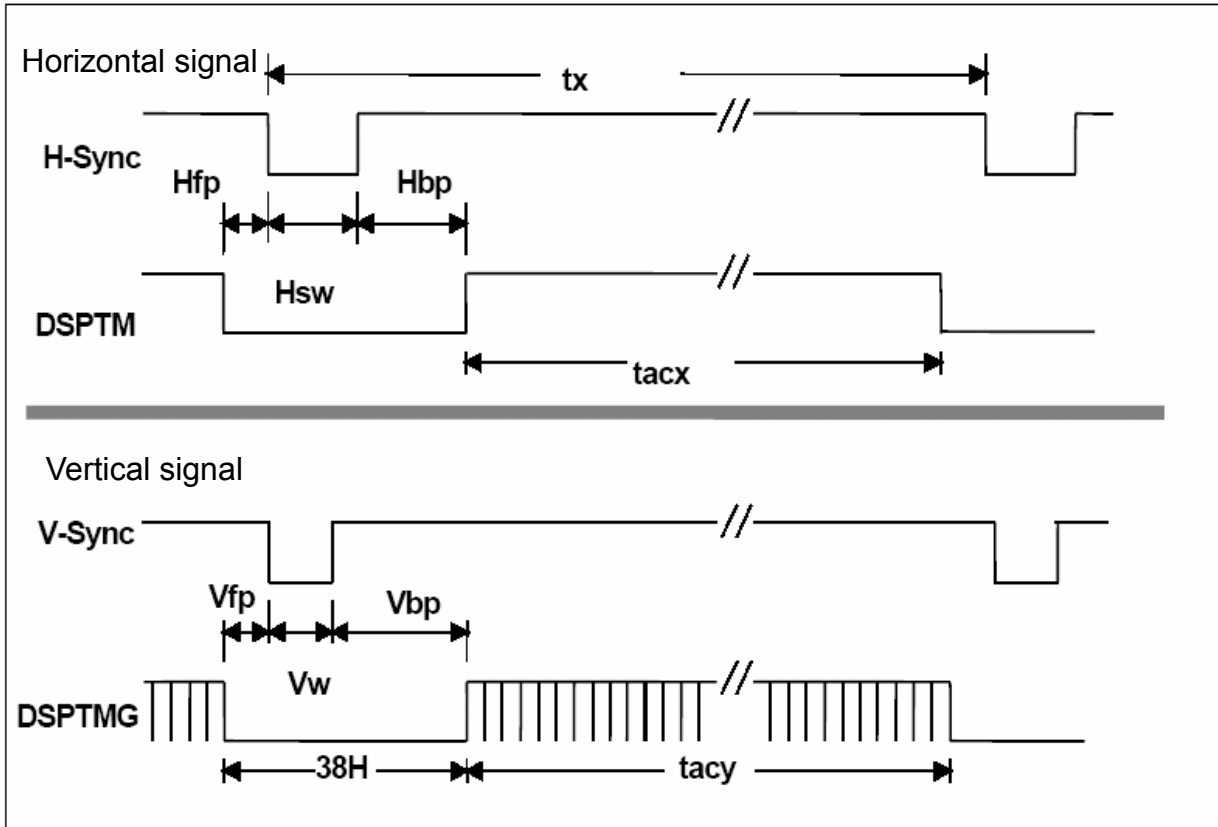
| Signal Name | Description | Remark |
|-------------|-------------------------|--|
| +RED5 | Red Data 5 (MSB) | Red-pixel data. Each red pixel's brightness data consists of these 6 bits pixel data. |
| +RED4 | Red Data 4 | |
| +RED3 | Red Data 3 | |
| +RED2 | Red Data 2 | |
| +RED1 | Red Data 1 | |
| +RED0 | Red Data 0 (LSB) | |
| | Red-pixel Data | |
| +GREEN 5 | Green Data 5 (MSB) | Green-pixel data. Each green pixel's brightness data consists of these 6 bits pixel data. |
| +GREEN 4 | Green Data 4 | |
| +GREEN 3 | Green Data 3 | |
| +GREEN 2 | Green Data 2 | |
| +GREEN 1 | Green Data 1 | |
| +GREEN 0 | Green Data 0 (LSB) | |
| | Green-pixel Data | |
| +BLUE 5 | Blue Data 5 (MSB) | Blue-pixel data. Each blue pixel's brightness data consists of these 6 bits pixel data. |
| +BLUE 4 | Blue Data 4 | |
| +BLUE 3 | Blue Data 3 | |
| +BLUE 2 | Blue Data 2 | |
| +BLUE 1 | Blue Data 1 | |
| +BLUE 0 | Blue Data 0 (LSB) | |
| | Blue-pixel Data | |
| -DTCLK | Data Clock | The typical frequency is 65.0 MHz. The signal is used to strobe the pixel data and DSPTMG signals. All pixel data shall be valid at the falling edge when the DSPTMG signal is high. |
| DSPTMG | Display Timing | This signal is strobed at the falling edge of -DTCLK. When the signal is high, the pixel data shall be valid to be displayed. |
| VSYNC | Vertical Sync | The signal is synchronized to -DTCLK . |
| HSYNC | Horizontal Sync | The signal is synchronized to -DTCLK. |

c. Input signal timing

Support Input Timing Table

| Description | Symbol | Min | Typ | Max | Unit |
|--------------------|--------|------|--------|------|--------|
| DTCLK frequency | fdck | | 65 | | [MHz] |
| DTCLK cycle time | tck | | 15.38 | | [nsec] |
| X total time | tx | 1320 | 1344 | 2047 | [tck] |
| X active time | tacx | | 1024 | | [tck] |
| H frequency | Hsync | | 48.363 | | [KHz] |
| H-Sync width | Hsw | | 136 | | [tck] |
| H back porch | Hbp | | 160 | | [tck] |
| H front porch | Hfp | | 24 | | [tck] |
| Y total time | ty | 803 | 806 | 2047 | [tx] |
| Y active time | tacy | | 768 | | [tx] |
| Frame rate | Vsync | | 60 | | [Hz] |
| V-sync Width | Vw | | 6 | | [tx] |
| V-sync front porch | Vfp | | 3 | | [tx] |
| V-sync back porch | Vbp | | 29 | | [tx] |

Note: Hsw(H-sync width) + Hbp(H-sync back porch) should be less than 515 tck.



d. Display Position

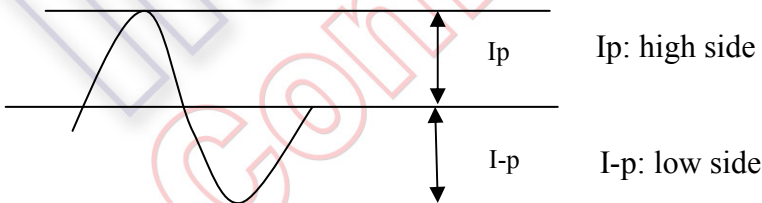
| | | | | | | |
|-----------|-----------|-------|-------------|-------|--------------|--------------|
| D(1, 1) | D(2, 1) | ..... | D(512, 1) | ..... | D(1023, 1) | D(1024, 1) |
| D(1, 2) | D(2, 2) | ..... | D(512, 2) | ..... | D(1023, 2) | D(1024, 2) |
| ⋮ | | | ⋮ | | ⋮ | ⋮ |
| D(1, 384) | D(2, 384) | ..... | D(512, 384) | ..... | D(1023, 384) | D(1024, 384) |
| ⋮ | | | ⋮ | | ⋮ | ⋮ |
| D(1, 767) | D(2, 767) | ..... | D(512, 767) | ..... | D(1023, 767) | D(1024, 767) |
| D(1, 768) | D(2, 768) | ..... | D(512, 768) | ..... | D(1023, 768) | D(1024, 768) |

e. Backlight driving conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark | Remark |
|------------------------|---------|--------|------|------|-------|----------|------------|
| Lamp voltage | VL | 575 | 640 | 705 | Vrms | | |
| Lamp operation current | IL | 2 | 6 | 6.5 | mArms | | Note 1 |
| Power consumption | PL | - | 3.84 | 4.4 | W | | |
| Lamp starting voltage | VLstart | 1300 | | | Vrms | T = 25°C | Note 2,3,4 |
| | | 1500 | | | | T = 0°C | Note 2,3,4 |
| Frequency | F | 50 | 60 | 80 | KHZ | | Note 4 |
| Lamp life time | | 10,000 | | | Hr | | Note 5 |
| Burst Mode | | 155 | 160 | 165 | HZ | | |
| Duty Cycle | | 30% | | 100% | | | |

Note 1 :

The degrees of unbalance: less than 10%
 The ratio of wave height: less than $\sqrt{2} \pm 10\%$



The degrees of unbalance = $|Ip - I-p| / Irms * 100(\%)$
 The ratio of wave height = $Ip(\text{or } I-p) / Irms$
 Lamp should be completely turned on.

Note 2:

The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise, the lamp may not be turned on normally.

Note 3:

Inverter should provide more than min. value, and then lamp could be completely turned on

Note 4:

Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

Note 5:

Lamp life definition :

(A) Lamp current $I_L = (6) \text{ mA}$

(B) The brightness of lamp becomes 50% of the initial brightness or not normal lighting.

Backlight connector : JST BHSR-02VS-1

| Pin no. | Symbol | Function | Remark |
|---------|--------|-------------------------|--------------------|
| 1 | VIH | Lamp high voltage input | Cable color: Pink |
| 2 | VIL | Lamp low voltage input | Cable color: White |

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C. Optical specifications

| Item | Symbol | Condition | Specification | | | Unit | Remark |
|-------------------------|------------|--------------------|---------------|-------|-------|------|------------|
| | | | Min. | Typ. | Max. | | |
| Response time | Tr+Tf | $\theta = 0^\circ$ | | 25 | 35 | ms | Note 4 |
| Contrast ratio | CR | $\theta = 0^\circ$ | 250 | 300 | | | Note 3,5 |
| Viewing angle | Top | $CR \geq 10$ | 10 | 15 | | deg | Note 3,5,7 |
| | Bottom | $CR \geq 10$ | 30 | 35 | | | |
| | Left | $CR \geq 10$ | 40 | 45 | | | |
| | Right | $CR \geq 10$ | 40 | 45 | | | |
| Brightness (5 points) | Y_l | | 170 | 200 | | nit | Note 3,6 |
| Color chromaticity(CIE) | W_x | $\theta = 0^\circ$ | -0.03 | 0.313 | +0.03 | | Note 3 |
| | W_y | | | 0.329 | | | |
| | R_x | | | 0.569 | | | |
| | R_y | | | 0.332 | | | |
| | G_x | | | 0.312 | | | |
| | G_y | | | 0.544 | | | |
| | B_x | | | 0.149 | | | |
| | B_y | | | 0.132 | | | |
| White uniformity (13) | δ_w | | 0.67 | | | | Note 3,8 |
| Cross talk | Ct | | | | 1.3% | | Note 9 |

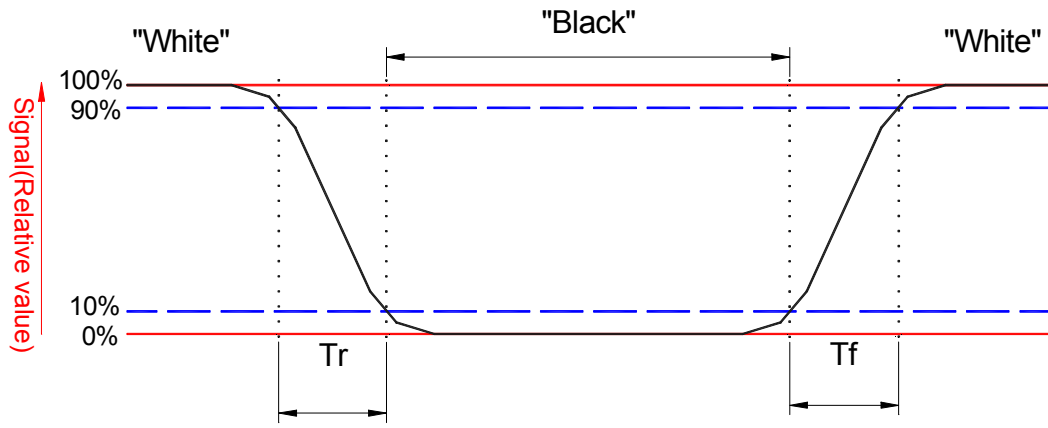
Note 1: Ambient temperature = 25°C.

Note 2: To be measured in dark room after backlight warm up 30 minutes.

Note 3: To be measured with a viewing cone of 2° by Topcon luminance meter BM-5A.

Note 4: Definition of response time:

The output signals of BM-7 are measured when the input signals are changed from “Black” to “White” (falling time) and from “White” to “Black” (rising time), respectively. The response time interval between the 10% and 90% of amplitudes. Refer to figure as below.



Note 5. Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

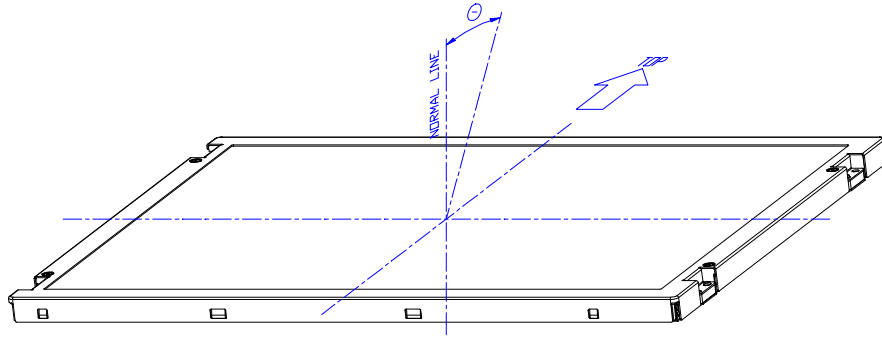
$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

Note 6: Driving conditions for CCFL: $I_L = 6.0 \text{ mA}$, 62 KHz Frequency.

Luminance are measured at the following thirteen points (1~13).

$$Y_L = \text{Point 5, 10, 11, 12, and 13 brightness average}$$

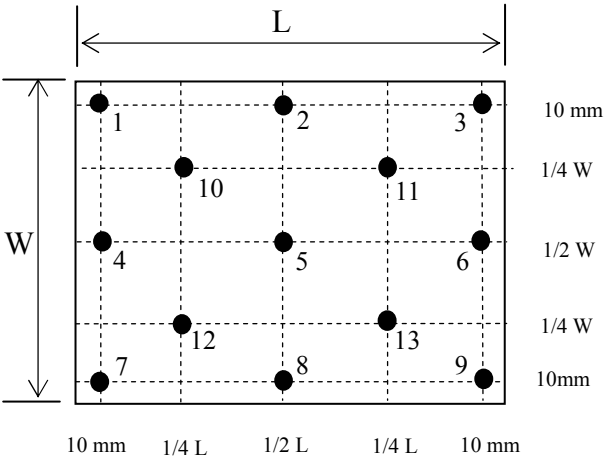
Note 7: Definition of viewing angle



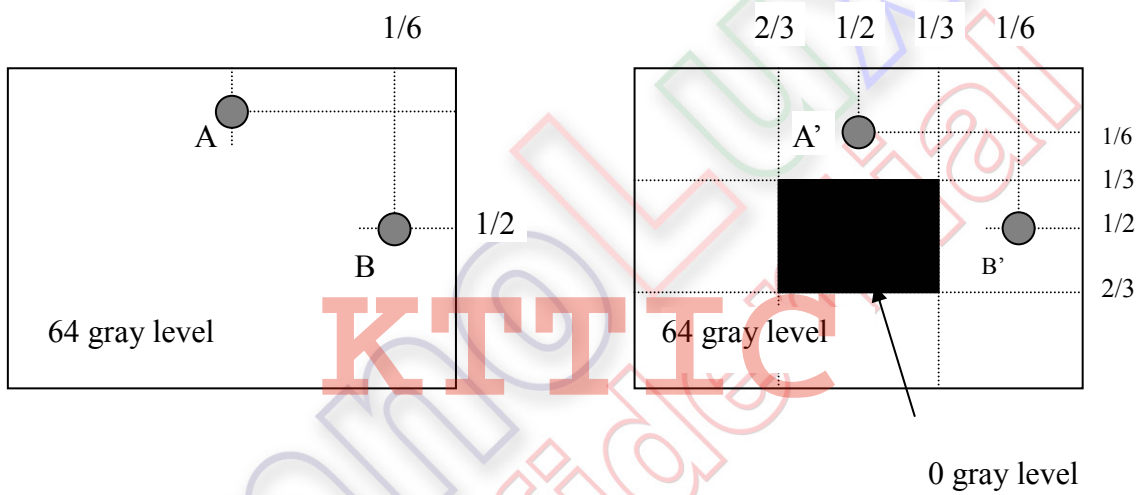
Note 8: Definition white uniformity:

Luminance are measured at the following thirteen points (1~13).

$$\delta_w = \frac{\text{Minimum Brightness of thirteen points}}{\text{Maximum Brightness of thirteen points}}$$



Note 9:



Unit: percentage of dimension of display area

$$|L_A - L_{A'}| / L_A \times 100\% = 2\% \text{ max.}, L_A \text{ and } L_{A'} \text{ are brightness at location A and A'}$$

$$|L_B - L_{B'}| / L_B \times 100\% = 2\% \text{ max.}, L_B \text{ and } L_{B'} \text{ are brightness at location B and B'}$$

D. Reliability test items

| Test Item | Test Condition | Judgement | Remark |
|--|---|-----------|--------|
| High temperature storage | 60°C, 40%RH ,240Hrs | Note 1 | Note 2 |
| Low temperature storage | -20°C, 240Hrs | Note 1 | Note 2 |
| High temperature & high humidity operation | 40°C, 90%RH,240Hrs (No condensation) | Note 1 | Note 2 |
| High temperature operation | 50°C, 40%RH, 240Hrs | Note 1 | Note 2 |
| Low temperature operation | 0°C, 240Hrs | Note 1 | Note 2 |
| Thermal Shock (non-operation) | -20°C~60°C 1Hr, 10mins, 1Hr, 100cycles | Note 1 | Note 2 |
| Electrostatic discharge (ESD) | 150 pF,330Ω, Contact: ±8kV,Air: ±15kV (operation) | Note 1 | |
| Vibration (Sine Wave) (non-operation) | Sinusoidal vibration, 1.5G zero-to-peak, 10 to 500 Hz, 0.5 octave/minute; 0.5Hr in each perpendicular axes. | Note 1 | Note 2 |
| Vibration (Random) (for package) (non-operation) | 0.015G ² /Hz from 5~200Hz\ -6dB/Octave from 200~500Hz 1Hr for each X,Y,Z three axes | Note 1 | Note 2 |
| Mechanical shock (non-operation) | 220G/2ms, Half Sine wave, ±X, ±Y, ±Z one time for each direction | Note 1 | Note 2 |

Note 1 :

Pass: Normal display image with no obvious non-uniformity and no line defect.
Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

Note 2 :

Evaluation should be tested after storage at room temperature for one hour.

E. Safety

(1) Sharp Edge Requirements

There will be no sharp edges or corners on the display assembly that could cause injury.

(2) Materials

a. Toxicity

There will be no carcinogenic materials used anywhere in the display module. If toxic materials are used, they will be reviewed and approved by the responsible InnoLux Toxicologist.

b. Flammability

All components including electrical components that do not meet the flammability grade UL94-V1 in the module will complete the flammability rating exception approval process. The printed circuit board will be made from material rated 94-V1 or better. The actual UL flammability rating will be printed on the printed circuit board.

C. Capacitors

If any polarized capacitors are used in the display assembly, provisions will be made to keep them from being inserted backwards.

F. Display quality

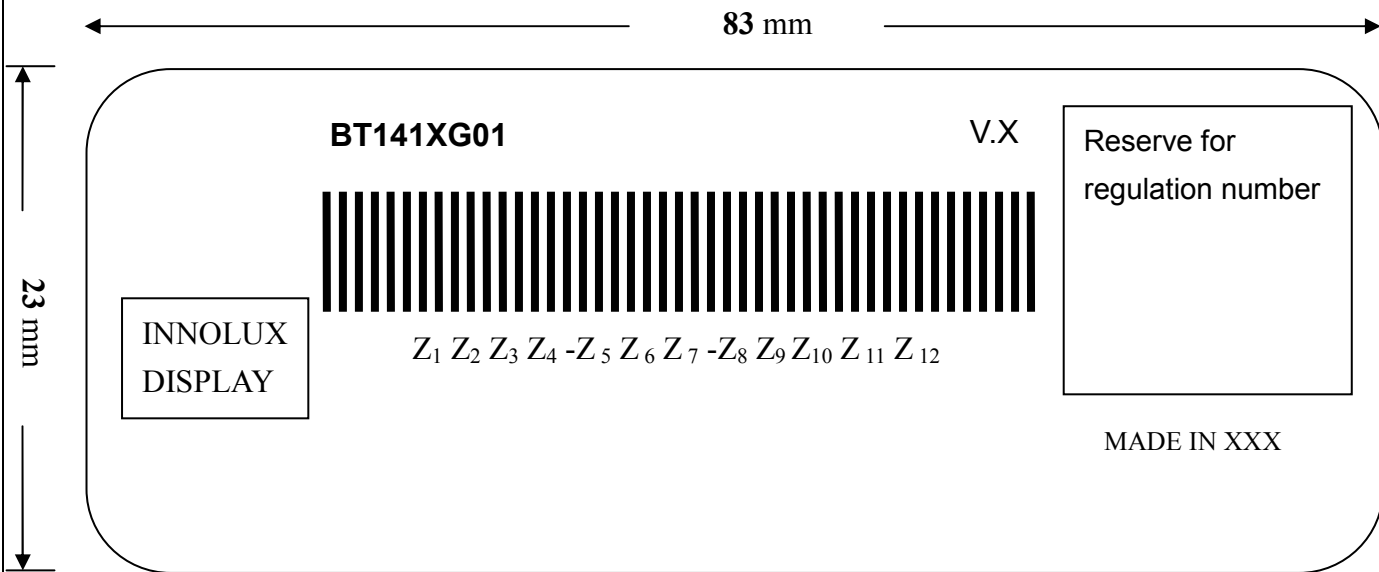
The display quality of the color TFT-LCD module should be in compliance with the InnoLux's Incoming inspection standard.

G. Handling precaution

The Handling of the TFT-LCD should be in compliance with the InnoLux's handling principle standard.

H. Label

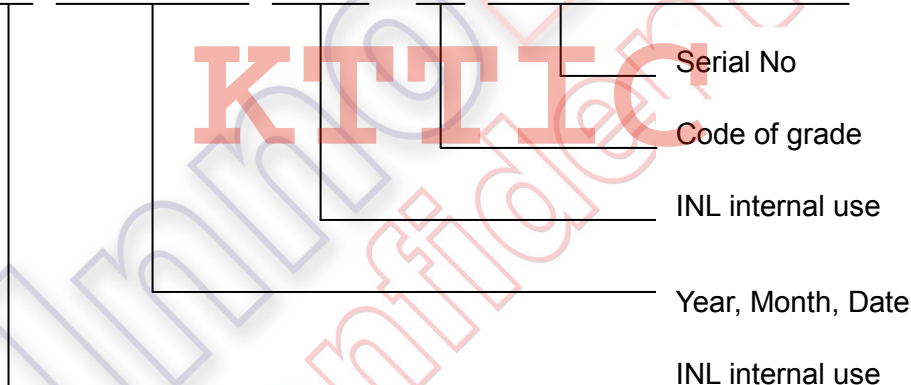
(1) Module Label



(a) Model name : BT141XG01

(b) Version : V.x, for example 0, 1, 2 etc.

(c) Serial ID : Z₁ Z₂ Z₃ Z₄ Z₅ Z₆ Z₇ Z₈ Z₉ Z₁₀ Z₁₁ Z₁₂



Serial ID includes the information as below :

(a) Manufactured Date: Year: 0~9, for 2000~2009

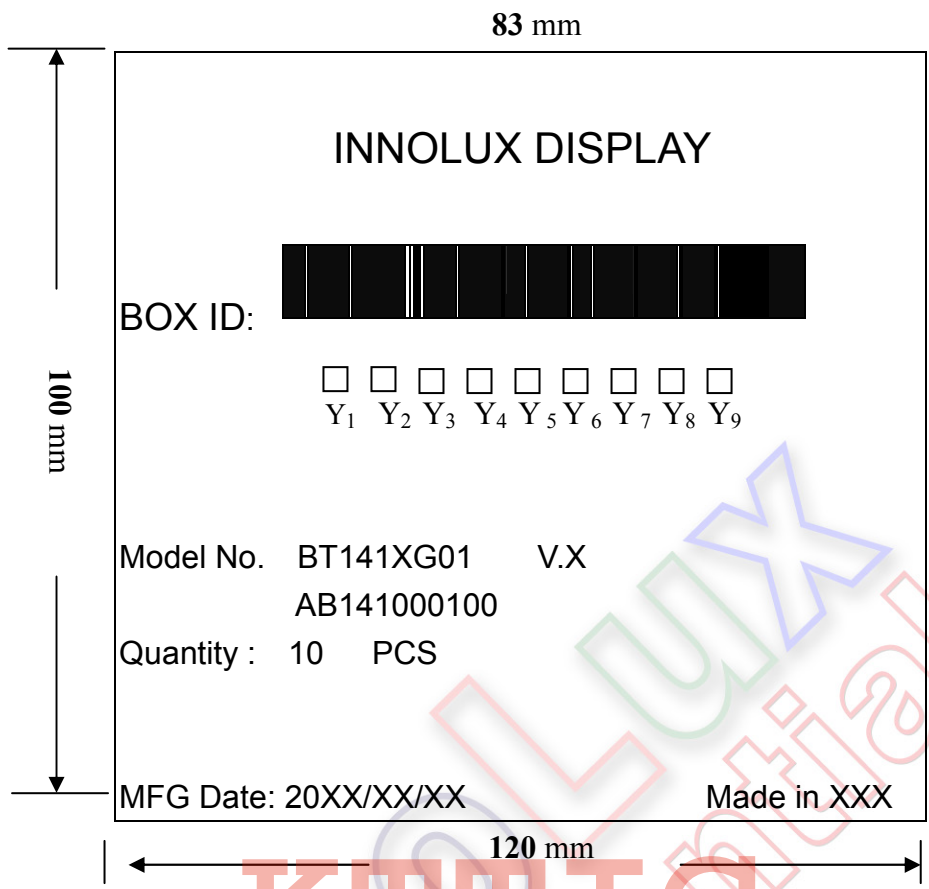
Month: 1~9 & A~C for Jan.~Dec.

Date: 1~9 & A~Z (exclude I, O, Q, U) for 1th~31th

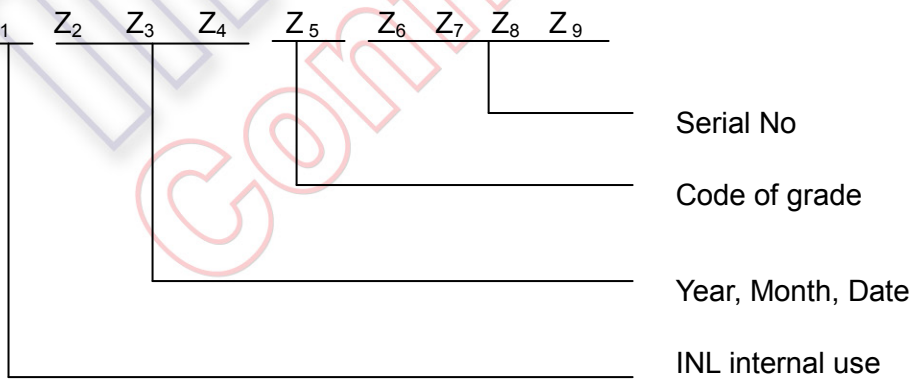
(b) Code of grade: 0, 1, 3, 5, 7

(c) Serial No: Module manufacture sequential no

(2) Carton Label



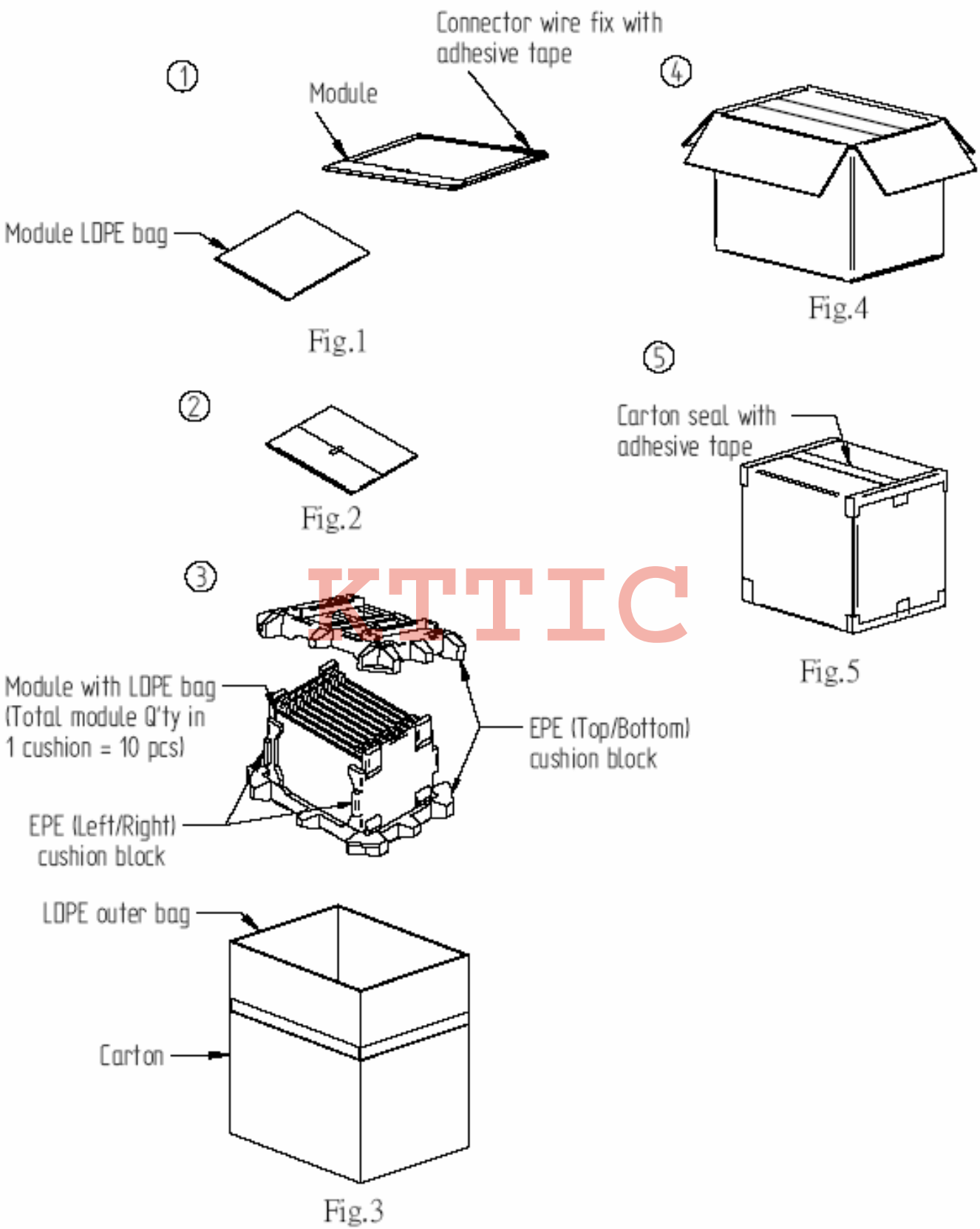
- (a) Model name : BT141XG01
- (b) Version : V.x, for example 0, 1, 2 etc.
- (c) Product number : AB141000100
- (d) Packing quantity : 10 pcs
- (e) Serial ID : Z₁ Z₂ Z₃ Z₄ Z₅ Z₆ Z₇ Z₈ Z₉



Serial ID includes the information as below :

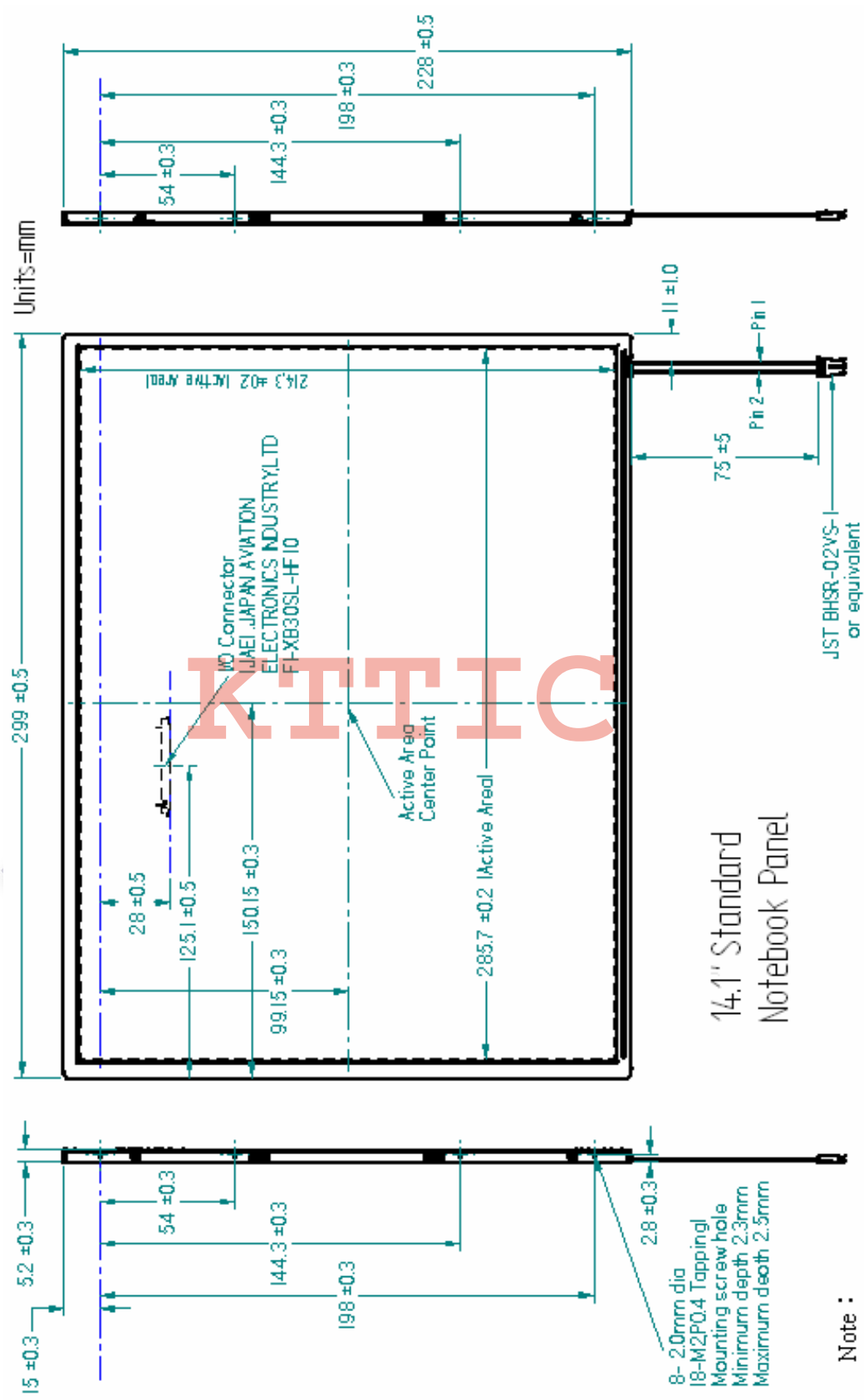
- (a) Manufactured Date: Year: 0~9, for 2000~2009
 Month: 1~9 & A~C for Jan.~Dec.
 Date: 1~9 & A~Z (exclude I, O, Q, U) for 1th~31th
- (b) Code of grade: 0, 1, 3, 5, 7
- (c) Serial No: Module packing sequential no

I. Packing form



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J. ME Drawing
(1) Front view

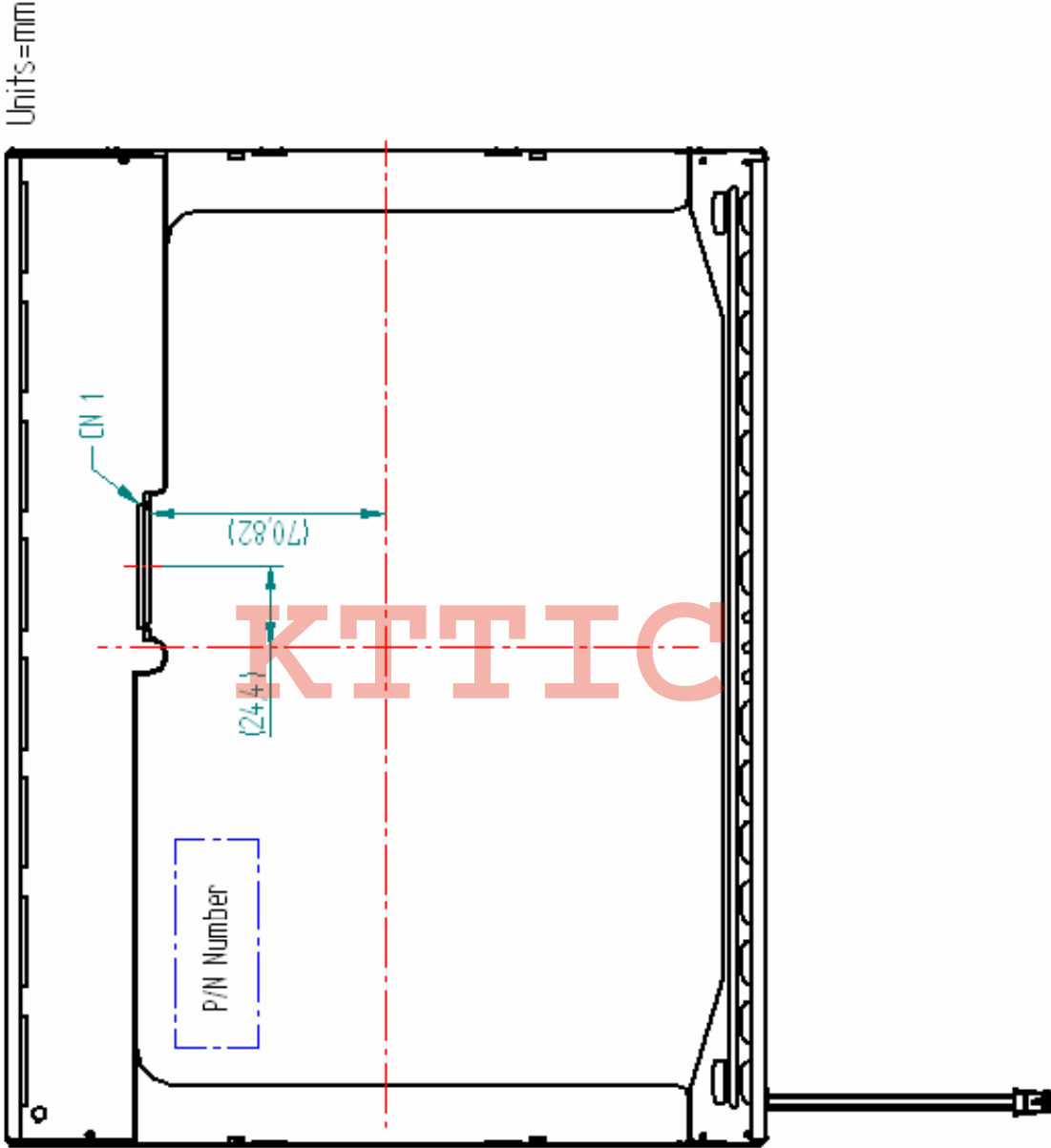


- Note :
1. Connector Pin 1 is High Voltage Line of Color Pink
 2. Connector Pin 2 is Low Voltage Line of Color White
 3. Unspecified tolerance refer to Level " 3 "

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(2) Back view



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