INNOLUX DISPLAY CORPORATION

BT156GW01 V.A LCD MODULE SPECIFICATION

( ) Preliminary Specification
(●) Final Specification

Customer	Checked & Approved by

Approved by	Checked by	Prepared by
MKT	PD	PM
		Annie Lu

Date: 2009/07/22

Innolux Display Corporation

No.160 Kesyue Rd., Chu-Nan Site, Hsinchu Science Park,

Chu-Nan 350, Miao-Li County, Taiwan

Tel: 886-37-586000 Fax: 886-37-586060

Version: 0.0

Record of Revision

Version	Revise Date	Page	Content
0.0	2009/07/22	All	First Edition issued

Contents:	Page

1. General Specifications

NO.	Item	Specification	Unit
1	Display resolution (pixel)	1366(H) X 768(V), HD resolution	
2	Active area	344.232(H) X 193.536(V)	mm
3	Screen size	15.6 inches diagonal	Inches
4	Pixel pitch	0.252(H) X 0.252(V)	mm
5	Color configuration	Stripe	
6	Overall dimension	359.8(W) X 210(H) X 5.5(D) (max)	mm
7	Weight	450 Max.	Grams
8	Surface treatment	Glare, 3H	
9	Input color signal	6 bit LVDS	
10	Display colors	262K (6 bit)	
11	Optimum viewing direction	6 o'clock	
12	Backlight	W-LED	
13	Glass thickness	0.5	mm
14	LED life time with LCM	12,000 (min.), T = 25°C	Hours
15	RoHS	RoHS compliance	

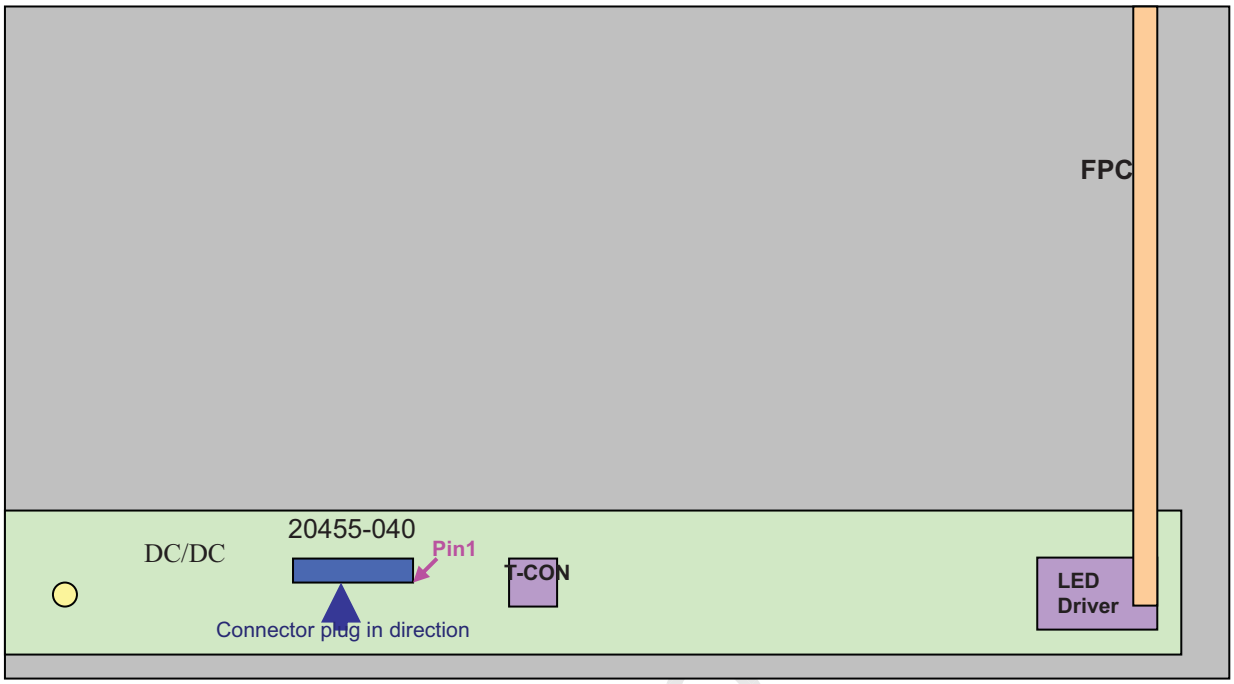
2. Electrical Specifications

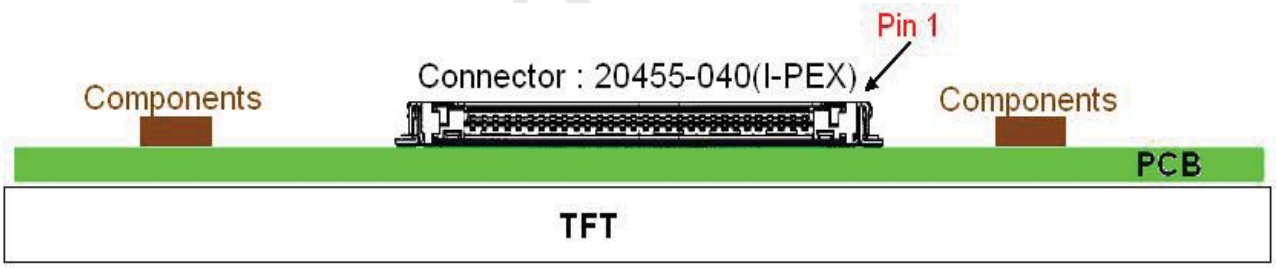
2-1. Pin Assignment

a. Panel connector
Connector Part No.: 20455-040-12 (I-PEX) or equivalent
User's connector Part No: 20453-040T-12 (I-PEX) or equivalent

Pin No	Symbol	Description	Remark
1	NC	No connection (Reserve)	
2	V_{CC}	Power Supply (+3.3V)	
3	V_{CC}	Power Supply (+3.3V)	
4	V_{EDID}	DDC Power +3.3V	
5	NC	No connection (Reserve)	
6	Clk_{EDID}	DDC Clock	
7	$DATA_{EDID}$	DDC Data	
8	Rxin0-	Differential Data Input	R0~R5,G0
9	Rxin0+	Differential Data Input	
10	GND	Ground	
11	Rxin1-	Differential Data Input	G1~G5,B0,B1
12	Rxin1+	Differential Data Input	
13	GND	Ground	
14	Rxin2-	Differential Data Input	B2~B5,DE,Hsync,Vsync
15	Rxin2+	Differential Data Input	
16	GND	Ground	
17	CLK-	Differential Clock Input	
18	CLK+	Differential Clock Input	
19	GND	Ground	
20	NC	No connection (Reserve)	
21	NC	No connection (Reserve)	
22	GND	Ground	
23	NC	No connection (Reserve)	
24	NC	No connection (Reserve)	
25	GND	Ground	
26	NC	No connection (Reserve)	
27	NC	No connection (Reserve)	
28	GND	Ground	
29	NC	No connection (Reserve)	
30	NC	No connection (Reserve)	
31	LED_GND	LED Ground	
32	LED_GND	LED Ground	
33	LED_GND	LED Ground	
34	NC	No connection (Reserve)	
35	LED_PWM	PWM dimming signal input	
36	LED_EN	LED enable pin (3.3V)	
37	NC	No connection (Reserve)	
38	V_LED	LED power supply 7.5V~21V	
39	V_LED	LED power supply 7.5V~21V	
40	V_LED	LED power supply 7.5V~21V	

b. General block diagram



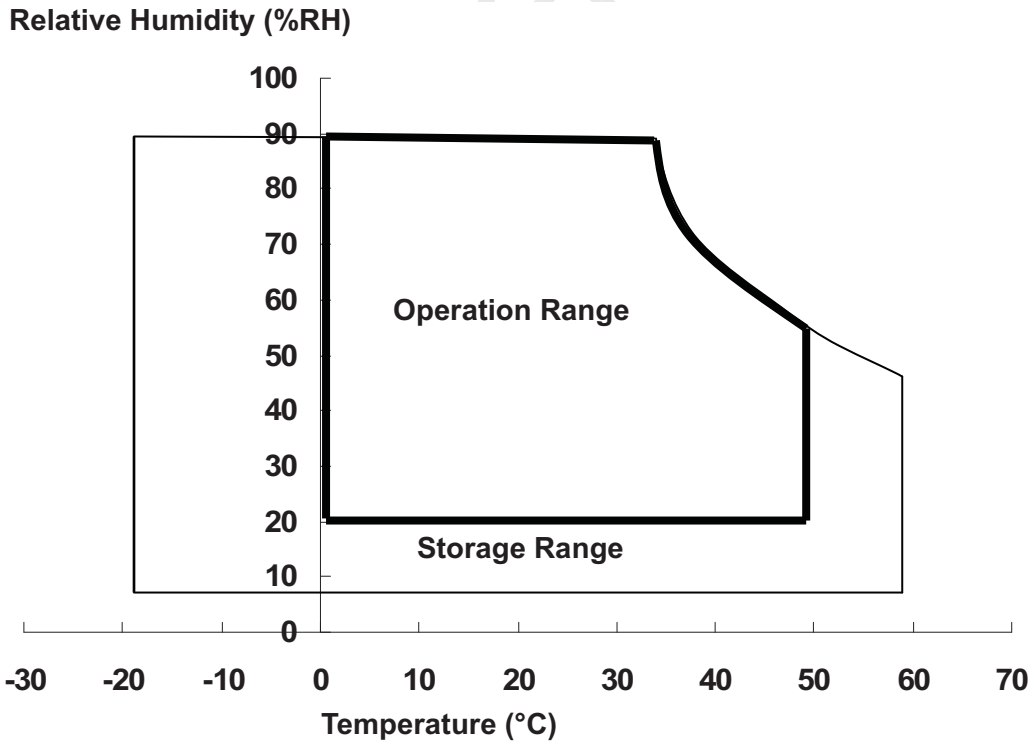


2-2. Absolute Maximum Ratings

Parameter	Symbol	Values		Unit	Remark
		Min.	Max.		
Power input voltage	V_{CC}	- 0.3	4.0	V	At 25℃
Signal input voltage	V_{IN}	- 0.3	4.0	V	At 25℃
LED input voltage	V_{LED}	- 0.3	30	V	At 25℃
Operating temperature	T_{OP}	0	50	℃	Note 1
Storage temperature	T_{ST}	- 20	60	℃	Note 2
Re-screw		-	5	Times	
Assured torque at side mount		-	2	kgf.cm	

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

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



2-3. Electrical Characteristics

a. Typical operating conditions

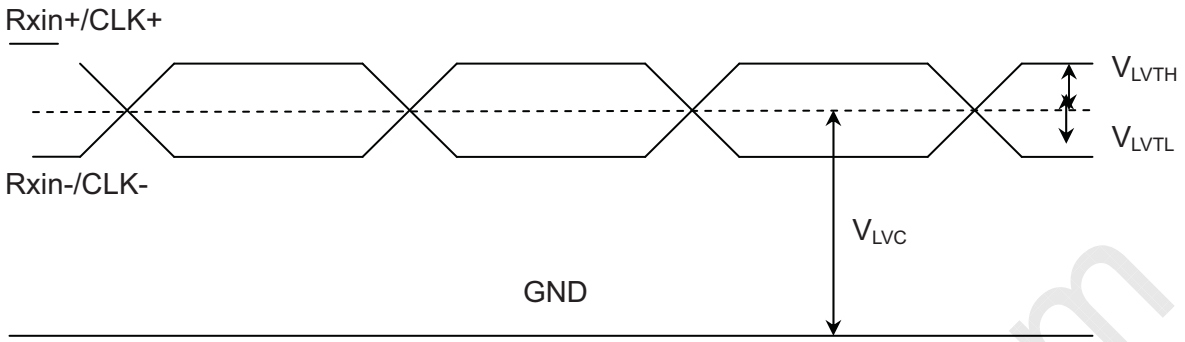
Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power input voltage		V_{CC}	3	3.3	3.6	V	
Permissive power input ripple		V_{RF}	-	-	0.1	V	
Power input current		I_{CC}	-	360	400	mA	Note 1
Power consumption		P_{logic}	-	1.2	1.3	Watts	Note 1
		$P_{logic-g}$	-	0.8	0.9	Watts	Note 2
		P_{total}		5.1	5.5	Watts	Note 1
		$P_{total-g}$		3.3	3.6	Watts	Note 3
LVDS interface	Differential input high threshold voltage	V_{LVTH}	-	-	+100	mV	V_{LVC}=1.2V, Note 4
	Differential input low threshold voltage	V_{LVTL}	-100	-	-	mV	V_{LVC}=1.2V, Note 4
	Common input voltage	V_{LVC}	1.0	1.2	1.4	V	Note 4
	Terminating resistor	R_T	90	100	110	ohm	
Initial inrush current		I_{inrush}	-	-	1.5	A	Note 5
Stable rush current		$I_{st-rush}$	-	-	0.0025	A^2sec	
LED Initial inrush current		$I_{LED-inrush}$	-	-	3.0	A	Note 6
LED stable rush current		$I_{LED-st-rush}$	-	-	0.0075	A^2sec	

Note 1: The specified input current and power consumption are under the V_{cc} =3.3 V, 25°C, f_V=60Hz (frame frequency) condition whereas black pattern is displayed.

Note 2: The logic power consumption @100 nits with full white pattern under the V_{cc} =3.3 V, 25°C, f_V=60Hz (frame frequency) condition

Note 3: The logic power consumption & BL power consumption @100 nits with full white pattern under the V_{cc} =3.3 V, 25 °C, f_V=60Hz (frame frequency) condition

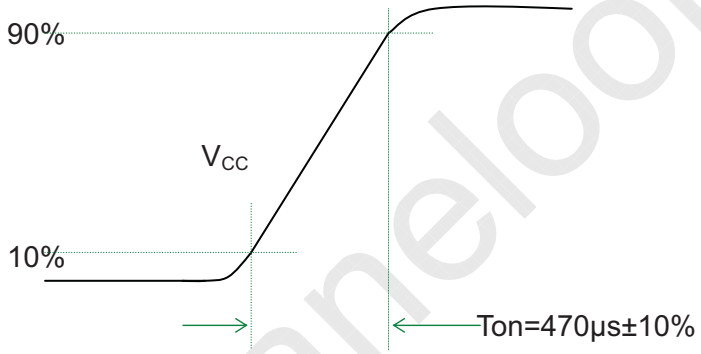
Note 4: LVDS waveform diagram



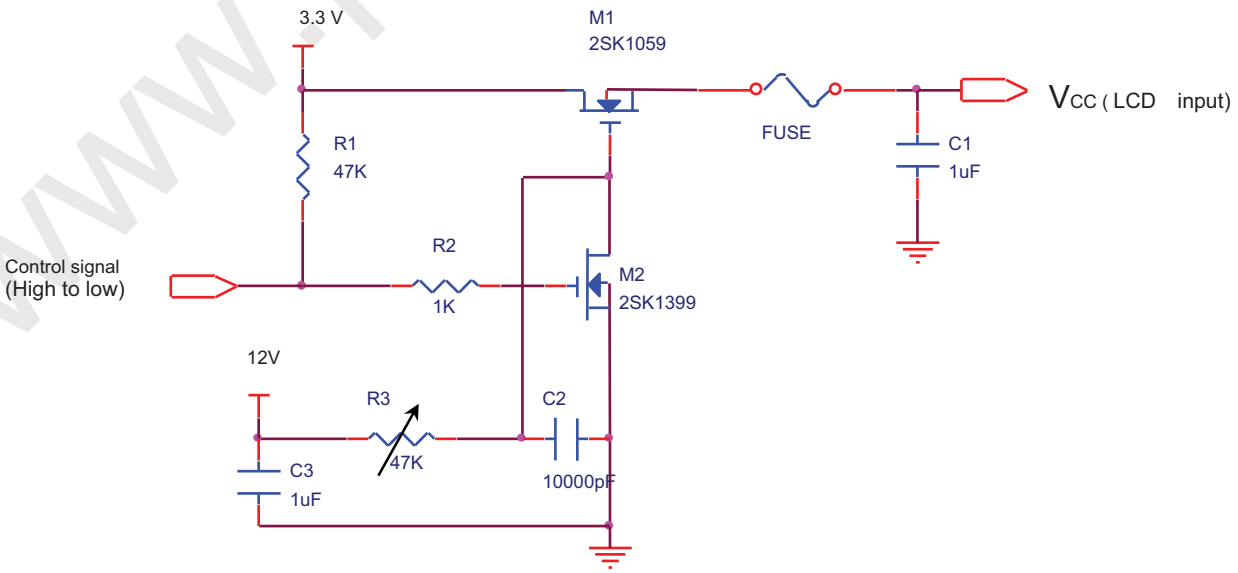
Note 5: Test condition

(1) Pattern: Black pattern

(2) V_{CC} = 3.3 V, V_{CC} rising time = 470 μs ± 10%



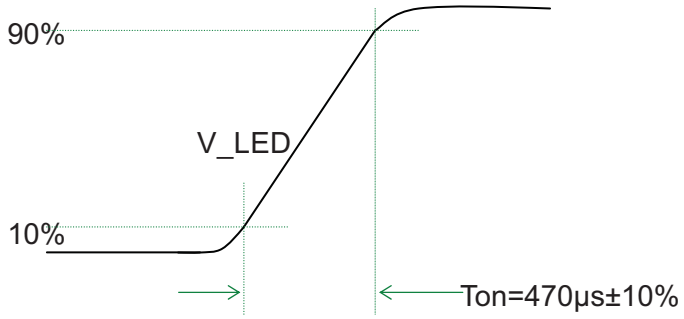
(3) Test circuit



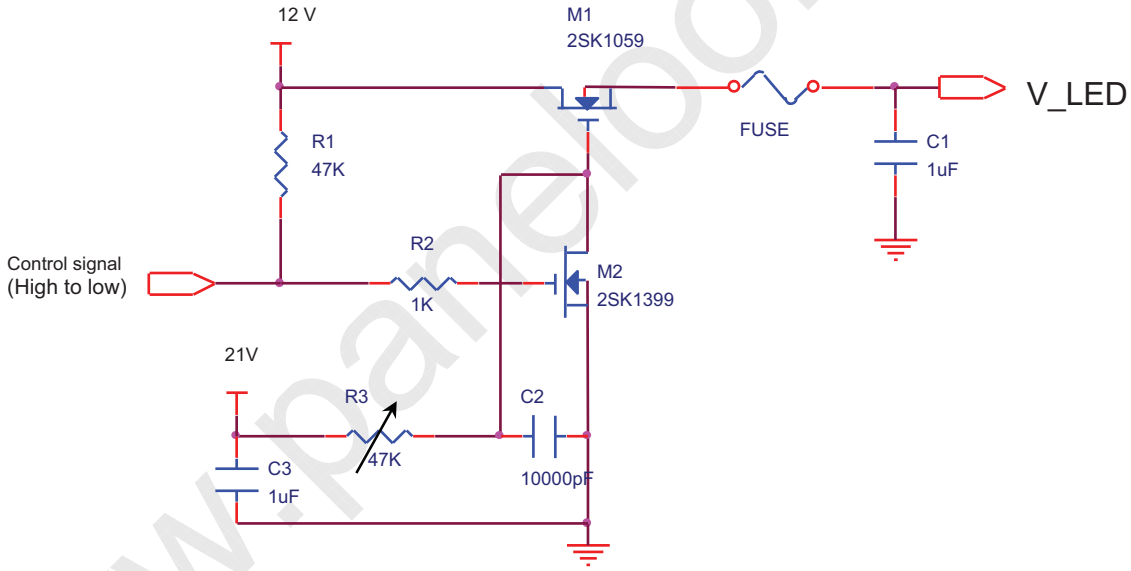
Note 6: Test condition

(1) LED duty 100%

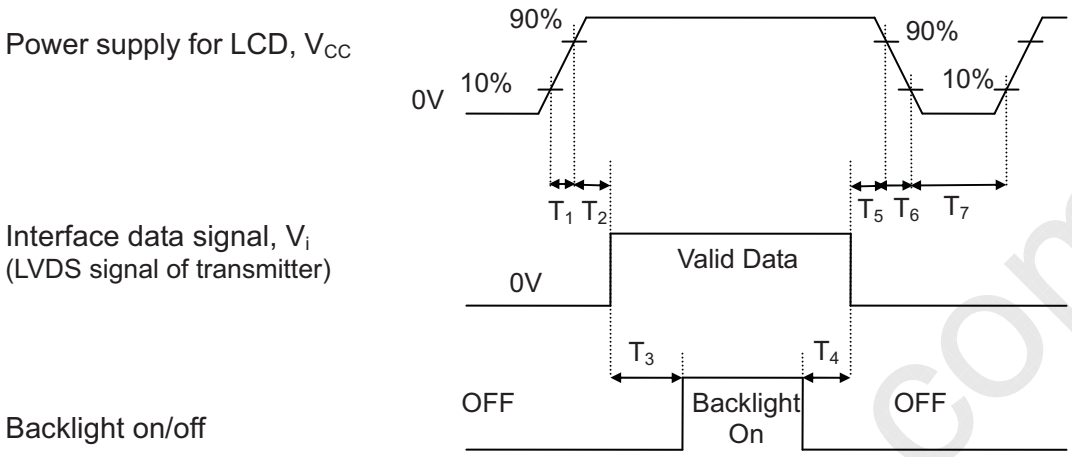
(2) V_LED = 12.0V, V_LED rising time = 470 μs ± 10%



(3) Test circuit



b. Power sequence

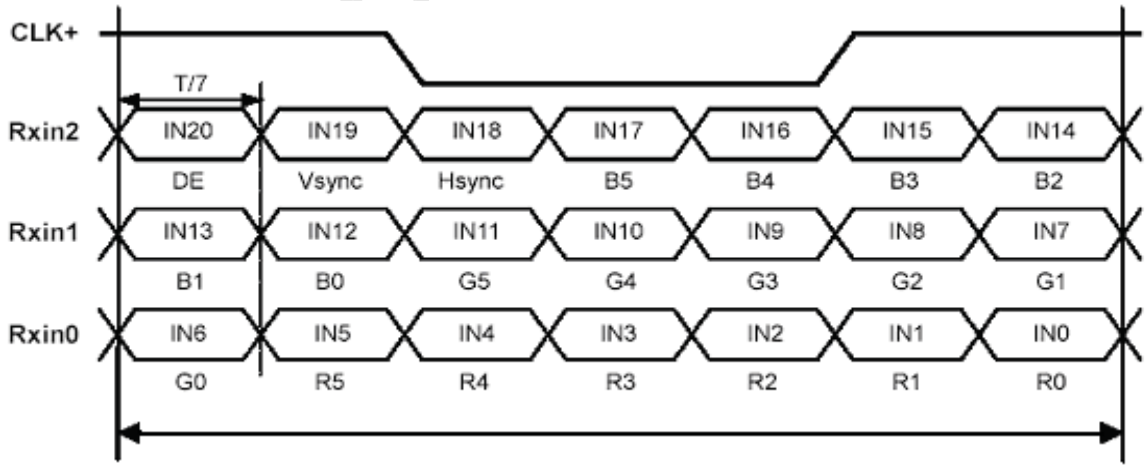


Power sequence timing table

Parameter	Value			Units
	Min.	Typ.	Max.	
T_1	0.5	-	10	ms
T_2	0	-	50	ms
T_3	200	-	-	ms
T_4	200	-	-	ms
T_5	0	-	50	ms
T_6	0	-	10	ms
T_7	400	-	-	ms

c. Display color vs. input data signals

Signal Name	Description	Remark
R5	Red Data 5 (MSB)	Red-pixel data. Each red pixel's brightness data consists of these 6 bits pixel data.
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0 (LSB)	
	Red-pixel Data	
G5	Green Data 5 (MSB)	Green-pixel data. Each green pixel's brightness data consists of these 6 bits pixel data.
G4	Green Data 4	
G3	Green Data 3	
G2	Green Data 2	
G1	Green Data 1	
G0	Green Data 0 (LSB)	
	Green-pixel Data	
B5	Blue Data 5 (MSB)	Blue-pixel data. Each blue pixel's brightness data consists of these 6 bits pixel data.
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0 (LSB)	
	Blue-pixel Data	

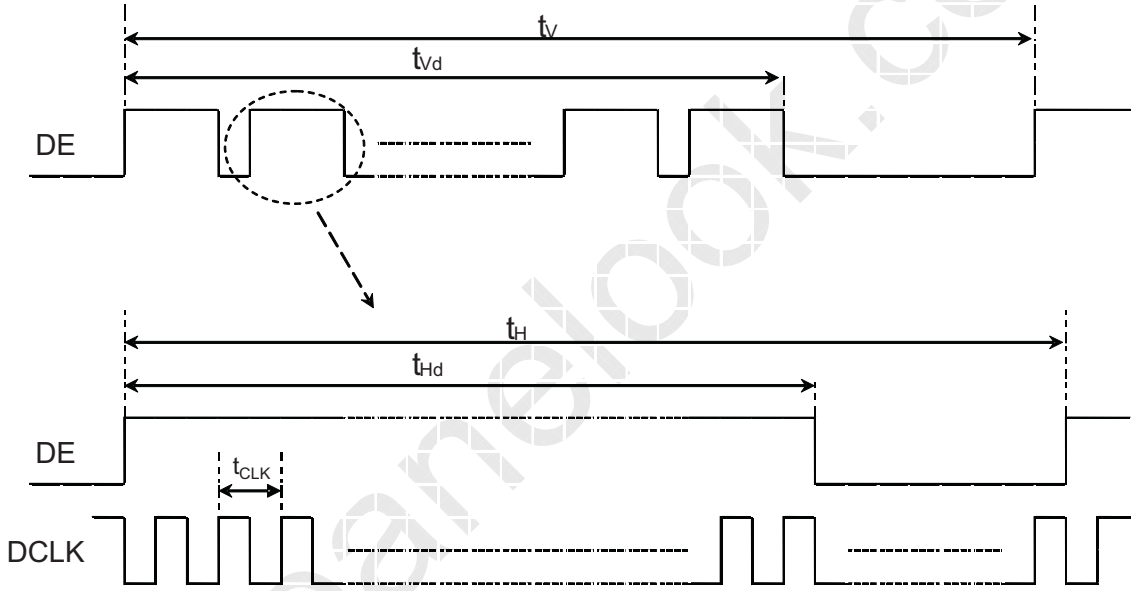


Signal for 1 DCLK cycle (t_{CLK})

d. Input signal timing

Timing table

Description	Symbol	Min	Typ	Max	Unit
Frame rate	--	50	60	--	Hz
Clock freq.	$1/t_{CLK}$	65	75	85	MHz
Line cycle time	t_H	1400	1560	1800	t_{CLK}
Line width-active	t_{Hd}	1366	1366	1366	t_{CLK}
Frame cycle time	t_V	780	806	900	t_H
V width-active	t_{Vd}	768	768	768	t_H



e. Display position

D(1, 1)	D(2, 1)	……	D(683, 1)	……	D(1365, 1)	D(1366, 1)
D(1, 2)	D(2, 2)	……	D(683, 2)	……	D(1365, 2)	D(1366, 2)
⋮		……	⋮	……	⋮	⋮
D(1, 384)	D(2, 384)	……	D(683, 384)	……	D(1365, 384)	D(1366, 384)
⋮		……	⋮	……	⋮	⋮
D(1, 767)	D(2, 767)	……	D(683, 767)	……	D(1365, 767)	D(1366, 767)
D(1, 768)	D(2, 768)	……	D(683, 768)	……	D(1365, 768)	D(1366, 768)

f. Backlight driving conditions

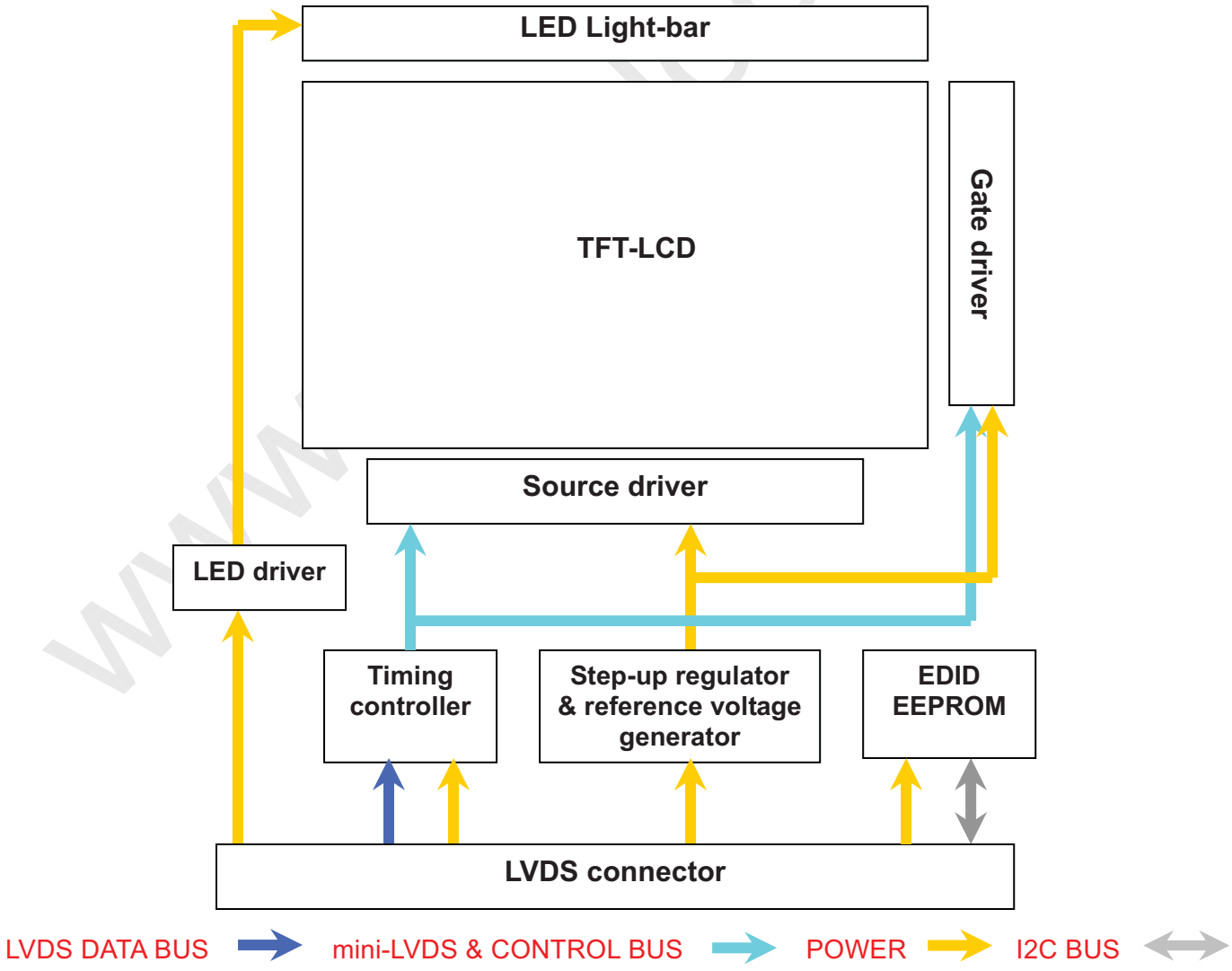
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Forward Voltage	V_F	3	3.2	3.4	V_{rms}	T = 25°C
LED Forward Current	I_F		20		mA_{rms}	T = 25°C
LED Power consumption	P_{LED}		3.93	4.20	W	T = 25°C
	P_{LED-G}		2.50	2.70	W	Note 1
Input PWM frequency	F_{PWM}	200	1000	2000	Hz	T = 25°C
Duty ratio	-	5		100	%	Note 2
LED life time (LED only)	-	15,000			Hr	T = 25°C , Note 3

Note 1: The BL power consumption @100 nits with full white pattern under the V_{cc} =3.3 V, 25 °C, f_V=60Hz (frame frequency) condition

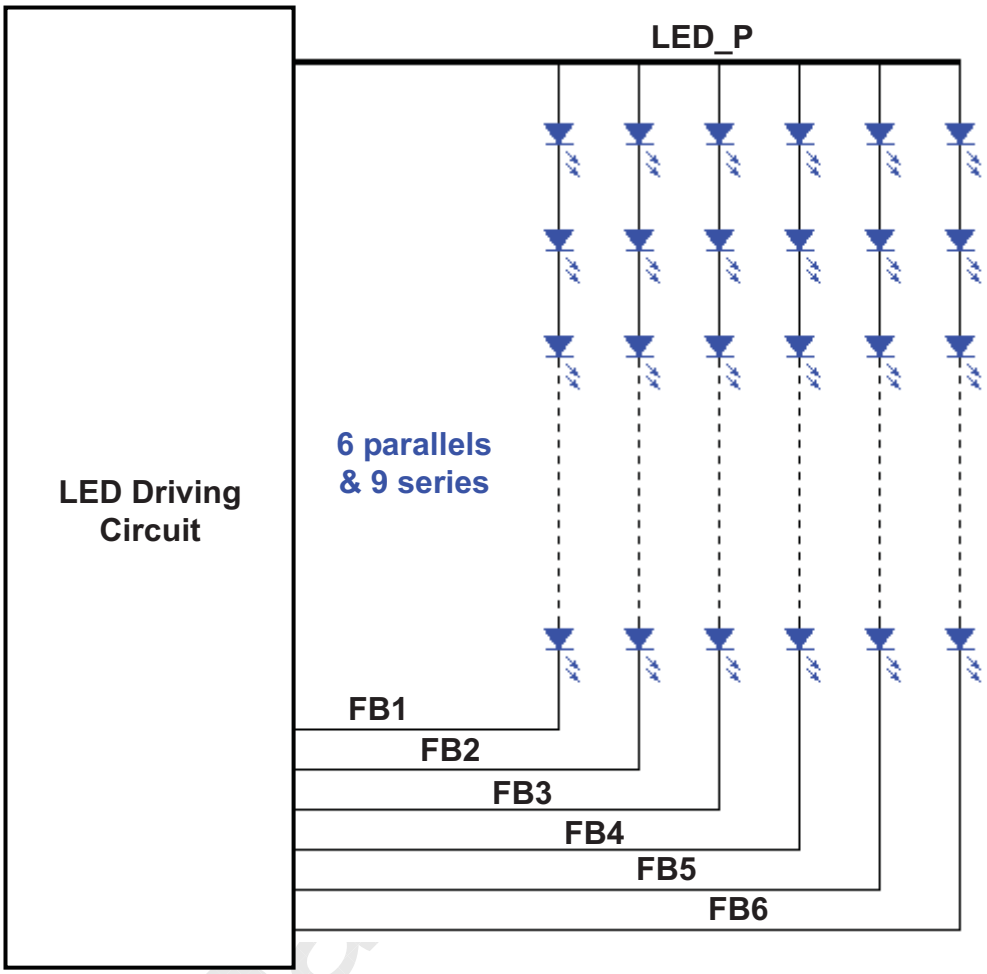
Note 2: PWM duty ratio linearity guarantees 10~100%.

Note 3: LED life time definition is brightness decrease to 50% of initial or abnormal lighting.

g. Module function block



h. LED circuit block



3. Optical specifications

Ambient temperature = 25℃

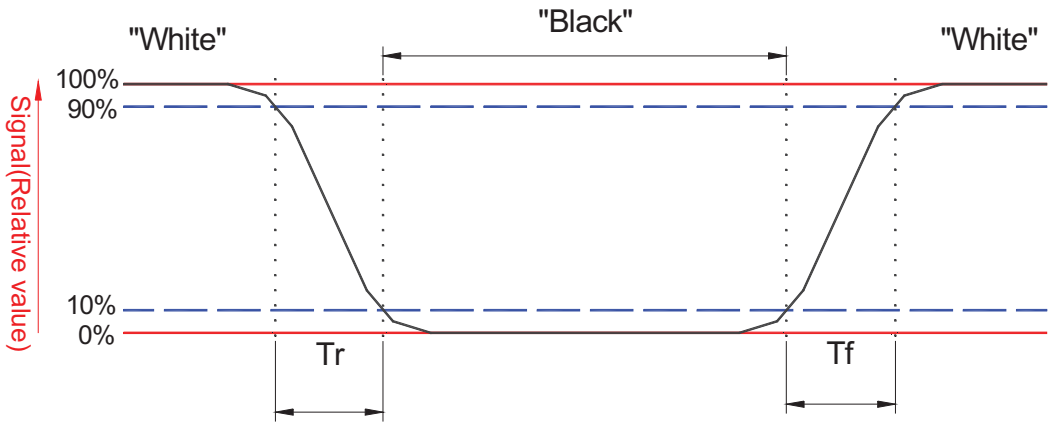
Item	Symbol	Condition	Specification			Unit	Remark
			Min.	Typ.	Max.		
Response time	Tr+Tf	θ= 0°		8	15	ms	Note 3
Contrast ratio	CR	θ= 0°	500	600			Note 2,4
Viewing angle	Top	CR≧10	15			deg	Note 2,4,6
	Bottom		30				
	Left		40				
	Right		40				
	Top	CR≧100	6				
	Bottom		11				
	Left		25				
	Right		25				
Brightness (5 points average)	Y_L		200	220		nit	Note 2,5
Color chromaticity (CIE)	W_x	θ= 0°	-0.03	0.313	+0.03		Note 2
	W_y			0.329			
	R_x			0.620			
	R_y			0.340			
	G_x			0.330			
	G_y			0.605			
	B_x			0.150			
	B_y			0.070			
Color gamut	NTSC	CIE1931	56	60		%	-
White uniformity	$\delta_{W(5)}$				1.25		Note 2,7
	$\delta_{W(13)}$				1.5		
Cross talk	Ct				2%		Note 8

Note 1: To be measured in dark room.

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

Note 3: 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 is between 10% and 90% of amplitudes. Refer to figure as below.



Note 4: Definition of contrast ratio:

Contrast ratio is calculated with the following formula:

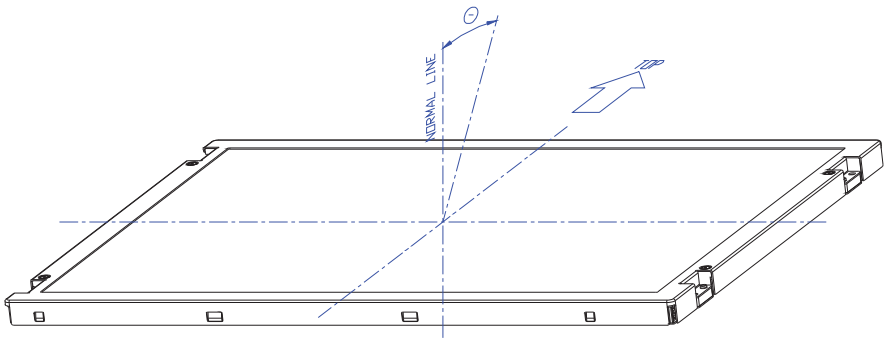
$$\text{Contrast ratio (Avg of 5pts)} = \frac{L_{\text{white (Avg of 5pts.)}}}{L_{\text{Black (Avg of 5pts.)}}}$$

Note 5: Driving current for LED should be 20 mA.

Luminance is measured at the following thirteen points (1~13):

Y_L = (Y5+ Y10+Y11+Y12 +Y13) / 5

Note 6: Definition of viewing angle



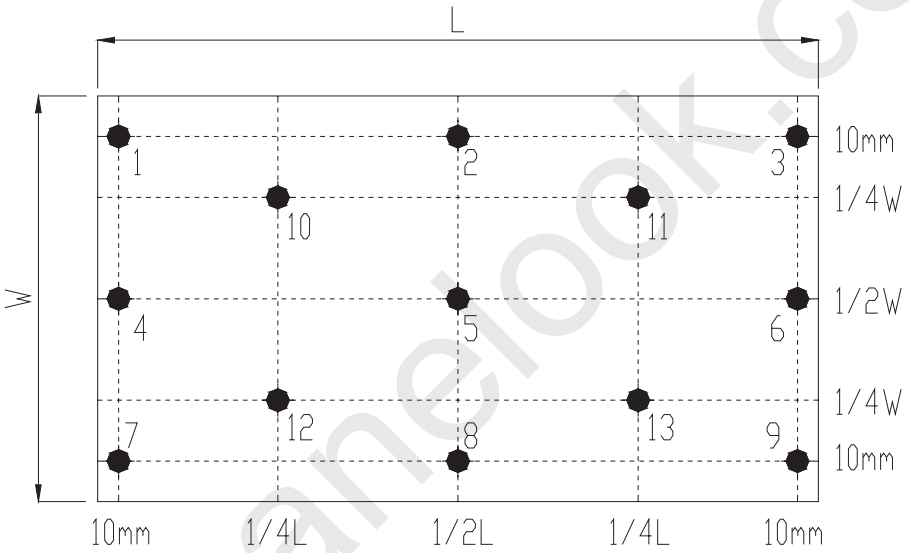
Note 7: Definition white uniformity

Luminance is measured at the following thirteen points (1~13):

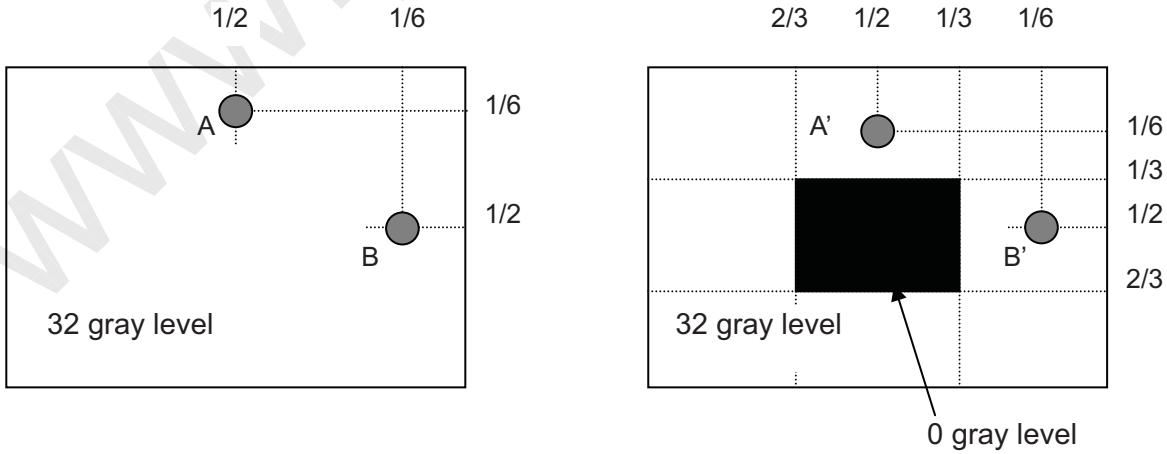
$$\delta_{W(13)} = \frac{\text{Maximum brightness of thirteen points}}{\text{Minimum brightness of thirteen points}}$$

$$\delta_{W(5)} = \frac{\text{Maximum brightness of five points}}{\text{Minimum brightness of five points}}$$

13 point measuring locations refer to the point 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13.
5 point measuring locations refer to the point 5, 10, 11, 12 and 13.



Note 8:



Unit: percentage of dimension of display area

I L_A-$L_{A'}$ I / L_A x 100%= 2% max., L_A and $L_{A'}$ are brightness at location A and A'

I L_B-$L_{B'}$ I / L_B x 100%= 2% max., $L_{B'}$ and $L_{B'}$ are brightness at location B and B'

4. Reliability test items

Test Item	Test Condition	Judgment	Remark
High temperature storage	60℃, 240 hours	Note 1	Note 2
Low temperature storage	-20℃, 240 hours	Note 1	Note 2
High temperature & high humidity operation	40℃, 90% RH, 240 hours (No condensation)	Note 1	Note 2
High temperature operation	50℃, 240 hours	Note 1	Note 2
Low temperature operation	0℃, 240 hours	Note 1	Note 2
Thermal shock (Non-operation)	-25℃ / 30 mins ~ 65℃ / 30 mins 100 cycles	Note 1	Note 2
Electrostatic discharge (ESD)	150 pF, 330Ω, Contact: ±8kV, Air: ±15kV	Note 1	
Vibration (Non-operation)	1.5G, 10 to 500 Hz random; 0.5hr in each perpendicular axes (X, Y, Z).	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.
Fail: No display image, obvious non-uniformity, or line defects.
Partial transformation of the module parts should be ignored.

Note 2: Evaluation should be tested after storage at room temperature more than one hour.

5. Safety

5-1. Sharp edge requirements

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

5-2. 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-V0 in the module will complete the flammability rating exception approval process. The printed circuit board will be made from material rated 94-V0 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.

6. Display quality

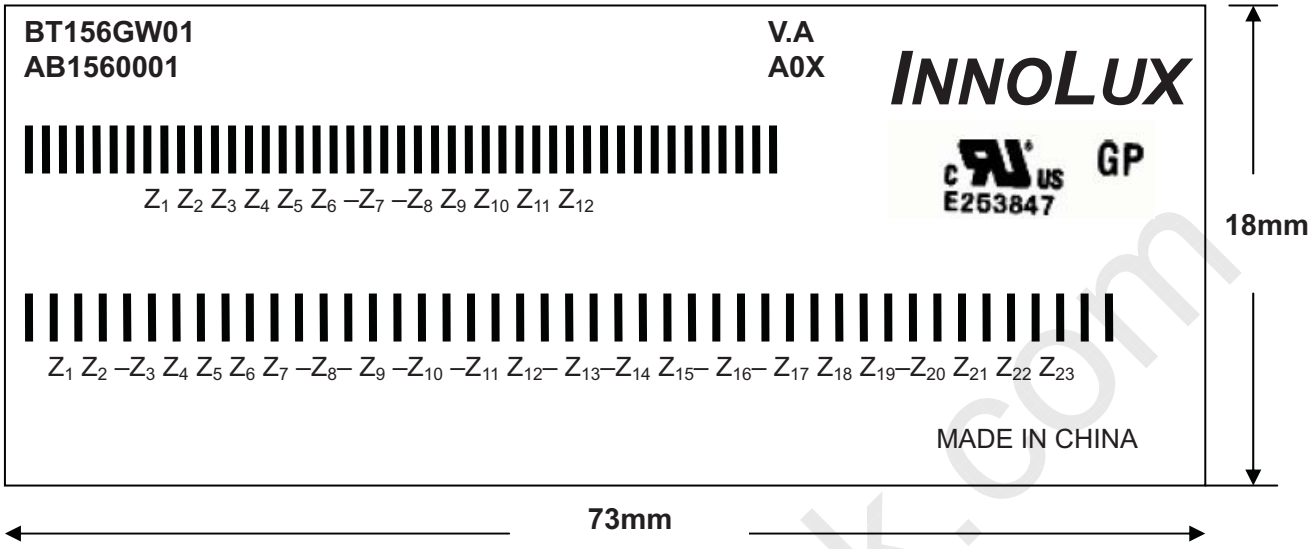
The display quality of the color TFT-LCD module should be in compliance with the InnoLux incoming inspection standard.

7. Handling precaution

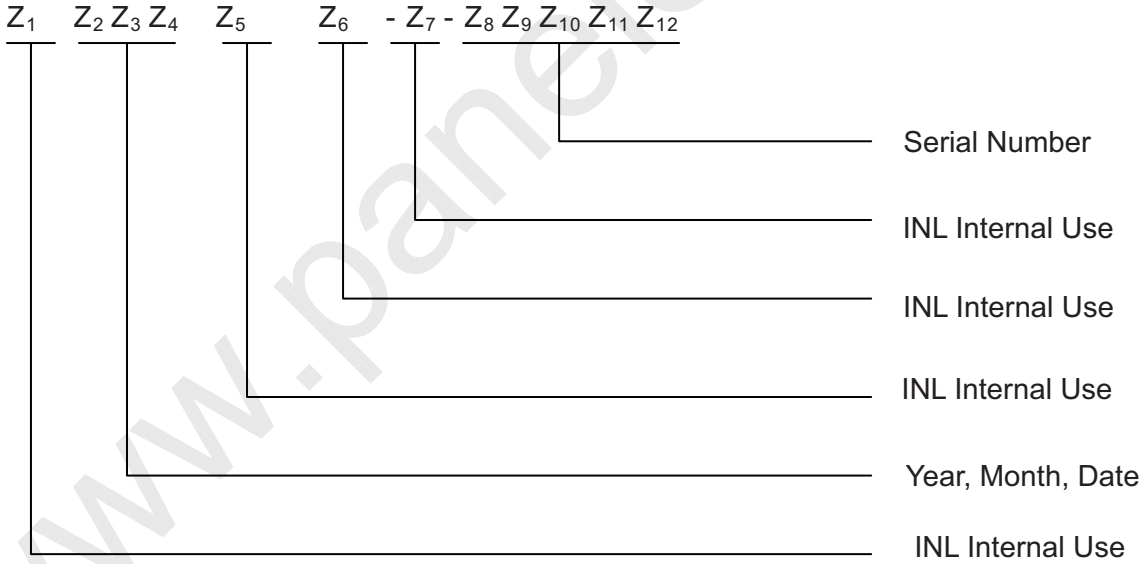
(1) Do not apply rough force such as bending or twisting to the module during assembly.
(2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
(3) It's not permitted to have pressure or impulse on the module because the LCD panel and backlight will be damaged.
(4) Always follow the correct power sequence when LCD module is connecting and operating.
(5) Do not pull the I/F connector in or out while the module is operating.
(6) Do not disassemble the module.
(7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
(8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
(9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.

8. Label Definition

8-1. Module label



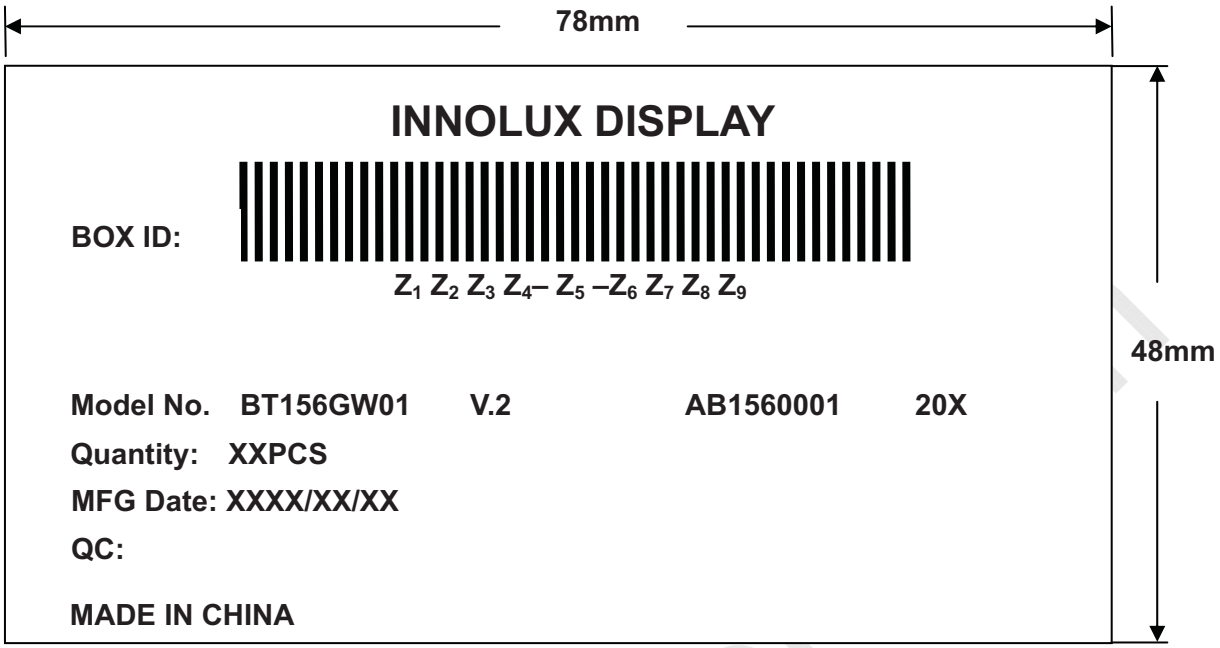
(1) Model Number : BT156GW01 V.A
(2) Product Number : AB1560001A0X
(3) Serial ID I (INL Internal Use): $Z_1Z_2Z_3Z_4Z_5Z_6$-Z_7-$Z_8Z_9Z_{10}Z_{11}Z_{12}$



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~V for 1st~31st.
(b) Serial Number: Module packing sequence number

(4) Serial ID II (INL Internal Use):
$Z_1 Z_2 –Z_3 Z_4 Z_5 Z_6 Z_7 –Z_8– Z_9 –Z_{10} –Z_{11} Z_{12}– Z_{13}–Z_{14} Z_{15}– Z_{16}– Z_{17} Z_{18} Z_{19}–Z_{20} Z_{21} Z_{22} Z_{23}$

8-2. Carton label



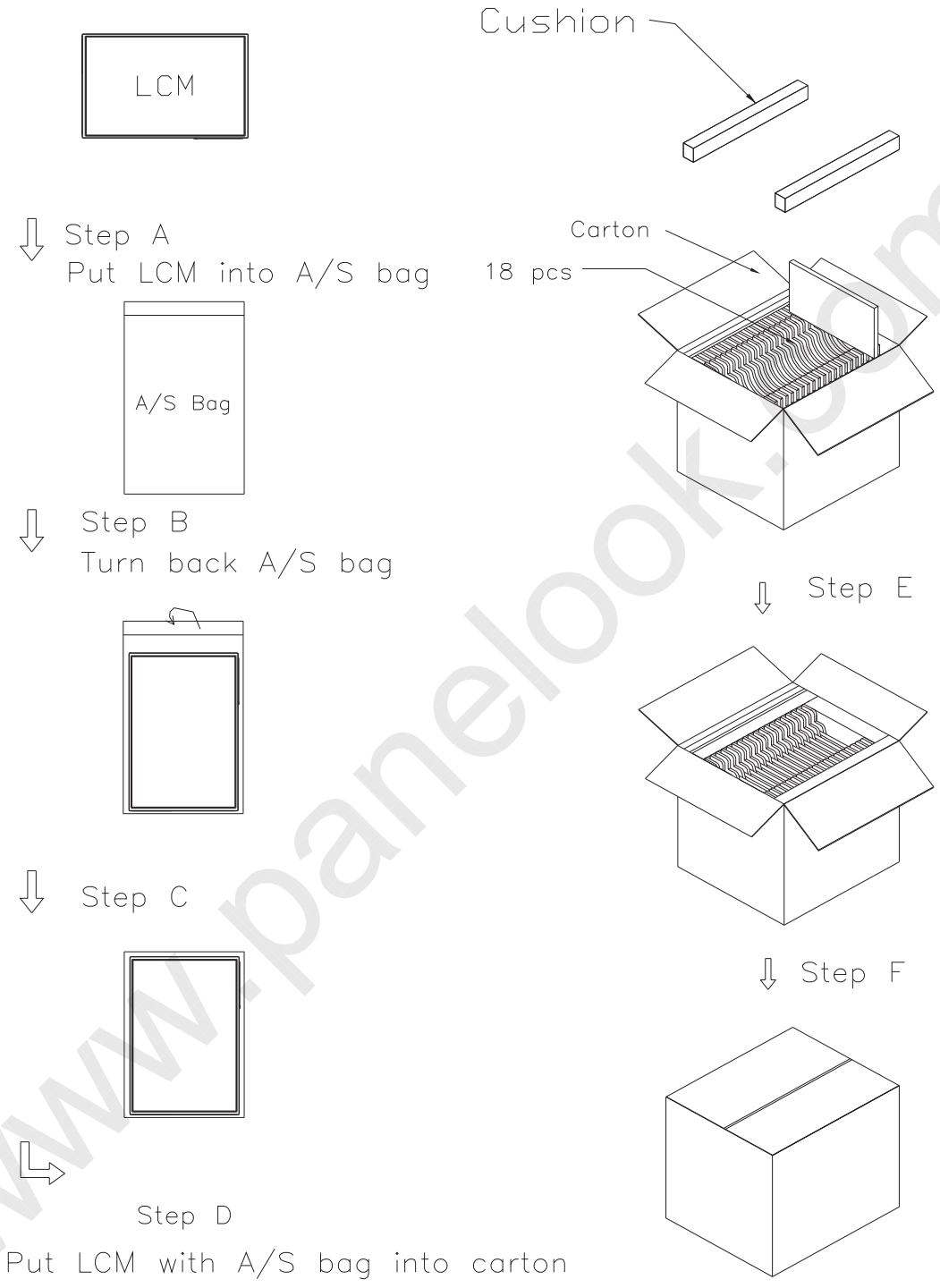
(1) Model No. : BT156GW01 V.A
(2) Package Quantity :XXPCS
(3) Serial ID:

Z_1 Z_2 Z_3 Z_4– Z_5 –Z_6 Z_7 Z_8 Z_9

- Z_9: Serial Number
- Z_8: INL Internal Use
- Z_7 Z_6 Z_5 Z_4: Manufactured Date
- Z_3 Z_2 Z_1: INL Internal Use

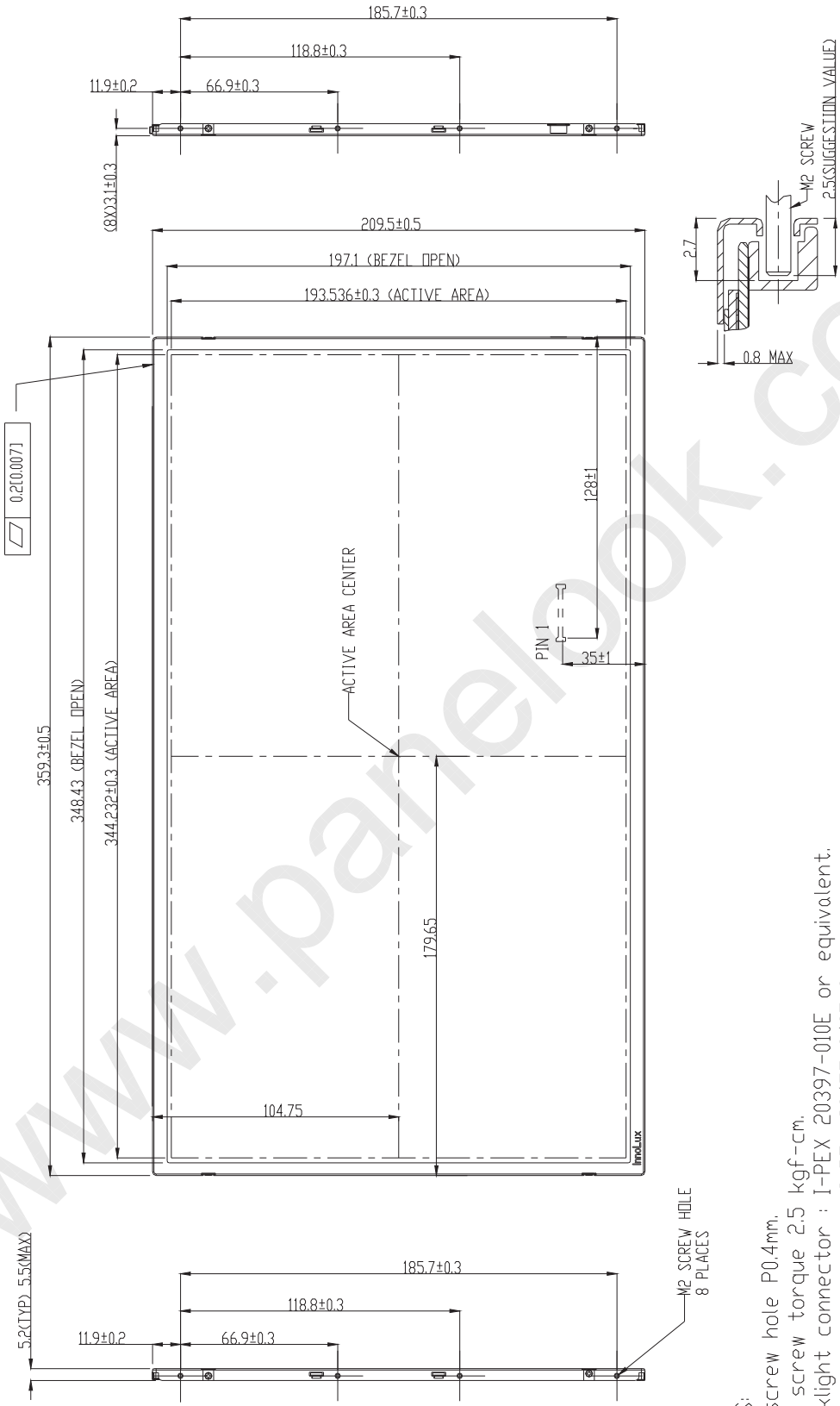
Serial ID includes the information as below:
(a) Manufactured Date:
Year: 0~9, for 2000~2009;
Month: 1~9 & A~C for Jan.~Dec.;
Date: 1~9 & A~V for 1st~31st.
(b) Serial Number: Module packing sequence number

9. Packing Form



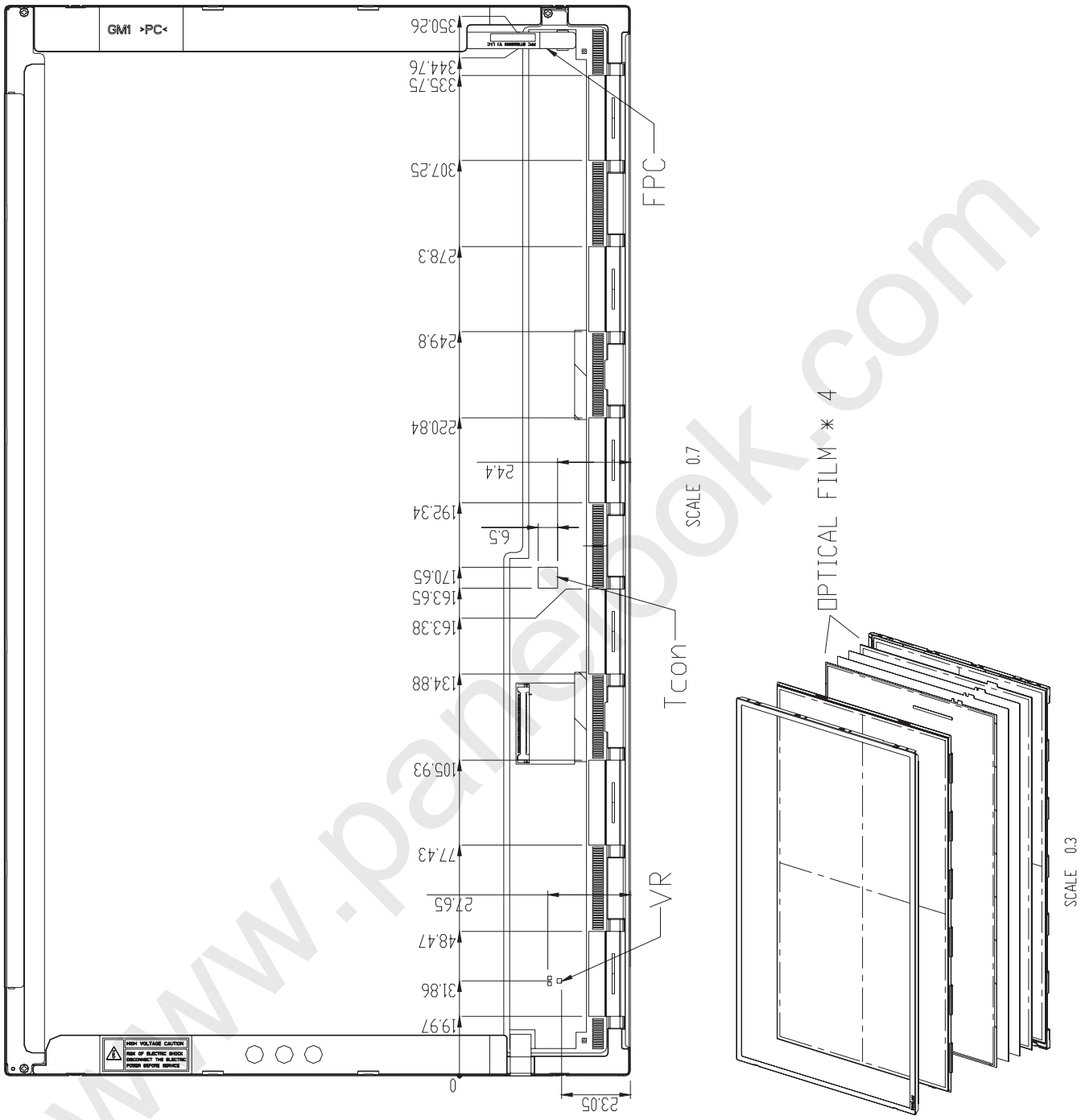
10. Mechanical Drawings

10-1. Front side



NOTES:
1.M2 screw hole P0.4mm.
2.Max screw torque 2.5 kgf-cm.
3.Backlight connector : I-PEX 20397-010E or equivalent.
4.LCD input connector : I-PEX 20455-040E-0* or equivalent.
5.In order to avoid IC damage, it is not allowed to have such overlappings as cables or antennas, camera, WLAN, WWAN over these COF locations.

10-2. Rear side



11. System Cover Design Notice

11-1. Interference examination (TCON / VR / COF IC vs cable or wire)

Definition:

a) Cable or wire overlap with TCON, VR, COF IC is forbidden for preventing from abnormal display after backpack test, hinge test, twist test or pogo test.

b) Cable or wire bypass TCON, VR, COF IC is recommended.

11-2. System inner surface examination

Definition:

a) Sponge tape or poron stick on PCBA or frame is forbidden for preventing from abnormal display after backpack test, hinge test, twist test or pogo test.