CUSTOMER APPROVAL SHEET

Company Name	
MODEL	C090EAN01.1
CUSTOMER APPROVED	Title : Name :

☐ **APPROVAL FOR SPECIFICATIONS ONLY (Spec. Ver. 0.3)**

☐ **APPROVAL FOR SPECIFICATIONS AND ES SAMPLE (Spec. Ver. 0.3)**

☐ **APPROVAL FOR SPECIFICATIONS AND CS SAMPLE (Spec. Ver. 0.3)**

☐ **CUSTOMER REMARK :**

1 Li-Hsin Rd. 2. Science-Based Industrial Park
Hsinchu 300, Taiwan, R.O.C.
Tel: +886-3-500-8899
Fax: +886-3-577-2730

Doc. Version	0.3
Total Page	24
Date	2014/12/05

Product Specification

9.0” COLOR TFT-LCD MODULE

MODEL NAME: C090EAN01.1

Model Name:	**C090EAN01.1**
Planned Lifetime:	From 2015/Jan To 2018/Apr
Phase-out Control:	From 2017/Apr To 2018/Apr
EOL Schedule:	2018/Apr

< ◆ >Preliminary Specification

< >Final Specification

Note: The content of this specification is subject to change.

Record of Revision

Version	Revise Date	Page	Content
0.0	2014/8/12	All	First draft.
0.1	2014/09/05	17	Modified power off sequence
		18	Added Max value of Response Time
0.2	2014/10/30	12	Added IVDD Inrush and IVDDA Inrush
		18	Modified Brightness SPEC
		18	Added Color Chromaticity SPEC
0.3	2014/12/05	16,17	Modified Power on and off sequence

Contents

A. General Description

C090EAN01.0 is an a-Si type Thin Film Transistor Liquid crystal Display (TFT-LCD) with AHVA (Advanced Hyper-Viewing Angle) technology. This model is composed of a TFT-LCD, driver ICs, PCB (Printed Circuit Board), and a backlight unit.

B. Features

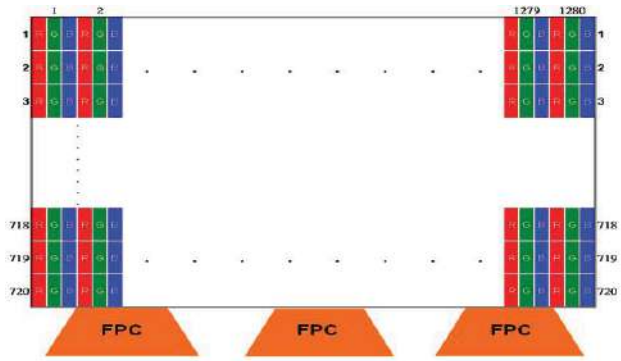
- 9.0”-inch display
- 1280 RGB x 720 resolution in RGB stripe dot arrangement
- High brightness
- Interfaces: LVDS (8bit JEIDA, DE mode)
- AHVA – wide view technology
- RoHS compliance

C. Physical Specifications

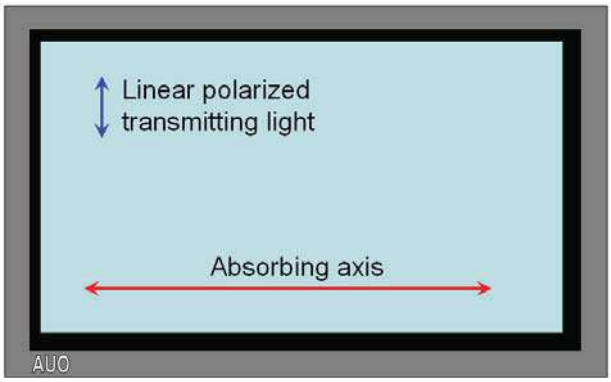
1. TFT LCD Panel

NO.	Item	Unit	Specification	Remark
1	Display Resolution	dot	1280 RGB(H)x 720(V)	
2	Active Area	mm	198.72 (H) x 111.78 (V)	
3	Screen Size	inch	9.0(Diagonal)	
4	Dot Pitch	μm	51.75 (R.G.B) x 155.25 (V)	
5	Color Configuration	–	R. G. B. Stripe	
6	Color Depth	–	16.7 M colors	
7	Overall Dimension	mm	210.7 x 126.8 x 7.1	
8	Weight	g	TBD	
9	Display Mode	–	Normally Black	
10	Surface Treatment	–	AG	

Note 1: Below figure shows dot stripe arrangement.

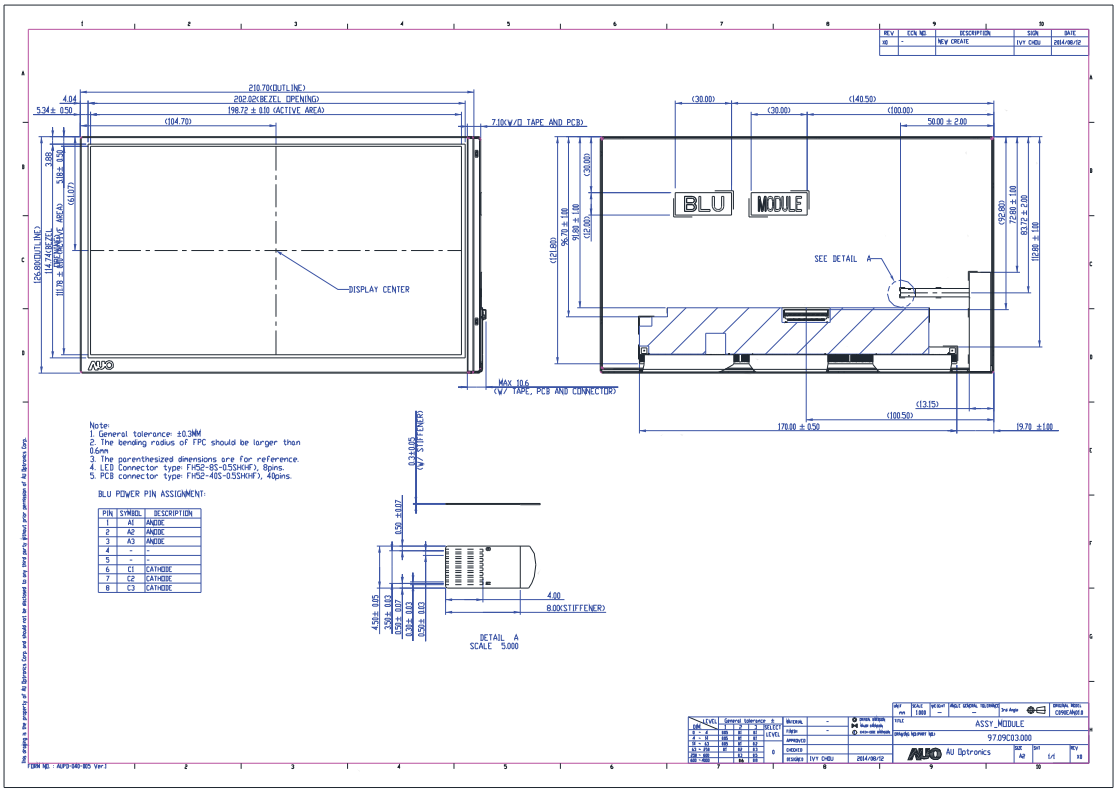


Note 2: Below figure shows dot stripe arrangement.



D. Outline Dimension

1. TFT-LCD Module



E. Electrical Specifications

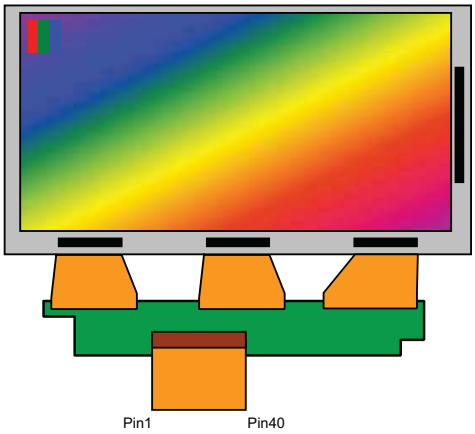
1. TFT LCD Panel Pin Assignment

Recommended Connector: FH52-40S-0.5SH

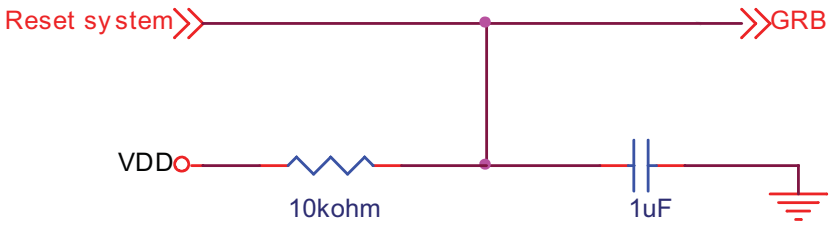
No.	Pin Name	I/O	Description	Remarks
1	NC		Dummy	
2	SHLR	I	Horizontal scan direction control. “H” Left to Right; “L” Right to Left. Internal pull-high. The external pull-up resister with 3.3k ohm should be used for changing the direction.	
3	UPDN	I	Vertical scan direction control. “H” Down to Up; “L” Up to Down. Internal pull-low. The external pull-up resister with 3.3k ohm should be used for changing the direction.	
4	VDD	PI	Digital power supply voltage.	
5	GND	G	Digital Ground.	
6	GRB	I	Global reset pin. (Low active)	
7	NC		Dummy	
8	GND	G	Digital Ground.	
9	CLKP	I	Positive LVDS differential clock input.	
10	CLKN	I	Negative LVDS differential clock input.	
11	GND	G	Digital Ground.	
12	PIND0	I	Positive LVDS differential input.	
13	NIND0	I	Negative LVDS differential input.	
14	GND	G	Digital Ground.	
15	PIND1	I	Positive LVDS differential input.	
16	NIND1	I	Negative LVDS differential input.	
17	GND	G	Digital Ground.	
18	PIND2	I	Positive LVDS differential input.	
19	NIND2	I	Negative LVDS differential input.	
20	GND	G	Digital Ground.	
21	PIND3	I	Positive LVDS differential input.	
22	NIND3	I	Negative LVDS differential input.	
23	GND	G	Digital Ground.	
24	GND	G	Digital Ground.	
25	VDD	PI	Digital power supply voltage.	
26	VDD	PI	Digital power supply voltage.	
27	GND	G	Digital Ground.	
28	NC		Dummy	
29	VDDA	PI	Analog power supply voltage.	
30	VDDA	PI	Analog power supply voltage.	
31	VDDA	PI	Analog power supply voltage.	
32	VDDA	PI	Analog power supply voltage.	
33	VDDA	PI	Analog power supply voltage.	
34	NC		Dummy	
35	GNDA	G	Analog Ground.	
36	GNDA	G	Analog Ground.	
37	GNDA	G	Analog Ground.	
38	GNDA	G	Analog Ground.	
39	GNDA	G	Analog Ground.	
40	GNDA	G	Analog Ground.	

Note1: I: Digital signal input, O: Digital signal output, G: GND, PI: Power input

Note2:



Note3: Outside Reset circuit



2. Differential Input Data Format

a. JEIDA format (DE mode)

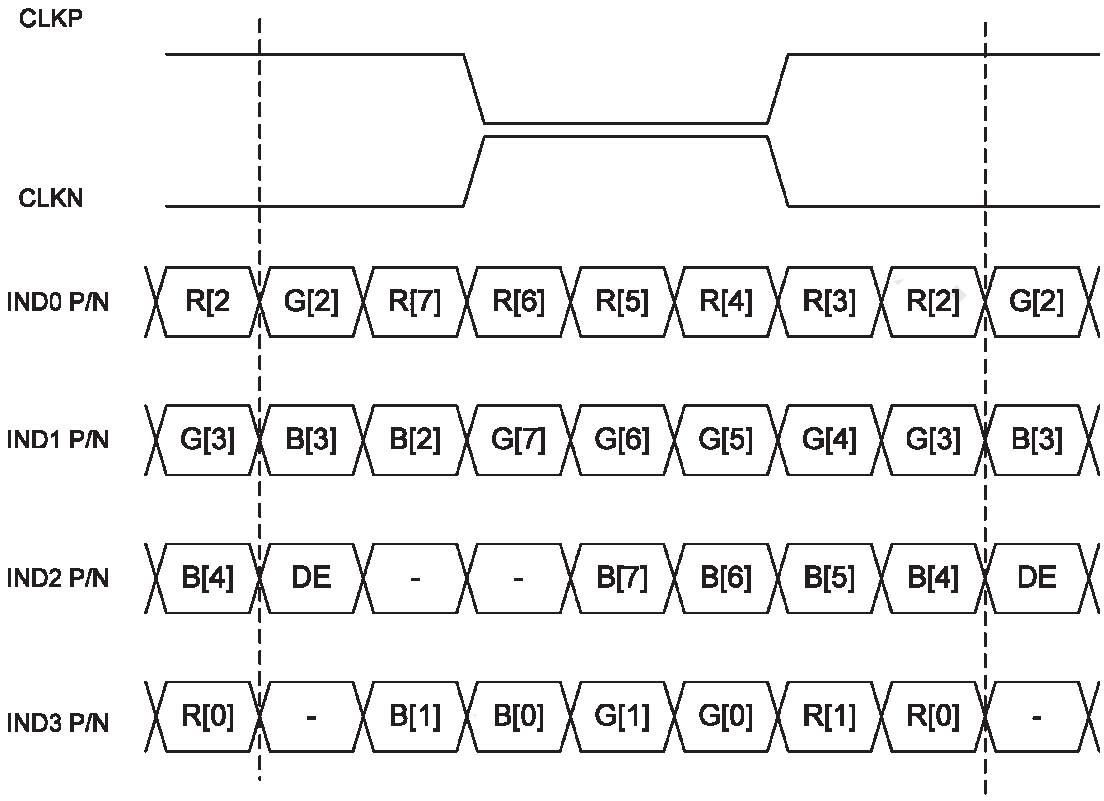


Fig. 1. LVDS input data JEIDA format

3. Input Timing Diagram

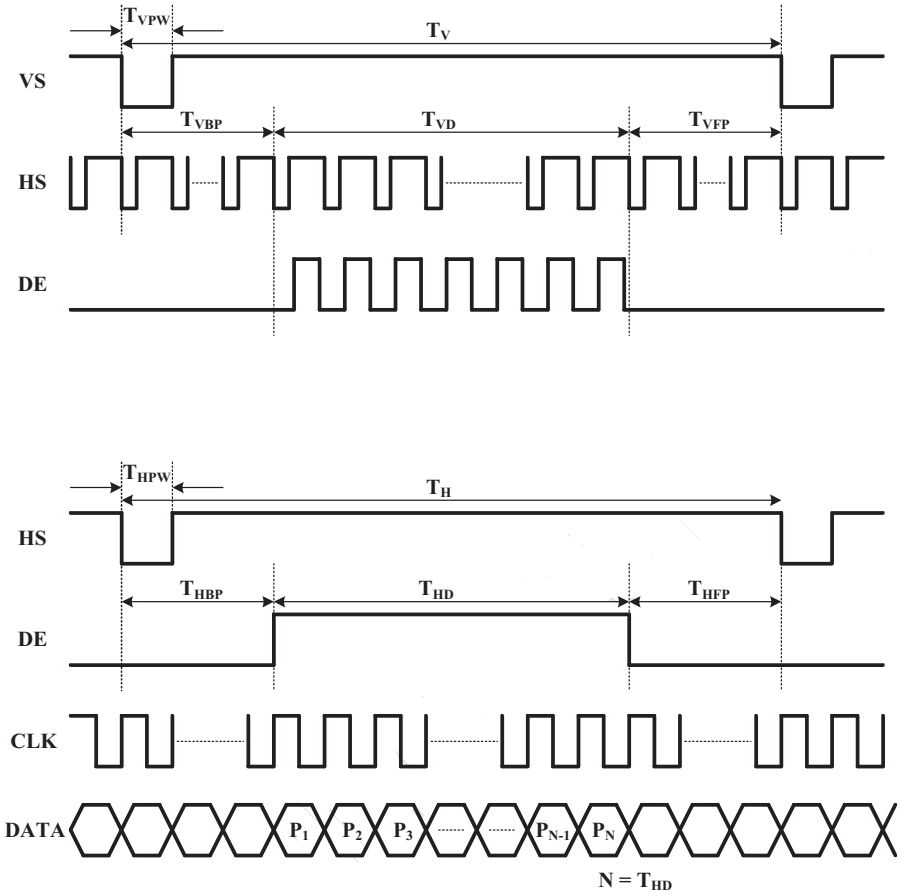


Fig. 2. Input Timing Diagram

Parameter		Symbol	Min.	Typ.	Max.	Unit.	Remark
CLK Frequency		F_{CLK}	58.4	58.7	75	MHz	
HSYNC	**Period**	T_H	1340	1344	1470	CLK	
	Horizontal display area	T_{HD}		1280		CLK	
	Blanking	$T_{HBP} + T_{HFP}$	60	64	190	CLK	
VSYNC	**Period**	T_V	726	728	850	HS	
	Vertical display area	T_{VD}		720		HS	
	Blanking	$T_{VBP} + T_{VFP}$	6	8	130	HS	

4. Absolute Maximum Ratings

Items	Symbol	Values		Unit	Condition
		Min.	Max.		
Power Voltage	VDD	-0.3	5	V	GND = 0 V
	VDDA	-0.3	5	V	GND = 0 V
Input Signal Voltage	Vi	-0.3	VDD + 0.3	V	GND = 0 V
Operation Temperature	Topa	-30	85	°C	Ambient
Storage Temperature	Tstg	-40	95	°C	Ambient

Note 1: Functional operation should be restricted under normal ambient temperature.

5. DC Electrical Characteristics

The following items are measured under stable condition and suggested application circuit.

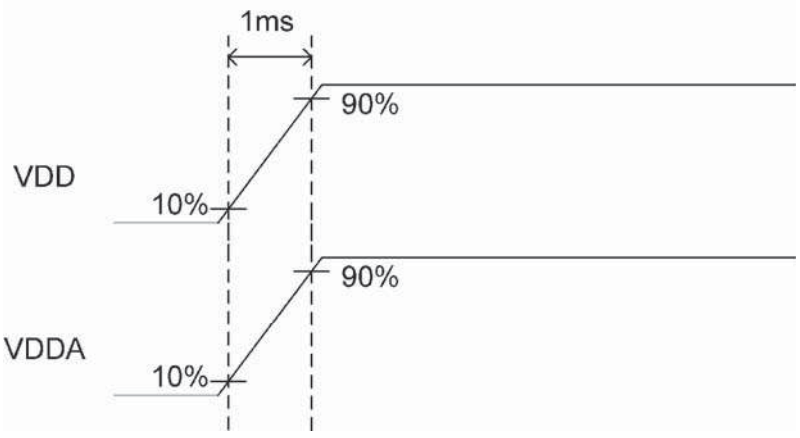
a. Power Specification

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Power Supply	VDD	3	3.3	3.6	V	
	IVDD	120	150	200	mA	Note 1
	IVDD Inrush	-	-	500	mA	Note2
	VDDA	3	3.3	3.6	V	
	IVDDA	200	420	690	mA	Note 1
	IVDDA Inrush	-	-	1100	mA	Note2

Note 1: The typ. current value is using the following test pattern.

Fig. 3. Test pattern for power specification

Note 2: Both of IVDD and IVDDA inrush current are defined in following condition.



b. Signal DC Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Input signal voltage	Vi	-0.3	-	VDD + 0.3	V	Note 1
Input high level voltage	V_{IH}	0.7VDD	-	VDD	V	Note 1
Input low level voltage	V_{IL}	GND	-	0.3VDD	V	Note 1
Differential input high threshold	R_{XVTH}	0.1	-	-	V	Note 2
Differential input low threshold	R_{XVTL}	-	-	-0.1	V	Note 2
Input voltage range (singled-end)	R_{XVIN}	0.8	-	1.6	V	Note 2
Input differential voltage	$\|V_{ID}\|$	0.1	-	0.6	V	Note 2
Differential Input Common Mode Voltage	R_{XVCM}	1.1	1.2	1.4	V	Note 2

Note 1: TTL interface signal DC characteristics
Note 2: LVDS interface signal DC characteristic

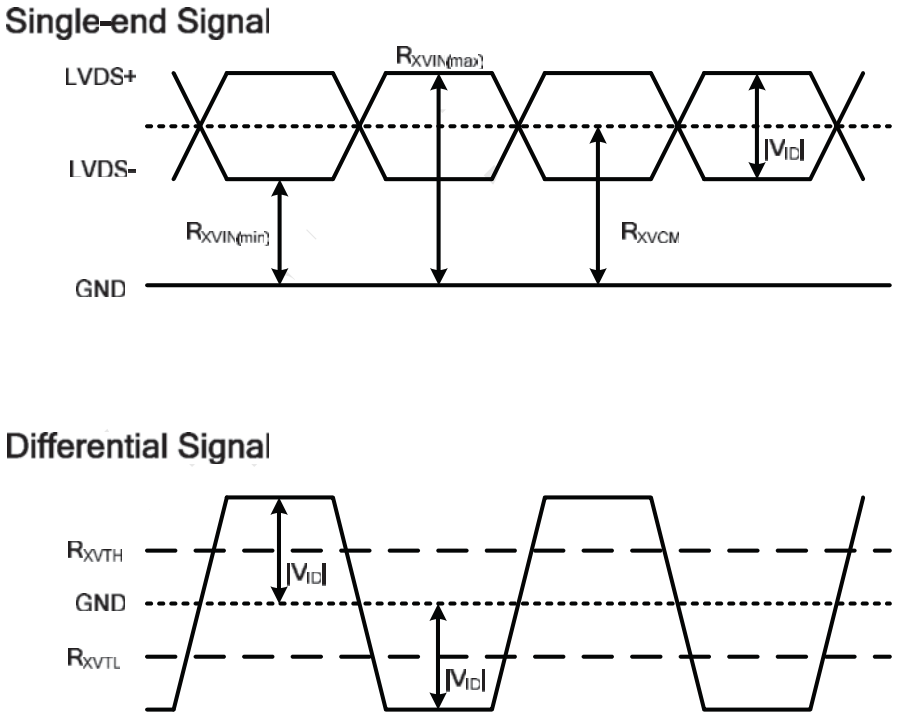


Fig. 4. LVDS DC characteristics diagram

c. Backlight Driving Conditions (Note 1)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Supply Current	I_L		80	85	mA	single serial (Note 3)
LED Supply Voltage	V_L			20.4	V	single serial Note 3
LED Life Time	L_L	10,000			hr	Note 2

Note 1: light-bar has 18 pieces of LED (3 strings, 6 pieces for each string).
Note 2: LED life time defining the 80% decreasing of the original brightness is 10,000 hours under the 80 mA of LED current in 25 °C.
Note 3: The LED supply power is for 3 string of LED.
Note 4: The voltage capacity of LED driver IC must be over max. of LED Voltage.

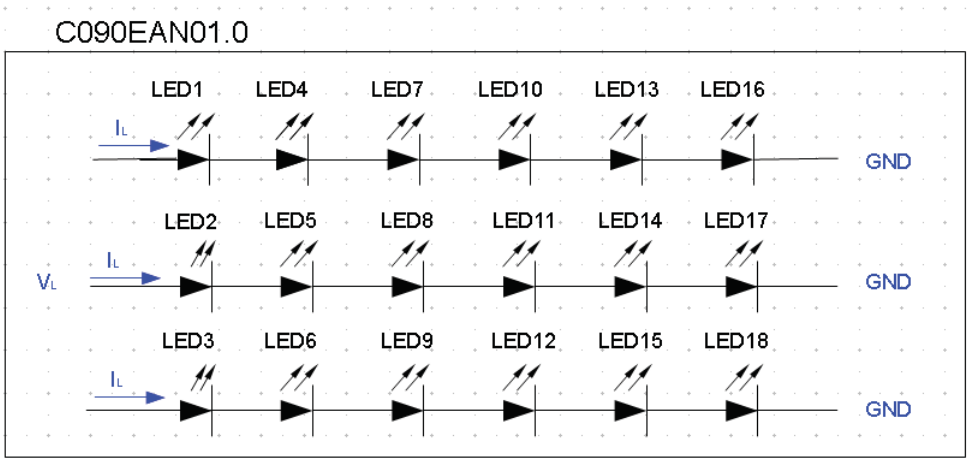


Fig. 5. Light bar structure

Note 5:

No.	Pin Name	I/O	Description
1	ANODE1	P	LED power supply
2	ANODE2	P	LED power supply
3	ANODE3	P	LED power supply
4	NC	-	No Connection
5	NC	-	No Connection
6	CATHODE1	G	Ground
7	CATHODE2	G	Ground
8	CATHODE3	G	Ground

6. AC Electrical Characteristics

a. Input AC characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
VDD power on slew time	T_{POR}	1	-	15	ms	From 0V to 90% VDD
GRB active pulse width	T_{GRB}	1	-	20	ms	VDD=3.3V

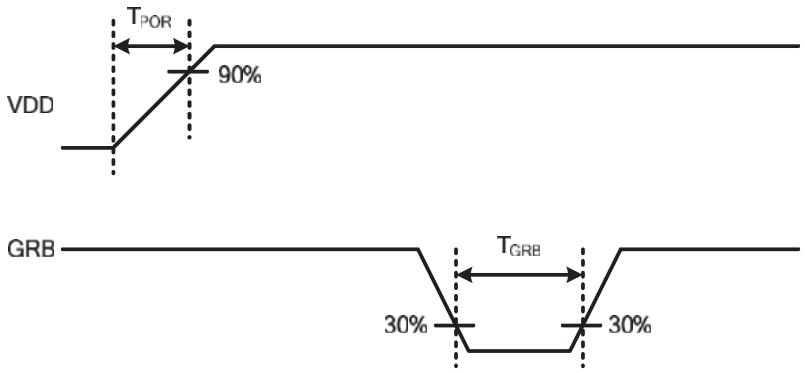


Fig. 6. VDD and GRB timing diagram

b. Differential signal AC characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Clock frequency	R_{XFCLK}	25	-	75	MHz	
Input data skew margin	T_{RSKM}		-	1/4	UI	$\|V_{ID}\|$ = 100 mV

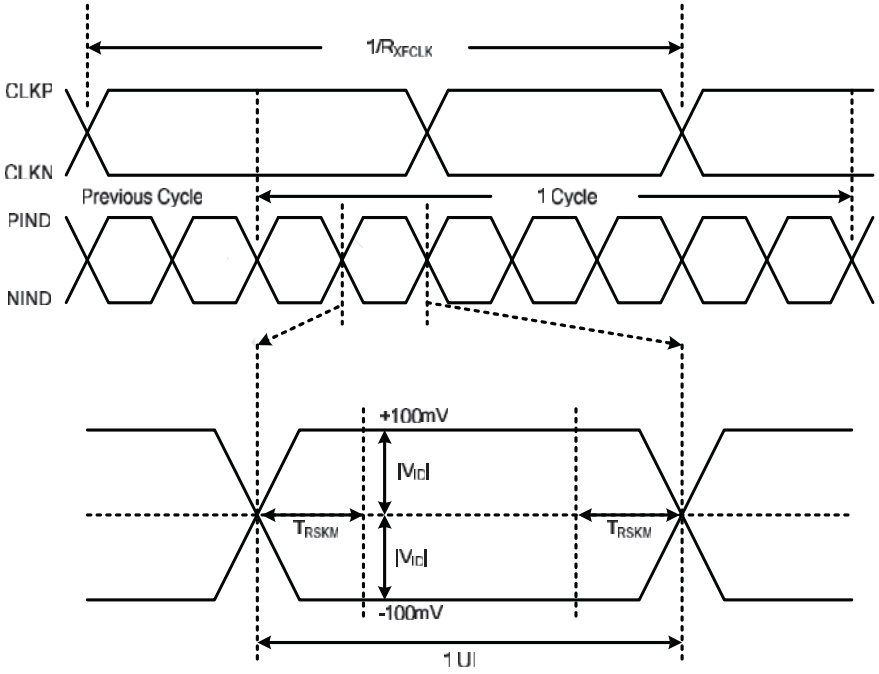


Fig. 7 LVDS AC characteristics diagram

7. Power on/off sequence

The LCD adopts high voltage driver IC, so it could be permanently damaged under a wrong power on/off sequence. The suggested LCD power sequence is below:

a. Power on sequence:

VDD&VDDA → GRB → LVDS → BKLEN

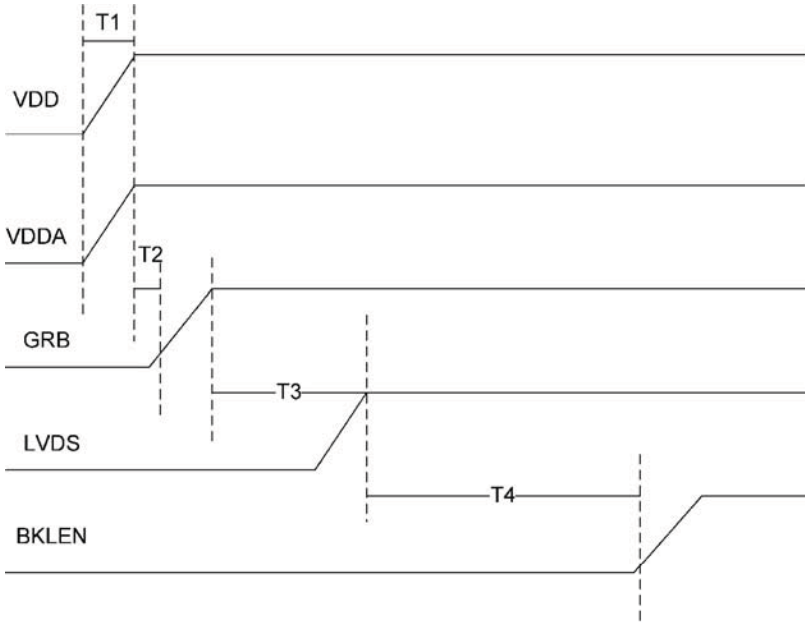


Fig. 8. Power on sequence

Power on timing:

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	1	-	15	ms
T2	1	-	-	ms
T3	1	-	**300**	ms
T4	300	350	-	ms

b. Power Off sequence:
BKLEN → LVDS → GRB → VDD&VDDA

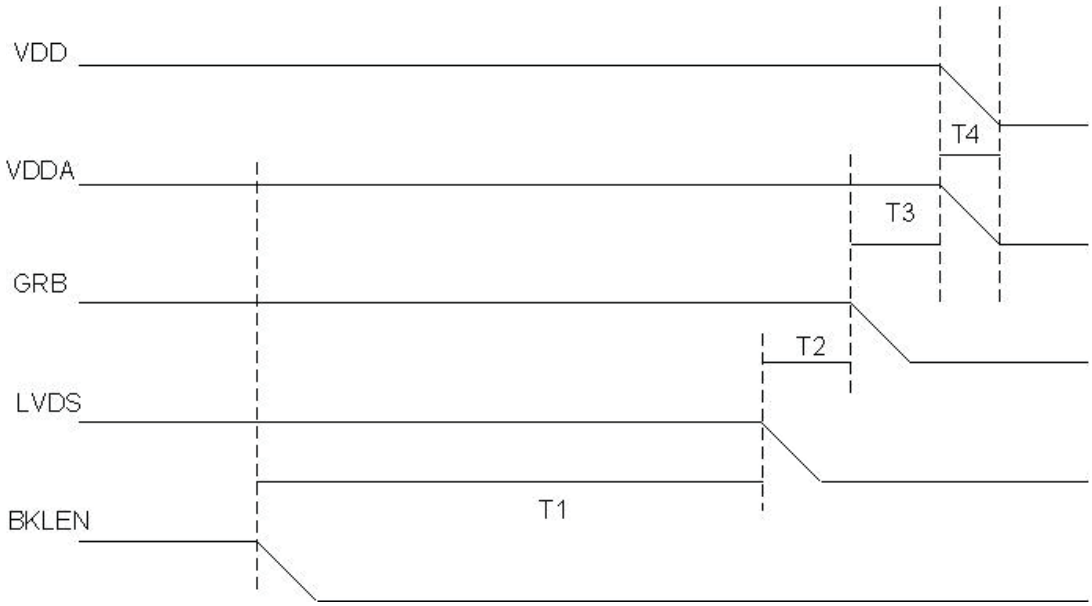


Fig. 9. Power off sequence

Power off timing:

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	90	100	-	ms
T2	1	30	**300**	ms
T3	1	30	40	ms
T4	50	-	-	ms

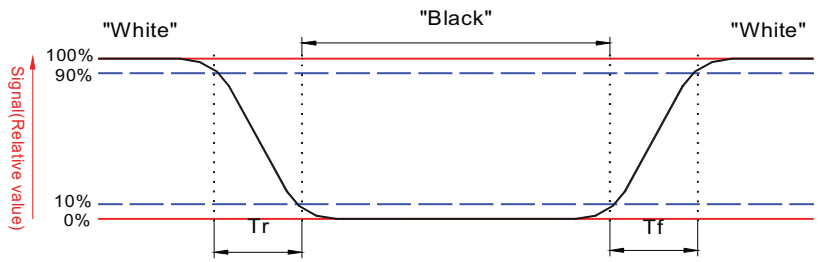
F. Optical specifications (Note 1, 2)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Response Time Rise	Tr	θ = 0°	-	TBD	15	ms	Note 3
Fall	Tf		-	TBD	15		
Viewing Angle Top Bottom Left Right		CR ≧ 10	-	80 80 80 80	-	deg.	Note 7, 8
Contrast ratio	CR	θ = 0°	800	1000	-		Note 4, 5, 6
Brightness	Y_L	θ = 0°	520	680	-	cd/m^2	Note 9
White Chromaticity	X	θ = 0°	0.258	0.298	0.338		Note 10
	Y	θ = 0°	0.277	0.317	0.357		
Red Chromaticity	X	θ = 0°	0.595	0.635	0.675		
	Y	θ = 0°	0.29	0.330	0.37		
Green Chromaticity	X	θ = 0°	0.274	0.314	0.354		
	Y	θ = 0°	0.562	0.602	0.642		
Blue Chromaticity	X	θ = 0°	0.11	0.150	0.19		
	Y	θ=0°	0.008	0.048	0.088		
Uniformity		-	80			%	Note 11

Note 1: Measurement should be performed in the dark room, optical ambient temperature = 25 °C, and backlight current I_L = 80mA.

Note 2: To be measured in the center area of TFT-LCD with a field angle of 1° by Topcon luminance meter SR3, after 10 minutes operation and warm up 30 minutes.

Note 3: Definition of response time:
The output signals of photo detector are measured when the input signals are changed from “black state” to “white state” (falling time) and from “white state” to “black state” (rising time), respectively.



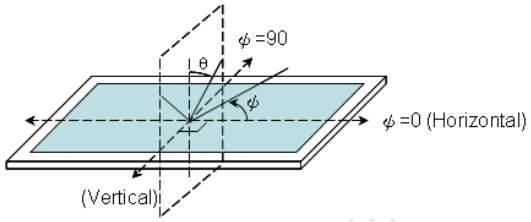
Note 4: Based on liquid crystal characteristics, the response time will become slower and the color of panel will become darker than the above optical specification when ambient temperature is below 25 °C.

Note 5: Contrast ratio is calculated with the following formula.

$$\text{Contrastratio} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector output when LCD is at "Black" state}}$$

Note 6: White Vdata=V1 or V18
Black Vdata=V9 or V10
(For definition of V1, V9, V10 & V18, please refer to Appendix)
The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 7: Definition of viewing angle: refer to figure as below.

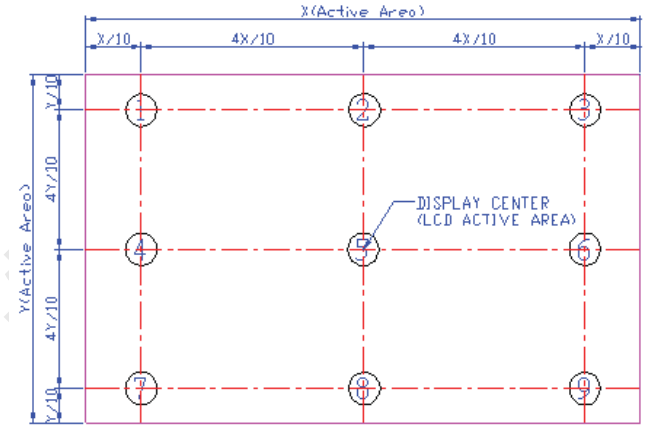


Note 8: Viewing angles are measured at the center of the panel when all the input terminals of LCD oanel are electrically opened.

Note 9: Brightness is measured at the center of the display.

Note 10: The viewing angles are measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 11: Luminance Uniformity of these 9 points is defined as below: (1 : 4 : 4 : 1)



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

G. Reliability Test Items(Note 1~3)

No.	Test items	Conditions		Remark
1	High temperature storage	Ta= 95 °C	240 Hrs	
2	Low temperature storage	Ta= -40 °C	240 Hrs	
3	High temperature operation	Ta= 85 °C	240 Hrs	
4	Low temperature operation	Ta= -30 °C	240 Hrs	
5	High temperature and high humidity	Ta= 60 ℃, 90 % RH	240 Hrs	Operation
6	Heat shock	-30 °C ~ 85 ℃ / 100 cycles 1 Hrs/cycle		Non-operation
7	Shock	100 G, 6 ms, ±X, ±Y, ±Z 3 times for each direction		
8	Electrostatic Discharge	Contact = ± 4 kV, class B Air = ± 8 kV, class B		IEC61000-4-2
9	Vibration	Frequency range	8 ~ 33.3 Hz	JIS D1601,A10 Condition A
		Stoke	1.3 mm	
		Sweep	2.9 G, 33.3 ~ 400Hz	
		Cycle	15 min.	
		2 hours for each direction of X, Z 4 hours for Y direction		
10	Vibration (with carton)	Random vibration: 0.015 G^2/Hz from 5 ~ 200 Hz –6 dB/Octave from 200 ~ 500 Hz		IEC 68-34
11	Drop (with carton)	Height: 60 cm 1 corner, 3 edges, 6 surfaces		

Note 1: Ta: Ambient temperature
Note 2: In the standard condition, there is no display function NG issue occurred. All the cosmetic specification is judged before the reliability stress.
Note 3: I_L = 80mA

H. Packing and Marking

1. Packing Form

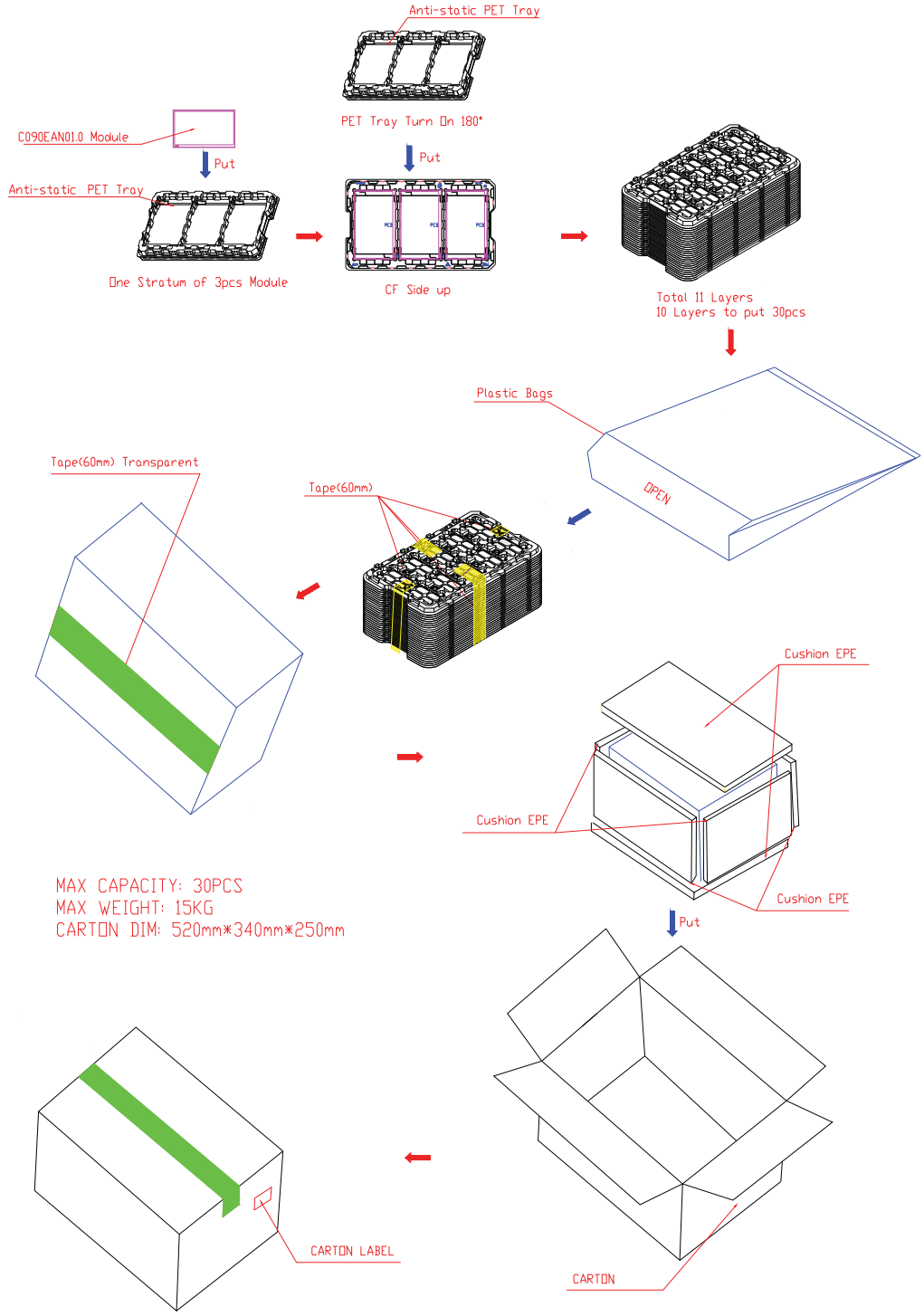
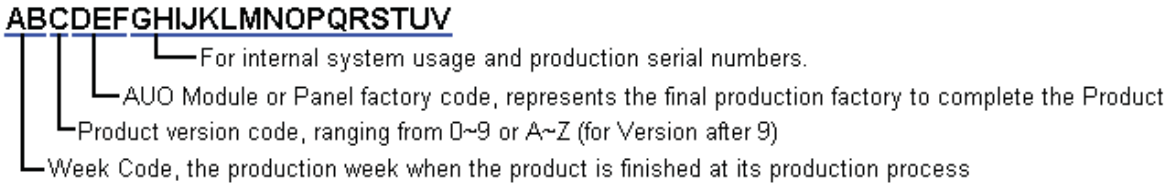


Fig. 10. Packing diagram

2. Module/Panel Label Information

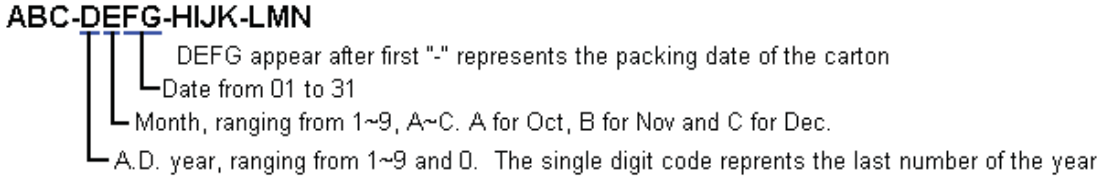
The module/panel (collectively called as the “Product”) will be attached with a label of Shipping Number which represents the identification of the Product at a specific location. Refer to the Product outline drawing for detailed location and size of the label. The label is composed of a 22-digit serial number with the following definition:



Example:
501M06ZL06123456781Z05:
Product Manufacturing Week Code: WK50
Product Version: Version 1
Product Manufacturing Factory: M06

3. Carton Label Information

The packing carton will be attached with a carton label where packing Q’ty, AUO Model Name, AUO Part Number, Customer Part Number (Optional) and a series of Carton Number in 13 or 14 digits are printed. The Carton Number is appearing in the following format:



Refer to the drawing of packing format for the location and size of the carton label.

4. Warehouse storage condition:

Room temperature: 25 +/- 5 degrees
Humidity: 30% ~ 70%