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MODEL	C090EAN02.0
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Product Specification

9.0" COLOR TFT-LCD MODULE

MODEL NAME: C090EAN02.0

Model Name: C090EAN02.0

Planned Lifetime: From 2018/Aug To 2023/Aug

Phase-out Control: From 2022/Aug To 2023/Aug

EOL Schedule: 2023/Sep

< ◆ > Preliminary Specification

< > Final Specification

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

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A. General Description

C090EAN02.0 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, FPC (flexible printed circuit), and a backlight unit.

B. Features

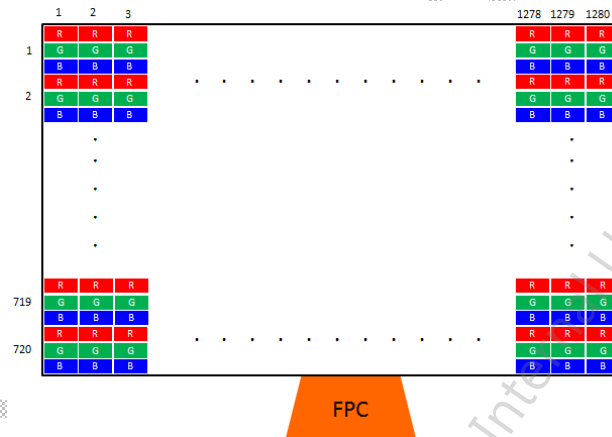
- 9.0"-inch display
- 1280 x 720 RGB resolution in RGB stripe dot arrangement
- High brightness
- Interfaces: LVDS (8bit JEIDA, DE mode)
- AHVA – wide view technology
- RoHS compliance

C. Physical Specifications

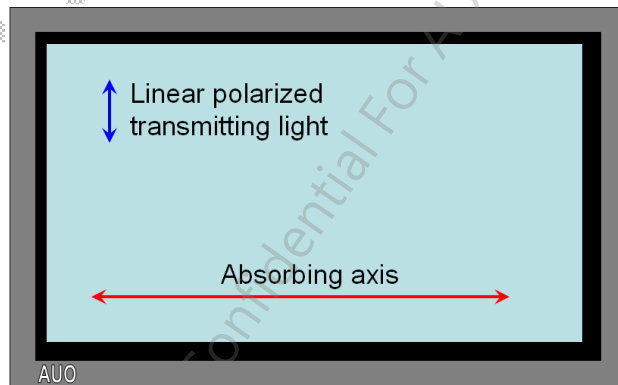
1. TFT LCD Panel

NO.	Item	Unit	Specification	Remark
1	Display Resolution	dot	1280 (H)x 720(V) RGB	
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 7.7	
8	Weight	g	TBD+/- 10%	
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.



E. Electrical Specifications

1. TFT LCD Panel Pin Assignment

Recommended Connector: 12001S-60B-GFN1

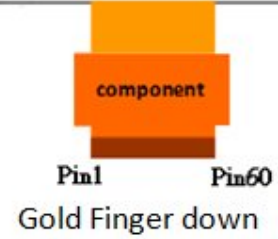
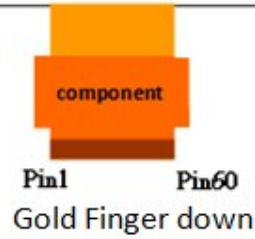
No.	Pin Name	I/O	Description	Remarks
1	VCOM	PI	Common electrode driving voltage	
2	NC	--	NC	
3	VDD	PI	Digital power supply voltage	
4	VDD	PI	Digital power supply voltage	
5	MODE	I	HV/DE Mode selection H:HV Mode, L:DE mode.	
6	UPDN	I	Up/Down selection	Note1
7	SHLR	I	Left/Right selection	Note1
8	GND	G	Ground	
9	V18	PI	Gamma correction voltage reference	
10	V17	PI	Gamma correction voltage reference	
11	V16	PI	Gamma correction voltage reference	
12	V15	PI	Gamma correction voltage reference	
13	V14	PI	Gamma correction voltage reference	
14	V13	PI	Gamma correction voltage reference	
15	V12	PI	Gamma correction voltage reference	
16	V11	PI	Gamma correction voltage reference	
17	V10	PI	Gamma correction voltage reference	
18	GND	G	Ground	
19	CLKP	I	Positive LVDS differential clock input.	
20	CLKN	I	Negative LVDS differential clock input.	
21	GND	G	Ground.	
22	PIND0	I	Positive LVDS differential input.	
23	NIND0	I	Negative LVDS differential input.	
24	GND	G	Ground.	
25	PIND1	I	Positive LVDS differential input.	
26	NIND1	I	Negative LVDS differential input.	
27	GND	G	Ground.	
28	PIND2	I	Positive LVDS differential input.	
29	NIND2	I	Negative LVDS differential input.	
30	GND	G	Ground.	
31	PIND3	I	Positive LVDS differential input.	
32	NIND3	I	Negative LVDS differential input.	
33	GND	G	Ground.	
34	V9	PI	Gamma correction voltage reference	

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35	V8	PI	Gamma correction voltage reference
36	V7	PI	Gamma correction voltage reference
37	V6	PI	Gamma correction voltage reference
38	V5	PI	Gamma correction voltage reference
39	V4	PI	Gamma correction voltage reference
40	V3	PI	Gamma correction voltage reference
41	V2	PI	Gamma correction voltage reference
42	V1	PI	Gamma correction voltage reference
43	AVDD	PI	Analog power supply voltage.
44	AVDD	PI	Analog power supply voltage.
45	NC		NC
46	STBYB	I	Standby mode. "H" for normal operation. "L" for standby mode.
47	NC		NC
48	NC		NC
49	NC		NC
50	NC		NC
51	NC		NC
52	INV2FB	I	One frame/ Two frame inversion selection. H:one frame inversion, L:two frame inversion.
53	NC		NC
54	VGH	PI	Positive power supply voltage for TFT.
55	NC		Dummy
56	VGL	PI	Negative power supply voltage for TFT.
57	NC		Dummy
58	VCOM	PI	Common electrode driving voltage
59	NC		NC
60	GND	G	Ground

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

Note1.



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2. Differential Input Data Format
a. JEIDA format

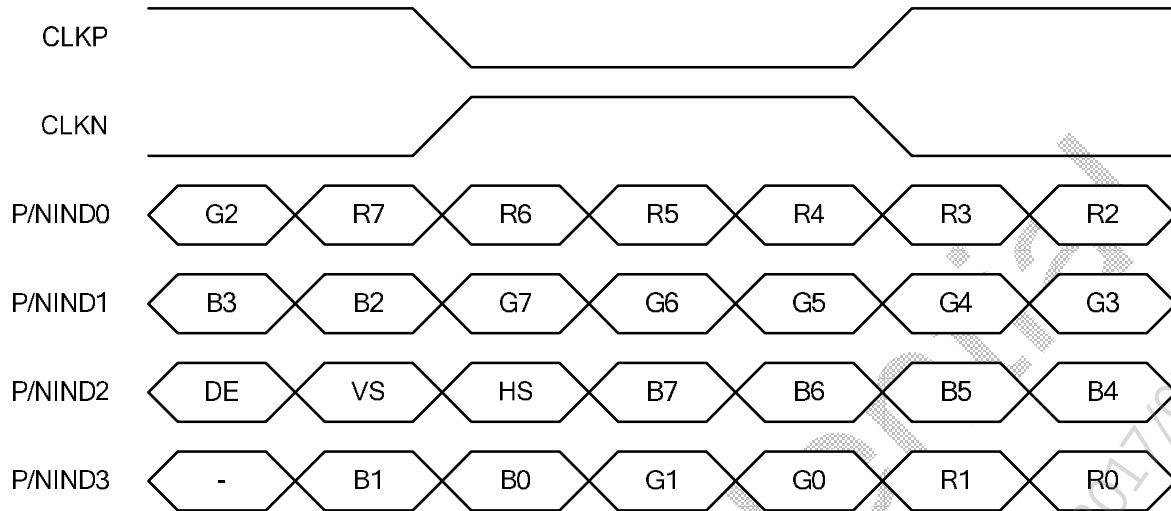


Fig. 1. LVDS input data JEIDA format

3. Input Timing Diagram

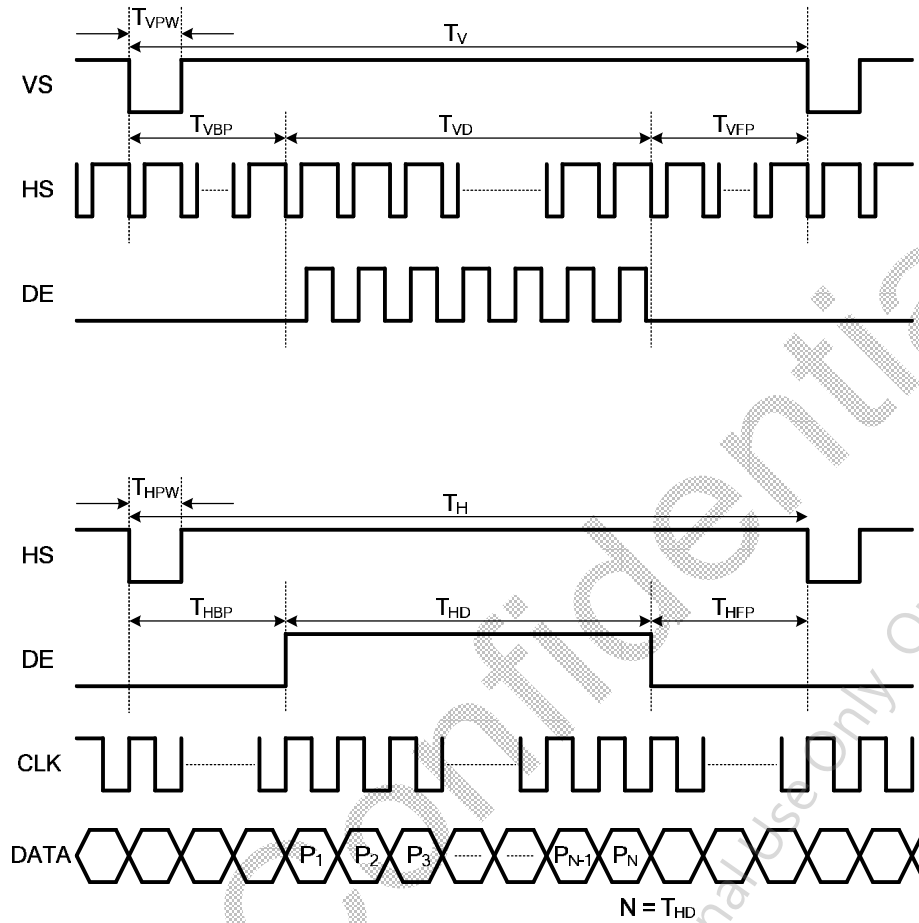


Fig. 2. Input Timing Diagram

HV Mode

Parameter		Symbol	Min.	Typ.	Max.	Unit.	Remark
CLK Frequency		F_{CLK}	69.49	70.825	75.54	MHz	
HSYNC	Period	T_H	1524	1537	1566	CLK	
	Horizontal display area	T_{HD}	1280			CLK	
	Back porch	T_{HBP}	48			CLK	
	Front porch	T_{HFP}	196	209	238	CLK	
	Pulse width	T_{HPW}	1	12	15	CLK	
VSYNC	Period	T_V	760	768	804	HS	
	Vertical display area	T_{VD}	720			HS	
	Back porch	T_{VBP}	30			HS	
	Front porch	T_{VFP}	10	18	54	HS	
	Pulse width	T_{VPW}	1	2	3	HS	

DE Mode

Parameter		Symbol	Min.	Typ.	Max.	Unit.	Remark
CLK Frequency		F_{CLK}	69.49	70.825	75.54	MHz	
HSYNC	Period	T_H	1524	1537	1566	CLK	
	Horizontal display area	T_{HD}	1280			CLK	
	Blanking	$T_{HBP} + T_{HFP}$	244	257	286		
VSYNC	Period	T_V	760	768	804	HS	
	Vertical display area	T_{VD}	720			HS	
	Blanking	$T_{VBP} + T_{VFP}$	40	48	84	HS	
Frame Rate		FR	60			Hz	

4. Absolute Maximum Ratings

Items	Symbol	Values		Unit	Condition
		Min.	Max.		
Power Voltage	VDD	-0.3	5	V	GND = 0
	AVDD	-0.3	15	V	GND = 0
	VGH	-0.3	VGL+40	V	GND = 0
	VGL	-20	+0.3	V	GND = 0
	VGH-VGL	-0.3	40	V	GND = 0
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	-	35	48	mA	
	AVDD	13	13.5	14	V	
	IAVDD	-	15	36	mA	
	VGH	17	18	19	V	
	IVGH	-	1	2	mA	
	VGL	-9	-8	-7	V	
	IVGL	-	1	2	mA	
	VCOM	-	4.6~4.9	-	V	
	IVCOM	-	3~3.3	-	mA	
Input gamma Voltage	V1~V9	0.4AVDD		AVDD-0.2	V	
	V10~V18	0.2		0.6AVDD	V	

Note 1: All conditions should be set typical value

Note 2: The panel can operate normally in the recommended operating condition.

Note 3: Test pattern is as the following picture.

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



Fig1. Typical current situation

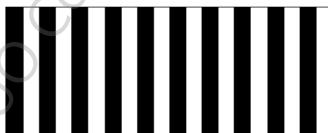


Fig2. Max current situation: Vertical stripe pattern alternating 0 gray scale with 255 gray scale every dot.

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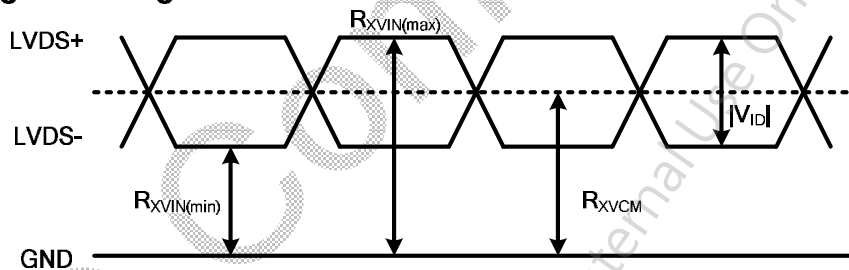
b. Signal DC Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Input signal voltage	V_i	-0.3	-	$V_{DD} + 0.3$	V	Note 1
Input high level voltage	V_{IH}	$0.7V_{DD}$	-	V_{DD}	V	Note 1
Input low level voltage	V_{IL}	GND	-	$0.3V_{DD}$	V	Note 1
Differential input high threshold	R_{XVTH}	0.2	-	-	V	Note 2
Differential input low threshold	R_{XVTL}	-	-	-0.2	V	Note 2
Input voltage range (singled-end)	R_{XVIN}	0	-	$(V_{DD}-1.2)$	V	Note 2
Input differential voltage	$ V_{ID} $	0.2	-	0.6	V	Note 2
Differential Input Common Mode Voltage	R_{XVCM}	$ V_{ID} /2$	-	$(V_{DD}-1.2)$ $- V_{ID} /2$	V	Note 2

Note 1: TTL interface signal DC characteristics

Note 2: LVDS interface signal DC characteristic

Single-end Signal



Differential Signal

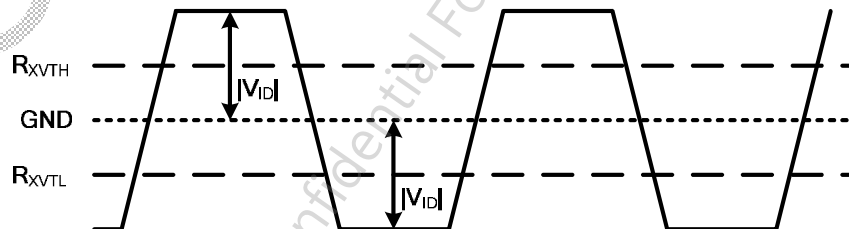


Fig. 3. LVDS DC characteristics diagram



c. Recommend Gamma Voltage

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Gamma Voltage	V1	-	11.995	-	V	
	V2	-	11.765	-	V	
	V3	-	10.38	-	V	
	V4	-	9.85	-	V	
	V5	-	9.189	-	V	
	V6	-	8.598	-	V	
	V7	-	8.1	-	V	
	V8	-	7.002	-	V	
	V9	-	6.914	-	V	
	V10	-	6.086	-	V	
	V11	-	5.998	-	V	
	V12	-	4.9	-	V	
	V13	-	4.402	-	V	
	V14	-	3.811	-	V	
	V15	-	3.15	-	V	
	V16	-	2.62	-	V	
	V17	-	1.235	-	V	
	V18	-	1.005	-	V	

d. Backlight Driving Conditions (Note 1)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Supply Current	I_L		80		mA	single serial (Note 3)
LED Supply Voltage	V_L			23.8	V	single serial (Note 3)
LED Life Time	L_L	10,000			hr	Note 2

Note 1: light-bar has 21 pieces of LED (3 strings, 7 pieces for each string).

Note 2: LED life time defining the 50% 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.

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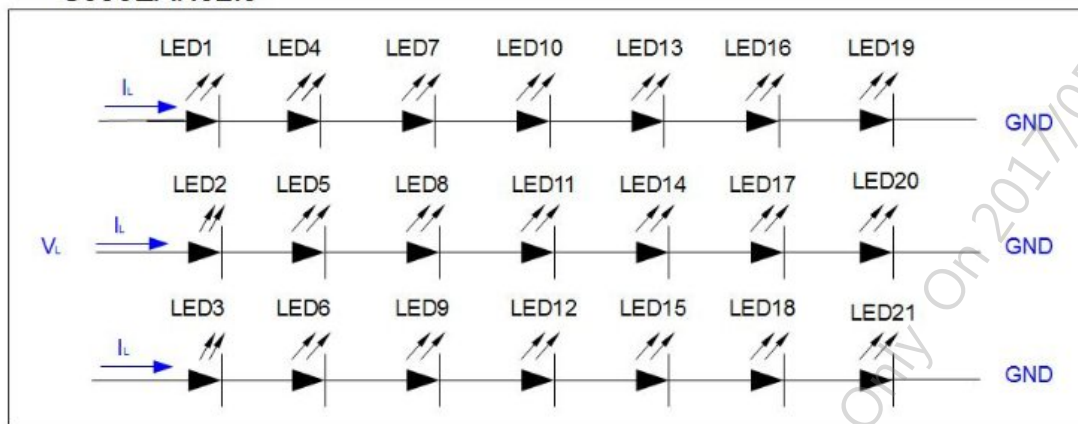


Fig. 5. Light bar structure

Note5:

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

6. AC Electrical Characteristics

a. Input AC characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
VDD power on slew time	T_{POR}	10	-	--	ms	From 0V to 90% VDD



Fig. 6. VDD and GRB timing diagram

b. Differential signal AC characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Clock frequency	R_{XFCLK}	69.49	70.825	75.54	MHz	
Input data skew margin	T_{RSKM}			400	ps	

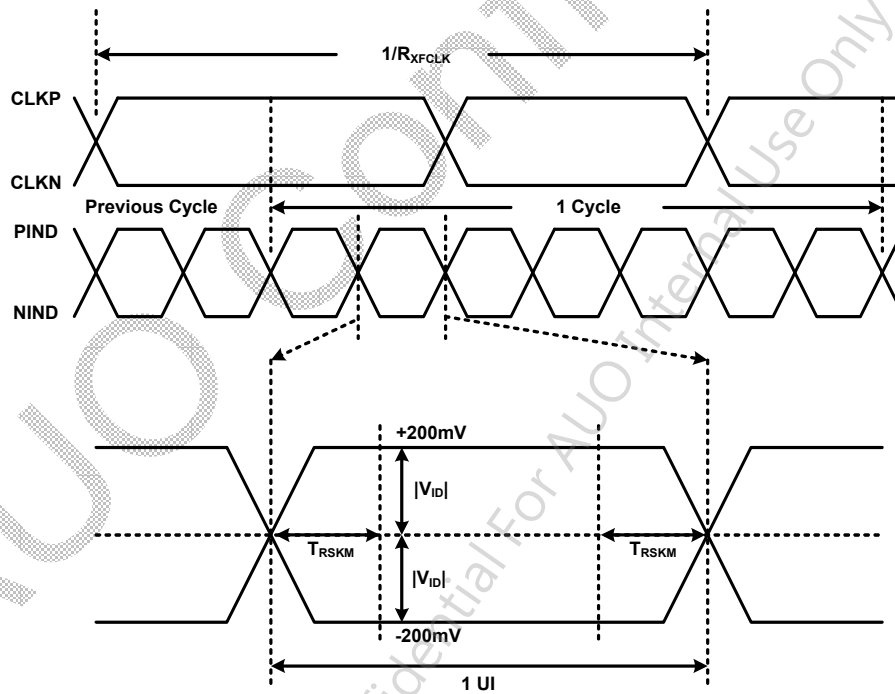


Fig. 7 LVDS AC characteristics diagram

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 → Digital input → STBYB → LVDS → VGL → AVDD & Vcom & Gamma Voltage & VGH → LED

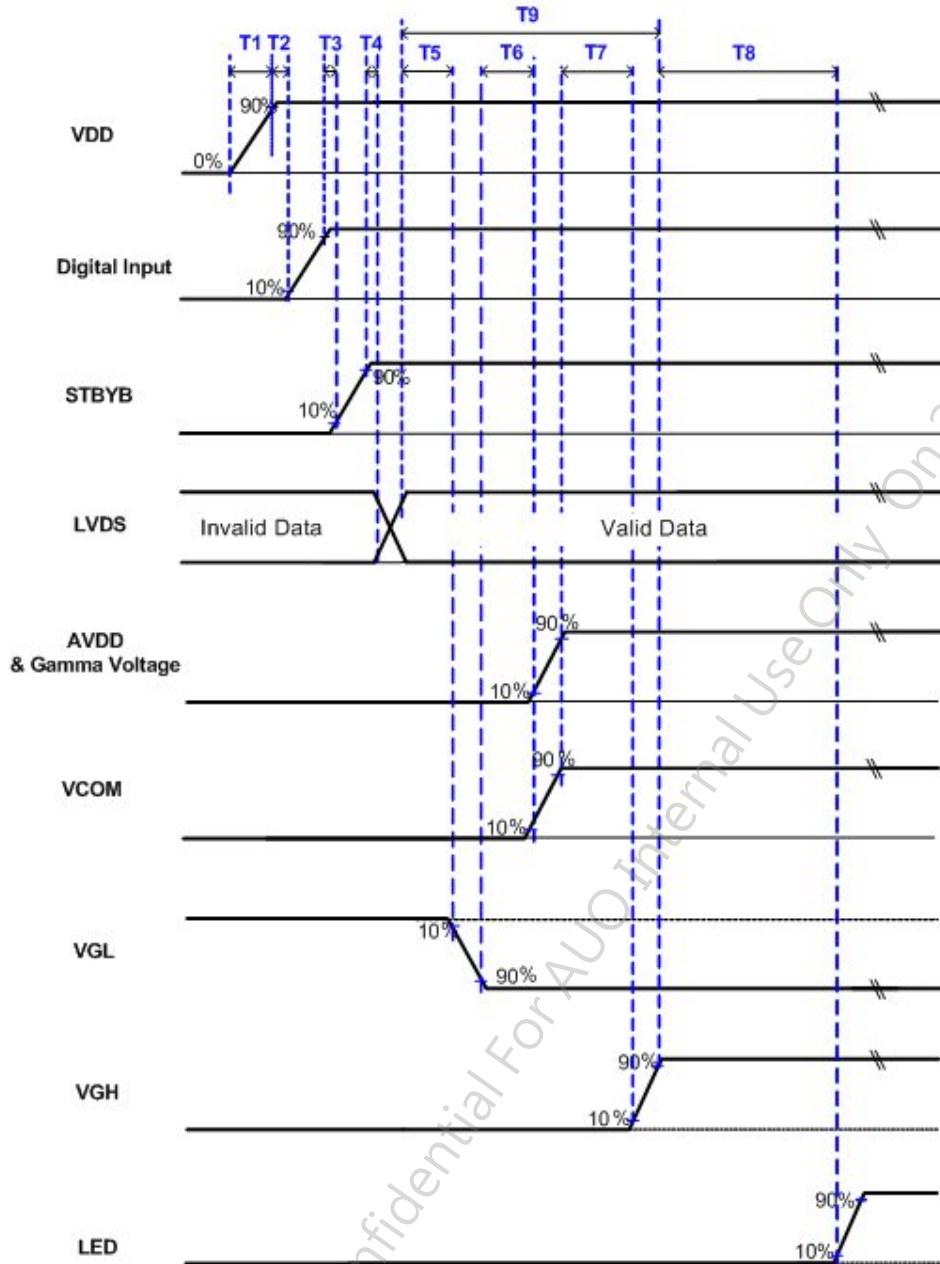


Fig. 8. Power on sequence

Power on timing:

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	10	--	--	ms
T2	1	--	--	ms
T3	0	--	--	ms
T4	0	--	--	ms
T5	0	--	--	ms
T6	0	--	--	ms
T7	0	--	--	ms
T8	100	--	--	ms
T9	--	--	60	ms

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b. Power Off sequence:

LED → STBYB → VCOM → LVDS → VGL → AVDD & Gamma Voltage & VGH → Digital Input & VDD

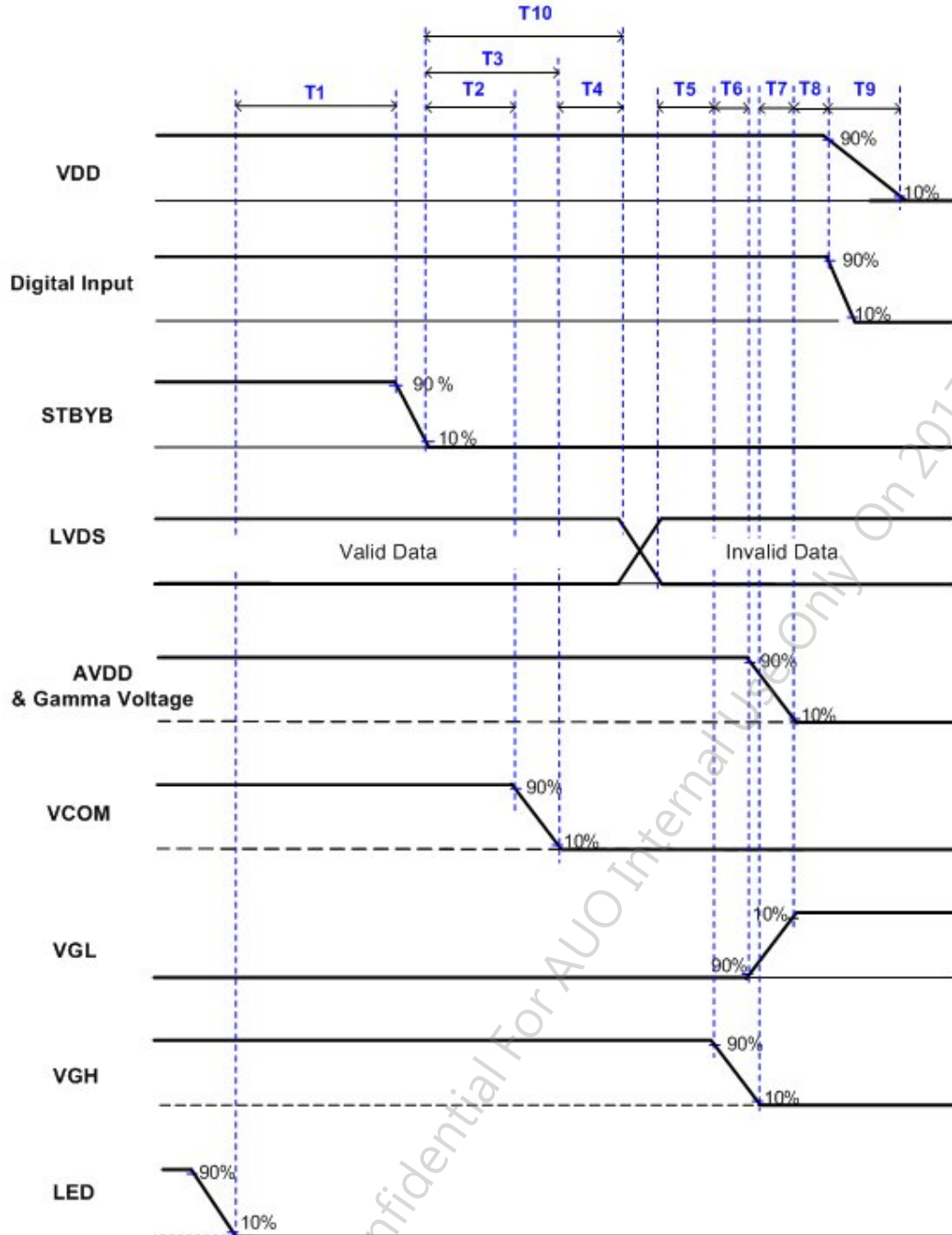


Fig. 9. Power off sequence

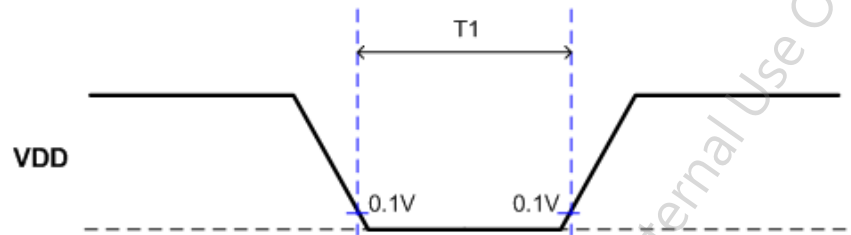
Power off timing:

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	90	100	--	ms
T2	34	--	--	ms
T3	34	--	70	ms
T4	0	--	--	ms
T5	0	--	--	ms
T6	0	--	--	ms
T7	0	--	--	ms
T8	0	--	20	ms
T9	50	--	--	ms
T10	100	--	--	ms

c. VDD off to on timing

Parameter	Value			Unit	Remark
	Min.	Typ.	Max.		
T1	1		--	s	Note 1

Note 1 : Before VDD turns ON, please make sure that AVDD; VGH; VGL; are all below intensity of 0.1V.



F. Optical specifications (Note 1, 2)

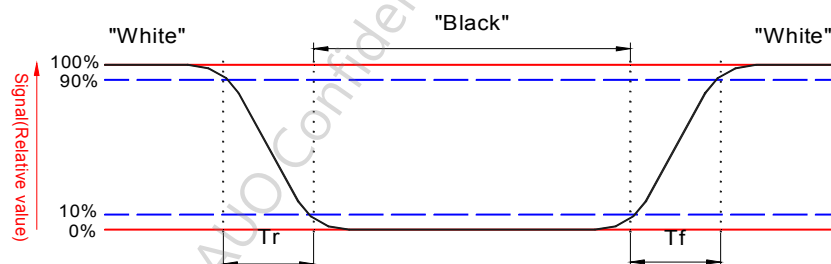
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Response Time Rise Fall	Tr	$\theta = 0^\circ$	-	-	20	ms	Note 3	
	Tf		-	-	20			
Viewing Angle Top Bottom Left Right		$CR \geq 10$	70 70 70 70	80 80 80 80	-	deg.	Note 7, 8	
Contrast ratio	CR	$\theta = 0^\circ$	800	1000	-		Note 4, 5, 6	
Brightness	Y_L	$\theta = 0^\circ$	650		-	cd/m ²	Note 9	
White Chromaticity	X	$\theta = 0^\circ$		0.296 (tentative)			Note 10	
	Y	$\theta = 0^\circ$		0.313 (tentative)				
Red Chromaticity	X	$\theta = 0^\circ$		0.64 (tentative)				
	Y	$\theta = 0^\circ$		0.333 (tentative)				
Green Chromaticity	X	$\theta = 0^\circ$		0.298 (tentative)				
	Y	$\theta = 0^\circ$		0.602 (tentative)				
Blue Chromaticity	X	$\theta = 0^\circ$		0.148 (tentative)				
	Y	$\theta = 0^\circ$		0.058 (tentative)				
Uniformity		-	80			%		Note 11

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

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.

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

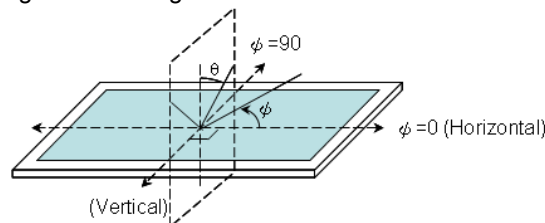
Note 6: White Vdata=V1 or V18

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.

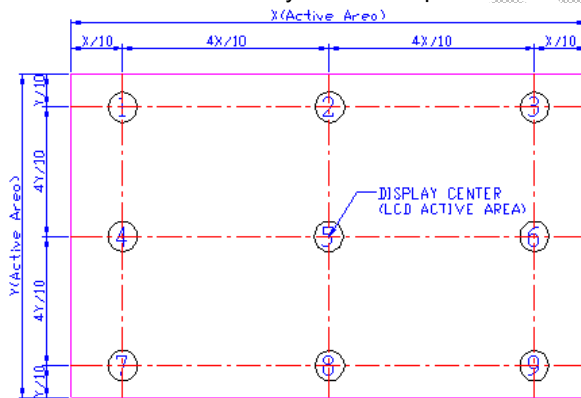


Note 8: Viewing angles are measured at the center of the panel when all the input terminals of LCD panel are electrically opened.

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 °C, 90 % RH	240 Hrs	Operation
6	Heat shock	-30 °C ~ 85 °C / 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 = ± 8 kV, class B Air = ± 15 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

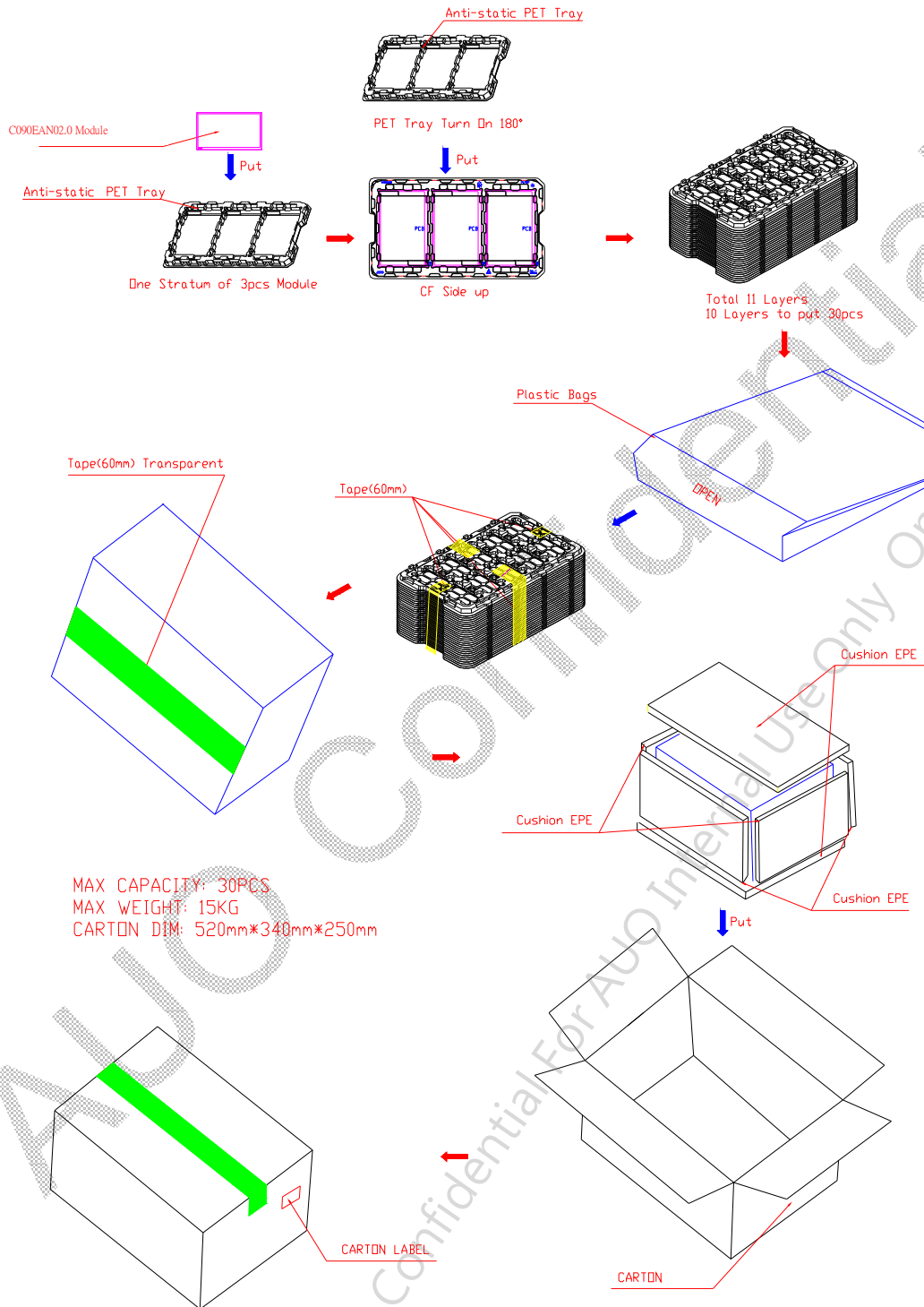


Fig. 10. Packing diagram

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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:

ABCDEFGHIJKLMN OPQRST UV

- └─ For internal system usage and production serial numbers.
- └─ AUO Module or Panel factory code, represents the final production factory to complete the Product
- └─ Product version code, ranging from 0~9 or A~Z (for Version after 9)
- └─ Week Code, the production week when the product is finished at its production process

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:

ABC-DEFG-HIJK-LMN

- └─ DEFG appear after first "-" represents the packing date of the carton
- └─ Date from 01 to 31
- └─ Month, ranging from 1~9, A~C. A for Oct, B for Nov and C for Dec.
- └─ A.D. year, ranging from 1~9 and 0. The single digit code represents the last number of the year

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