Specification for Approval

PRODUCT NAME:
PRODUCT NO.: P F O 9 5 0 6

CUSTOMER
APPROVED BY
DATE:

PACER PLC APPROVED

REVISION RECORD

REV.	REVISION DESCRIPTION	REV. DATE	REMARK
X01	■ Initial release	2005. 07. 06	
A01	■ Transfer from X version ■ Add warranty ■ Add module weight ■ Modify CIE specification ■ Modify dark room contrast ■ Modify interface timing chart ■ Add application circuit ■ Modify packing specification	2005. 07. 21	Page 4, 5, 8, 12, 14 & 17

CONTENTS

1. SCOPE

The purpose of this specification is to define the general provisions and quality requirements that apply to the supply of display cells manufactured by Pacer. This document, together with the Module Assembly Drawing, is the highest-level specification for this product. It describes the product, identifies supporting documents and contains specifications.

2. WARRANTY

Pacer warrants that the products delivered pursuant to this specification (or order) will conform to the agreed specifications for twelve (12) months from the shipping date ("Warranty Period"). Pacer is obligated to repair or replace the products which are found to be defective or inconsistent with the specifications during the Warranty Period without charge, on condition that the products are stored or used as the conditions specified in the specifications. Nevertheless, Pacer is not obligated to repair or replace the products without charge if the defects or inconsistency are caused by the force majeure or the reckless behaviors of the customer.

After the Warranty Period, all repairs or replacements of the products are subject to charge.

3. FEATURES

- small molecular organic light emitting diode.
- Color : 262 K color and 65K colors
- Panel resolution : 128*128
- Driver IC : SSD1339
- Excellent Quick response time : 10μs
- Extremely thin thickness for best mechanism design. : 2.05 mm
- High contrast : 500:1
- Wide viewing angle : 160□
- Strong environmental resistance.
- 16-bit 6800-series Parallel Interface, 16-bit 8080-series Parallel Interface, 8-bit 6800-series Parallel Interface, 8-bit 8080-series Parallel Interface Serial Peripheral Interface.
- Wide range of operating temperature : -20 to 70°C

4. MECHANICAL DATA

NO	ITEM	SPECIFICATION	UNIT
1	Dot Matrix	128 x 3x 128	dot
2	Dot Size	0.045 (W) x 0.19 (H)	mm^2
3	Dot Pitch	0.07 (W) x 0.21 (H)	mm^2
4	Aperture Rate	58	%
5	Active Area	26.855 (W) x 26.86 (H)	mm^2
6	Panel Size	36.0 (W) x 36.0 (H)	mm^2
7	Panel Thickness	2.05 ± 0.1	mm
8	Module Size	36.0 (W) x 58.5 (H) x 2.05 (T)	mm^3
9	Diagonal A/A size	1.5	inch
10	Module Weight	5.70 ± 10%	gram

5. MAXIMUM RATINGS

ITEM	MIN	MAX	UNIT	Condition	Remark
Supply Voltage (V_{DD})		3.5	V	Ta = 25°C	
Supply Voltage(Vcc)		18	V	Ta = 25°C	
Operating Temp.	-20	70	°C		
Storage Temp	-40	85	°C		
Humidity		85	%		
Operating Life Time	2200	-	Hrs	80 cd/m2, 50% Check board	Note (1)
Operating Life Time	3000	-	Hrs	60 cd/m2, 50% Check	Note (2)
Operating Life Time	7000	-	Hrs	40 cd/m2, 50% Check	Note (3)
Storage Life Time	20000	-	Hrs	Ta=25°C, 50% RH	

Note:

(A) Under Vcc = 17 Volts, Ta = 25°C, 50% RH.

(B) End-of-life is defined when the luminance has decayed to less than 50% of the initial luminance.

(1) Setting of 80cd/m2 :

- Master contrast setting : 0x09H
- Frame rate : 85 Hz
- Duty setting : 1/128

(2) Setting of 60cd/m2 :

- Master contrast setting : 0x06H
- Frame rate : 85 Hz
- Duty setting : 1/128

(3) Setting of 40cd/m2 :

- Master contrast setting : 0x03H
- Frame rate : 85 Hz
- Duty setting : 1/128

6. ELECTRICAL CHARACTERISTICS

6.1 D.C ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETERS	TEST CONDITION	MIN	TYP	MAX	UNIT
V_{CC}	Driver power supply (for OLED panel)	Ta=-20°C to +70°C	16.5	17	17.5	V
V_{DD}	Logic operating voltage	Ta=-20°C to +70°C	2.4	2.7	3.5	V
V_{DDIO}	Logic I/O operating voltage	Ta=-20°C to +70°C	1.5	1.8	3.5	V
V_{OH}	Hi logic output level	Iout=100 uA, 3.3MHz	0.9*V_{DDIO}		V_{DDIO}	V
V_{OL}	Low logic output level	Iout=100uA, 3.3MHZ	0		0.1*V_{DDIO}	V
V_{IH}	Hi logic input level	Iout=100uA, 3.3MHZ	0.8*V_{DDIO}		V_{DDIO}	V
V_{IL}	Low logic output level	Iout=100uA, 3.3MHZ	0		0.2*V_{DDIO}	V
I_{CC}	Operating current for V_{CC} (No panel attached)	Contrast=FF		1.3		mA
I_{DD}	Operating current for V_{DD} (No panel attached)	Contrast=FF		0.4		mA
I_{SEG}	Segment output current (No panel attached)	Contrast=FF		160		uA
		Contrast=AF		110		uA
		Contrast=5F		60		uA
		Contrast=00		0		uA

Note : V_{DD}=2.7 Volts□V_{CC}=17 Volts□Frame rate= 85 Hz□No panel attached.

6.2 ELECTRO-OPTICAL CHARACTERISTICS

PANEL ELECTRICAL SPECIFICATIONS

PARAMETER	MIN	TYP.	MAX	UNITS	COMMENTS
Normal mode current	-	21	23	mA	All pixels on (1)
Standby mode current		1.5	4	mA	Standby mode 10% pixels on (2)
Normal mode power consumption	-	357	391	mW	All pixels on (1)
Standby mode power consumption		15	40	mW	Standby mode 10% pixels on (2)
Pixel Luminance	50	60		cd/m^2	Display Average
Standby Luminance		20		cd/m^2	
CIEx (Red)	0.61	0.66	0.71		CIE1931
CIEy (Red)	0.28	0.33	0.38		CIE1931
CIEx (Green)	0.25	0.30	0.35		CIE1931
CIEy (Green)	0.55	0.60	0.65		CIE1931
CIEx (Blue)	0.09	0.14	0.19		CIE1931
CIEy (Blue)	0.13	0.18	0.23		CIE1931
CIEx (White)	0.24	0.29	0.34		CIE1931
CIEy (White)	0.27	0.32	0.37		CIE1931
Dark Room Contrast	500:1				
Viewing Angle	160			degree	
Response Time		10		μs	

Normal mode condition :

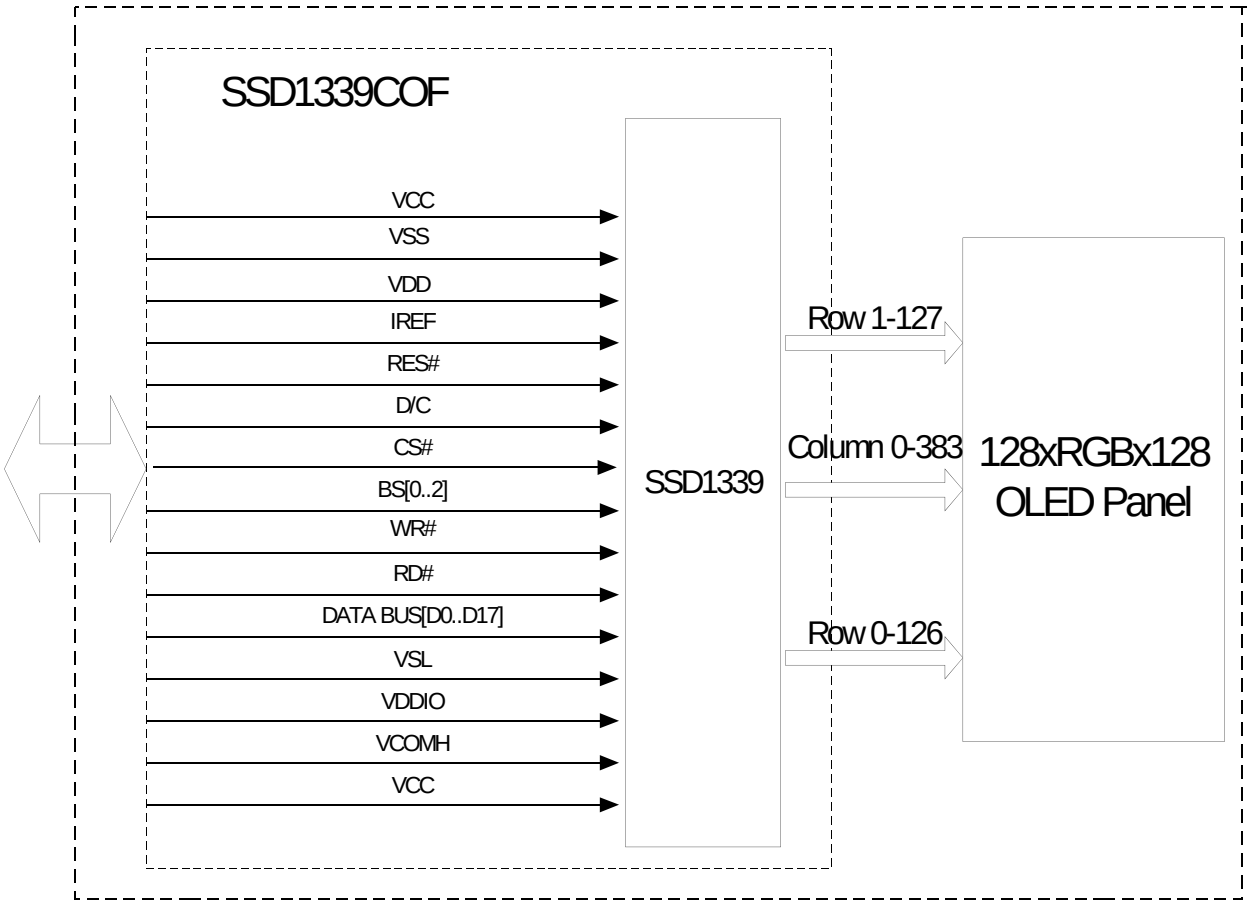
- Driving Voltage : 17 V
- Contrast setting : 0x06H
- Frame rate : 85 Hz
- Duty setting : 1/128

Standby mode condition :

- Driving Voltage : 10V
- Contrast setting : 0x04H
- Frame rate : 85 Hz
- Duty setting : 1/128

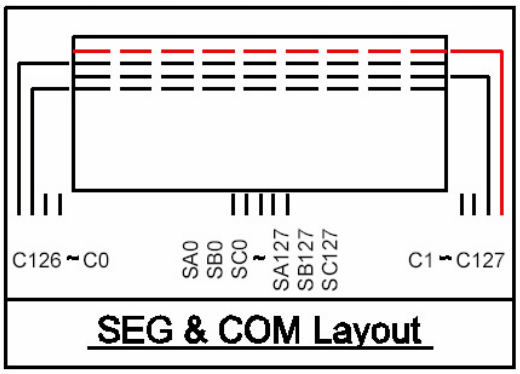
7. INTERFACE

7.1 FUNCTION BLOCK DIAGRAM



PACER 128xRGBx128 OLED Module

7.2 PANEL LAYOUT DIAGRAM



7.3 PIN ASSIGNMENTS

PIN NAME	PIN NO	DESCRIPTION
NC	1	No connection.
VSS	2	Ground.
TEST	3	No connection.
VDD	4	Digital voltage power supply.
TEST	5	No connection.
TEST	6	No connection.
TEST	7	No connection.
IREF	8	A resistor should be connected between this pin and VSS.
RES#	9	Hardware Reset pin (Low active).
D/C	10	H: Data; L: Command.
CS#	11	Chip select pin.
BS2	12	Interface select pin.
BS1	13	Interface select pin.
BS0	14	Interface select pin.
R/W#	15	8080: data write enable pin; 6800: Read/Write select pin.
E/RD#	16	8080: data read enable pin; 6800: Read/Write enable pin.
D0	17	16 /18 bits data bus.
D1	18	
D2	19	
D3	20	
D4	21	
D5	22	
D6	23	
D7	24	
D8	25	
D9	26	
D10	27	
D11	28	
D12	29	
D13	30	
D14	31	
D15	32	
D16	33	
D17	34	
VSL	35	This is segment voltage reference pin.
VDDIO	36	I/O voltage power supply.
VCOMH	37	A capacitor should be connected between this pin and VSS.
VCC	38	Analog power supply.
NC	39	No connection

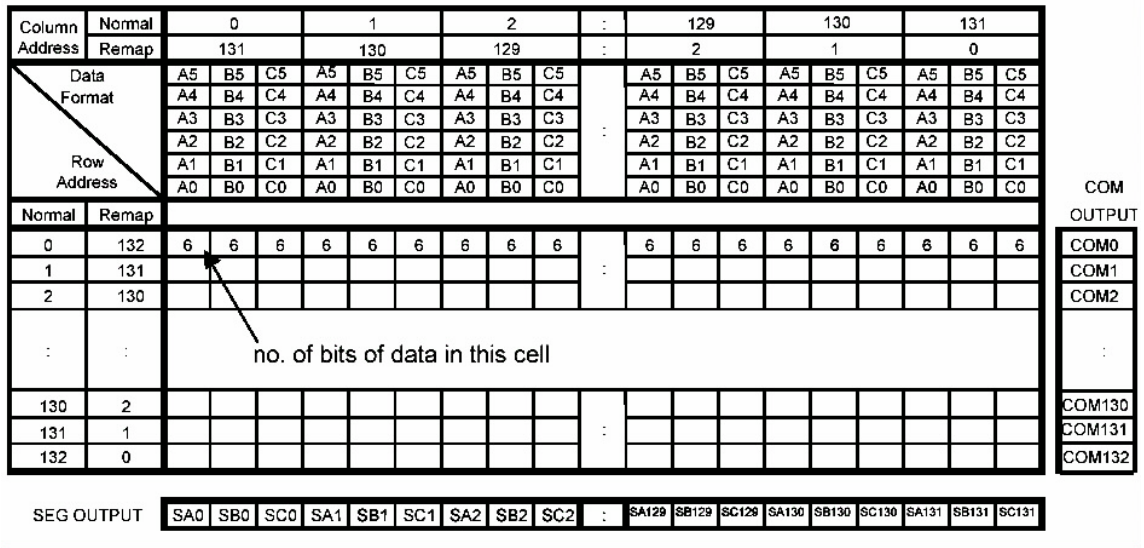
7.4 GRAPHIC DISPLAY DATA RAM ADDRESS MAP

The GDDRAM is a bit mapped static RAM holding the bit pattern to be displayed. The size of the RAM is 132 x 132 x 18bits.

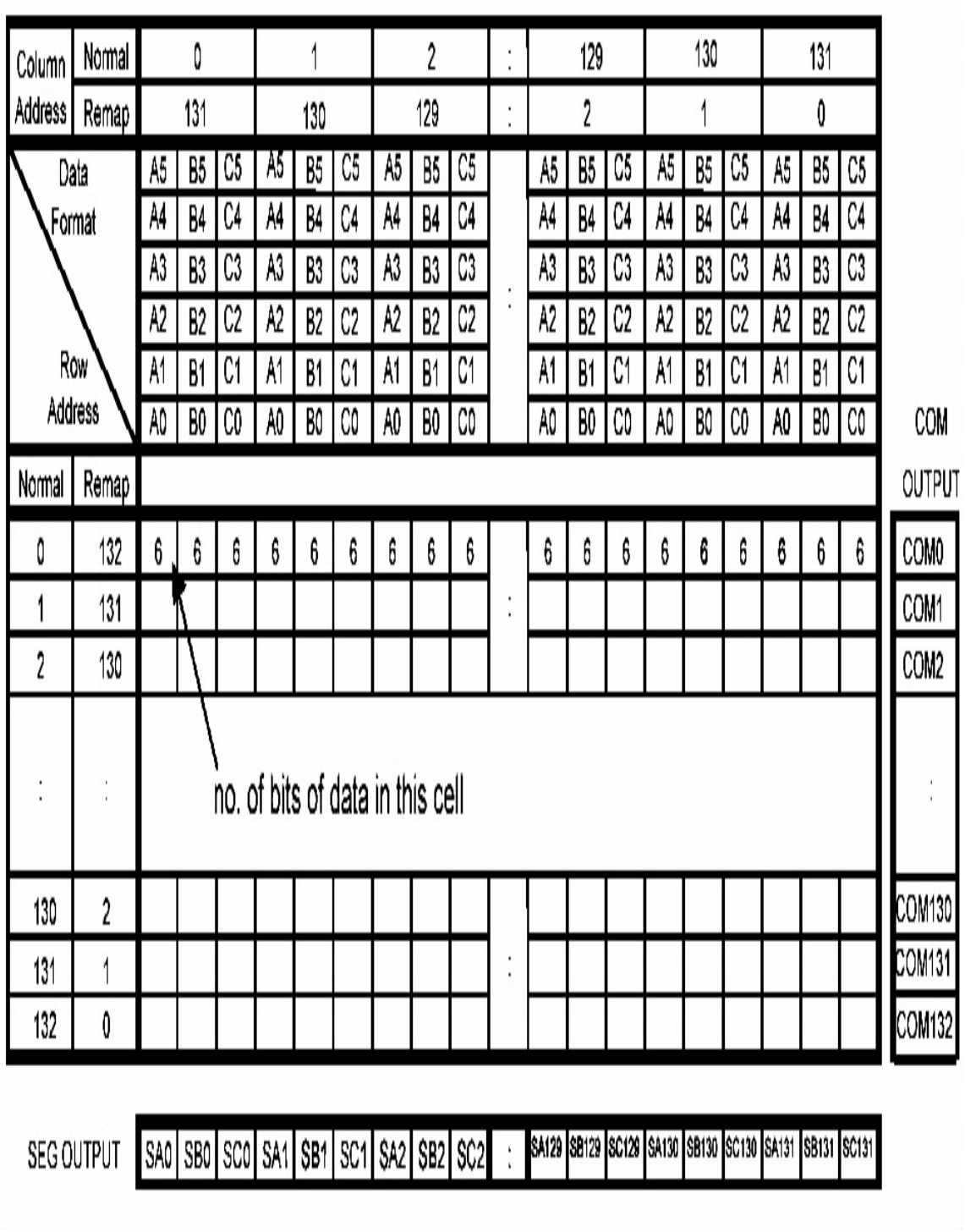
For mechanical flexibility, re-mapping on both Segment and Common outputs can be selected by software.

For vertical scrolling of the display, an internal register storing display start line can be set to control the portion of the RAM data to be mapped to the display.

Each pixel has 18-bit data. Each sub-pixels for color A, B and C have 6 bits. The arrangement of data pixel in graphic display data RAM is shown below.

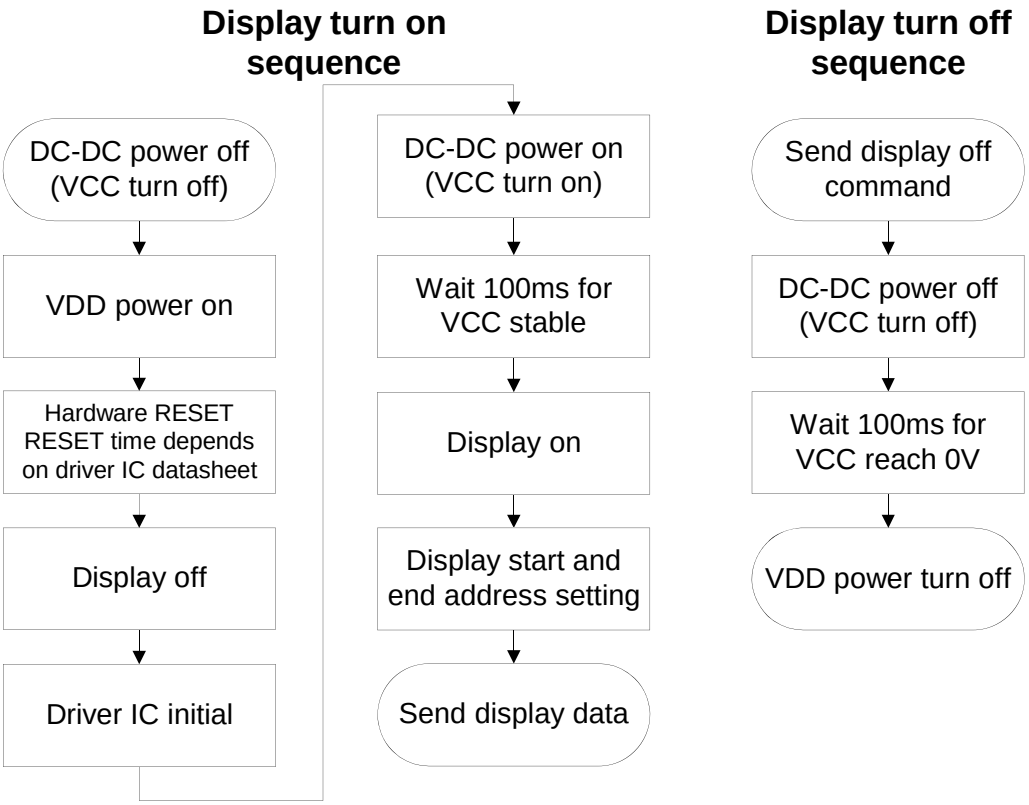


7.5 INTERFACE TIMING CHART



8. POWER ON / OFF SEQUENCE & APPLICATION CIRCUIT

8.1 POWER ON / OFF SEQUENCE



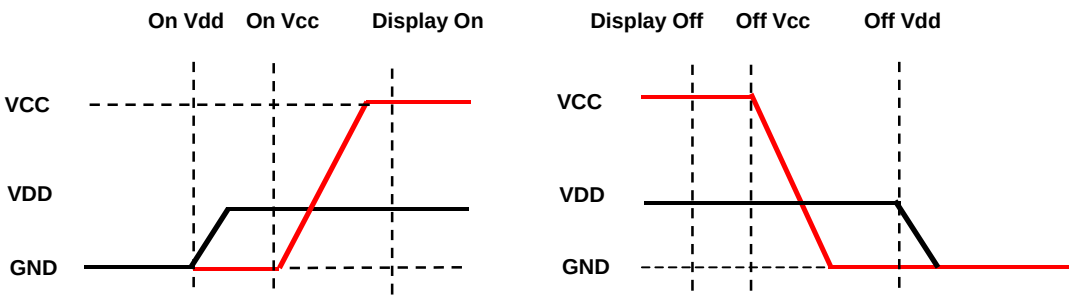
To protect OLED panel and extend the panel lifetime, the driver IC power up/down routine should include a delay period between high voltage and low voltage power sources turn on/off.

Power up Sequence:

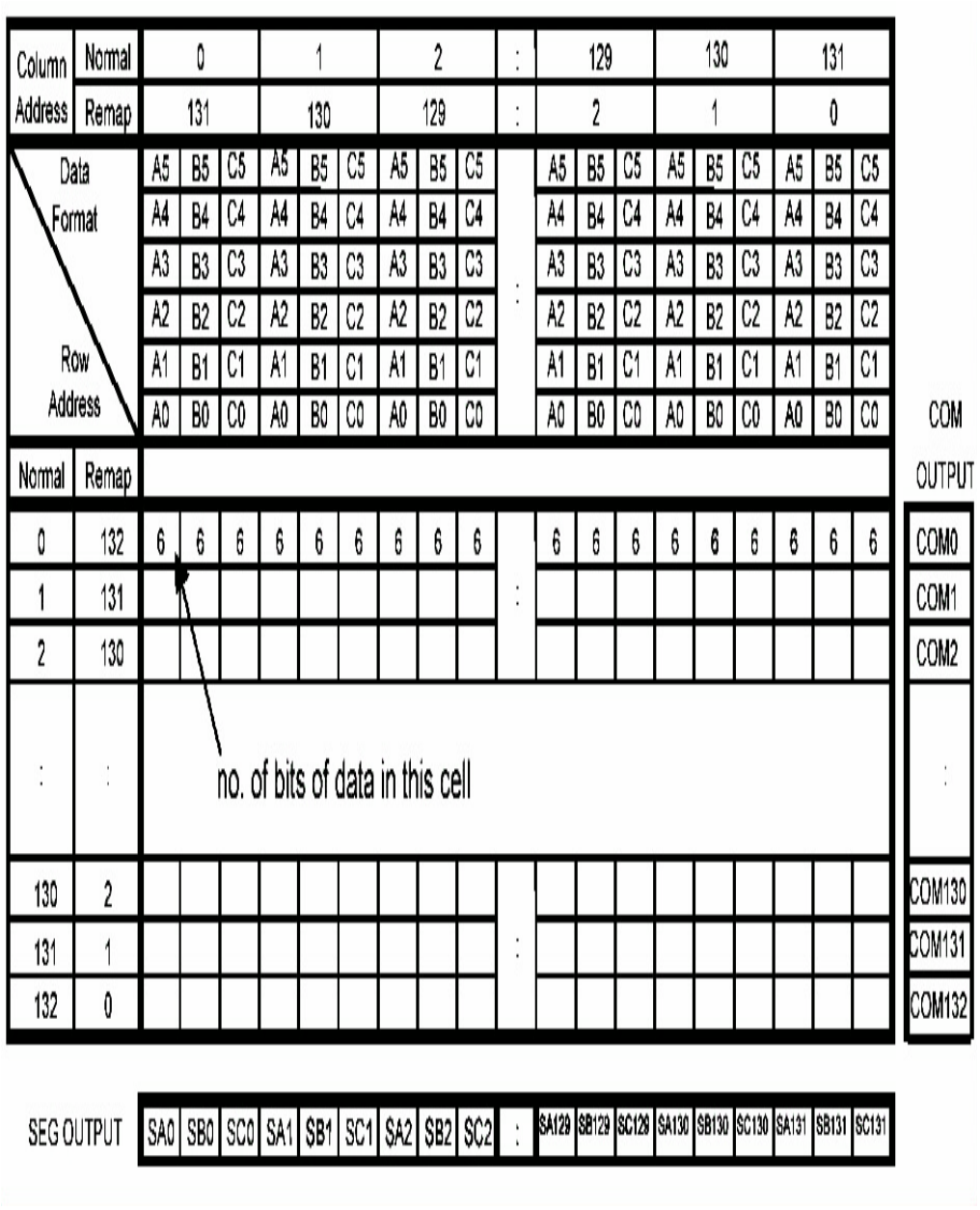
1. **Power up Vdd**
2. **Hardware RESET**
3. **Send display off command**
4. **Power up Vcc**
5. **Delay 100ms (when Vcc is stable)**
6. **Send Display on command**

Power down Sequence:

1. **Send Display off command**
2. **Power down Vcc**
3. **Delay 100ms (When Vcc is reach 0 and panel is completely discharges)**
4. **Power down Vdd**



8.2 APPLICATION CIRCUIT



8.3 RECOMMEND DC-DC CIRCUIT : LM2731YML or TPS61040

Refer to application notes.

8.4 COMMAND TABLE

Refer to IC Spec.: SSD1339

9. RELIABILITY TEST CONDITIONS

No.	Items	Specification	Quantity
1	High temp. (Non-operation)	85°C, 240hrs	3
2	Low temp. (Non-operation)	-40°C, 240hrs	2
3	High temp. (Operation)	70°C, 120hrs	3
4	Low temp. (Operation)	-20°C, 120hrs	2
5	High temp. / High humidity (Non-operation)	85°C, 85%RH, 120hrs	5
6	High temp. / High humidity (Operation)	65°C, 90%RH, 96hrs	5
7	Thermal shock (Non-operation)	-40°C ~85°C (-40°C /30min; transit /3min; 85°C /30min; transit /3min) 1cycle: 66min, 20 cycles	2
8	OLB Peel strength (Non-operation)	500g/cm (Speed~ 50mm/min)	5
9	Vibration	Frequency : 5~50HZ, 0.5G Scan rate : 1 oct/min Time : 2 hrs/axis Test axis : X, Y, Z	1 Carton
10	Drop	Height: 120cm Sequence : 1 angle□3 edges and 6 faces Cycles: 1	1 Carton
11	ESD (Non-operation)	Air discharge model, ±8kV, 10 times	5

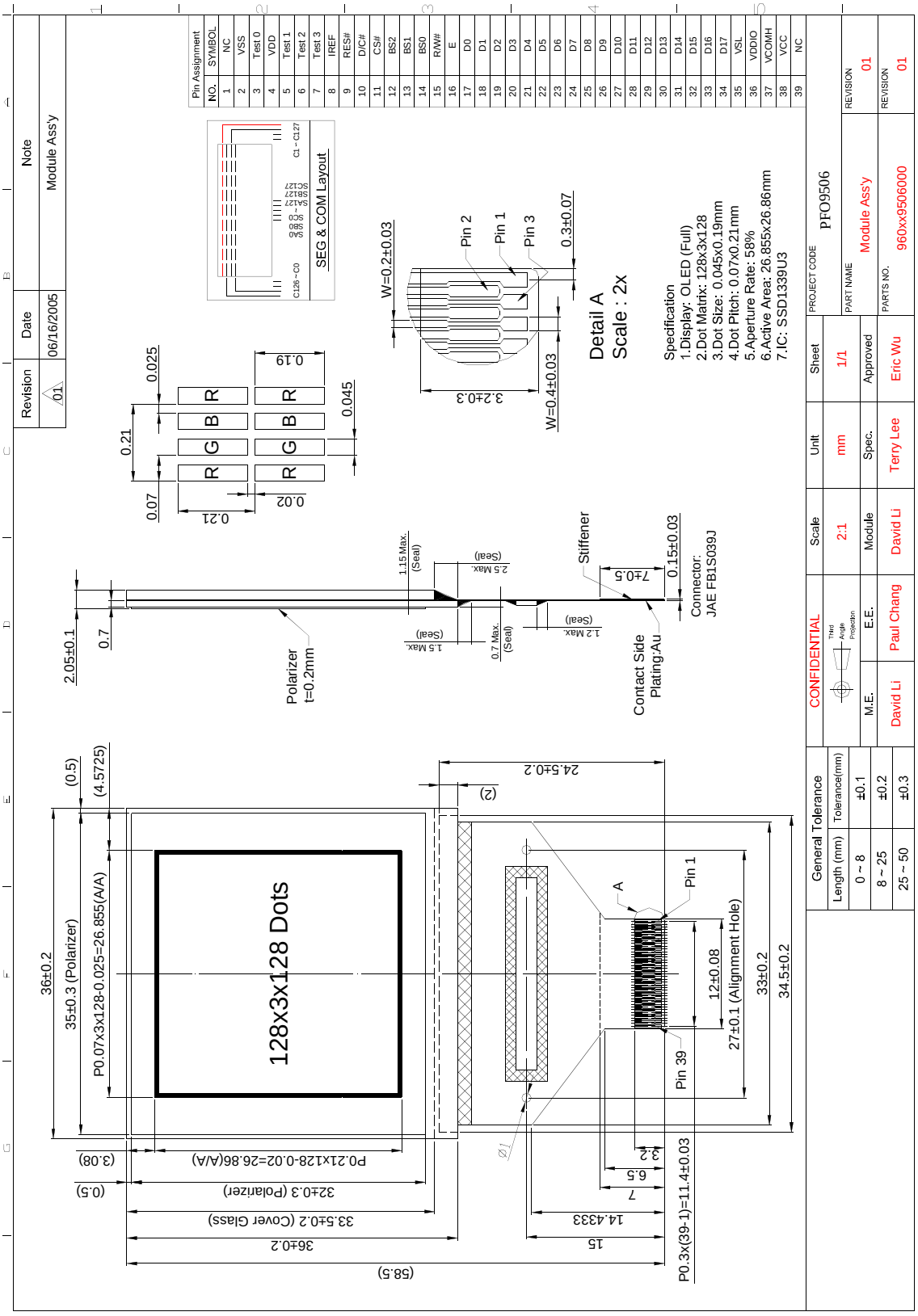
Test and measurement conditions

1. All measurements shall not be started until the specimens attain to temperature stability.
2. The test pattern at operating condition is 50% alternating check board.
3. The degradation of Polarizer are ignored for item 1, 5 & 6.

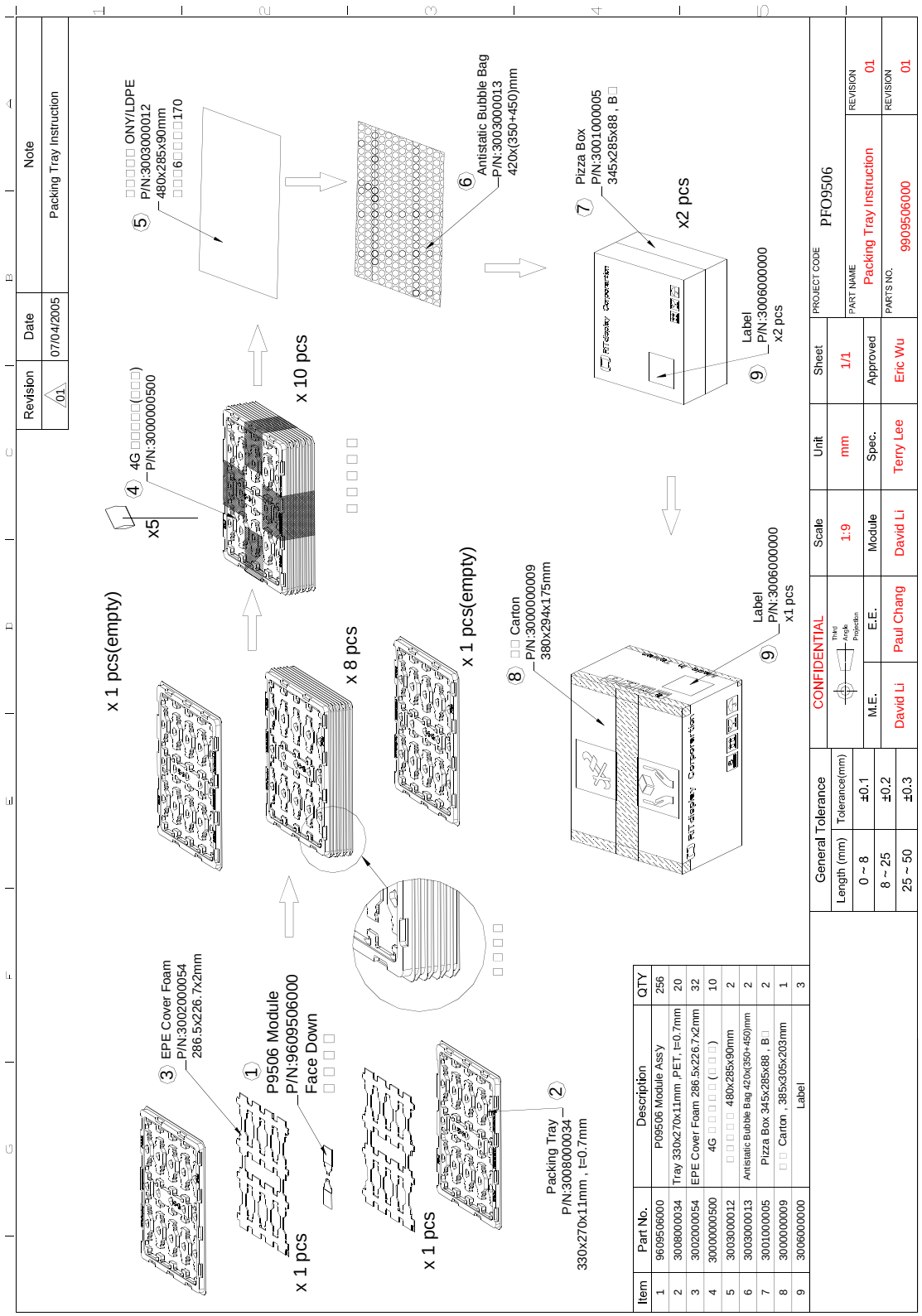
Evaluation criteria

1. The function test is OK.
2. No observable defects.
3. Luminance: > 50% of initial value.
4. Current consumption: within ± 50% of initial value.

10. EXTERNAL DIMENSION



11. PACKING SPECIFICATION



Item	Part No.	Description	QTY
1	9609506000	P09506 Module Assy	256
2	3008000034	Tray 330x270x11mm ,PET, t=0.7mm	20
3	3002000054	EPE Cover Foam 286.5x226.7x2mm	32
4	3000000500	4G (□□□)	10
5	3003000012	□□□□□ 480x285x90mm	2
6	3003000013	Antistatic Bubble Bag 420x(350+450)mm	2
7	3001000005	Pizza Box 345x285x88 , B□	2
8	3000000009	□□ Carton , 385x305x203mm	1
9	3006000000	Label	3

12. APPENDIXES

APPENDIX 1: DEFINITIONS

A. DEFINITION OF CHROMATICITY COORDINATE

The chromaticity coordinate is defined as the coordinate value on the CIE 1931 color chart for R, G, B, W.

B. DEFINITION OF CONTRAST RATIO

The contrast ratio is defined as the following formula:

$$\text{Contrast Ratio} = \frac{\text{Luminance of all pixels on measurement}}{\text{Luminance of all pixels off measurement}}$$

C. DEFINITION OF RESPONSE TIME

The definition of turn-on response time Tr is the time interval between a pixel reaching 10% of steady state luminance and 90% of steady state luminance. The definition of turn-off response time Tf is the time interval between a pixel reaching 90% of steady state luminance and 10% of steady state luminance. It is shown in Figure 2.

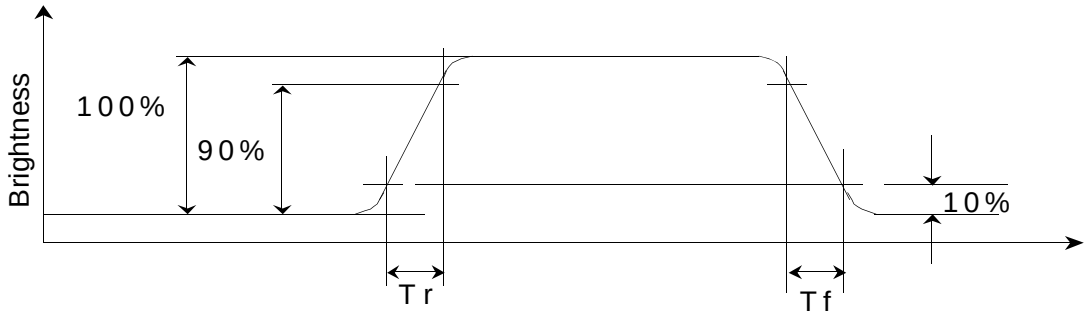
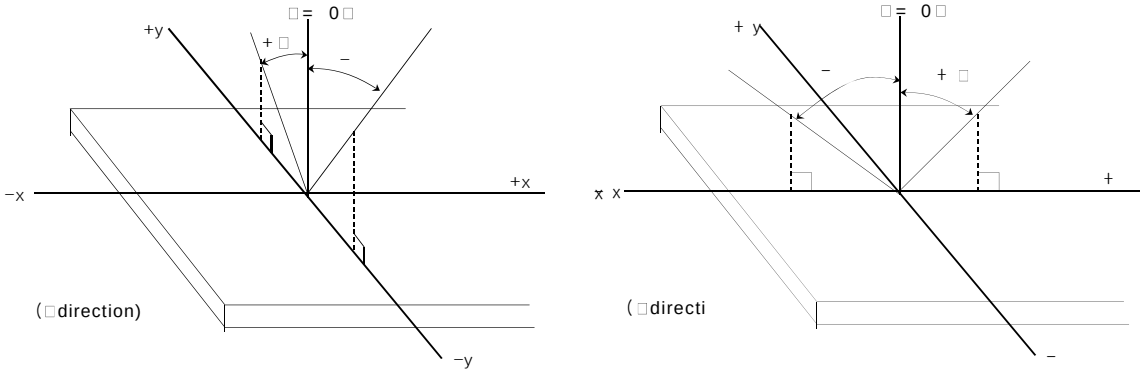


Figure 2 Response time

D. DEFINITION OF VIEWING ANGLE

The viewing angle is defined as Figure 3. Horizontal and vertical (H & V) angles are determined for viewing directions where luminance varies by 50% of the perpendicular value.



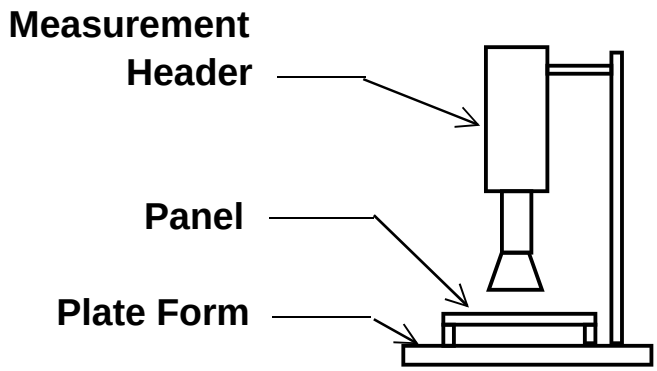
Vertical angles **Horizontal angles**

Figure 3 Viewing angle

APPENDIX 2: MEASUREMENT APPARATUS

A. LUMINANCE/COLOR COORDINATE

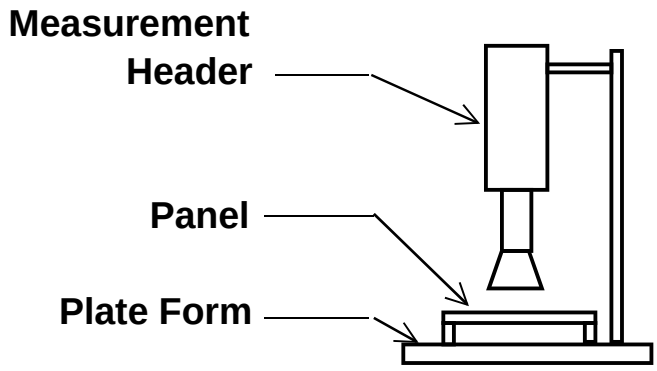
PHOTO RESEARCH PR-705, MINOLTA CS-100



**PR-705 /
MINOLTA CS-100
Color Analyzer**

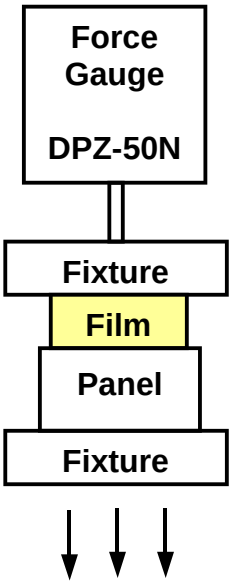
B. CONTRAST / RESPONSE TIME / VIEWING ANGLE

WESTAR CORPORATION FPM-510

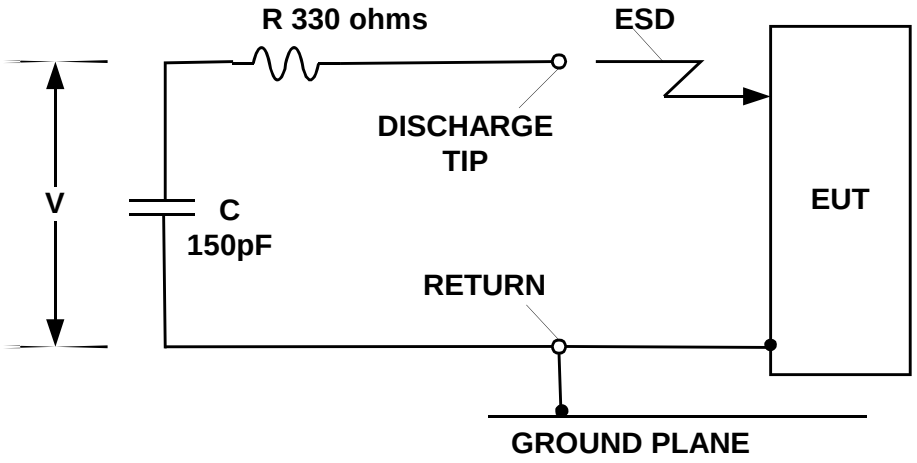


**Westar FPM-510
Display Contrast /
Response time /
View angle Analyzer**

C. PEEL STRENGTH



D. ESD ON AIR DISCHARGE MODE



APPENDIX 3: PRECAUTIONS

A. RESIDUE IMAGE

Because the pixels are lighted in different time, the luminance of active pixels may reduce or differ from inactive pixels. Therefore, the residue image will occur. To avoid the residue image, every pixel needs to be lighted up uniformly.