

LCD MODULE SPECIFICATION

Module Size: 10.1"1200x1920

Date: 2015-05-18

Version: A

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Revision History

Version	Revise Date	Page	Content	Prepared by
A	2015-5-18	All	First Release	



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1 General Specification

1.1 Features

- TFT-LCD Panel
- One backlight with 32pcs white LEDs
- MIPI Interface
- This product accords with RoHS and REACH environmental criterion.

1.2 Application

Display module for Portable Terminal

1.3 General Specification

No.	Item	Specification	request	Unit	Remark
1	Display Size	→	10.1	Inch	
2	TFT Technology Type	→	a-Si		
3	Liquid Crystal Alignment Method	ADS	IPS or equivalence		
4	Resolution	→	1200*RGB*1920		
5	Display mode	Normal Black	Transmissive		
6	Color Depth	→	16.7M (RGB 24bit)		
7	Viewing Direction	→	Full Viewing Angle Min75/Typ80@CR>10		
8	Contrast Ratio	700 Min. / 900 typ.	800 min/1000 typ		
9	Luminance	→	340 min/400 typ	cd/m ²	9point average
10	Module Size	LCD →	143(W)*227.926(H)*2.20m m(T)	mm	Note 1 CPK>1.33
11	Maximum Thickness	→	LCD:0.25(Typ)/0.25(Typ) Module:2.20(Typ)/2.40(max)	mm	Note 1
12	Panel Active Area	→	135.36(W)*216.576(H)	mm	Note 1
13	Pixel Size	→	0.0376*0.1128	mm	
14	Pixel Pitch	→	0.1128	mm	
15	Pixel Aspect Ratio	→	1:1	mm	
16	Driver IC	NT51021	TBD		2EA

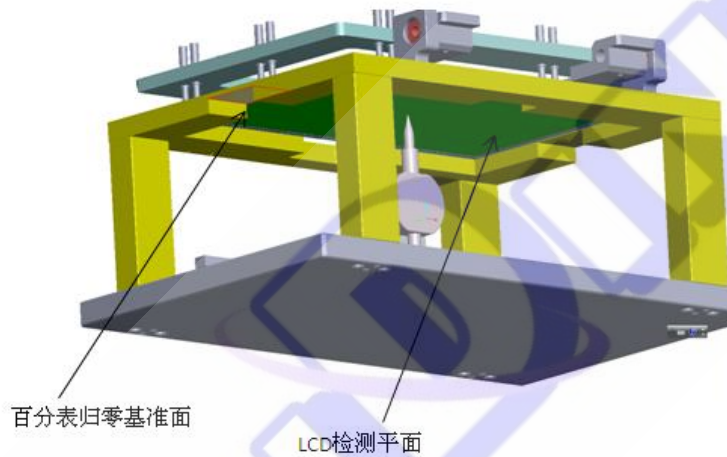
17	Driver IC RAM Size	N/A	Ramless		
18	Light Source	→	LED Backlight		
19	Interface	→	MIPI 4 lane		
20	Vcom type	→	DC Vcom		
21	Driver Inversion type	Column Inversionon	Column Inversionon /Z Inversion		
22	Operation Temperature	→	-10~+60	degC	
23	Storage Temperature	→	-20~+70	degC	
24	Weight	→	130g(max)	Gram	
25	Pixel Per inch	225	224	PPI	
26	Pixel Aperture Ratio	63%(Normal) 62%(Matrix @blue)	TBD	%	
27	Environmental Protection Requirement	→	RoHS & REACH must be executed		
28	Connection method	LCD Conn: FH35C-51S-0.3SH W(50) TP Conn: FH34SRJ-8S-0.5SH (50) Fingerprint identification Conn: FH34SRJ-10S-0.5S H(50)	LCD Conn:TBD TP Conn:TBD Fingerprint identification Conn:TBD		
29	Color Enhancement	→	Need		Note 4
30	CABC Function	→	Need		
31	Dynamic Contrast	TBD	TBD		
32	Gamma Correction	RGB independent Gamma Correction function	RGB Separate γ Correction Function		
33	Polarizer Type	HC,2H	Hard coat treating		
		APF,Haze45%	Glare	3H	
34	Panel gate scan direction reverse	→	Support		Warning
35	warpage	→	front side warpage value < 0.3mm(TBD)		Note 2 , If the warpage

			rear side warpage value <0.3mm.		doesnot meet0.3mm, according to 0.4mm control.
36	Diagonal Stripes&Morie	→	Invisible		Note 3

Note 1:Please Refer to the mechanical drawing.

Warning: Some GOP panel can not support gate bidirectional scanning , or even some gate bidirectional scanning GOP panel are abnormal working when the gate scanning direction set to be reversed.

Note 2: Warpage inspected by measuring system to analyze surface warpage and module



thickness.

Note 3: Viewing distance: 20cm to 25cm.

Viewing angle: $\theta_L < 45^\circ$, $\theta_R < 45^\circ$, $\psi_T < 45^\circ$, $\psi_B < 45^\circ$.

The viewing angle Refer to Note 9.

2 Pin Assignments

2.1 Display Interface

Pin No.	Symbol	Description	I/O
1	GND	Ground	P
2	GND	Ground	P
3	NC	NC(Internal use)	-
4	VDD_IO	Power only for digital IO circuit. Typ 3.3V	P
5	VBAT_SYS	Power Supply 3.0-4.4V	P

6	VBAT_SYS	Power Supply 3.0-4.4V	P
7	VBAT_SYS	Power Supply 3.0-4.4V	P
8	NC	NC(Internal use)	-
9	FB4-	Cathode	P
10	FB3-	Cathode	P
11	FB2-	Cathode	P
12	FB1-	Cathode	P
13	NC	NC	-
14	LED+	Anode	P
15	LED+	Anode	P
16	NC	NC	P
17	GND	Ground	P
18	MIPI_DATA0_P	MIPI Differential Data Input	I
19	MIPI_DATA0_N	MIPI Differential Data Input	I
20	GND	Ground	P
21	MIPI_DATA1_P	MIPI Differential Data Input	I
22	MIPI_DATA1_N	MIPI Differential Data Input	I
23	GND	Ground	P
24	MIPI_CLK_P	MIPI Differential Clock Input	I
25	MIPI_CLK_N	MIPI Differential Clock Input	I
26	GND	Ground	P
27	MIPI_DATA2_P	MIPI Differential Data Input	I
28	MIPI_DATA2_N	MIPI Differential Data Input	I
29	GND	Ground	P
30	MIPI_DATA3_P	MIPI Differential Data Input	I
31	MIPI_DATA3_N	MIPI Differential Data Input	I
32	GND	Ground	P
33	ID0	ID0 (GND)	O
34	LEDPWMOUT	PWM Control Signal of LED Convert(3.3V)	O
35	GND	Ground	P
36	I2C_SCL_TP	I2C CLK,TYP. 1.8V	I

37	I2C_SDA_TP	I2C SDA,TYP. 1.8V	I
38	TP_INT	Interrupt Pin	I
39	TP_RST	Reset Pin	I
40	AVDD_TP	Analog Power supply, TYP. 3.3V	P
41	DVDD_TP	I/O Digital Power supply, TYP. 1.8V	P
42	GND	Ground	P
43	DRDY_N/IRQ	Active (high) when data is available and inactive(low) when data is not available. Referenced to VDDIO	I
44	SLEEP/RESET	Used to bring Module in and out of Sleep mode. When asserted, the device enters sleep mode and sensor operation is suspended. When de-asserted, the device enters it's operating mode.	I
45	ID	For FPC Sensor connect ID pin to VDDIO(3.3V) For Synaptics Sensor connect ID pin to GND	I
46	MOSI	SPI data input (host interface). This signal is used to transfer data into the sensor. Referenced to VDDIO	I
47	MISO	SPI data output (host interface). This signal is used to transfer data out of sensor. Referenced to VDDIO	O
48	SS_N/CS	Slave Select, active low (host interface). The host SPI interface is active when SS_N is low; it is inactive when SS_N is high, with MISO driven to a high impedance state. Referenced to VDDIO	I
49	VDDIO	Digital Power supply. Connect to 3.3V	P
50	SCLK	SPI data clock (host interface). Referenced to VDDIO	I
51	GND_Fingerprint	FingerprintGround	P

2.2 Pin assignment for TP

No.	Symbol	Description
1	I2C_SCL	I2C CLK,TYP. 1.8V
2	I2C_SDA	I2C SDA,TYP. 1.8V
3	TP_SYNC	SYNC signal for touch panel, TYP 3.3V
4	TOUCH_INT	Interrupt Pin, TYP 1.8V

5	TOUCH_RESET	Reset Pin, TYP 1.8V
6	GND	Ground
7	AVDD	Analog Power supply, TYP. 3.3V
8	DVDD_IO	I/O Digital Power supply, TYP. 1.8V

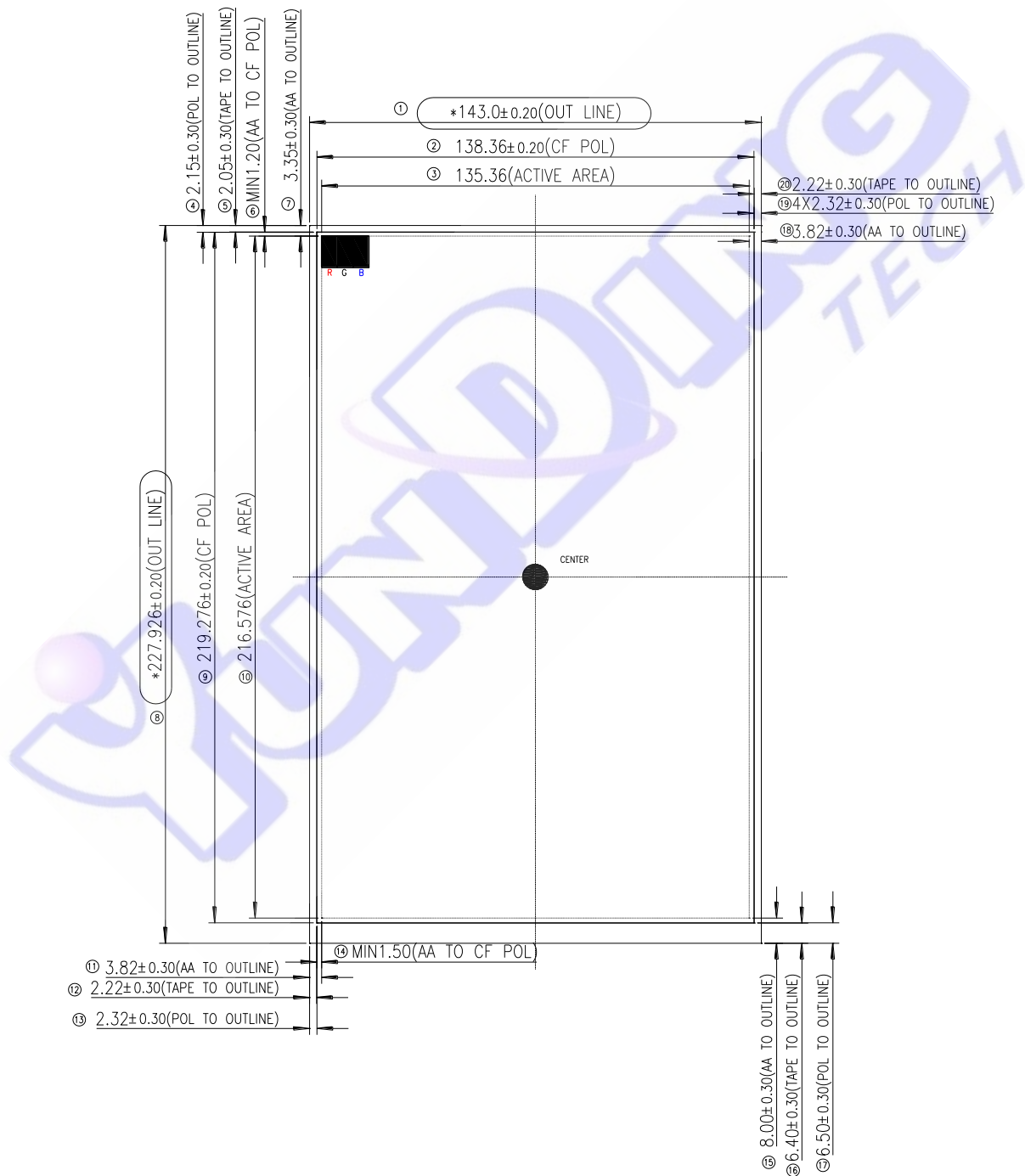
2.3 Pin assignment for Fingerprint identification

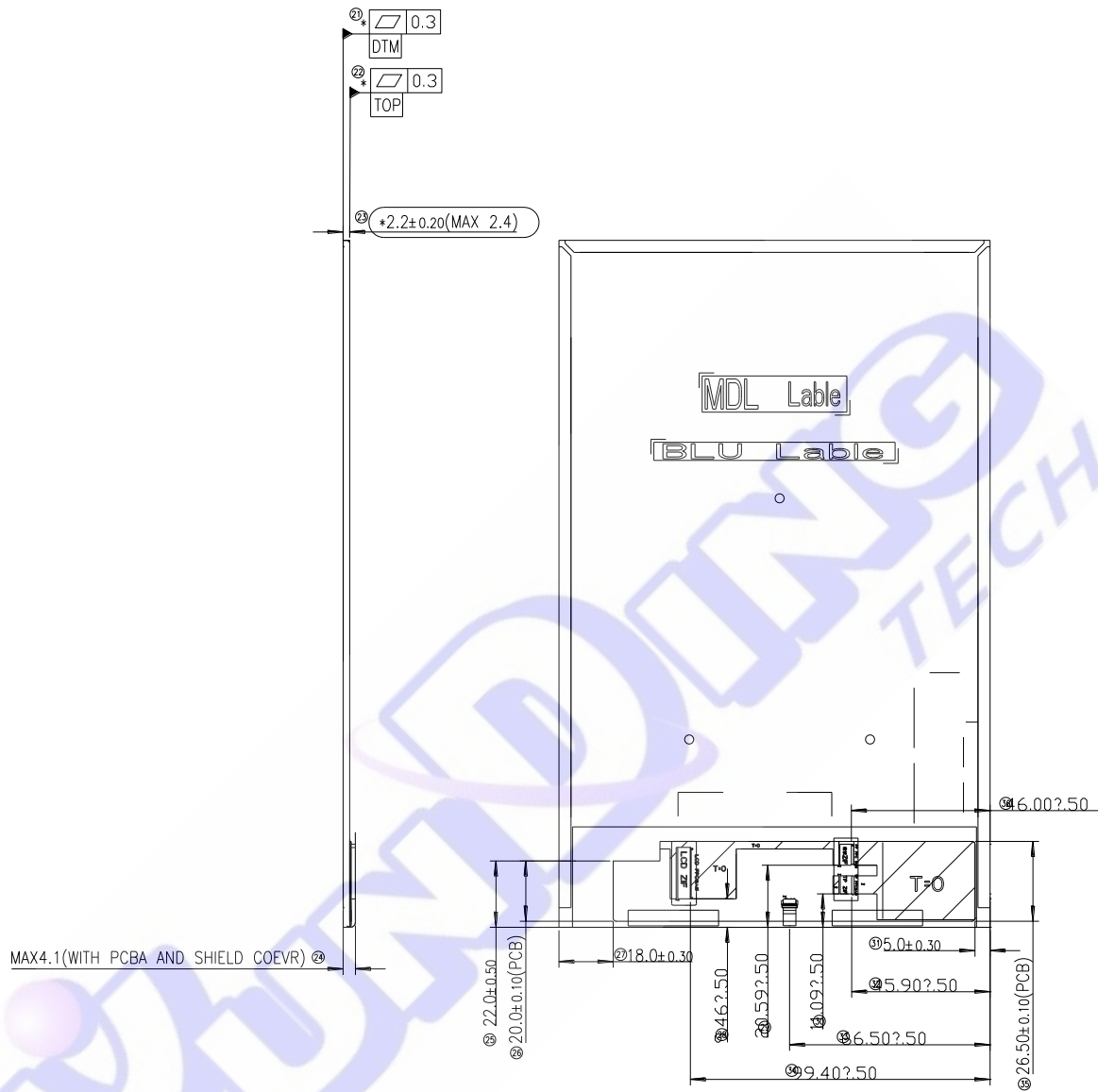
NO	Signal	Description	Remark
1	DRDY_N/IRQ	Active (high) when data is available and inactive(low) when data is not available. Referenced to VDDIO	IRQ
2	SLEEP/RESET	Used to bring Module in and out of Sleep mode. When asserted, the device enters sleep mode and sensor operation is suspended. When de-asserted, the device enters it's operating mode.	RESET
3	ID	For FPC Sensor connect ID pin to VDDIO(3.3V) For Synaptics Sensor connect ID pin to GND	ID PIN
4	MOSI	SPI data input (host interface). This signal is used to transfer data into the sensor. Referenced to VDDIO	MOSI
5	MISO	SPI data output (host interface). This signal is used to transfer data out of sensor. Referenced to VDDIO	MISO
6	SS_N/CS	Slave Select, active low (host interface). The host SPI interface is active when SS_N is low; it is inactive when SS_N is high, with MISO driven to a high impedance state. Referenced to VDDIO	CS
7	VDDIO	Digital Power supply. Connect to 3.3V	VDDIO 3.3V
8	NC		
9	SCLK	SPI data clock (host interface). Referenced to VDDIO	CLK
10	GND_ Fingerprint	Connect to ground	GND

3 Module data for customer

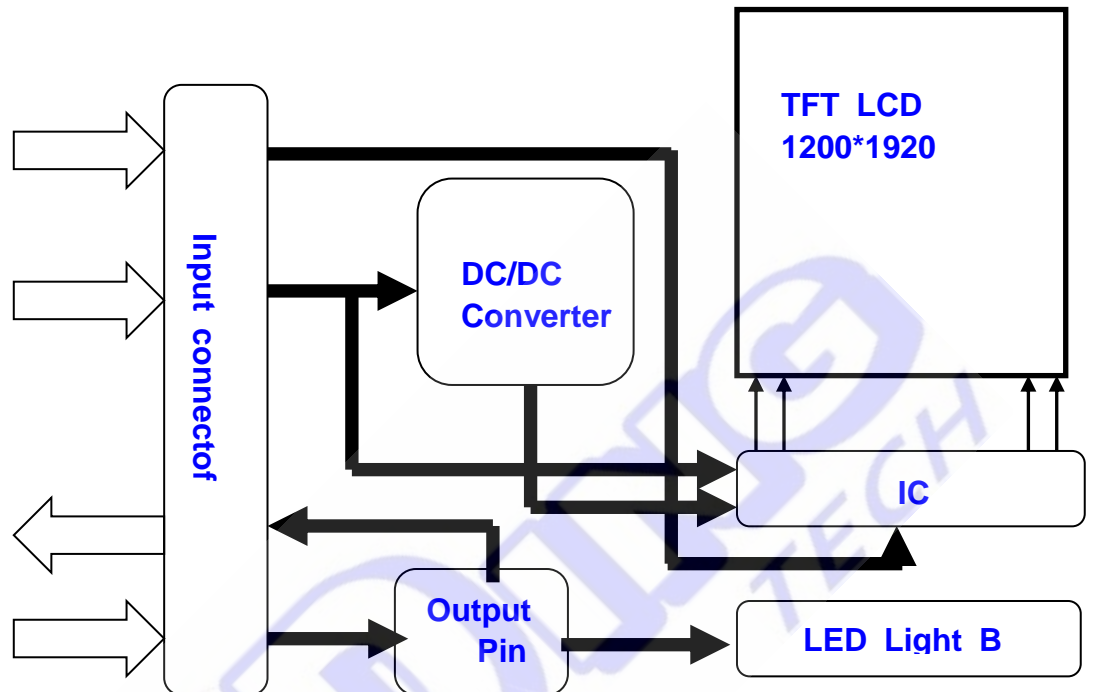
3.1 Mechanical Drawing

Drawing Attachment:





4 Block Diagram



Features

[F101WM-NH0 is 10.1" 8 color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, MIPI driver IC, control circuit and backlight. By applying 8 bit digital data, 1200×RGB (3) ×1920, 16.7M-color images are displayed on the 8" diagonal screen

5 Register & Pixel Data Format

5.1 8080 CPU 18bit Data Format

5.2 RGB 18bit Data Format

5.3 3-SPI Data Format

5.4 MIPI 24bit RGB Data Format

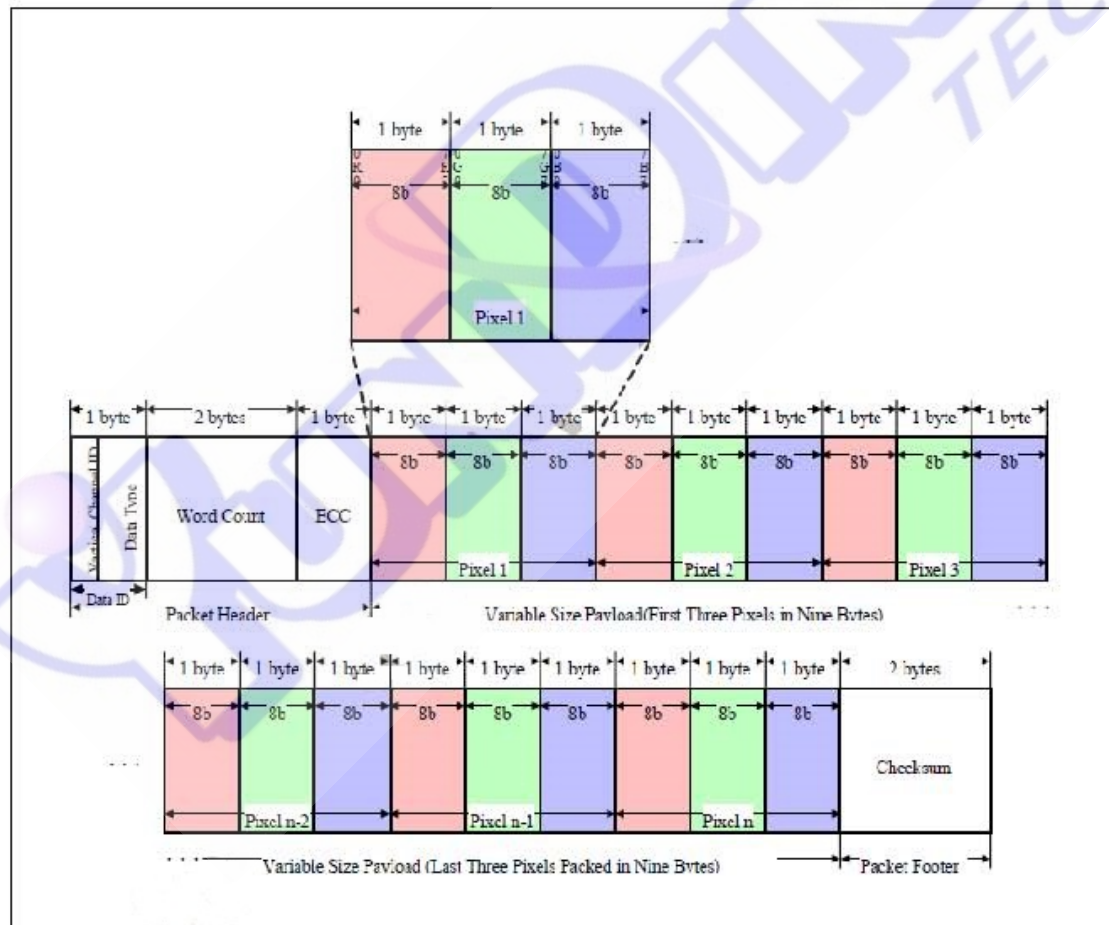
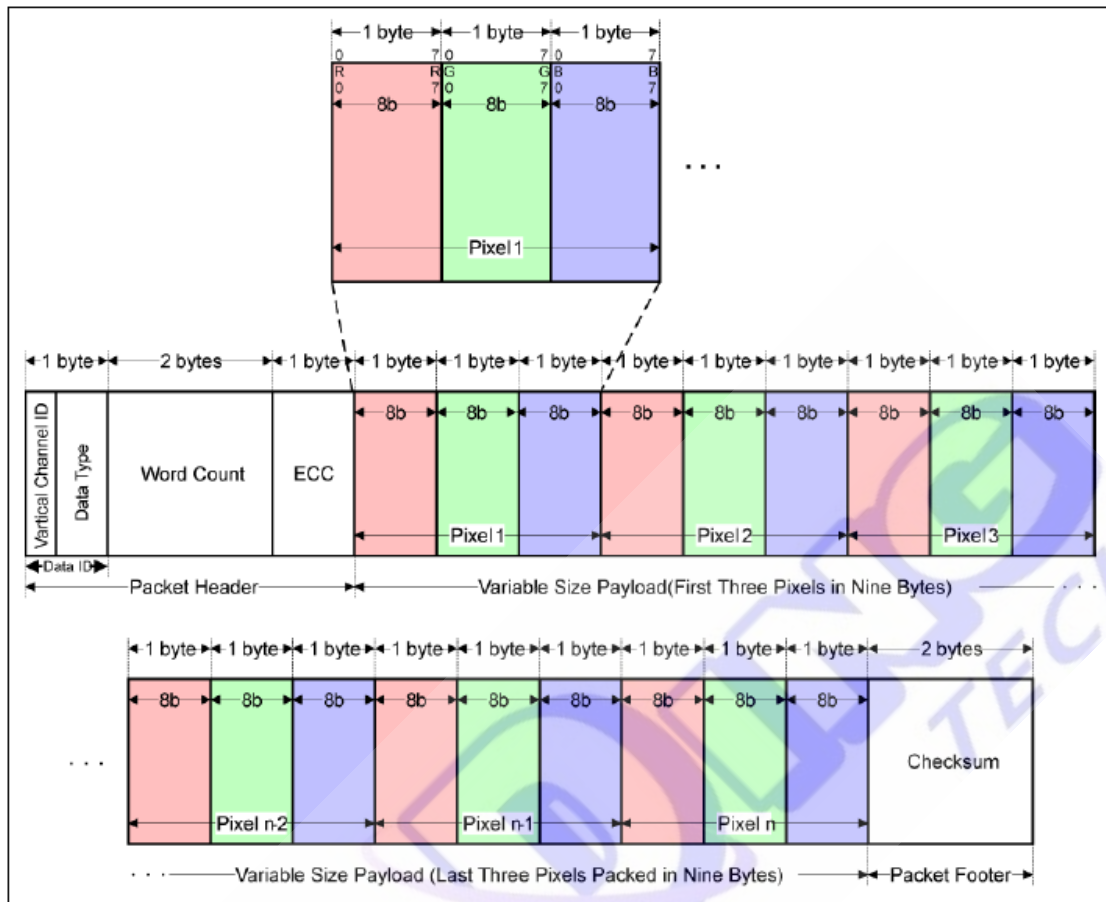
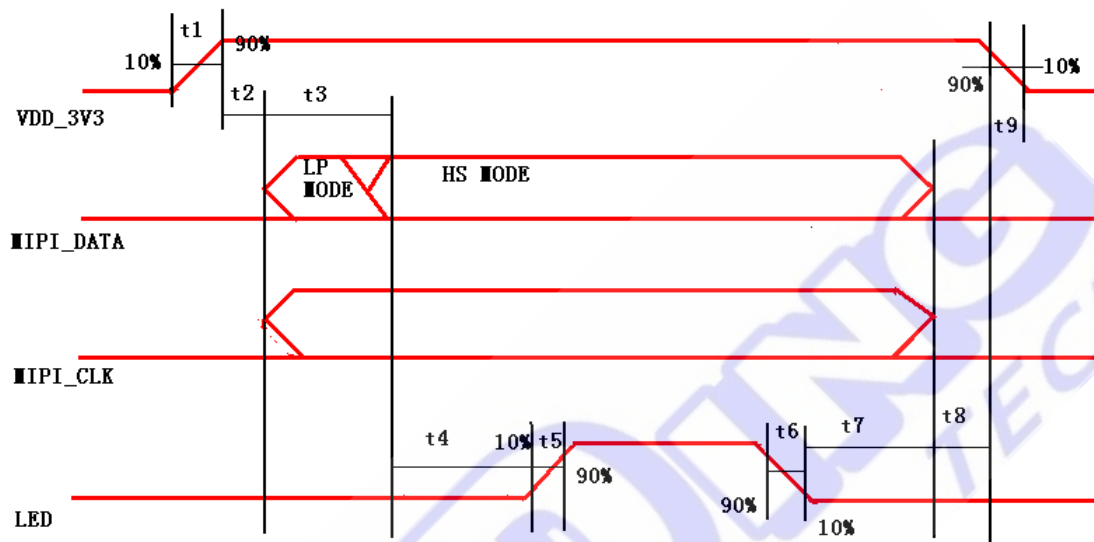


Figure 23 24-bit per Pixel – RGB Color Format, Long packet



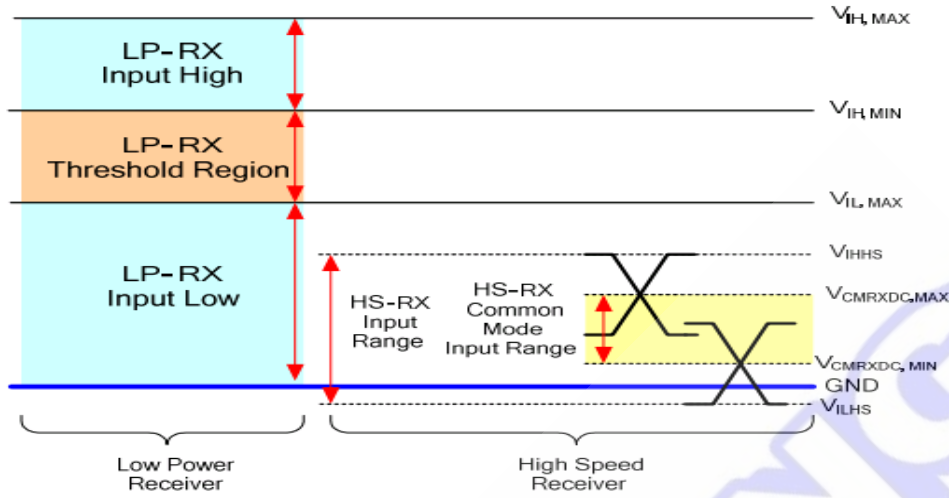
6 Timing Characteristics

6.1 Power on/off Sequence



Value					Remark
Parameter	Min.	Typ.	Max.	Unit	
t1	0.1	-	20	ms	
t2	1	-	20	ms	
t3	20	-	40	ms	
t4	200	-	-	ms	
t5	0.1	-	20	ms	
t6	0.1	-	20	ms	
t7	200	-	-	ms	
t8	0	-	20	ms	
t9	0.1	-	20	ms	

6.2 MIPI Input Signal Characteristics



Parameter	Symbol	Min	Typ	Max	Unit	Condition
MIPI digital operation current	I_{VCCIF}	-	-	24	mA	-
MIPI digital stand-by current	$I_{VCCIFST}$	-	200	-	uA	-
MIPI Characteristics for High Speed Receiver						
Single-ended input low voltage	V_{ILHS}	-40	-	-		
Single-ended input high voltage	V_{IHHS}	-	-	460	mV	
Common-mode voltage	V_{CMRXDC}	155	-	330	mV	
Differential input impedance	Z_{ID}	80	100	125	Ω	
HS transmit differential voltage($V_{OD}=V_{DP}-V_{DN}$)	$ V_{OD} $	85	200	250	mV	
MIPI Characteristics for Low Power Receiver						
Pad signal voltage range	V_I	-50	-	1350	mV	
Ground shift	V_{GNDSH}	-50	-	50	mV	

Output low level	V_{OL}	-150	-	150	mV	
Output high level	V_{OH}	1.1	1.2	1.3	V	

6.3 Signal Timing Characteristics

ITEM		SYMBOL	min	typ	max	UNIT	
LCD	Frame Rate	-	-	60	-	Hz	
	Pixels Rate	-	156.8	156.8	159.9	MHz	
Timing	DCLK	Frequency	fCLK	490	490	498	MHz
		Period	Tclk	2.01	2.04	2.04	ns
	Horizontal	Horizontal total time	tHP	1343	1343	1366	t _{CLK}
		Horizontal Active time	tHadr	1200			t _{CLK}
		Horizontal Pulse Width	tHsync	1	1	1	t _{CLK}
		Horizontal Back Porch	tHBP	32	32	32	t _{CLK}
		Horizontal Front Porch	tHFP	110	110	133	t _{CLK}
	Vertical	Vertical total time	tvp	1946	1946	1951	t _H
		Vertical Active time	tVadr	1920			t _H
		Vertical Pulse Width	tVsync	1	1	1	t _H
		Vertical Back Porch	tVBP	14	14	14	t _H
		Vertical Front Porch	tVFP	11	11	16	t _H
	Bit Rate		TX SPD	980	980	995	Mbps

	(MBPS)				
Lane	-	4	-	Lane	



7 Electrical Specifications

7.1 DC Characteristics Requirement

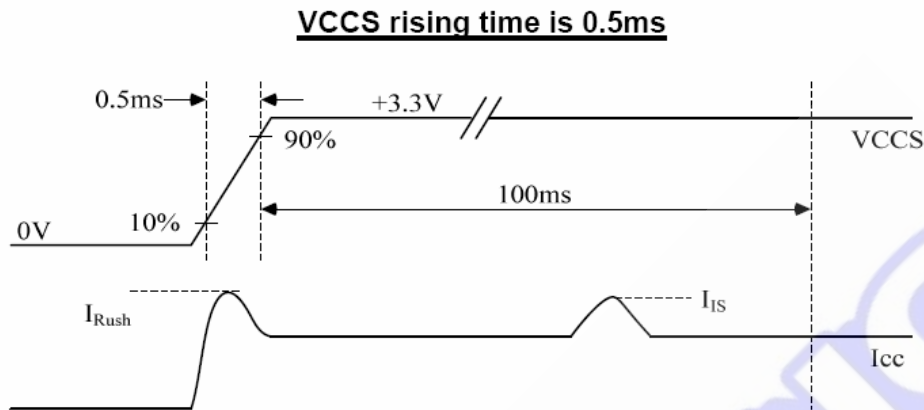
Item	Symbol	Values			Unit	Remark	
		Min	Typ	Max			
Power Supply Voltage	VDD_IO	3.0	3.3	3.6	V		
	VBAT_SYS	3.0	3.8	4.4	V		
Ripple Voltage	VRP	-	50	-	mV		
Inrush Current	IRUSH	-	-	1.5	A		
LEDPWMOUT	High Level	VOH	0.7*VDD	-	VDD	V	
	Low Level	VOL	0	-	0.3*VDD	V	
Frame frequency	fFrame	55	60		HZ		

Note 5:

Note 5: IRUSH: the maximum current when VBAT_SYS is rising

IIS: the maximum current of the first 100ms after power-on

Measurement Conditions: Shown as the following figure. Test pattern: black.



7.2 Power Consumption of TFT Panel

Power Supply: Frame Frequency: VDDframe>=60HZ @ 25degC

Display Mode	Item	Symbol	Value		Unit	Remark
			Typ	Max		
Display White	Current of VDD_IO	IVDD_IO	-	10	mA	
	Current of VBAT_SYS	IVBAT_SYS	-	180	mA	
Display Black	Current of VDD_IO	IVDD_IO	-	10	mA	
	Current of VBAT_SYS	IVBAT_SYS	-	180	mA	
Standby Mode	Current of VDD_IO	IVDD_IO	-	0	mA	
	Current of VBAT_SYS	IVBAT_SYS	-	0	mA	

7.3 Power Consumption of Backlight

Test Condition: ILED=20mA LED 32PCS

Warning: LCM Brightness must match Optical Spec requirement when ILED=20mA

Backlight Unit Schematic:

Item	Symbol	Values			Request Values			Unit	Remark
		Min	Typ	Max	Min	Typ	Max		
Forward Voltage	V _f		3.0	3.2		3.0	3.2	V	Note 6
Power Consumption	P _{BL}		1920	2100		1920	2100	mW	
LED Quantity		32			32			pcs	
LED Rank		Luminous Flux: 2900mcd			Luminous Flux:			lm	
		Chromaticity: CDE /2/3			Chromaticity:				

Note 6: When I_{LED}=20mA, the V_{BL} must be in the range of above table specified.

The FPC wire resistance between LED+ and LED- must be less than 0.15ohm

$$P_{BL} = I_{LED} \times V_{BL}$$

8 Optical Specifications

Test condition: IOVCC=3.3V, VBAT_SYS=3.8V, I_{LED}=20mA, Ta=25°C

Item	Symbol	Condition	BOE Reply			Request Value			Unit	Note
			Min	Typ	Max	Min	Typ	Max		
luminance	B _p	θ=0°	→	→		340	400	--	cd/m ²	
Maximum Brightness of Black Pattern	B _{blk}	θ=0°	---	---	→	---	---	0.65	cd/m ²	Note 7
Brightness Uniformity	ΔB _p		→	→	---	75	80	--	%	Note 8
Color Uniformity	Δu'v' (w.r.t. center)							TBD		Note26 Sign the limit sample shall prevail.
	Δu'v'			0.01	0.015			TBD		
	Δu'v' (worst neighbor)			0.003	0.007			TBD		
Viewing Angle	θ _L	Cr≥10	→	→		75	80	--	deg	Note 9
	θ _R		→	→		75	80	--		
	ψ _T		→	→		75	80	--		
	ψ _B		→	→		75	80	--		
Contrast Ratio	Cr	θ=0°	700	900		800	1000	--	-	Note 10

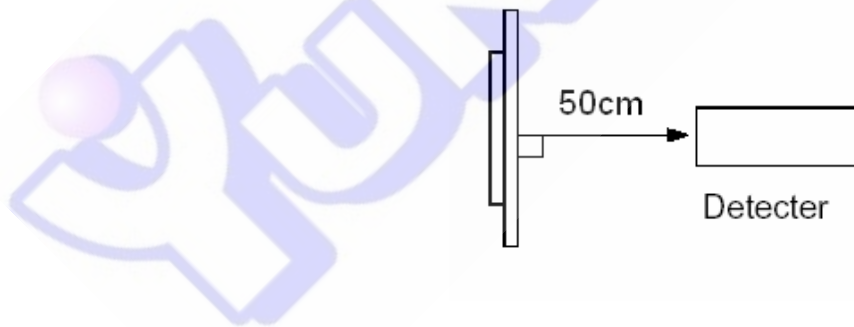
Response Time	T_r+T_f	FF=0°	→	→	--	25	35	ms	Note 11		
	Tgray				-	45	55	ms			
Color Coordinate of CIE1931	Rx	$\theta=0^\circ$ $=0^\circ$		0.635		0.64			-	Note 12	
	Ry			0.336		0.33					
	Gx			0.303		0.30					
	Gy			0.598		0.60					
	Bx			0.143		0.15					
	By			0.058		0.06					
	Wx			0.265	0.295	0.325	0.27	0.30			0.33
	Wy			0.285	0.315	0.345	0.28	0.31			0.34
NTSC Ratio	NTSC	CIE1931	→	→		65	70	--	%	Note 13	
Color Temperature	CT			→		-	7500	-			
Flicker	amount	-			→	-	-	-30	dB	Note 14	
Gamma		-	→	→	→	1.9	2.2	2.5		Note 15	
Crosstalk	ΔCT	-	→	→	→	-	1.1	1.2		Note 16	
Transmittance with APF,haze45%	Tm			5.1%		TBD		--	%		
Reflectance	Rf	@550nm				--		TBD	%	Note 17	
Polarization Direction of Front Polarizer	PdF							TBD	deg	Note 18	
Polarization Direction of Rear Polarizer	PdR							TBD	deg		
Luminance decrease ratio		$\theta L=30^\circ$			→	---	---	70	%	Note 19	
		$\theta R=30^\circ$			→	---	---	70	%		
		$\psi T=30^\circ$			→	---	---	70	%		
		$\psi B=30^\circ$			→	---	---	70	%		
Contrast decrease ratio		$\theta L=30^\circ$			→	---	---	70	%	Note 20	
		$\theta R=30^\circ$			→	---	---	70	%		
		$\psi T=30^\circ$			→	---	---	70	%		
		$\psi B=30^\circ$			→	---	---	70	%		
Color shift		$\theta L=30^\circ$			→	---	---	3	JNCD	Note 21	
		$\theta R=30^\circ$			→	---	---	3	JNCD		
		$\psi T=30^\circ$			→	---	---	3	JNCD		
		$\psi B=30^\circ$			→	---	---	3	JNCD		
Gray inversion angle		$\psi=0^\circ$					NA		deg	Note 22	

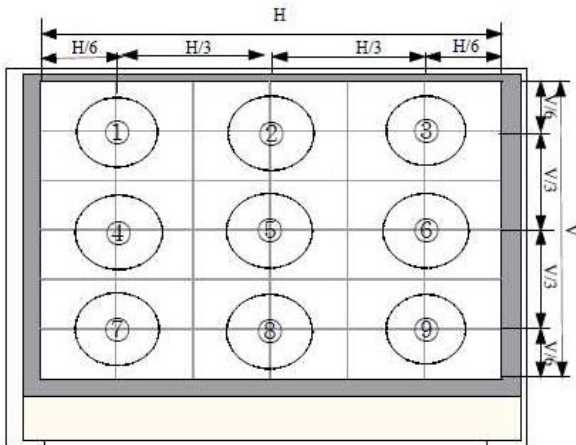
Afterimage								3	Minute	Note 23
CABC Test										Note 24
Hot spot	ΔBp	θ=0°	→	75	80				%	Note25
		=0°								Every near 9 points
		θ=0°	→	80	85				%	Note25
		=0°								

Note7:Luminance measurement

The test condition is at ILED=20mA and measured on the surface of LCD module at 25°C.

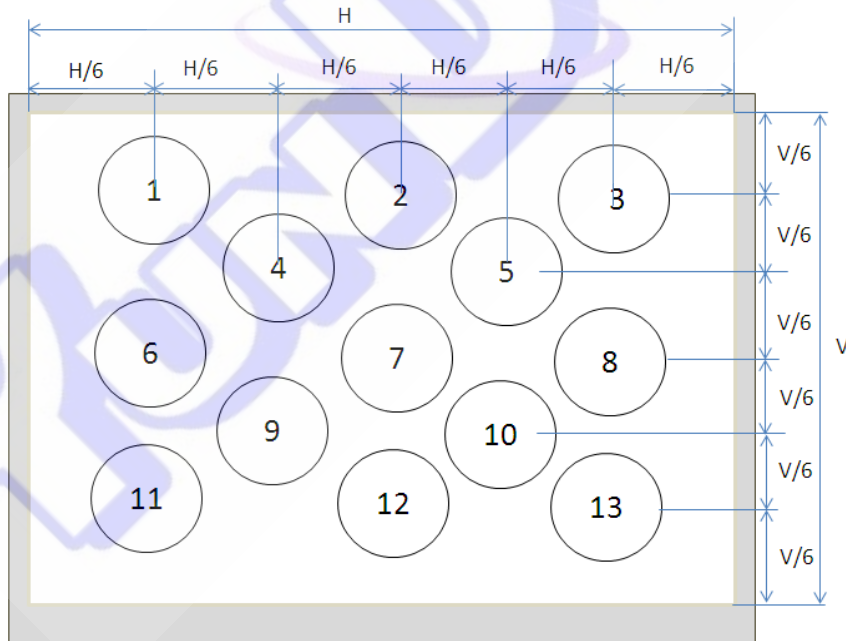
- The data are measured after LEDs are lighted on for more than 5 minutes and LCM displays are fully white. The brightness is the average value of 9 measured spots. Measurement equipment CS2000 or similar equipments(Field of view:1deg,Distance:50cm)
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25°C.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of LCD panel must be after more than 5 minutes while backlight turning on.





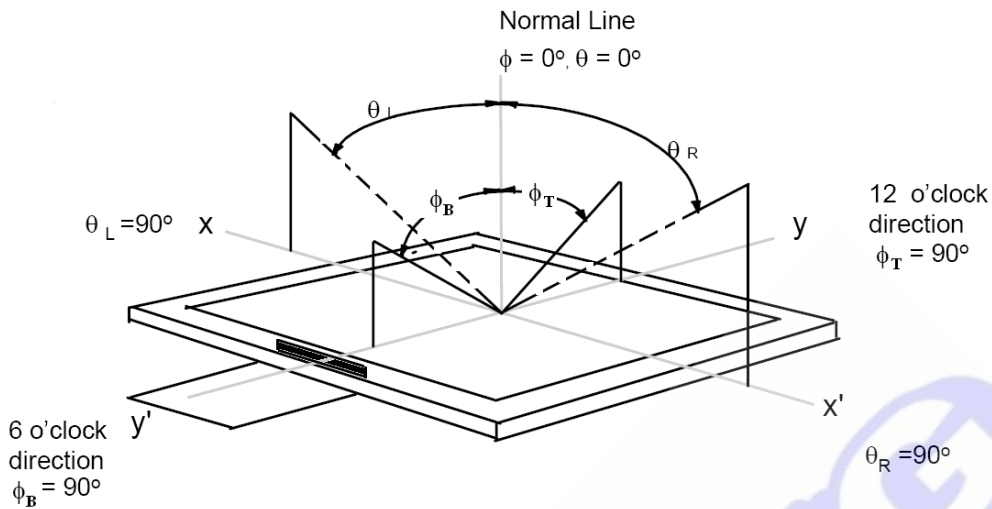
Note8:Uniformity

- The test condition is at $I_{LED}=20mA$ and measured on the surface of LCD module at $25^{\circ}C$.
- Measurement equipment:CS2000 or similar equipments
- The luminance uniformity is calculated by using following formula:
- $\Delta Bp = Bp (Min.) / Bp (Max.) \times 100 (\%)$
- $Bp (Max.) =$ Maximum brightness in 13 measured spots
- $Bp (Min.) =$ Minimum brightness in 13 measured spots.



Note 9:The definition of Viewing Angle

Refer to the graph below marked by θ and Φ



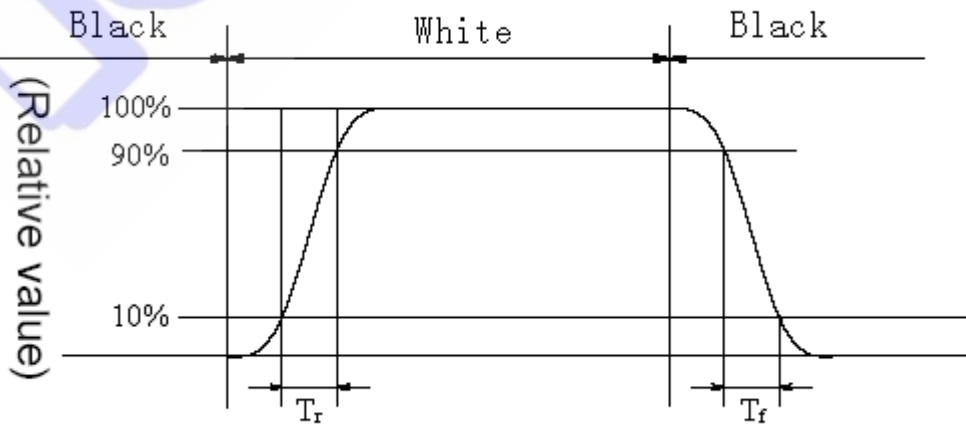
Note10: The definition of Contrast Ratio (Test LCM using CS2000 or similar equipments):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

Note11: Definition of Response time.(Test LCD using DMS501 or similar equipments):

The output signals of photodetector are measured when the input signals are changed from "black" to "white" (Voltage falling time) and from "white" to "black" (Voltage rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figures below.



Response time of gray to gray:

- Measurement equipment: DMS501 or similar equipments.
- Test method: we define 8 grays L0-L7, the grays of L0-L7 were defined as: 0, 36, 73, 109, 146, 182, 219, 255. The output signals of photodetector are measured when the input signals are changed from “Lx” to “Ly”, x, y = [0, 7]. The response time is defined as the time interval between the 10% and 90% of amplitudes. The result of the test can be noted as below:

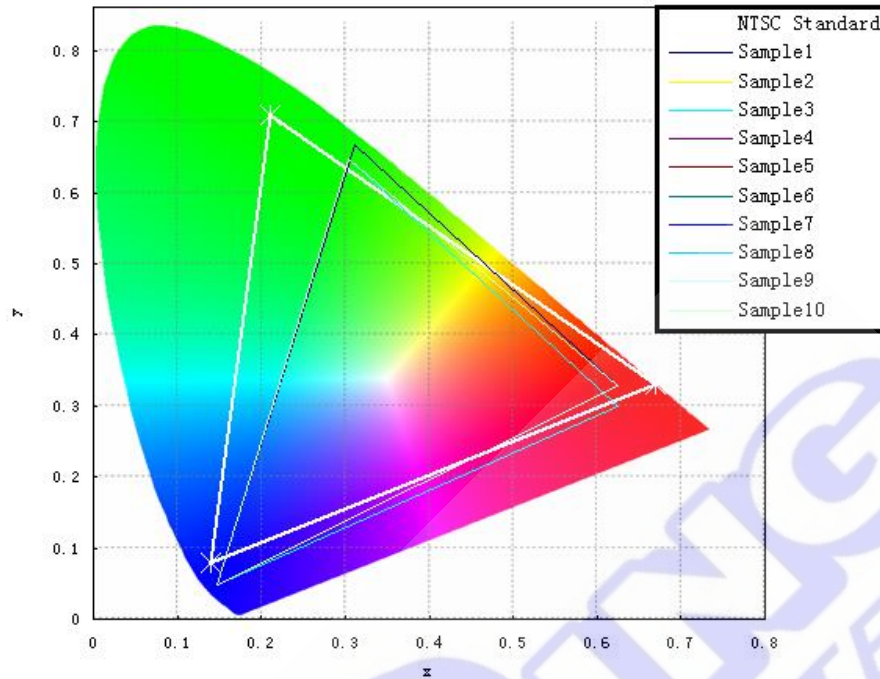
	L0	L1	L2	L3	L4	L5	L6	L7
L0	■							
L1		■						
L2			■					
L3				■				
L4					■			
L5						■		
L6							■	
L7								■

Note 12: Color Coordinates of CIE 1931

- The test condition is at ILED=20mA and measured on the surface of LCD module at 25°C.
- Measurement equipment: CS2000 or similar equipments
- The Color Coordinate (CIE 1931) is the measurement of the center of the display shown in below figure.

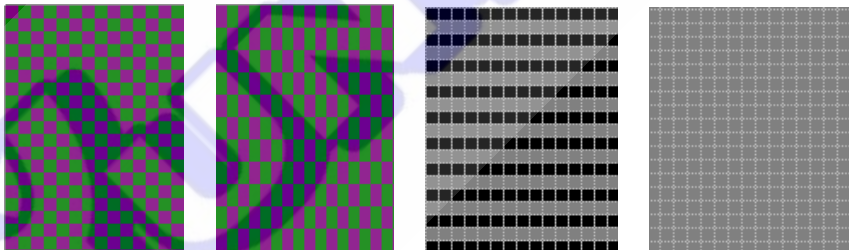
Note 13: Definition of Color of CIE Coordinate and NTSC Ratio.

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$



Note 14: Flicker

- Measurement equipment :CA-210 or similar equipments
- Measuring temperature: Ta=25℃.
- Test method: JEITA method
- Test pattern : Refer to below(Test Pattern should be full-fill of display screen)



1 Dot Inversion, 2 Dot Inversion, Line Inversion, Frame Inversion

The point should be marked is, for line and frame inversion, the background of Flicker Test Pattern-“gray “ are defined as middle gray scale .For example, RGB 24bit “gray” defined as below:

R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

For Dot inversion, the RGB data for first pixel is (127, 0, 127), the RGB data for the second pixel is (0, 127, 0).

- Frame Frequency Requirement before test: The LCD must be tuned to more than 65HZ before measurement.
- Measurement Point: the center of display active area
- Conversion of Flicker ratio:

$$\text{Flicker [dB]} = 10 \times \log[P_x/P_0]$$

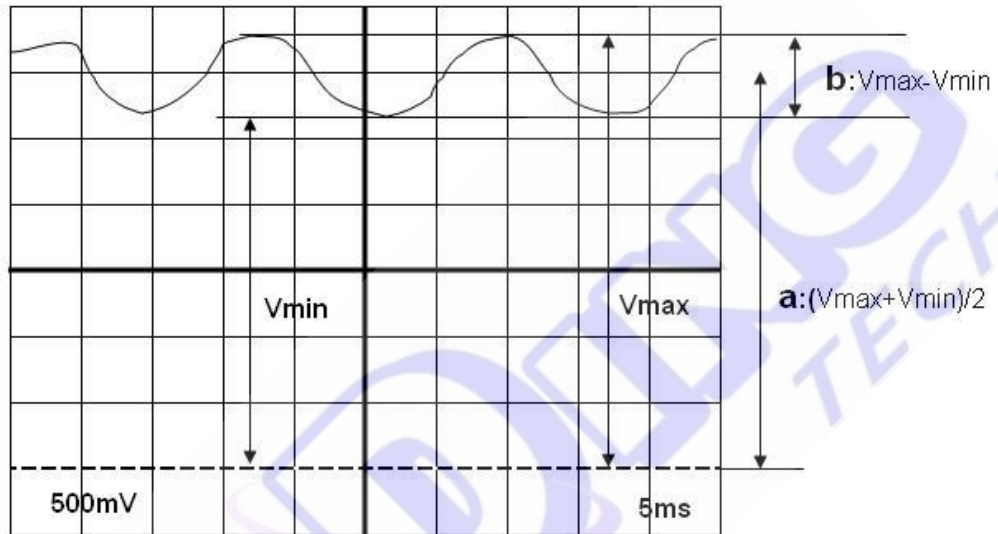
Where

P_x: Maximum power spectrum of AC component after passing through integrator

P₀: Power spectrum of DC component after passing through integrator

AC component=b (Refer to below diagram)

DC component=a (Refer to below diagram)



Note 15: gamma curve control

- 1,the whole curve's tolerance must control within +/-0.3, test the gray scale below:
0, 8, 16, 25, 33, 41, 49, 58, 66, 74, 82, 90, 99, 107, 115, 123, 132, 140, 148, 156, 165, 173, 181, 189, 197,206, 214, 222, 230, 239, 247, 255

Note 16:Crosstalk

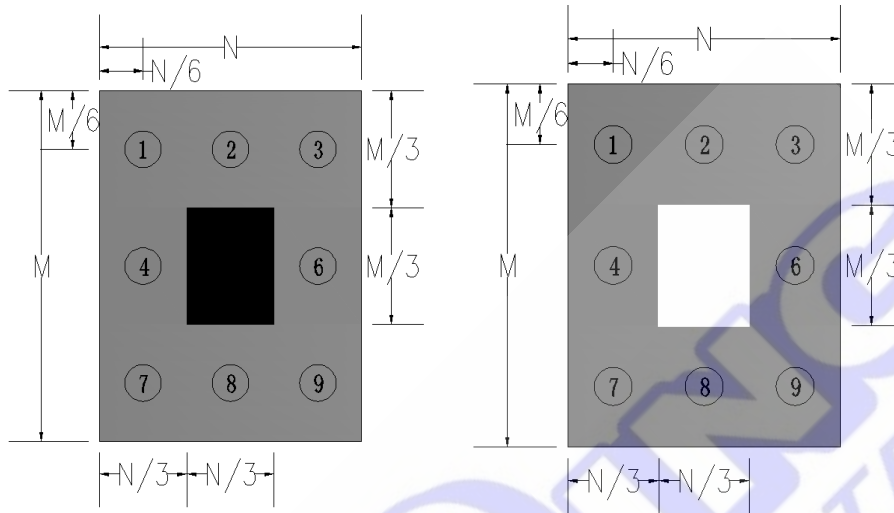
- There should be no visible cross-talk in normal direction of the display when the two "Cross-talk Test Patterns " below are loaded.
- Measurement equipment:CS2000 or similar equipments
- The point should be marked is, the background of Cross-talk Test Pattern-"gray " are defined as middle gray scale . For example, RGB 24bit "gray" defined as below:

R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

- $\Delta B_{pn} = B_{pn}(\text{gray}) / B_{pn}(\text{white})$
Which n means the dot No. In the Cross-talk Test Pattern ;
B_{pn} (gray) means the brightness of the No.n spots in Cross-talk Test Pattern;

B_{pn} (white) means the brightness of the No.n spots in Full white Test Pattern;

- ΔB_p (Max.) = Maximum value in $\Delta B_p1 \sim \Delta B_p9$, except the No. 5 spot.
- ΔB_p (Min.) = Minimum value in $\Delta B_p1 \sim \Delta B_p9$, except the No.5 spot.
- $\Delta CT = \Delta B_p$ (Max.) / ΔB_p (Min.).
- ΔCT must be less than 1.10



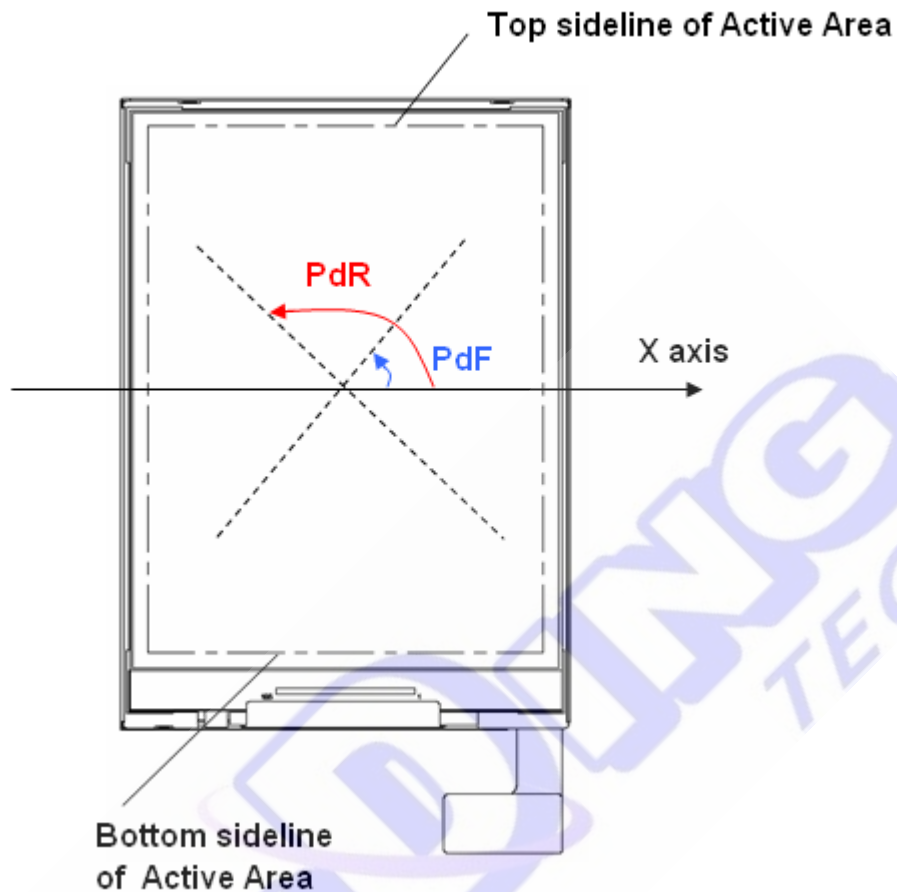
Cross-talk Test Pattern

Note 17: Reflectance Ratio

- Measurement equipment : X-rite SP64
- Measurement parameter: Reflectance Ratio @550nm

Note 18: Polarization Direction Definition

- Viewing direction is normal user viewing direction which is vertical to the display surface
- The polarizer which is closer to viewer is defined as Front Polarizer
- The polarizer which is on the rear side of viewer is defined as Rear Polarizer
- The X axis is defined as parallel line to top & bottom sidelines of the Active Area
- Pdf which is marked in blue arrow is polarization degree of Front polarizer
- Pdb which is marked in red arrow is polarization degree of Back polarizer
- The polarization degree parameter must be indicated in range of 0deg to 180deg according to above definition



Polarization Definition

Note 19: Definition of Luminance decrease ratio

- Refer to the graph of note 9.
- Test pattern : Full White
- The luminance decrease ratio is calculated by using following formula:

$$\text{Luminance decrease Ratio} = 1 - \frac{\text{Luminance test at } \theta_L/\theta_R/\psi_T/\psi_B=30^\circ}{\text{Luminance test at } \theta_L/\theta_R/\psi_T/\psi_B=0^\circ}$$

Note 20: Definition of Contrast decrease ratio

- Refer to the graph of note 9.
- Using contrast test method.
- The contrast decrease ratio is calculated by using following formula:

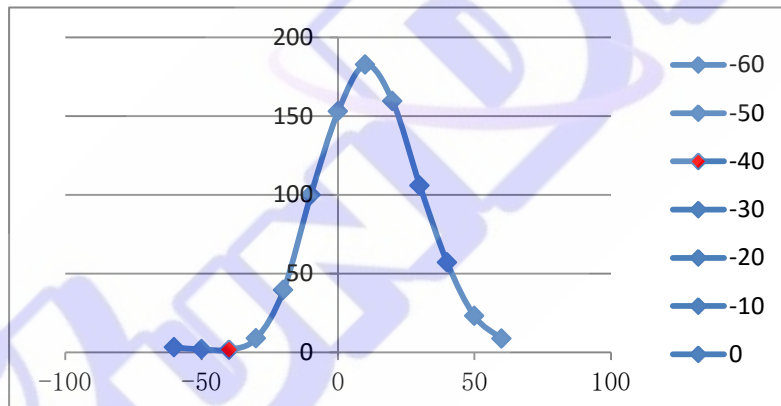
$$\text{Contrast decrease Ratio} = 1 - \frac{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=30^\circ}{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=0^\circ}$$

Note21: Color Shift JNCD

- For JNCD measure:
- Fix on one pattern like white pattern,
- On the condition $\theta=0$ $F=0^\circ$, we can get the color coordinate (u_1', v_1') and on $\theta L=30^\circ$ we can get another color coordinate (u_2', v_2')
- $\Delta = \text{Square Root}((u_2' - u_1')^2 + (v_2' - v_1')^2)$
- JNCD stands for "Just Noticeable Color Difference"
- For the (u', v') color space $JNCD=0.0040$.
- $2JNCD$ means $\Delta u'v' < 0.0080$
- For color shift we need to measure white/red/green/blue pattern.
- This Requirement is from our customer and we have test some of our phone display and the result is OK.

Note 22: Definition of gray inversion angle

- Refer to the graph of note 9.
- Using luminance test method.
- Test pattern : 128 gray
- If the viewing direction is 12 o'clock ,then test the luminance while $\theta=-60^\circ$; $\theta=-50^\circ$; $\theta=-40^\circ$; $\theta=-30^\circ$; $\theta=-20^\circ$; $\theta=-10^\circ$; $\theta=0^\circ$; $\theta=10^\circ$; $\theta=20^\circ$; $\theta=30^\circ$; $\theta=40^\circ$; $\theta=50^\circ$; $\theta=60^\circ$. The luminance test as figure below:



The minimum luminance should not happen in $|\theta| < 40^\circ$

Note 23: After image judgment

- Power on the LCD 1 hour at tessellated picture(8*8), then switch to 128 gray picture or Flicker picture, if the afterimage can't be seen within 3 minutes, the LCD is OK.

Note 24: CABC Test

- Measurement equipment :CS-2000 or similar equipments
- Testing picture: CABC Brightness-Gray and APL FIX gamma test picture.

Test method:

- Power on LCD, test Brightness-Gray picture, drawing the brightness-gray curve, confirm save the power's scale.
- Test APL FIX gamma picture, drawing the APL FIX gamma curve, assurance the curve is smooth.
-

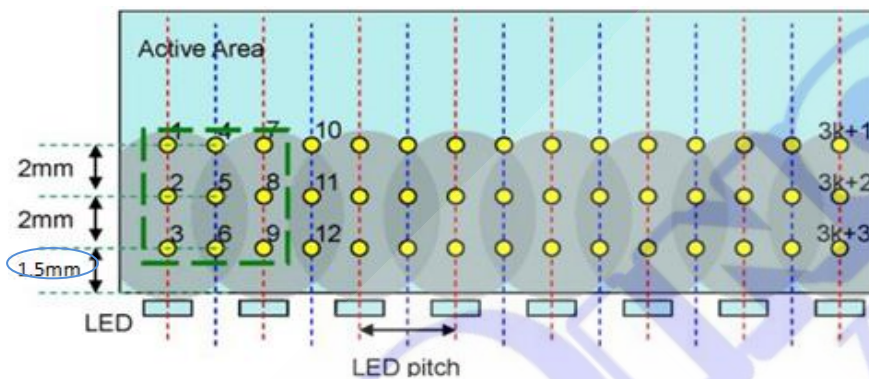
Note 25: Hot spot Test

(Based on VESA-2.0-306-1)

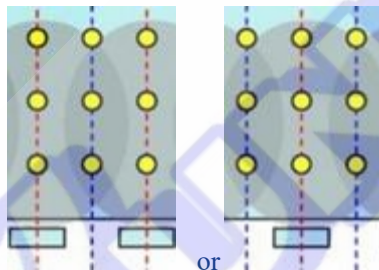
Equipment used by : Imaging Photometer System

The goal of this measurement is to evaluate the uniformity of between the worst-case bright and dark spots found along the LED launching area of the module.

1. The backlight is to be measured at the module level, using the drive circuit contained on the LCD module or the recommended circuit.
2. The backlight shall be allowed to warm up for 1 minute for this test.
3. The display shall be driven with all white pixels with the contrast set to optimal.
4. The luminance shall be measured directly in front of the LEDs ("Hot areas") and directly between the LEDs ("Dark areas") along the launching area edge of the panel. The measurement spot size of the "hot" and "dark" locations shall be 5mm in diameter.
5. Hot Spot uniformity is defined as:



- Hot spot uniformity = L_{Min} / L_{Max}
- Every near 9 points define



Note 26 Color uniformity

- Measurement Conditions

Recommended measuring equipment for color is ICPMI16 Colorimeter or similar CCD type equipment.

The optical characteristics are determined after the unit has been 'ON' and stable at the following conditions:

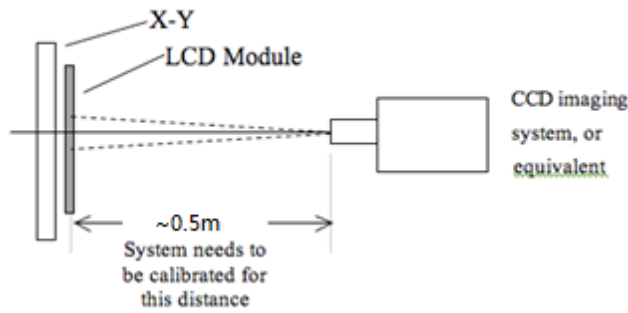
Maximum brightness

Dark environment

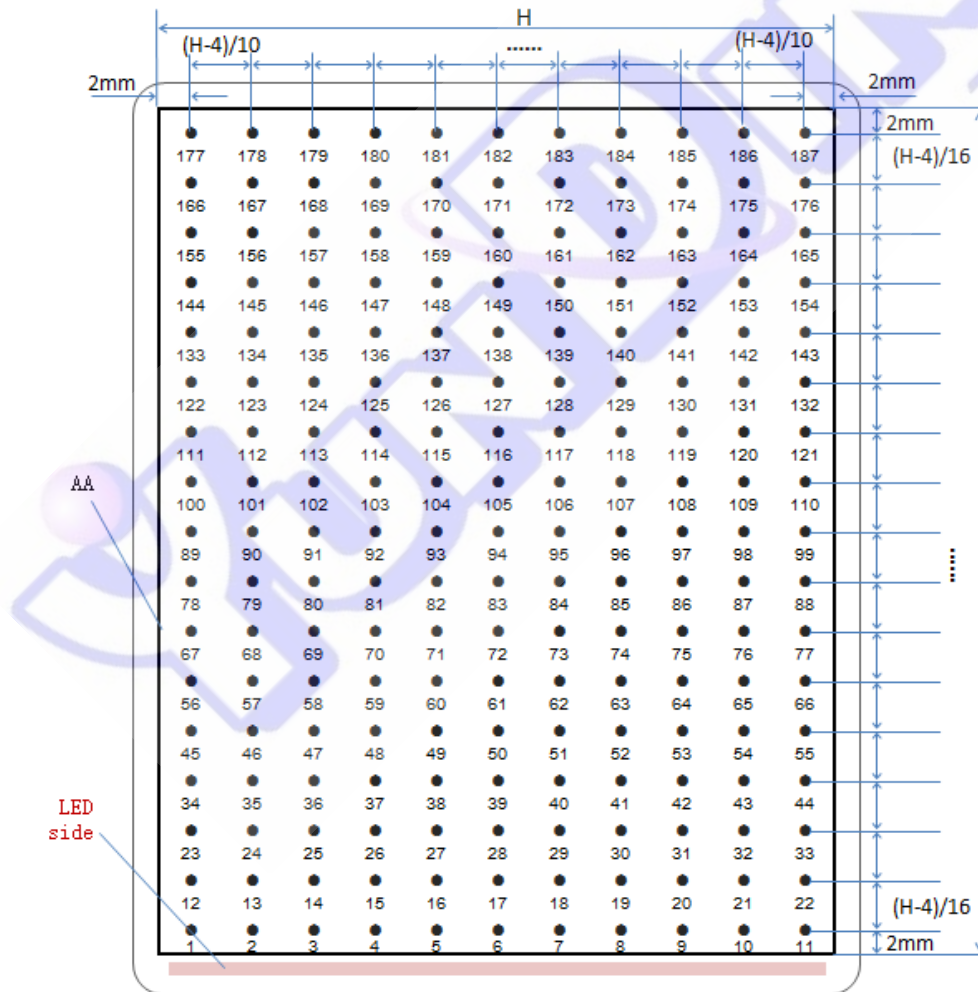
Ambient temperature at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$

- Optical measurement system

Color Measurement



- Total 187 measure points should set as shown in the following figures. The CIE 1976 Standards shall be used.
- The color difference is calculated by using following formula:
 Max (Δu^*v^*-A) (the max Δu^*v^* value between two random point of 187 point)
 Max (Δu^*v^*-B) (the max Δu^*v^* value between two adjacent point in column and row of 187point)



9 Packing Method

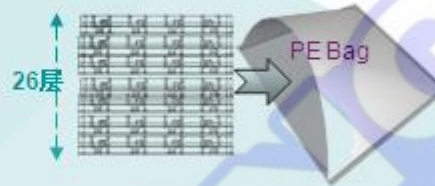
9.1 Packing order

- 将 1pcs MDL 平放入Tray, CF 侧向上放置:



- 将26pcs PET Tray 平放入PE Bag 顶部1pcs 空Tray

- Tray 不旋转码放



- 每个Pallet上放3层Box
- 1层8箱 共计24ea Box
- Pallet外进行缠膜包装
- 容量: 600pcs/Pallet



贴附信息标签



胶带十字封口

- 将风琴袋弯折后用胶带进行十字封口, 用1pcs 信息标签贴附在封口边缘:
- 将PET Tray堆码后平放入Inner Box 上下放置EPE Board
- 容量: 25pcs/Inner Box

- **Box Dimension: 375mm(W) x 280mm(D) x 290mm(H)**
- **Package Quantity in one Box: 25pcs**

10 Reliability Requirement

NO	Document No.	Type	Attachment file
1	-	mechanism	Attachment
2	-	environment	
3	-	electric	
4	-	ROSH	Attachment

Double-Click the “Attachment Icon” above for opening attachment file.

10.1 General Reliability Requirement

Test item	Test condition	No. of failures / No. of examinations
Low temperature storage test	Ta= -20°C, 240h	0/5
High temperature storage test	Ta= 70°C, 240h	0/5
Low temperature operation test	Ta= -10°C, 240h	0/10
High temperature operation test	Ta= 60°C, 240h	0/10
High temperature & High humidity operation test	Ta=50°C, 90%RH, 240h	0/32
Thermal Shock	(-20°C 30min) → (70°C 30min)]/cycle, 100cycles	0/32
Electrostatic discharge test	330ohm,150pf Contact:+/-4KV Air: +/-8KV	0/5

Note 26:Electrostatic discharge test Requirement :

- It must test 9 spots as marked in below picture
- 10 times for each spots
- The interval between the two neighboring discharge must be Less than 3 seconds

