PRODUCTION SPECIFICATION
OF TFT LCD MODULE

Model No. : M215HCS01 B1F

OC PN: SN215CS01-1

CUSTOMER	
CONFIRMED BY	
APPROVED BY	

DILIANG ELECTRONICS	
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Date	Rev.	Page	Old Description	New Description	Remark
2023.10.15	1.0	All	The specification was first issued		

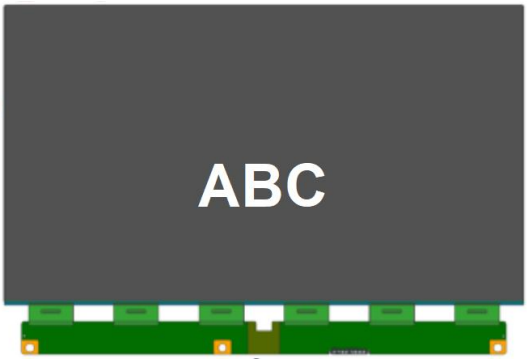
1. GENERAL DESCRIPTION

1.1 OVERVIEW

M215HCS01 B1F is a TFT LCD **FRAME LESS** module which used CSOT SN215CS01-1 open cell. This Opencell is a diagonal **21.5”** TFT Liquid Crystal Display open cell and it supports 1920 x 1080 FHD mode with 16.7M colors. This product is with data driver ICs and a 30-pinsconnector with LVDS interface.

1.2 General Specifications

Item	Specification	Unit	Note
Screen size	21.5 inch		
Active Area	476.064 (H) ×267.786 (V)	mm	
Module Size	488.00 (H) * 276.70 (V) *13.10 (D)	mm	
Weight	1.7	kg	Max.
Driving Scheme	a-Si TFT Active Matrix	-	
Number of Pixels	1920 * 1080	pixel	
Pixel Pitch (Sub Pixel)	0.24795*0.24795	mm	
Pixel Arrangement	RGB Vertical Stripe	-	
Display Colors	16.7 M	color	8bit
Display Mode	HIS, Normally Black		
Display Orientation	Signal input with “ABC”		
Module Brightness	250	Cd/㎡	Typical value measured at DL BLU
Color Chroma	R = (0.655, 0.337)		
	G = (0.307, 0.617)		
	B = (0.145, 0.065)		
	W = (0.310, 0.330)		
Contrast Ratio	1000:1(Typ.)		
Color Gamut	99% sRGB		
View Angle (CR 10)	+89/-89 (H), +89/-89 (V) (Typ.)		
Surface Treatment	Anti-glare, Haze 2%, Hard Coating (3H)		



1.3. Mechanical Specification

Item		Min	Typ	Max	Unit	Note
Weight		-100	1400	+100	g	-
Module Size	Horizontal(H)	(TYP)-0.5	484.50	(TYP)+0.5	mm	1
	Vertical (V)		284.40		mm	
	Depth(D)		12.35		mm	

2. Absolute Maximum Ratings

2.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Conditions
Operating Temperature	TOP	0	+50	[oC]	Note 3
Glass surface temperature (operation)	TGS	0	+65	[oC]	Note 3, Note 4
Operation Humidity	HOP	5	90	[%RH]	Note 3
Storage Temperature	TST	-20	+60	[oC]	
Storage Humidity	HST	5	90	[%RH]	

Note 1: (1) a. 90 % RH Max. (Ta ≤ 40 。C).

b. Wet-bulb temperature should be 39℃ Max.(Ta>40℃)

c. No condensation

d. Operating condition with a assemble module

(2) Any point on the Driver surface must be less than 120 ºC under any condition ,If the surface temperature is out of the spec, thermal solutions should be applied to avoid be damaged.

(3) Surface temperature of display area is measured at 50℃ dry condition

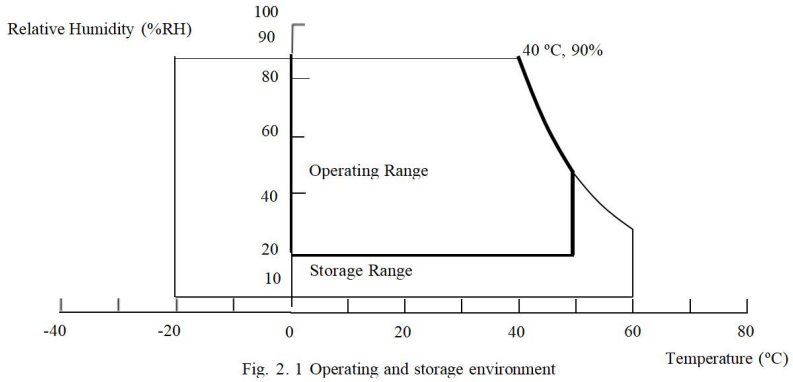


Fig. 2. 1 Operating and storage environment

2.2 Backlight Unit

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
LED operation Voltage	V_{led}	51	-	57	V_{led}	
LED operation Current	I_{led}	-	240	-	mA	- (1)
BackLight Power	P_{BL}	12.24	-	13.68	W	
Lift time	Lt	30000	40000	-	Hrs	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal operating Conditions.

3. ELECTRICAL CHARACTERISTICS

3.1 Open Cell Power Consumption (TA = 25 ± 2 °C)

3.1.1 Power Consumption

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		VCC	4.5	5.0	5.5	V	-
Ripple Voltage		VRP	-	-	500	mV	(2)
Power Consumption		PLCD	-	3.5	5.5	W	(3)
Rush Current		IRUSH	-	-	3	A	(4)
Power Supply Current	White Pattern	-	-	0.38	0.5	A	(3)
	Horizontal Stripe	-	-	0.92	1.1	A	
	8 Color Bar H	-	-	0.56	0.7	A	

Note ：

(1) Measurement Conditions

Item	Symbol	Value	Unit
Temperature	Ta	25±2	℃
Humidity	Ha	50±10	%RH

Note:

(1) The Ripple Voltage should be measured under the condition of VCC(typ),TA=25 ± 2 ℃ , FR=Max. (Frame Rate)condition and at that time, we recommend the bandwidth configuration of oscilloscope is to be under 20MHz.Refer to page 9 for the white pattern.

(2) Measurement condition: VCC rising time = 470 μs.

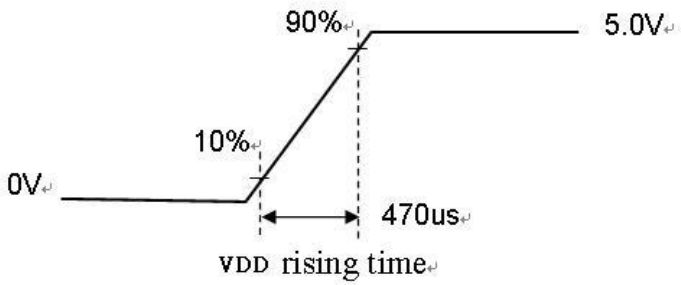


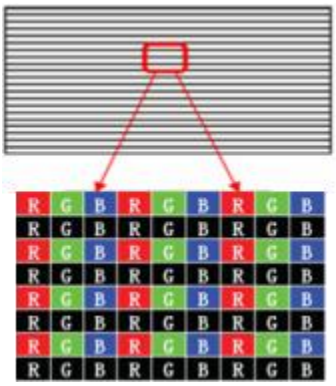
Fig. 3.1 VCC rising time condition

(3) Measurement condition: VCC = 5V, Ta = 25 ± 2ºC, F = 60 Hz. The test patterns are shown as below.

A. White Pattern

B. color bar H

C: Horizontal 1 line Pattern



(4)The typical power consumption is specified at the pattern with the color bar H, refresh rate is 60Hz, VIN is 5V.

The max power consumption is specified at the pattern with the Horizontal 1 line, refresh rate is 75Hz, VIN is 5V.

3.1.2 LVDS Characteristics

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
LVDS interface	Differential Input High Threshold Voltage	V_{TH}	-	-	+100	mV	(1)
	Differential Input Low Threshold Voltage	V_{TL}	-100	-	-	mV	
	Common Input Voltage	V_{CM}	1.0	1.2	1.4	V	
	Differential input voltage	$\|V_{ID}\|$	100	-	600	mV	
	Terminating Resistor	RT	90	100	110	ohm	

Note:

(1) The product should be always operated within above ranges.

(2) The LVDS input signal has been defined as follows:

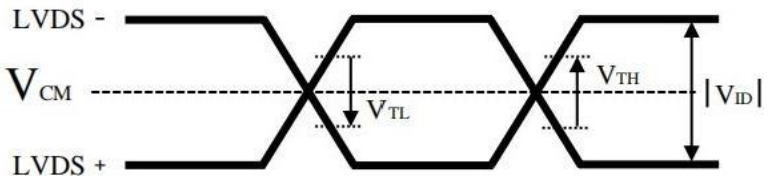


Fig. 3.2 LVDS input signal

3.1.3 LVDS format

VESA Format

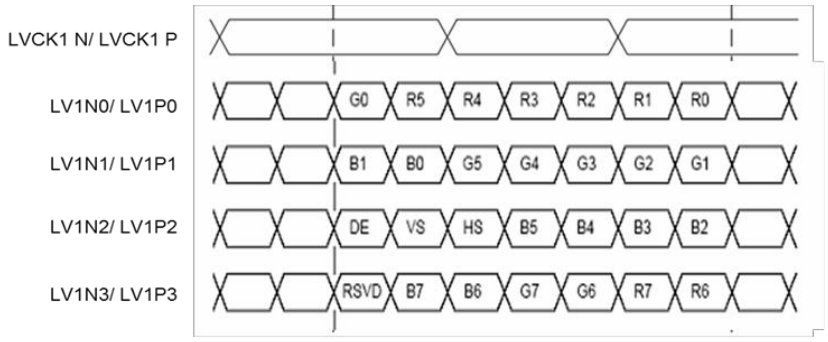
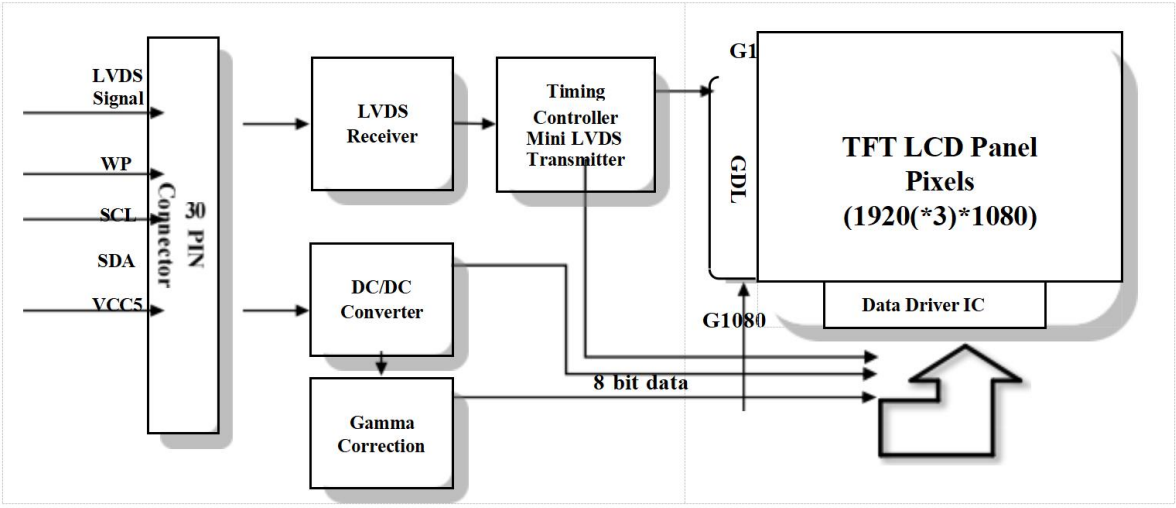
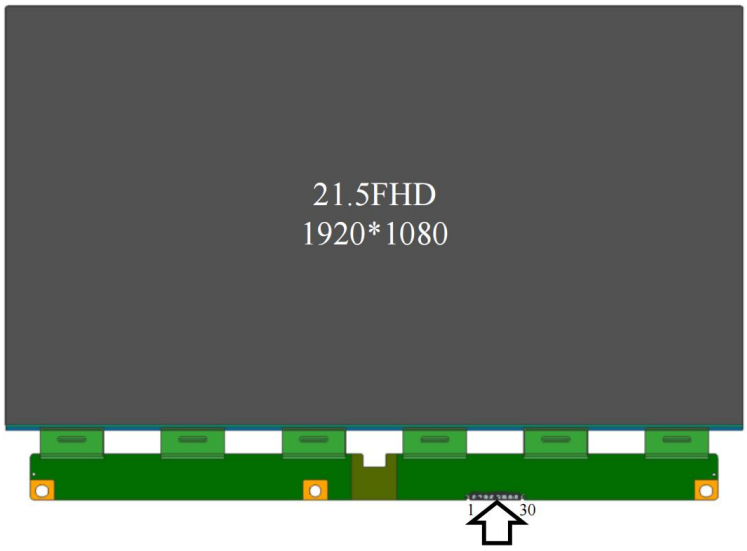


Fig 3.3 VESA format

3.2 Block diagram



3.2.1 Block Diagram of Interface



LVDS 2CH Signal Input

4. Interface Connections

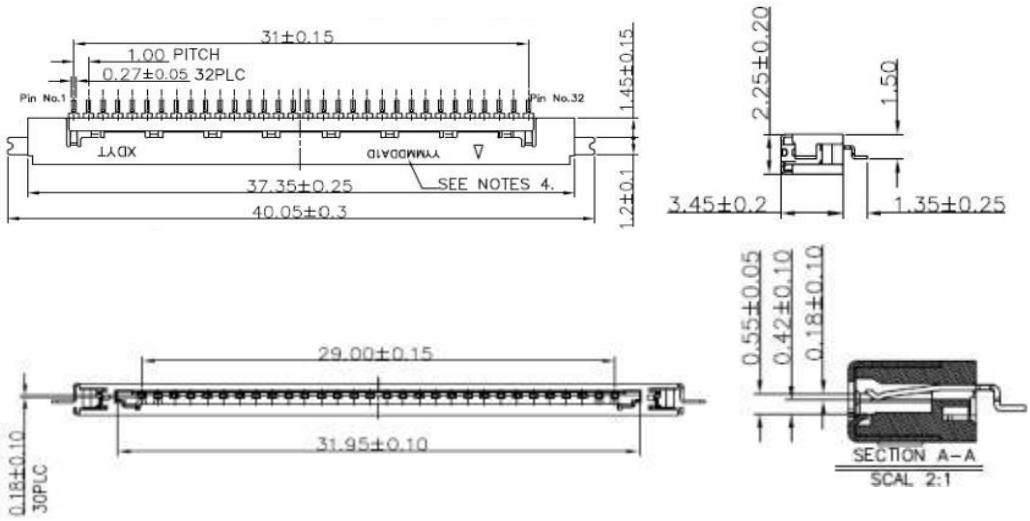
4.1 Interface Pin Assignment

CN1: 3-10522317-0 1mm 30P SMT or equivalent (see Note (1))

PIN #	Symbol	Description	REMARK
1	RXO0-	LVDS Odd Data(-)	
2	RX00+	LVDS Odd Data(+)	
3	RXO1-	LVDS Odd Data(-)	
4	RXO1+	LVDS Odd Data(+)	
5	RXO2-	LVDS Odd Data(-)	
6	RXO2+	LVDS Odd Data(+)	
7	GND	Power Ground	
8	RXOCLK-	LVDS Odd Clock(-)	
9	RXOCLK+	LVDS Odd Clock(+)	
10	RXO3-	LVDS Odd Data(-)	
11	RXO3+	LVDS Odd Data(+)	
12	RXE0-	LVDS Even Data(-)	
13	RXE0+	LVDS Even Data(+)	
14	GND	Power Ground	
15	RXE1-	LVDS Even Data(-)	
16	RXE1+	LVDS Even Data(+)	
17	GND	Power Ground	
18	RXE2-	LVDS Even Data(-)	
19	RXE2+	LVDS Even Data(+)	
20	RXECLK-	LVDS Even Clock(-)	
21	RXECLK+	LVDS Even Clock(+)	
22	RXE3-	LVDS Even Data(-)	
23	RXE3+	LVDS Even Data(+)	
24	NC	For HKC test only, WP	
25	NC	For HKC test only, SCL	（2）
26	NC	For HKC test only, SDA	（2）
27	NC	For HKC test only, Bist	（2）
28	Vcc	Power supply+5.0V	
29	Vcc	Power supply +5.0V	
30	Vcc	Power supply +5.0V	

Note:

（1）Interface Connector Information



4.2 Built-in Self Test Patterns

The TCON is built invariable test patterns. The sequence and display time of test patterns could be set by EEPROM code.An example BIST pattern is as the following table.

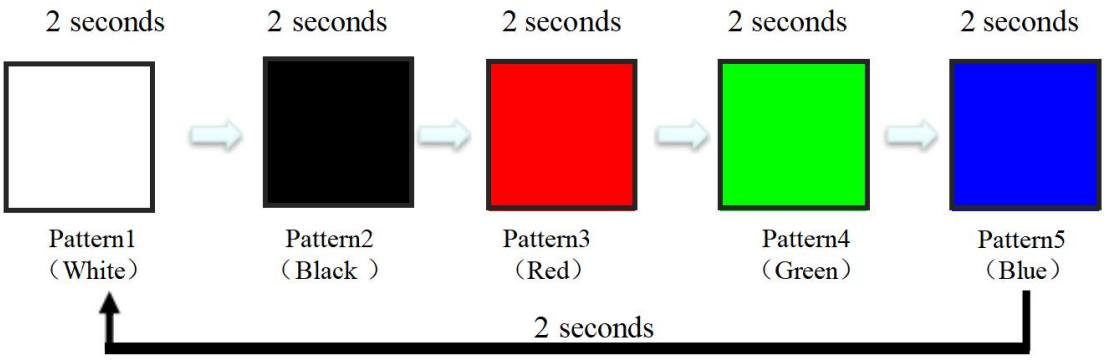


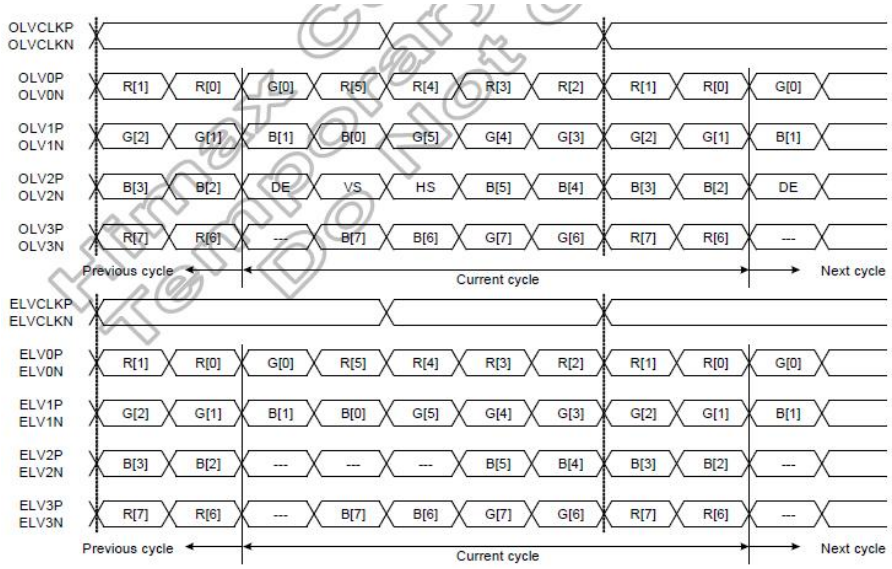
Figure 4.2 BIST patterns

Note: BIST_MODE pull high/low setting

L = Connect to GND, H =Connect to +3.3V

BIST_MODE	Note
L or Open	Available LVDS Signal input:Display LVDS Input Pattern No LVDS Signal or unavailable LVDS Signal input: Display Black Pattern
H	Available LVDS Signal input:Display LVDS Input Pattern No LVDS Signal or unavailable LVDS Signal input: Display Bist Pattern

4.3 LVDS data mapping type could be set by internal registers, and 8-bit data sequence is shown as following table.



4.4 Backlight Electrical / Optical Characteristics

4.4.1 backlight connector

"CN2 : BH3.5-2P

Pin#	Signal Name
1	VDD-
2	VDD-
3	VDD+
4	VDD+
5	VDD-
6	VDD-

4.4.2 LED Bar

Parameter	Symbols	Min	Typ	Max	Unit
Forward Voltage (one circuit)	VF	2.8	-	3.6	MHz
Reverse Current (one circuit)	IR	-	-	10	µA
Forward Current	IF	-	60	100	Ma
Chromaticity Coordinates	X	0.247	0.267	0.287	
	Y	0.222	0.242	0.262	
Lumen	¢	20	22	24	LM
Viewing Angle	2θ1/2	-	120	-	Deg.
Number Of LED	Pcs	-	72	-	Pcs
Operation Voltage(LB)	VLB	51	-	57	V
Operation Current(LB)	ILB	-	240	-	mA
Power Consumption	PLB	12.24	-	13.68	W

5. Interface Timing

5.1 Timing Table (DE Only Mode)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fclkin	45	74.25	95	MHz	(1)
	Input cycle to cycle jitter	Trel	-	-	200	Ps	(2)
	Spread spectrum modulation range	Felkin_mod	Felkin-3%	-	Felkin+3%	MHz	(3)
	Spread spectrum modulation frequency	FSSM	30	-	200	KHz	
LVDS Receiver Data	Receiver Skew Margin	TRSM	-380	-	380	PS	(4)
Vertical Term	Frame Rate	F	48	60	75	Hz	
	Total	TV	1110	1125	1836	TH	TV=TVD+ TVB
	Active Display	TVD	1080			TH	
	Blank	TVB	30	45	756	TH	
Horizontal Term	Total	TH	1050	1100	1250	TCLK	TH = THD+THB
	Active Display	THD	960			TCLK	
	Blank	THB	90	140	290	TCLK	

(1) The TFT LCD open cell is operated in DE only mode, H sync and V sync input signal have no effect on normal operation.

(2) Please make sure the range of pixel clock follows the following equations:

FCLK (max) ≥ Fmax ×TV ×TH FCLK (min) ≤ Fmin ×TV ×TH

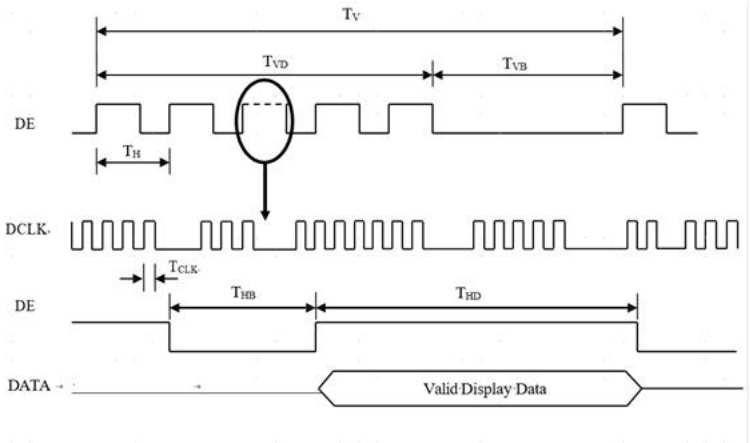


Fig. 5.1 Interface signal timing diagram

5.2 Power On/Off Sequence

To prevent a latch-up or DC operation of the Open cell, the power on/off sequence should be as the diagram below.

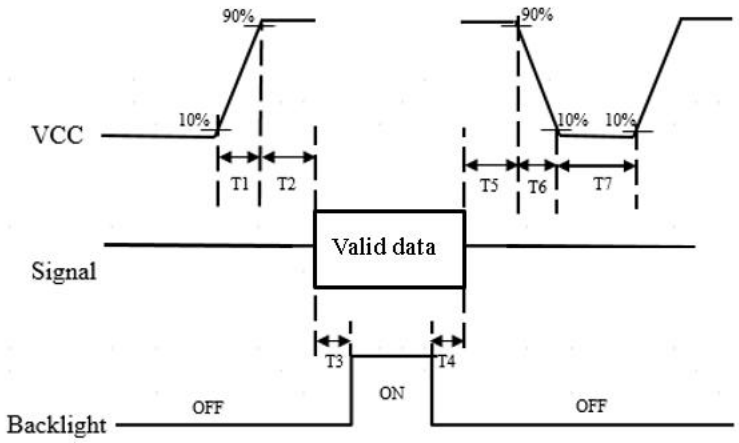


Fig.5.2 Power on/off sequence

Item	Values			Units
	Min.	Typ.	Max.	
T1	0.5		10	ms
T2	0	30	50	ms
T3	450			ms
T4	100	250		ms
T5	0	20	50	ms
T6	0.1		100	ms
T7	1000			ms

Attention:

(1) Apply the light bar voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

(2) In case that VCC is in off level, please keep the level of input signals on the low or high impedance.

(3) T4 should be measured after the module has been fully discharged between power off and on period.

(4) Interface signal shall not be kept at high impedance when the power is on.

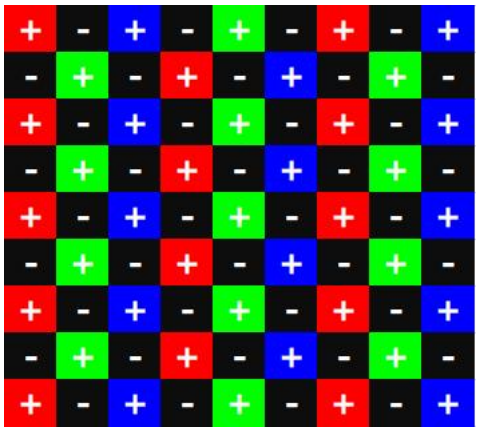
(5)To avoid some abnormal display noise, we suggest “Vcc falling time” to follow “T6” definition.

5.3 Flicker Adjustment

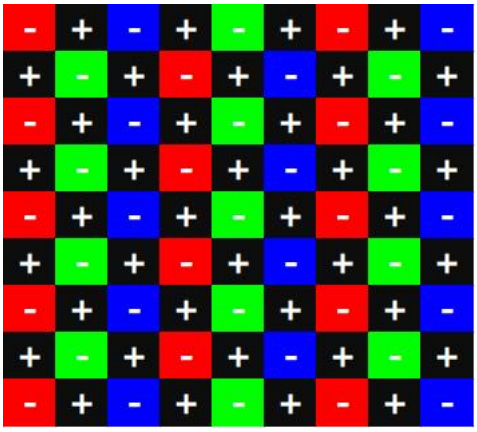
5.3.1 Flicker must be optimized after module assembly and aging. Its patterns are as follow:
sub pixel checker under 50% gray level

Sub pixel checker 128 gray

Frame

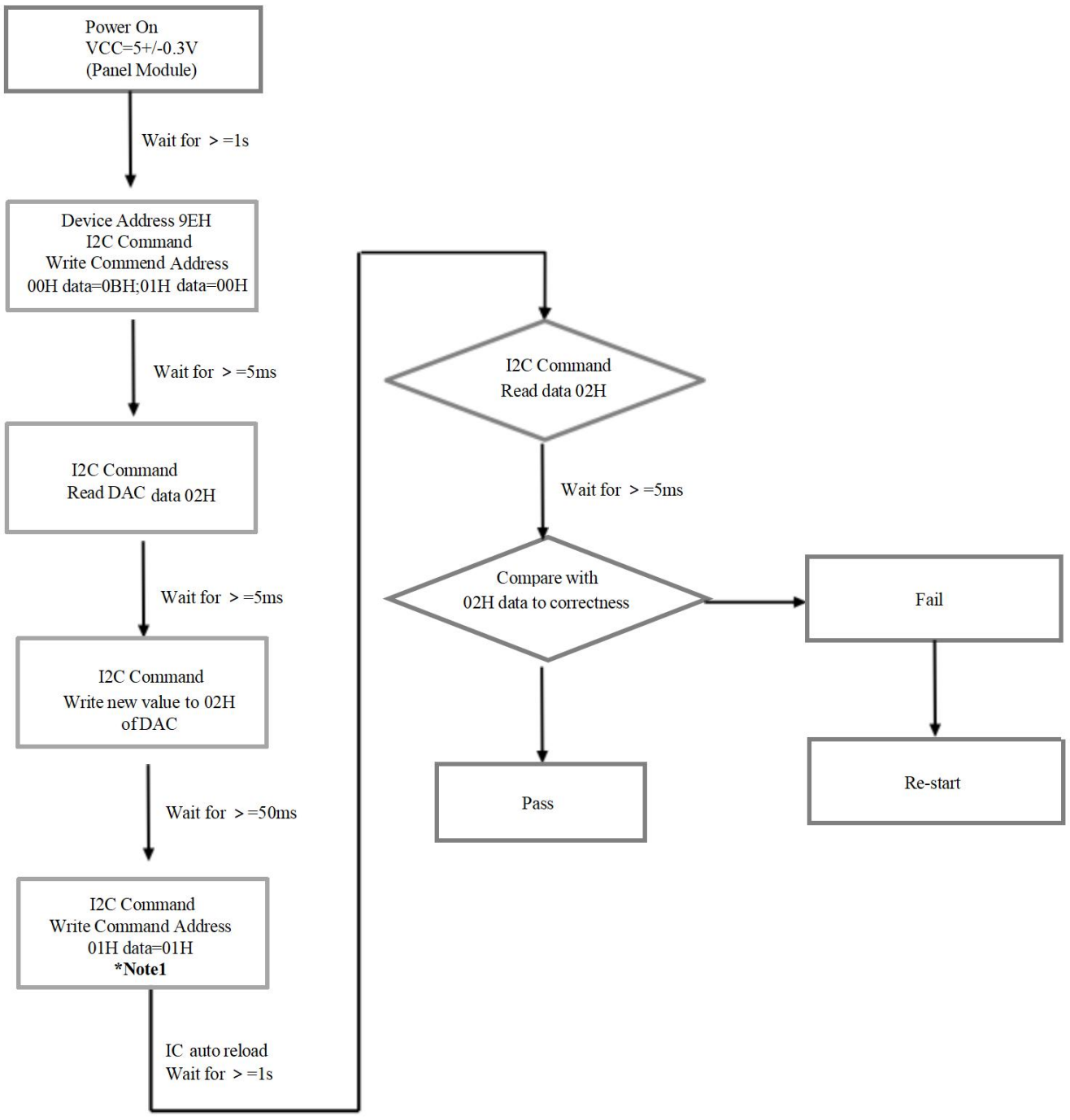


Frame N+1



5.3.1 Bright sub-pixel=G127(50% grayscale); dark sub-pixel=G0（0% grayscale）

5.3.2 Digital VCOM Modify Flow



5.3.3 VCOM Adjust Step

DEVICE ADDRESS	Command address	Descritpion	D7	D6	D5	D4	D3	D2	D1	D0	Default
0b1001111	00h	WP_PASSCODE	WP_PASSCODE(7:0)								0B
0b1001111	01h	WRITE_PROT								DEVICE_WP	00
0b1001111	02h	VCOM		VCOM(6:0)							40

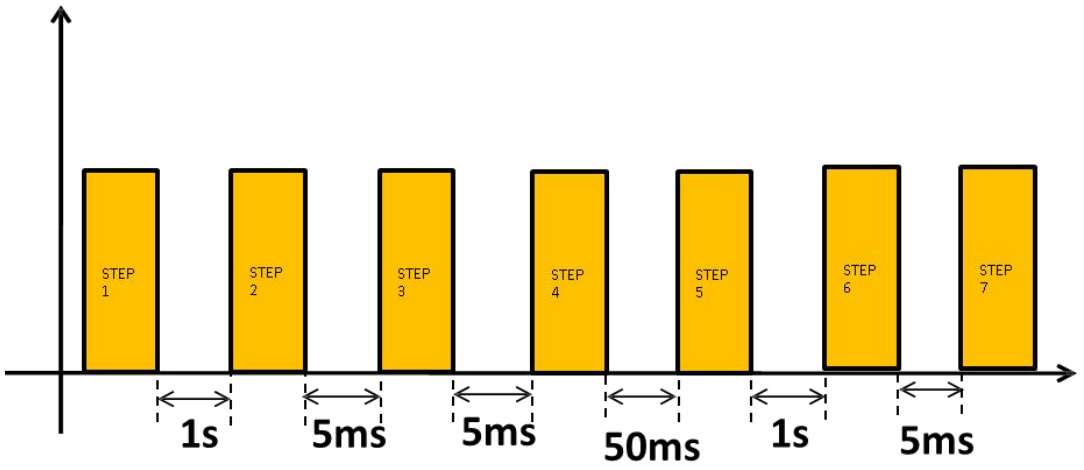
Slave address 10011110 = 9Eh STEP1.
Power On
Wait 1s STEP2
Multi-Write command: 9Eh; 00h, 0Bh, 00h.

- Address 00h writes 0Bh
- Address 01h writes 00h.

Wait 5ms STEP3
Single read VCOM command: 9Eh, 02h, 9E+1h, Read V
COM data.
Wait 5ms STEP4
Single write new VCOM command: 9Eh, 02h, xxh.

- xxh = new VCOM code

Wait 50ms STEP5
Single write command: 9Eh, 01h, 01h.
•Address 01h writes 01h. (Program to MTP)
Wait 1s STEP6
Single read new VCOM command: 9Eh, 02h, 9E+1h, Read new VCOM data.
Wait 5ms STEP7
Check new VCOM code. If yes, done; Otherwise, go to STEP2.
3.6.4 Interval times of Step to Step
The interval times must follow below figure.



5.3.4 Driver IC ESD Spec

If the LCD module is designed with the Plastic Bezel, we suggest ESD protection solutions should be applied to avoid IC damaged, as shown in Fig.5.3.4

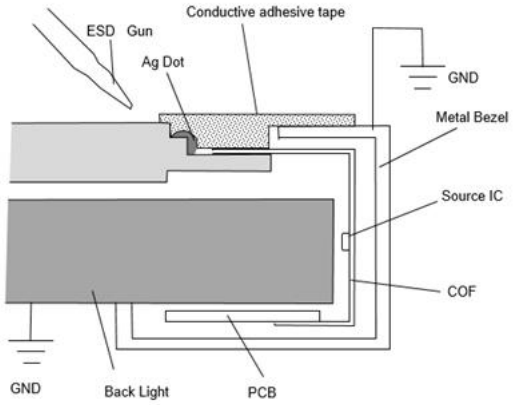


Figure 5.3.4 Source COF IC ESD protection

6 Optical Characteristics

6.1 Test Condition

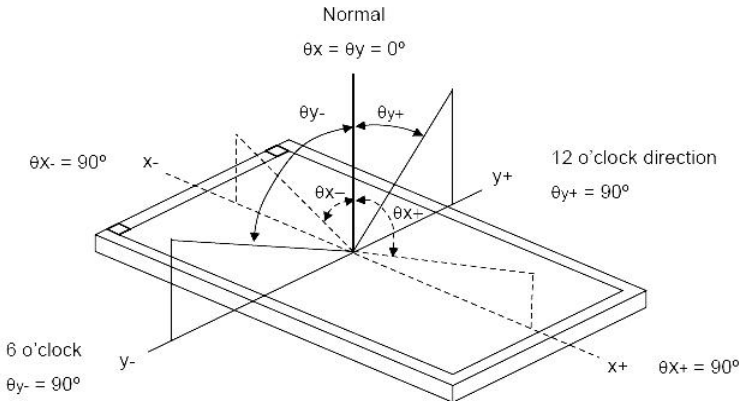
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25 ± 2	℃
Ambient Humidity	Ha	50 ± 10	%RH
Supply Voltage	Vcc	5.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Input Voltage	V_{LED}	53.0	V
LED Input Current	I_{LED}	240.0	mA
Power Consumption	Pw	12.7	W

6.2 Optical Characteristics

The relative measurement methods of optical characteristics are shown as below.
The following items should be measured under the test conditions described in 6.1

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	Θx=0° Θy=0°	700	1000	—	—	—
Response Time		Tg		—	14	25	ms	Note 3
Brightness uniformity		BU	θx=0,θy=0, viewing normal angle	70	75	—	—	Note 2
Center Luminance of White		Lc		220	250	—	cd/m2	—
The color chromatic	Red	Rx		Typ. -0.03	0.655	Typ. +0.03	—	—
		Ry			0.337		—	—
	Green	Gx			0.307		—	—
		Gy			0.617		—	—
	Blue	Bx			0.145		—	—
		By			0.065		—	—
	White	Wx			0.310		—	—
		Wy			0.330		—	—
Viewing Angle	Horizontal	θx+	CR≧10	85	89	—	Deg	Note 1
		θx-		85	89	—		
	Vertical	θy+		85	89	—		
		θy-		85	89	—		

Note 1: The definition of viewing angle



Note 2: Definition of luminance , CR measured positions and brightness uniformity

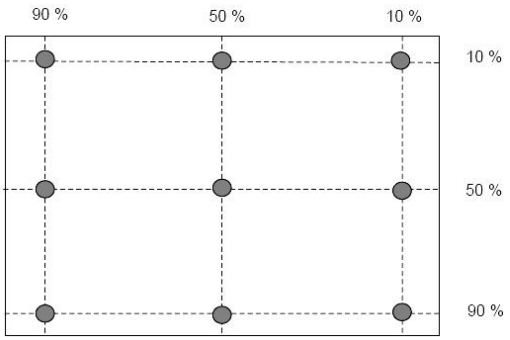
(a) Measure White luminance on the below 9 points and take the average value .

(b) CR : measures the same 9 points and take the average value .The Definition of Contrast Ratio is as follows :

CR = ON(white L63)Luminance / OFF (Black L0)Luminance

(c) The definition of White Vibration

$$\frac{\text{The minimum brightness of 9 dot}}{\text{The maximum brightness of 9 dot}} \times 100\%$$

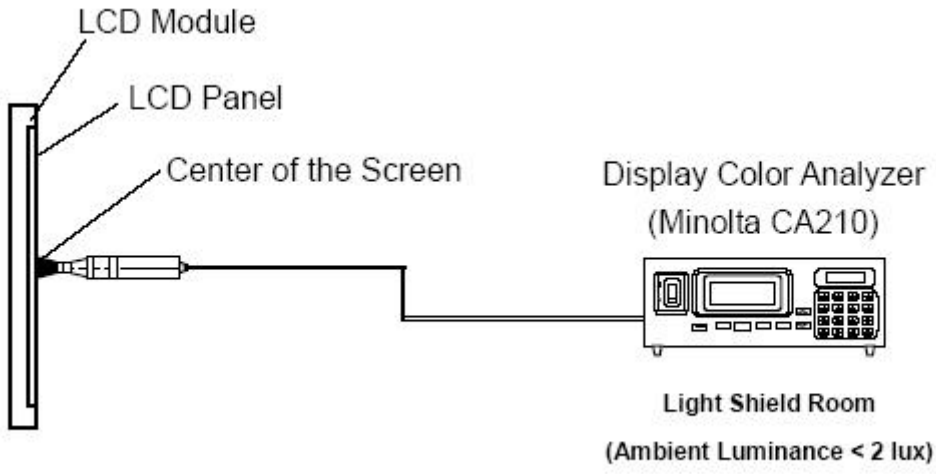


Note 3:Definition of Response time (Tg):

Average of gray to gray response time (Tg) means the average switching time of luminance ratios among 0%,25%,50%,75%,and 100% to each other and is optimized on frame rate =60Hz（ Max 75Hz ）

Measured Response time		To				
		0%	25%	50%	75%	100%
From	0%		$T_{0\%to25\%}$	$T_{0\% to 50\%}$	$T_{0\% to 75\%}$	$T_{0\% to 100\%}$
	25%	$T_{25\% to 0\%}$		$T_{25\% to 50\%}$	$T_{25\% to 75\%}$	$T_{25\% to 100\%}$
	50%	$T_{50\% to 0\%}$	$T_{50\% to 25\%}$		$T_{50\% to 75\%}$	$T_{50\% to 100\%}$
	75%	$T_{75\% to 0\%}$	$T_{75\% to 25\%}$	$T_{75\% to 50\%}$		$T_{75\% to 100\%}$
	100%	$T_{100\% to 0\%}$	$T_{100\% to 0\%}$	$T_{100\% to 50\%}$	$T_{100\% to 75\%}$	

Note 4: The measure method



(a) : The measurement point is the center of the active area except for the measurement of Luminance Uniformity

(b) : Photometer :CA-210

Note 5: Definition of Crosstalk (2D)

Crosstalk of one area of the LCD surface by another shall be measured by comparing the luminance (A), with all display pixels set to a gray level, to the luminance (B) of that same area when any adjacent area is driven full white pattern which shown in Fig. 4.5. The gray level of background is set to 25% full gray pattern.Crosstalk % = Max.$(\frac{|L_B(X)-L_A(X)|}{L_A(X)} \times 100\%)$, Where the X is point 1 to 4 shown in Fig.6.2

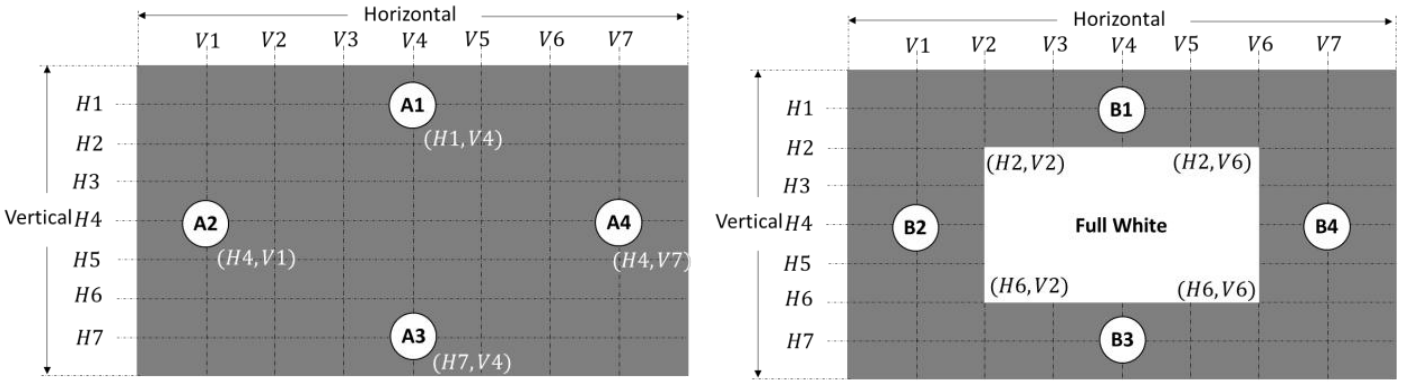


Fig 6.2 Definition of Crosstalk (2D)

Note 6: gamma scale is calculated by the average between gray level 50 and 128.

7.0 Reliability Test

Environment test conditions are listed as following table.

No	Test Items	Conditions
1	High temperature storage test	60℃, 240hrs
2	Low temperature storage test	-20℃, 240hrs
3	High temperature & high humidity ope ration test	50℃, 80%RH, 240hr
4	High temperature operation test	60℃, 240hrs
5	Low temperature operation test	-5℃ , 240hrs
6	Thermal shock	TST- 1: -20~60℃, per 30min, 100 cycle, Storage TST-2: -40~100℃, per 30min, 100 cycle, Storage
7	High temperature & high humidity storage test	THS: 60℃/90%RH, 240hrs THS(8585): 85℃/85%RH, 240hrs
8	Packing Vibration	1.07Grms, 5~300Hz, Random +Z, 2hrs
9	Drop Test	Free fall or one-sided stationary fall

8.0 Shipping Label

8.1Panel Label

8.2 Carton Label

9. Packaging

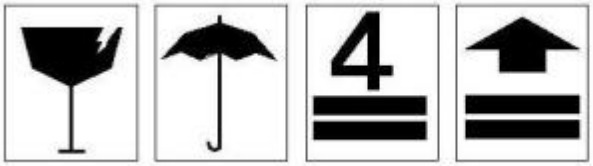
9.1 Carton(internal package)

(1)Packaging Form

(2) Packaging Method

Note 1) Acceptable number of piling : 10 sets

9.2 Packing Mark



10. PRECAUTION

10.1 ASSEMBLY AND HANDLING PRECAUTIONS

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 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 LED panel and Backlight will will be damaged.
4 Always follow the correct power sequence when LED module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
5 Do not pull the I/F connector in or out while the module is operating .
6 Do not disassemble the module.
Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very
7 soft and easily scratched.
8 It is dangerous that moisture come into or contacted the LED module, because moisture may damage LED module when it is operating.
9 High temperature or humidity may reduce the performance of module. Please store LED module within the specified storage conditions.
10 When ambient temperature is lower than 10 ℃ may reduce the display quality. For example, the response time will become slowly.

10.2 SAFETY PRECAUTIONS

1 It is dangerous that moisture come into or contacted the LED module, because the moisture may damage LED module when it is operating.
2 If the liquid crystal material leaks from the panel,it should be kept away from the eyes or mouth, in case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
3 After the modlule's end of life, it is not harmful in case of normal operation and storage.

11. Outline dimensions