111 Corning Rd, Suite 116 • Cary, NC 27518

LCD087-050CTL1ARNTTR4.0

4.97" FHD High Bright Wide Gamut

w/PCAP

1080*1920

Table of Contents

Revision History

Document Revision

Date	Version #	Description
12/20/2018	R1.0	Preliminary Release
4/03/2019	R1.2	Updated Sections: Optical Characteristics, Reliability and Drawing
01/28/2020	R2.0	Updated to CSOT cell with all properties. Datasheet document revision alignment.
3/11/2020	R2.1	Updated drawing
1/5/2021	R3.0	DDIC changed to FT8736 and MIPI sequence reduced, packaging specified. Drawing added as high-resolution appendix. ID and MIPI INIT sections added. Optical coordinates updated. 3 point uniformity specified.
9/7/2021	R4.0	Revised spec for LTS cell. Drawing, Optical, ID field, diagrams updated.
11/17/2021	R4.1	Update Chromaticity typical value and MIPI initial commands.

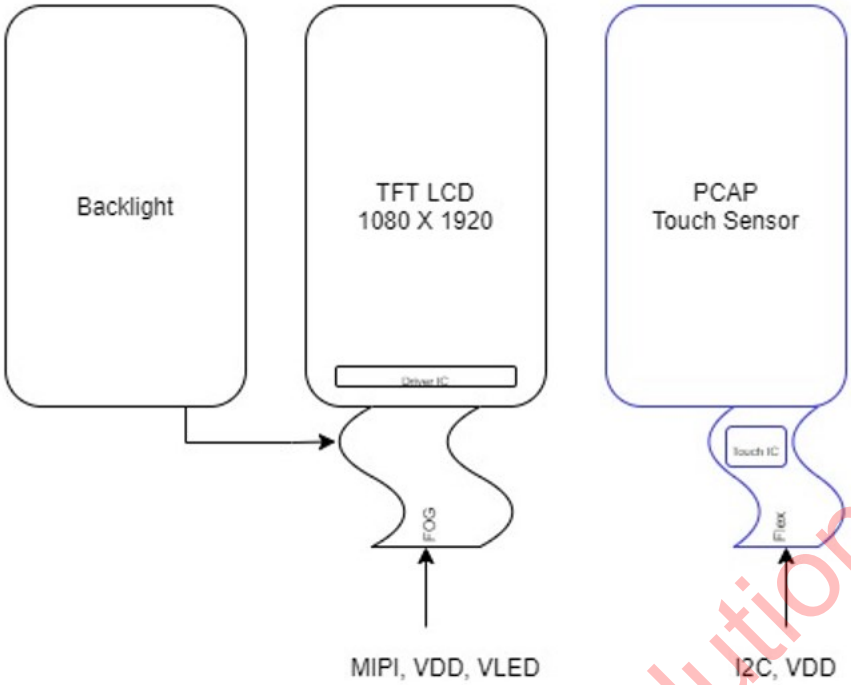
Hardware Revision

Date	Version #	Description
12/20/2018	R0.1	Production sample
3/27/2019	R1.0	Production Release
01/28/2020	R2.0	Updated from Sharp to CSOT glass cell.
3/11/2020	R2.1	Changed CG from 1.1 to 0.7mm
1/5/2021	R3.0	DDIC changed to FT8736
9/7/2021	R4.0	HW update for LTS cell.

General Specifications

Item	Specification	Unit
Outline Dimensions	75.88 (W) X 119.47(L) X 4.20(H)	mm
Display Size	4.97	inches
Active Area	61.88 X 110.02	mm
Sub Pixel Pitch	19.1 X 57.3	um
Number of Dots	1080 X 1920	-
LCD Type	IPS 16.7M Display Color by 8bit	-
Backlight Type	LED Wide Gamut	-
Viewing Direction	Free	-
Touch Panel	PCAP FT5446U	-
Luminance	2000	cd/m^2
Interface	MIPI – Himax HX8399-C	-
Surface Treatment	Cover Lens w/AR	-
Operating	-20 to 70	°C

Block Diagram



Pin Out-LCD

Recommended mating connector Panasonic AYF333135

Number	Symbol	I/O	Description
1	LEDA1	P	LED anode
2	LEDA2	P	LED anode
3	LEDK1	P	LED cathode
4	LEDK2	P	LED cathode
5	NC	-	No Connection
6	GND	P	Ground
7	TE	O	Tear Enable effect pin
8	NC	-	No connection
9	IOVCC	P	Power supply (1.8V)
10	AVDD	P	Positive analog supply voltage
11	AVEE	P	Negative analog supply voltage
12	LEDPWM	O	LED PWM signal
13	RESET	I	Reset in pin (Active low)
14	GND (LCD ID0)	P	GND (Customer ID pin)
15	IOVCC (LCD ID1)	P	IOVCC (Customer ID pin)
16	GND	P	Ground
17	MIPI_2P	I	Positive MIPI data
18	MIPI_2N	I	Negative MIPI data
19	GND	P	Ground

20	MIPI_1P	I	Positive MIPI data
21	MIPI_1N	I	Negative MIPI data
22	GND	P	Ground
23	MIPI_CLKP	I	Positive MIPI clock
24	MIPI_CLKN	I	Negative MIPI clock
25	GND	P	Ground
26	MIPI_0P	I	Positive MIPI data
27	MIPI_0N	I	Negative MIPI data
28	GND	P	Ground
29	MIPI_3P	I	Positive MIPI data
30	MIPI_3N	I	Negative MIPI data
31	GND	P	Ground

Pin Out – PCAP

Recommended mating connector Hirose FH34SRJ-8S-0.5SH (50)

Number	Symbol	I/O	Description
1	RST	I	Reset signal (1.8V)
2	VDD	p	Power Supply (3.3V)
3	INT	O	Interrupt out (1.8V)
4	SDA	I/O	Serial Data (1.8V)
5	SCL	I	Serial Clock (1.8V)
6	NC	-	NC
7	GND	P	Ground
8	GND	P	Ground

*IO must be externally configured to run at 1.8V

Absolute Max Ratings – LCD

Item	Symbol	Value	Unit
Power Supply Voltage for Logic	IOVCC	-0.3 – 3.6	V
Power for Analog Negative	VSN	0 ~ -6.6	V
Power for Analog Positive	VSP	-0.3 ~ +6.6	V
Operating Temperature	Topr	-20 to 70	°C
Storage Temperature	Tstg	-30 to 80	°C

Absolute Max Ratings – PCAP

Item	Symbol	Value	Unit
Operating Voltage	VDD	2.7 – 3.6	V
I/O Supply Voltage	IOVDD	1.71 – 3.6	V

Electrical Characteristics - LCD

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Operating Voltage	IOVCC	1.65	1.8	3.3	V	-
Voltage for Analog Negative	VSN	-6.0	-5.5	-4.8	V	-
Voltage for Analog Positive	VSP	4.8	5.5	6.0	V	-
Supply Current	IDD(IOVCC)	-	7	-	mA	Ta = 25 °C
Supply Current	IDD(VSN)	-	10	-	mA	Ta = 25 °C
Supply Current	IDD(VSP)	-	37	-	mA	Ta = 25 °C
Input Voltage	Vih	0.7IOVCC	-	IOVCC	V	-
	Vil	0	-	0.3IOVCC	V	-
Input Leakage Current	IiL	-1.0	-	1.0	µA	Vin = IOVCC

Electrical Characteristics – PCAP

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Operating Voltage	VDD	-	2.8	3.3	V	-
I/O Supply Voltage	IOVDD	-	1.8	3.3	V	
Supply Current (active)	IDD(VDD)	-	9.8	-	mA	Ta = 25 °C
Input Voltage	Vih	0.7*IOVDD	-	IOVDD	V	-
	Vil	-0.3	-	0.3*IOVDD	V	-
Output Voltage	Voh	0.7*IOVDD	-	-	V	-
	Vol	-	-	0.3*IOVDD	V	-
I/O Leakage Current	Ili	-1	-	1	µA	-

Backlight Specifications

The backlight wiring is on the primary 31 pin connector.

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Voltage	Vf	28.5	30	31.5	V	
Supply Current	If	-	160	-	mA	2000 NITS
Backlight Color	Blue					

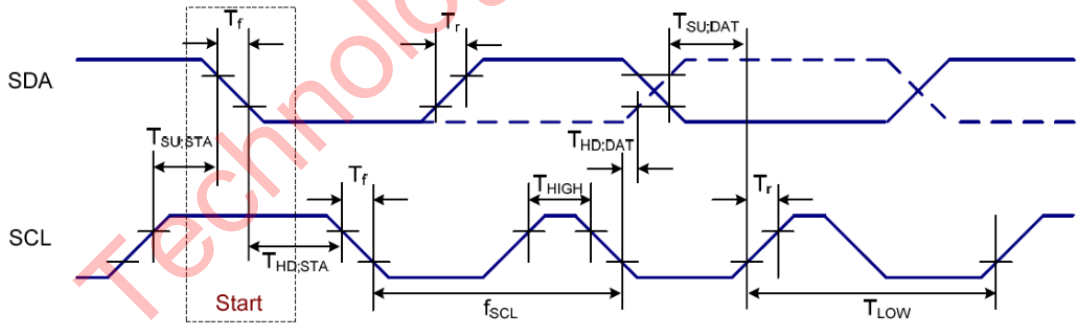
Timing Specifications - LCD

Refer to HX8399-C datasheet

Timing Specifications – PCAP

Refer to FT5446U datasheet.

Standardized timings provided for reference.



Symbol	Parameter	Min	Typ	Max	Unit
f_{SCLK}	SCL clock frequency	50	100	400	kHz
T_{LOW}	SCL clock LOW period	1.3	-	-	us
T_{HIGH}	SCL clock HIGH period	0.6	-	-	us
$T_{SU;DATA}$	Data set-up time	100	-	-	ns
$T_{HD;DATA}$	Data hold time	0	-	0.9	us
T_r	SCL and SDA rise time	20	-	300	ns
T_f	SCL and SDA fall time	20	-	300	ns
T_f	SDA fall time for read out	20	-	1000	ns
C_b	Capacitive load represented by each bus line	-	-	400	pF
$T_{SU;STA}$	Setup time for a repeated START condition	0.6	-	-	us
$T_{HD;STA}$	START condition hold time	0.6	-	-	us
$T_{SU;STO}$	Setup time for STOP condition	0.6	-	-	us
T_{SW}	Tolerable spike width on bus	-	-	50	ns
T_{BUF}	BUS free time between a STOP and START condition	4.7	-	-	us

ID Register Bit Definitions

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ID1	0	1	1	0	0	0	0	0
	HW ID: 0x60							
ID2	0	0	0	0	0	0	0	0
	LOT ID: 0x00							
ID3	0	0	0	0	0	0	0	0
	COLOR ID: 0x00							

MIPI Init

The MIPI initialization sequence consists of below commands. This initializes the LCD panel.

DCS_Long_Write_3P(0xB9,0xFF,0x83,0x99);

DCS_Short_Write_1P(0xD2,0x55);

DCS_Long_Write_FIFO(16,0xB1,0x02,0x04,0x70,0x90,0x01,0x32,0x33,0x11,0x11,0x4D,0x57,0x56,0x73,0x02,0x02);

DCS_Long_Write_FIFO(12,0xB2,0x00,0x80,0x80,0xAE,0x0A,0x0E,0x75,0x11,0x00,0x00,0x00);

DCS_Long_Write_FIFO(47,0xB4,0x00,0xFF,0x04,0xA4,0x02,0xA0,0x00,0x00,0x10,0x00,0x00,0x02,0x00,0x24,0x02,0x04,0x0A,0x21,0x03,0x00,0x00,0x08,0xA6,0x88,0x04,0xA4,0x02,0xA0,0x00,0x00,0x10,0x00,0x00,0x02,0x00,0x24,0x02,0x04,0x0A,0x00,0x00,0x08,0xA6,0x00,0x08,0x11);

DCS_Long_Write_FIFO(34,0xD3,0x00,0x00,0x00,0X00,0x00,0x00,0x18,0x18,0x32,0x10,0x09,0x00,0x09,0x32,0x10,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x11,0x00,0x02,0x02,0x03,0x00,0x00,0x00,0x0A,0x40);

DCS_Long_Write_FIFO(33,0xD5,0x18,0x18,0x18,0x18,0x21,0x20,0x18,0x18,0x19,0x19,0x19,0x19,0x18,0x18,0x18,0x18,0x03,0x02,0x01,0x00,0x2F,0x2F,0x30,0x30,0x31,0x31,0x18,0x18,0x18,0x18,0x18,0x18);

DCS_Long_Write_FIFO(33,0xD6,0x18,0x18,0x18,0x18,0x20,0x21,0x19,0x19,0x18,0x18,0x19,0x19,0x18,0x18,0x18,0x18,0x00,0x01,0x02,0x03,0x2F,0x2F,0x30,0x30,0x31,0x31,0x18,0x18,0x18,0x18,0x18,0x18);

DCS_Long_Write_FIFO(9,0xD8,0x0A,0xBE,0xFA,0xA0,0x0A,0xBE,0xFA,0xA0);

DCS_Short_Write_1P(0xBD,0x01);

DCS_Long_Write_FIFO(9,0xD8,0x0F,0xFF,0xFF,0xE0,0x0F,0xFF,0xFF,0xE0);

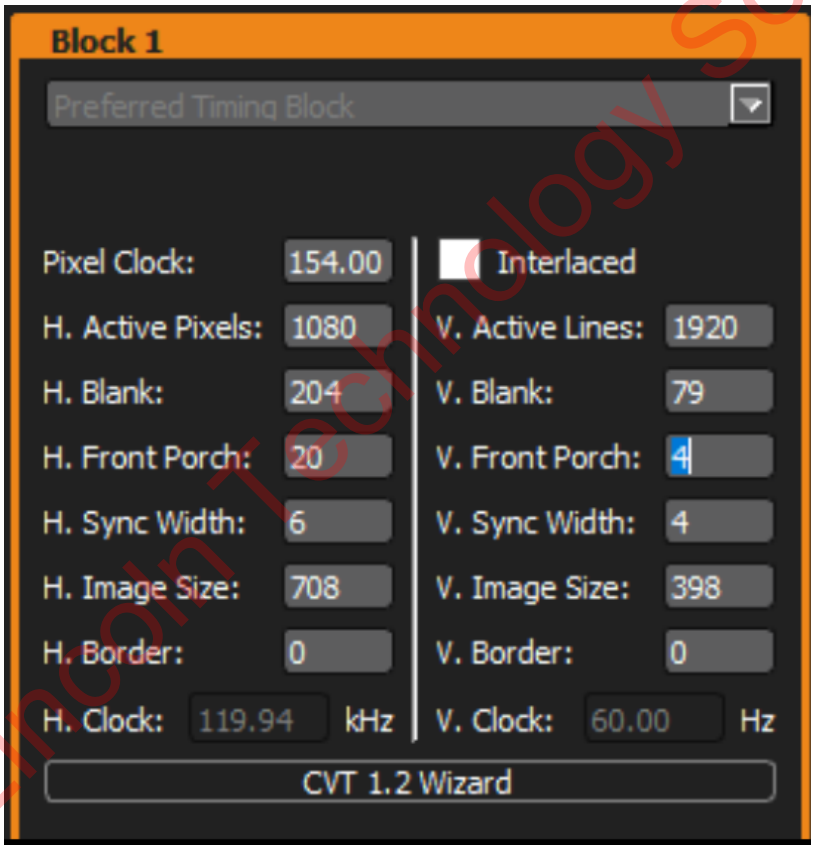
DCS_Short_Write_1P(0xBD,0x02);

DCS_Long_Write_FIFO(9,0xD8,0x0F,0xFF,0xFF,0xE0,0x0F,0xFF,0xFF,0xE0);

DCS_Short_Write_1P(0xBD,0x00);

```
DCS_Long_Write_FIFO(55,0xE0,0x01,0x11,0x1C,0x17,0x39,0x43,0x54,0x51,0x5A,0x64,0x6C,0x74,0x7A,0x83,0x8D,0x92,0x99,0xA4,
0xA9,0xB4,0xAA,0xBA,0xBE,0x63,0x5E,0x69,0x73,0x01,0x11,0x1C,0x17,0x39,0x43,0x54,0x51,0x5A,0x64,0x6C,0x74,0x7A,0x83,0x8
D,0x92,0x99,0xA4,0xA7,0xB2,0xA9,0xBA,0xBE,0x63,0x5E,0x69,0x73);
Delay (200);
DCS_Long_Write_2P(0xB6,0x92,0x92);
DCS_Short_Write_1P(0xCC,0x00);
DCS_Long_Write_4P(0xBF,0x40,0x41,0x50,0x49);
DCS_Long_Write_2P(0xC6,0xFF,0xF9);
DCS_Long_Write_2P(0xC0,0x25,0x5A);
DCS_Short_Write_1P(0x36,0x02);//µ÷ÊÔ¾µÏñ
        DCS_Short_Write_NP(0x11);
        Delay (200);
        DCS_Short_Write_NP(0x29);
    Delay (400);
```

EDID Parameters



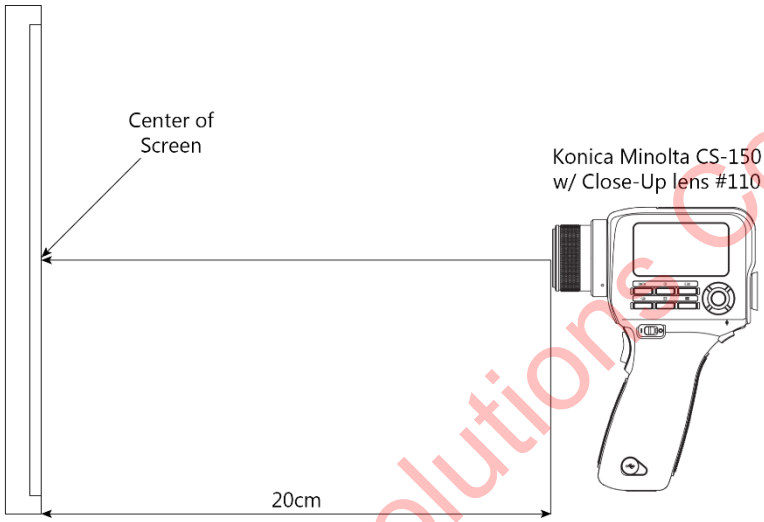
Optical Characteristics

All measurements taken after minimum runtime of 25 minutes.

Item		Symbol	Conditions	Specification			Unit	Note
				Min	Typ	Max		
Response Time		Tr Tf	Ta = 25°C	-	25	-	ms	(1)(4)
Contrast Ratio		CR	Normal Viewing Angle	1000	1200	-	-	(1)(3)(5)
Viewing Angle	Hor.	X-	CR>10	70	80	-	Deg	(3)(5)
		X+		70	80	-	Deg	
	Ver.	Y+		70	80	-	Deg	
		Y-		70	80	-	Deg	
Chromaticity	Red	RX	Ta = 25 °C	-	.6737	-	-	
		Ry		-	.3125	-	-	
	Green	GX		-	.2769	-	-	
		Gy		-	.6938	-	-	
	Blue	BX		-	.1584	-	-	
		By		-	.0739	-	-	
	White	WX		-	.3241	-	-	
		Wy		-	.3399	-	-	
Luminance		L	Ta = 25 °C	-	2000	-	cd/m2	(1)
Color Gamut Ratio DCI-P3				-	96	-	%	
Color Gamut Coverage DCI-P3				-	95	-	%	
Uniformity		U		75	80	-	%	(2)

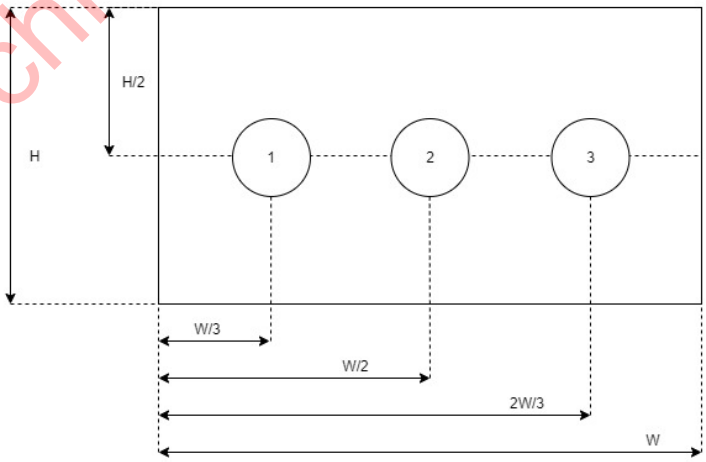
Note 1: Measurement setup

The LCD module should be stabilized at a given temperature for 25 minutes to avoid abrupt temperature change during measurement. After temperature saturation measurement should be executed.



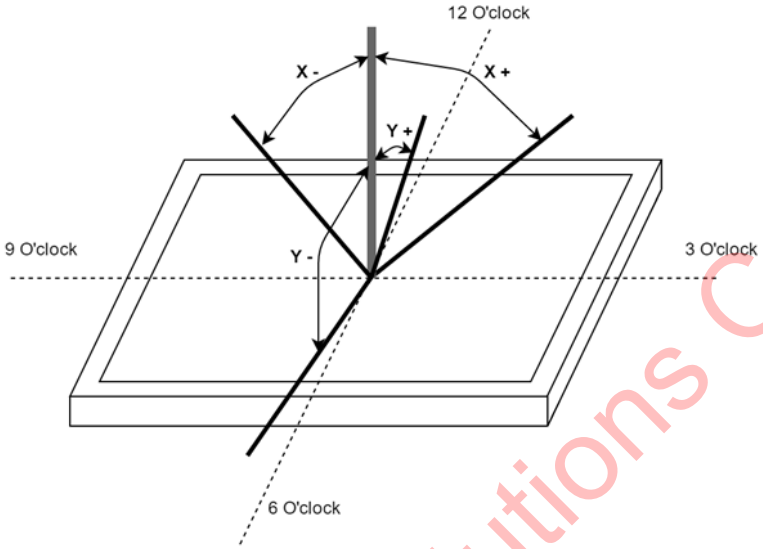
Note 2: Brightness Uniformity

Brightness uniformity = (Minimum Luminance of 3 points / Max Luminance of 3 points) * 100



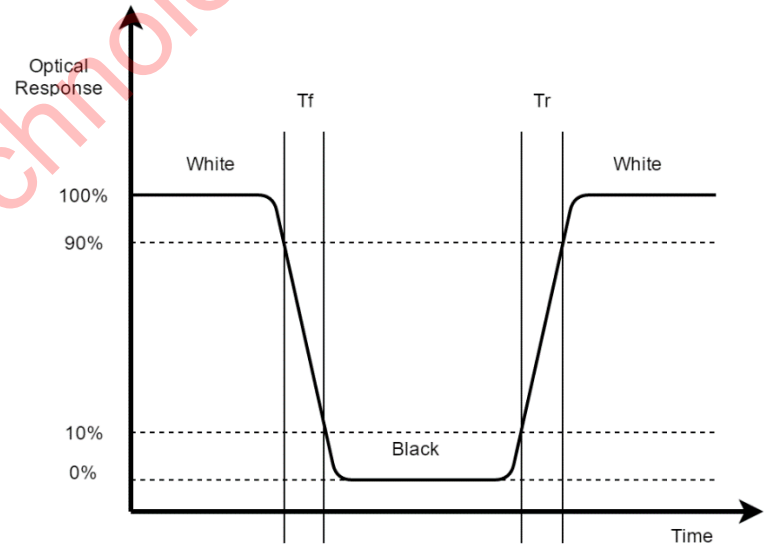
Note 3: Viewing Angle

Definition of viewing angle for Y+/- and X+/- is as follows.



Note 4: Response Time

Definition of response time as follows below.



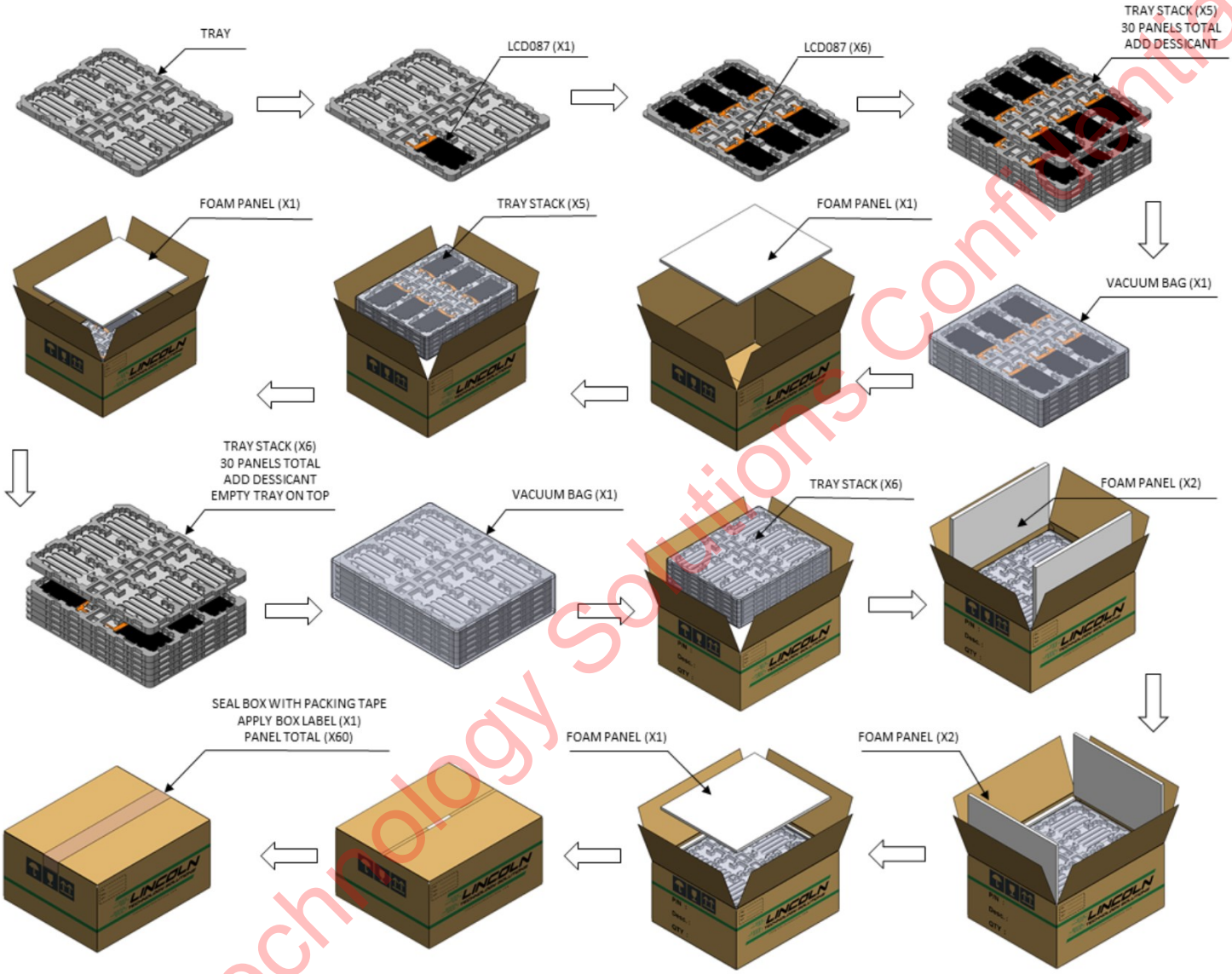
Note 5: Contrast Ratio

Definition of Contrast Ratio is as follows.

Contrast measurements shall be made at a viewing angle of 0° at the center of the surface.

$$CR = \frac{\text{Luminance when displaying White}}{\text{Luminance when displaying Black}}$$

Packaging

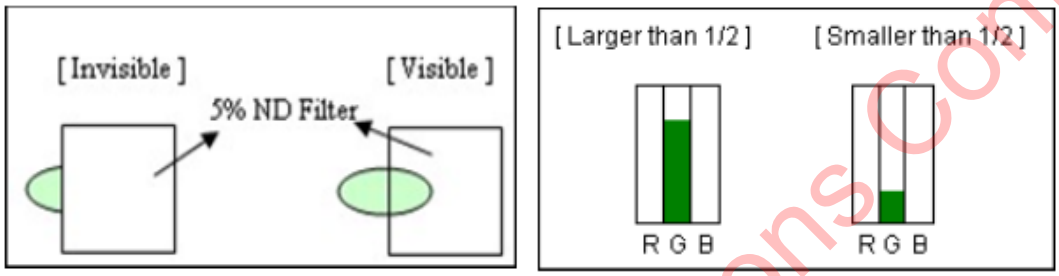


Quality & Inspection Criteria

Terminologies:

LCD: Liquid Crystal Display; Each pixel contains three dots of R, G, and B (sub-pixel).

Bright Dot: 1 sub-pixel is a dot. Defects should be larger than 1/2 of a sub-pixel. Dots that are not visible through a 5% ND filter or smaller than 1/2 of sub-pixel size will not be counted as a dot defect.

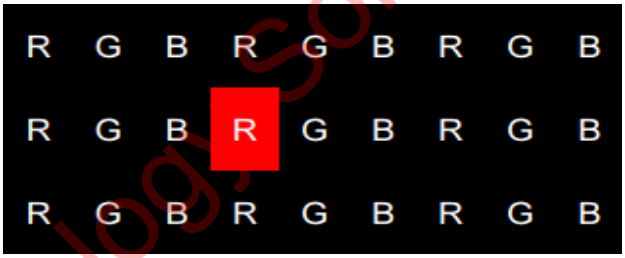


"No dot defect" (=ignored)

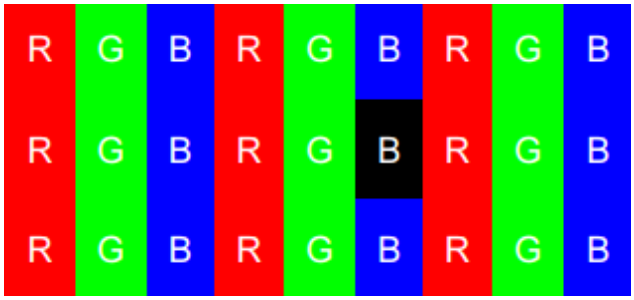
"1 dot defect" (=counted)

"1 dot defect" (=counted)

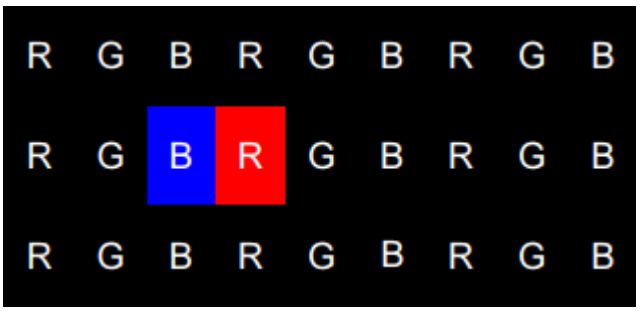
"No dot defect" (=ignored)



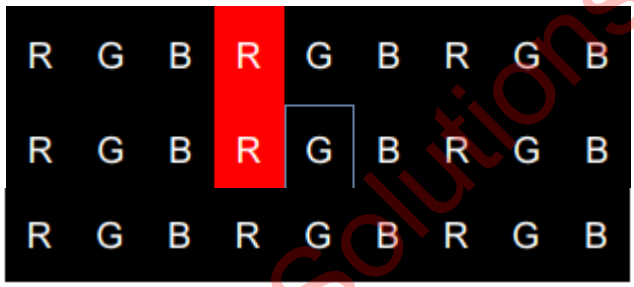
Dark Dot: Any single sub-pixel that does not light up in a white screen or another non-black screen is called a dark dot.



Two adjacent dots (horizontal direction): Use the bright dot illustration as an example to demonstrate two horizontal consecutive dots.



Two adjacent dots (vertical direction): Use the bright spot illustration as an example to demonstrate two vertical consecutive dots.



Two adjacent dots (bevel direction): Use the bright spot illustration as an example to demonstrate two consecutive dots in the bevel direction.

Three or more adjacent dots (horizontal): Use the bright spot illustration as an example to demonstrate three or more consecutive horizontal and vertical dots.

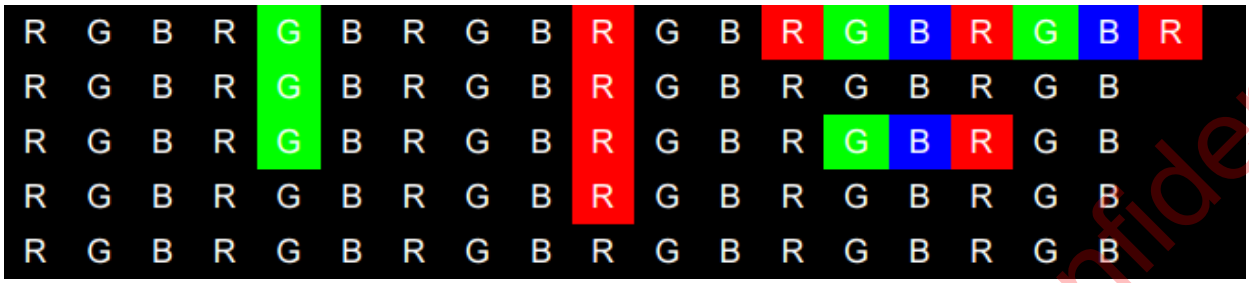
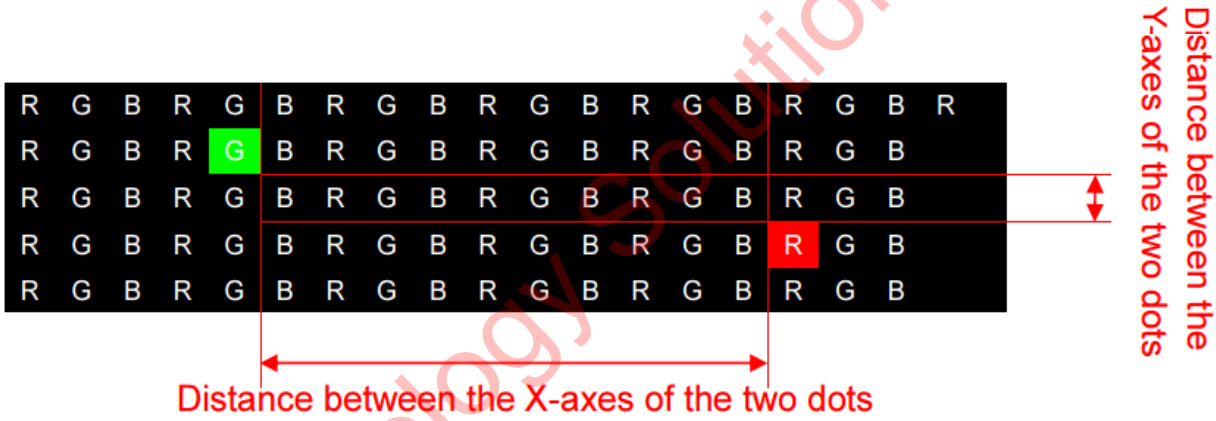


Illustration of spacing between two dots: (Distance is the relative distance between the X-axes of the two dots or the relative distance between the Y-axes of the two dots, whichever is larger)



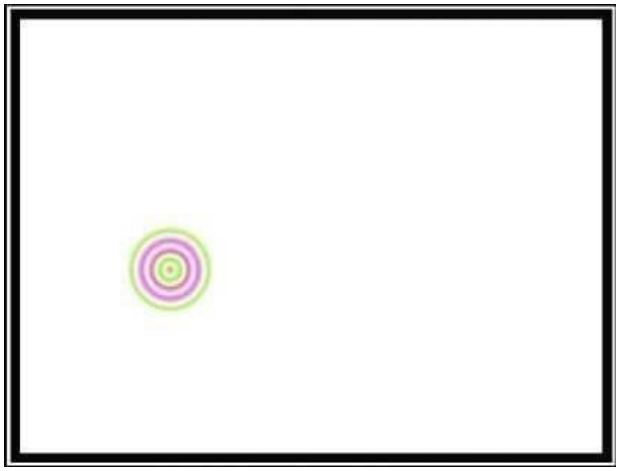
Functional Test

The LCD display testing program should display the following screens in order: all red, all green, all blue, all white, all gray, all black.

Inspection Requirements

After booting the system (single illumination), there are no non-display, unlit backlight, dark backlight, blinking, or other abnormal signs, and there are no bright lines, dark lines, or bright rims/leakage of light close to the LCD bezel.

Newton's Ring



Under high temperature and high humidity conditions, uneven deformations caused by heat in different layers of the LCD module will result in the display of an all-white screen. However, this condition can be recovered when temperature is resumed under normal circumstances. A specific determination can be conducted according to the operating conditions and storage conditions defined in the product's technical specifications. Any exception will be negotiated and mutually agreed by both parties. (Ripples are not permitted at fixed locations. For ripples at non-fixed locations, they are OK if they disappear within two seconds.)

LCD blaze

Uneven internal LCD installation, surface deformation of the LCD polarizer, internal structural interference of the LCD module, damaged LCD backlight plates, and other factors may cause partial fading of color on the LCD display. When observed from a certain incident angle (upper 10°, lower 3°, 40° on both sides), they will appear as white cicatrices, typically about the size of a grain of rice. In serious cases, they accumulate in large patches or stripes, appear in different degrees under various colors (red, blue, green, black, gray, white), and are especially obvious under an all-gray screen. Blazes with diameters ≥ 0.5mm are not allowed: for those with diameters under 0.5 mm, 2 are acceptable if the space between them is ≥ 15mm. Card chromatic aberration ratio versus ND Filter: 1.0 + 0.3 standard = 5% ND Filer (see definition of Mura).

Mura

Mura refers to the unevenness and irregularity that is visible in the image. It is difficult for visual inspection to recognize the non-uniform brightness or mura. Mura detection is subjective and therefore doesn't have pass/fail criteria. There are several precautions to take which can avoid mura. Avoid high ambient temperatures around the module, frame warpage and high temperature operation over long periods of time. Utilize screen savers to avoid mura.

Inspection Conditions

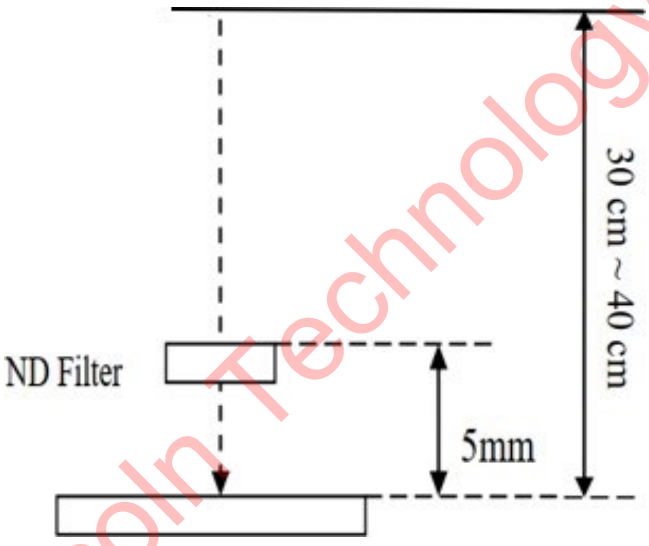
Inspection distance should be 35cm ± 5cm with a FujiFilm ND-LCD 5% filter approximately 5cm from the backlight surface.

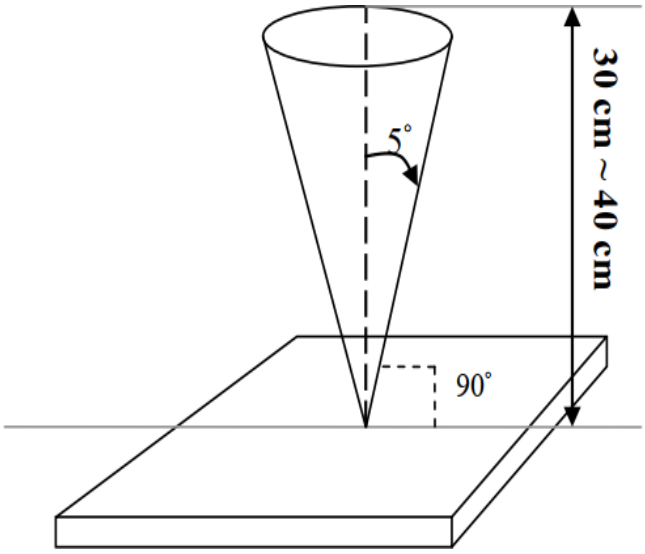
Viewing angle: 90° ± 5°.

Room temperature: 23+/- 2°C

Humidity: 60 +/- 10%

Inspection Ambient Illumination: 300-700 LUX





Acceptance Criteria Table:

There should be no corrosion or cracking, or an uneven coating layer on LCD display surface, and there should be no sign of coagulation, flaking, cracking, or wear. The definition of minor defects and acceptance criteria are shown in the following table:

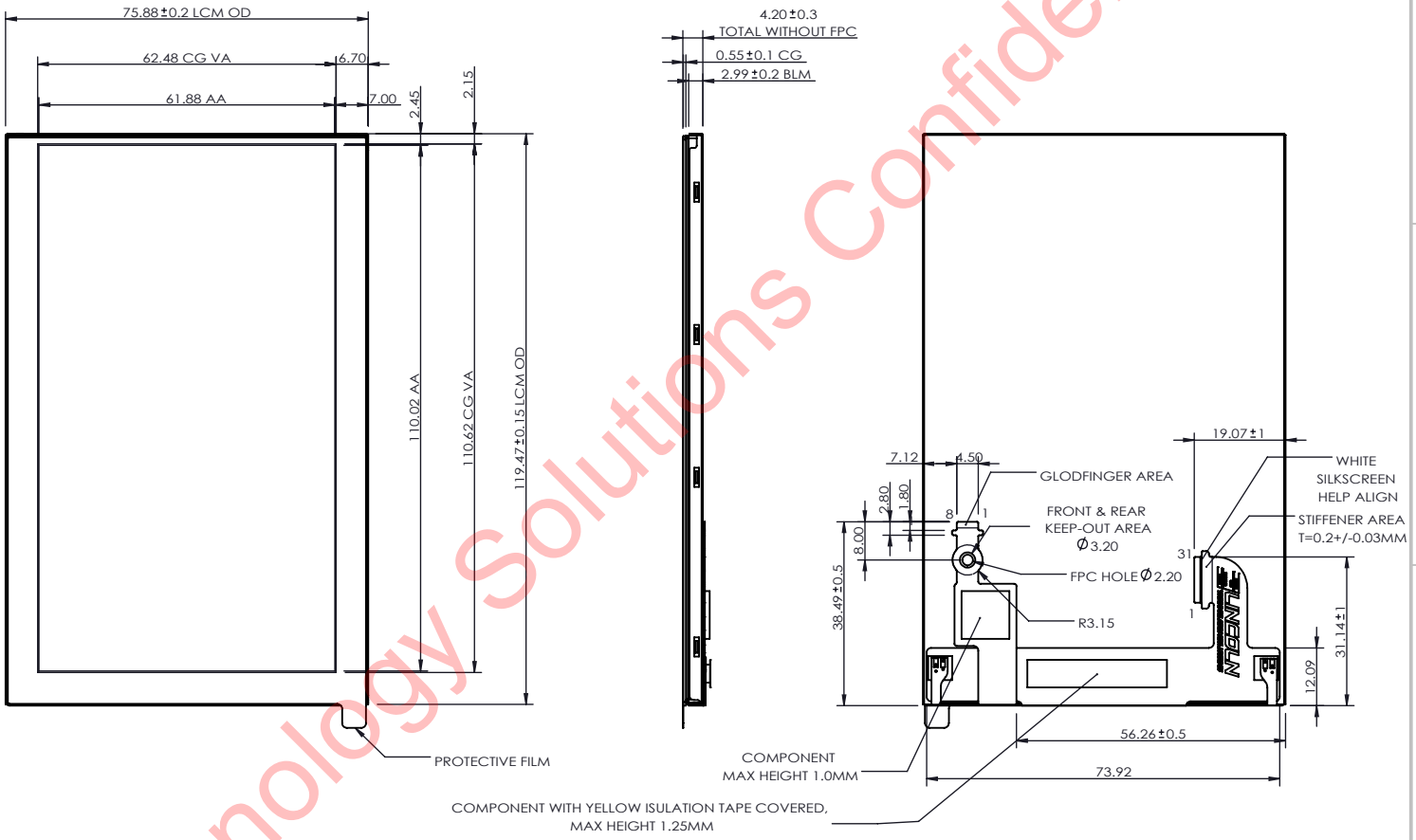
Item	Size	Unit	Acceptance qty.
Unfelt scratch visible with backlight off.	W < 0.05	mm	Ignore
	W > .05 and < .10 L > .3 and < 3.0	mm	4
	W > .10 or L > 3.0	mm	none
	Visible with backlight on		none
Felt scratch	None allowed		
Dent visible with backlight off	D < .2	mm	Ignore
	D > .2 and < .5	mm	5
	Spacing between defects must be > 30mm		
	D > .5	mm	none
	Visible with backlight on		none
Bubble visible with backlight off	D < .2	mm	Ignore
	D > .2 and < .5	mm	5
	D > .5	mm	none
	Visible with backlight on		none
	W < .05		Ignore

Item	Size	Unit	Acceptance qty.
Foreign material (line shape) visible with backlight on		mm	
	W > .05 and < .10 L > .3 and < 2.0	mm	4
	W > .10 or L > 2.0	mm	none
Foreign material (dot shape) visible with backlight on	D < .2	mm	Ignore
	D> .2 and < .5	mm	5
	D > .5	mm	none
Bright dot defect(lit)	1 dot	-	4
	2 adjacent dots	-	0
Dark dot defect (not lit)	1 dot	-	5
	2 adjacent dots	-	2
	3 adjacent dots	-	0

Appendix 1: Drawing

LCD-FPC:		CTP-FPC:	
PIN	NAME	NO.	ASSIGNMENT
1	LEDA1	1	RST 1.8V
2	LEDA2	2	VDD 3.3V
3	LEDK1	3	INT 1.8V
4	LEDK2	4	SDA 1.8V
5	NC	5	SCL 1.8V
6	GND	6	NC
7	TE	7	GND
8	NC	8	GND
9	IOVCC		
10	AVDD		
11	AVEE		
12	LEDPWM		
13	RESET		
14	GND (LCD_IDO)		
15	IOVCC (LCD_ID1)		
16	GND		
17	DSI_D2+		
18	DSI_D2-		
19	GND		
20	DSI_D1+		
21	DSI_D1-		
22	GND		
23	DSI_CLK+		
24	DSI_CLK-		
25	GND		
26	DSI_DO+		
27	DSI_DO-		
28	GND		
29	DSI_D3+		
30	DSI_D3-		
31	GND		

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	INITIAL ISSUE	2021/9/8	QIN
	B	UPDATED THE FPC DIMENSIONS	2021/9/9	QIN



DRAWN BY: JY	DATE 2021/9/9
CHECKED BY: QIN	DATE 2021/9/9
MATERIAL: N/A	
FINISH: N/A	DESCRIPTION 5" HBWG W/PCAP
COMMENTS: ALL DIMENSIONS ARE IN MILLIMETRES.GENERAL TOLERANCES ARE ± 0.3MM.	PART NO. LCD087-050CTL1ARNTTR4.0 REV. B

SCALE: 1:1.5	SHEET 1 OF 1
DO NOT SCALE DRAWING	