



LCD105-238NTL0NCNTBR2.2

23.8" High Bright, Wide Color Gamut

3840\*2160

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## Revision History

### Document Revision

Date	Version #	Description
2/21/2022	R1.0	Update PEM locations and mechanical drawing.
3/25/2022	R1.1	Added Power Sequence, Signal Timing, and eDP Interface Timing sections
12/1/2023	R1.2	New QDEF, updated color characterization, updated drawing

### Hardware Revision

Date	Version #	Description
7/23/2019	R0.1	Production sample
11/1/2019	R0.2	Production sample – internal structure changes
1/24/2020	R0.3	Production sample – Rev 0.3
6/11/2020	R1.0	Production HW
9/14/2020	R1.1	Production HW with pan head and FK cover.
4/25/2021	R1.2	New OEM FOB MV238QUMN20
4/27/2021	R1.3	New QDEF As of 4/27/21 any LCD received after this date with Loctite on the rear screws
10/19/2021	R1.4	LTS BL with MV238QUM-N20
12/6/2021	R2.0	LTS factory production with GV238QUB-N12 cell
2/21/2022	R2.1	Update PEM locations
12/1/2023	R2.2	QDEF supplier change

## General Specifications

Item	Specification	Unit
Outline Dimensions (Bezel + Cover plate)	570.50 x 340.50 x 16.60	mm
Display Size	23.8 Diagonal	inches
Active Area	527.04 X 296.46	mm
Pixel Pitch	0.13725 X 0.13725	mm
Number of Dots	3840 X 2160	-
Backlight Type	Blue LED w/ wide gamut film	-
Touch Panel	None	-
Luminance (Uncalibrated, t=0)	1300	cd/m <sup>2</sup>
Interface	4 Lane eDP with 5.4Gbps Link Rates	-
Color Gamut Ratio DCI-P3	>100% DCI-P3	%
LCD Type	10 bit (8bit + 2 H-FRC)	-

## Pin Out - LCD

The interface connector is a 30-pin wire to board connector with 0.5mm pitch having part number MSAK24025P30.

Number	Pin Name	I/O	Description
1	VDD	P	10 V Power Supply
2	VDD	P	10 V Power Supply
3	VDD	P	10 V Power Supply
4	VDD	P	10 V Power Supply
5	VDD	P	10 V Power Supply
6	GND	P	Ground
7	GND	P	Ground
8	NC	-	No Connection
9	NC	-	No Connection
10	GND	P	Ground
11	HPD	I/O	Hot Plug Detection Signal
12	GND	P	Ground
13	DAUXN	I/O	Aux Compliment Signal
14	DAUXP	I/O	Aux True Signal
15	GND	P	Ground
16	DRX0P	I	DP Lane 0 True signal
17	DRX0N	I	DP Lane 0 Compliment signal
18	GND	P	Ground
19	DRX1P	I	DP Lane 1 True signal

20	DRX1N	I	DP Lane 2 Compliment signal
21	GND	P	Ground
22	DRX2P	I	DP Lane 2 True signal
23	DRX2N	I	DP Lane 2 Compliment signal
24	GND	P	Ground
25	DRX3P	I	DP Lane 3 True signal
26	DRX3N	I	DP Lane 3 Compliment signal
27	GND	P	Ground
28	GND	P	Ground
29	NC	-	No Connection
30	BIST	-	BIST Function

## Absolute Max Ratings - LCD

Item	Symbol	Value	Unit
Operating Temperature	Topr	0 to 50	°C
Storage Temperature	Tstg	-20 to 60	°C
Power Supply Voltage	VDD	-0.3 to 12	V
Logic Supply Voltage	VIN	VSS-0.3 to VDD+0.3	V

## Electrical Characteristics – LCD

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Operating Voltage	VDD	9	10	11	V	-
Supply Current	IDD(VCC)	-	410	560	mA	-
Differential Input Voltage	Vih	-	-	+100	mV	-
	Vil	-100	-	-	mV	-
In-Rush Current	IRUSH	-	2	3	A	-
Permissible Input Ripple Voltage	VRF	-	-	400	mV	-
Differential Input Voltage	VID	100	-	600	mV	-
Common mode Differential Voltage	Vcm	0	-	2	V	-
Power Consumption	PDLCD	-	3	6.8	W	-

## Backlight Specifications

This design has 2 LED rails to achieve maximum brightness. The backlight has two of Hirose's DF3E series connectors. The 2mm pitch connector part number is DF3E-2P-2H. The part has mounting holes for increased durability during wire install. The supply current mentioned below is the sum, i.e., .6A per backlight connector is required for a total of 1.2A(typical). All measurements are native white point at turn on (t=0).

### Backlight - Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Voltage	Vf	-	65	-	V	
Supply Current	If	-	1.2	-	A	1300 cd/m2
Backlight Color	Blue					

### Backlight - DF3E pinout

Number	Name	I/O	Description
1	LEDA	P	BL Power positive
2	LEDK	P	BL Power negative



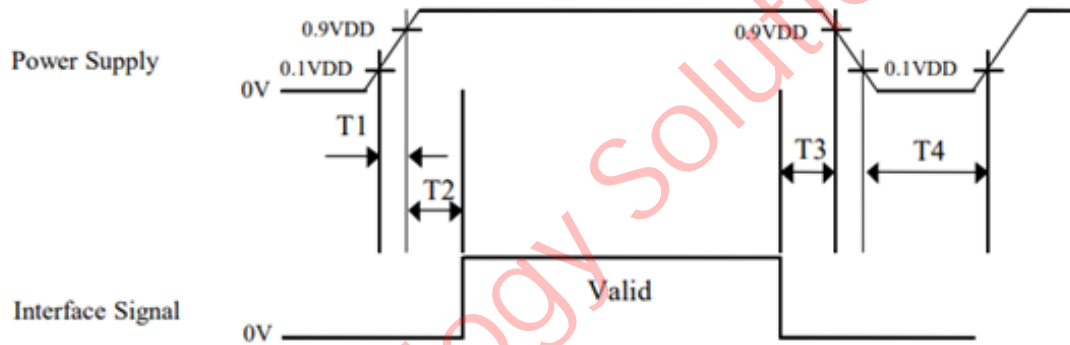
## Optical Characteristics

All measurements are native(uncalibrated), recorded after panel has been powered on for a minimum of 25 minutes. Uniformity will be measured with panel mounted in fully constrained housing.

Item		Symbol	Conditions	Specification			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR	Normal Viewing Angle	900		-	-	(1)(4)(6)
Viewing Angle	Hor.	X-	C R>10	80	80	-	Deg	(1)(4)
		X+		80	80	-	Deg	
	Ver.	Y+		80	80	-	Deg	
		Y-		80	80	-	Deg	
Luminance		L	Backlight On Ta = 25 °C	1200	1300	-	cd/m2	(1), Typ @ 1.2A
Black Uniformity		BU		75	-	-	%	(3)
White Uniformity		U		75	-	-	%	(2)
Red	x			-	.6732	-	-	
	y			-	.3205	-		
Green	x			-	.2103	-	-	
	y			-	.7202	-		
Blue	x			-	.1480	-	-	
	y			-	.0525	-		

White Point	x	Backlight On Ta = 25 °C	-	.3308	-	-	
	y		-	.3608	-	-	
Color Gamut Coverage	CG		-	97	-	%	DCI-P3
Response Time	Tr Tf		-	14	20	ms	(1)(5)

## Power Sequence

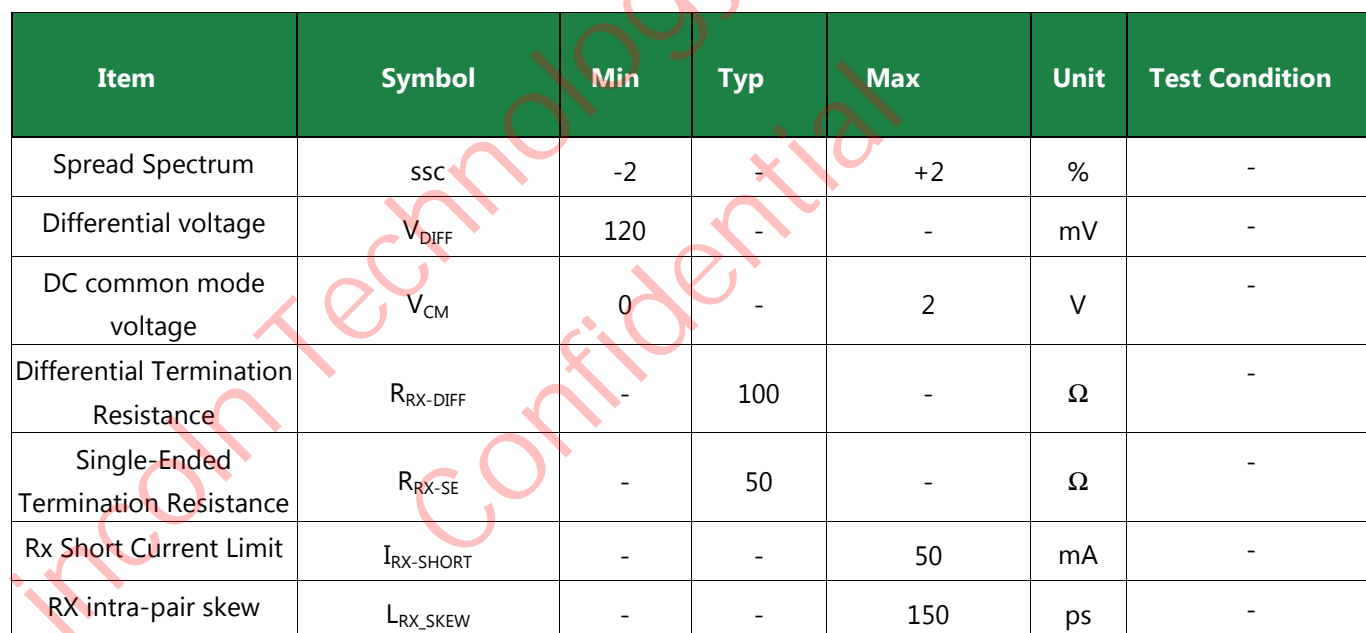


Symbol	Min	Typ	Max	Unit
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	1000	-	-	ms

## Signal Timing Specification

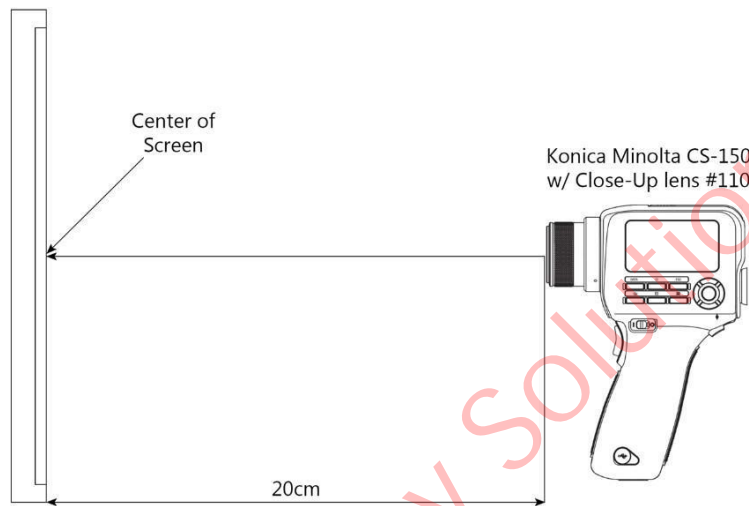
Item	Symbol	Min	Typ	Max	Unit	Test Condition
DCLK	tCLK	1.82	1.87	1.94	ns	-
	fCLK	514.8	534.26	546.48	MHz	-
H Period	tHP	3900	3940	3960	tCLK	-
H Valid	tHV	3840	3840	3840	tCLK	-
H Blank	tHB	234	236.4	237.6	-	60HZ
H Frequency	fH	56	67.5	84.5	KHz	-
V Period	tVP	2200	2260	2300	tHP	-
V Valid	tVV	2160	2160	2160	tHP	-
V Blank	tVB	40	100	140	tHP	-
V Frequency	fV	50	60	62	Hz	-

## Rev.1.2



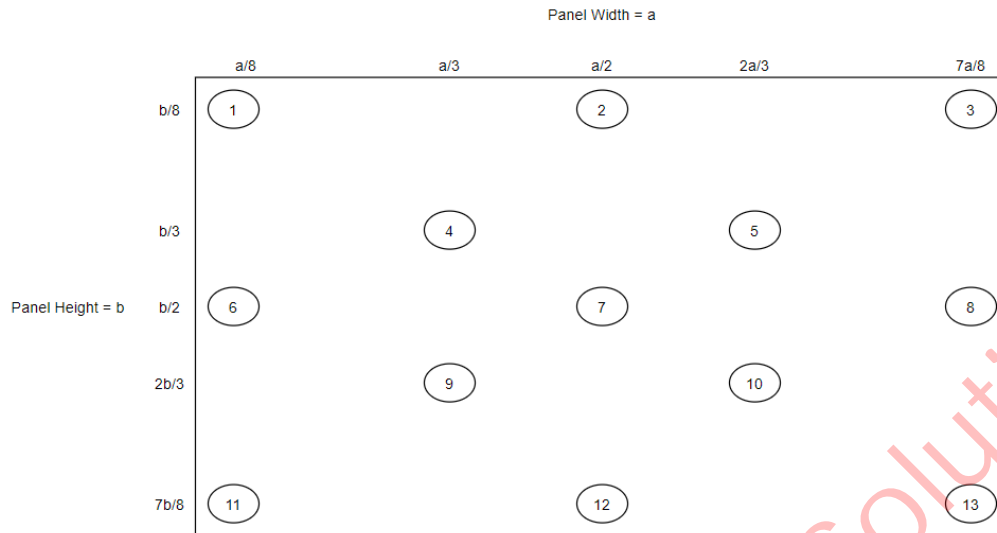
**Note 1: Measurement setup**

The LCD module should be stabilized at a given temperature for a minimum of 25 minutes to avoid abrupt temperature change during measurement. After temperature saturation measurement should be executed. Probe is orthogonal to panel face.



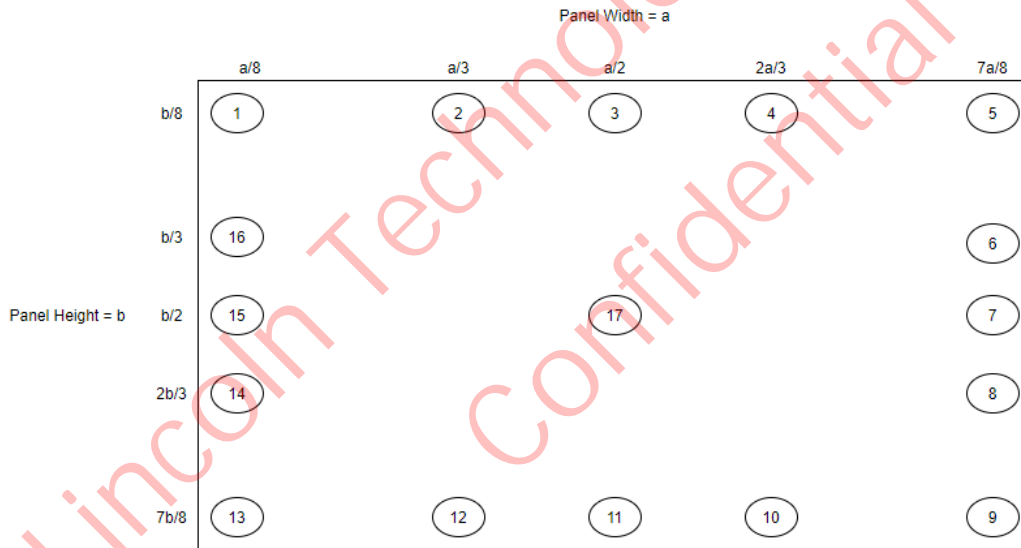
### Note 2: Brightness Uniformity

Minimal brightness uniformity is defined as  $\{0.75 \leq (\text{Measurement Point 7} / \text{Measurement Point X}) \leq 1.25\}$



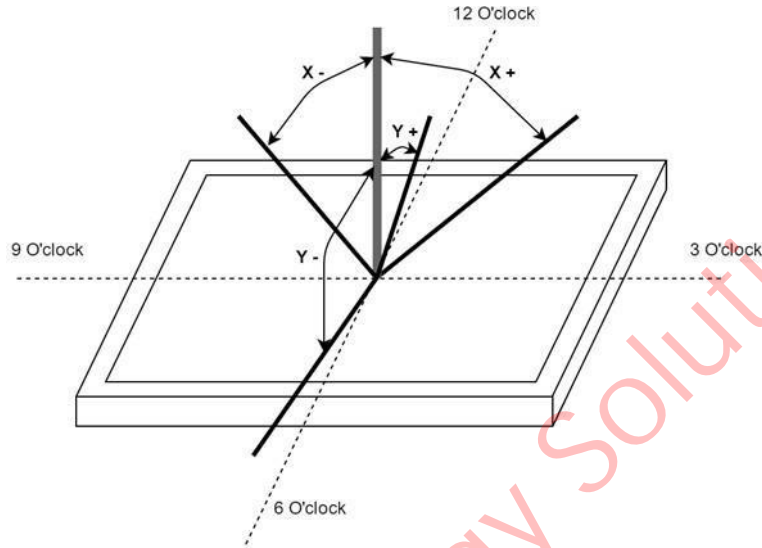
### Note 3: Dark Uniformity

Minimal dark uniformity is defined as  $\{0.75 \leq \text{Measurement Point 17} / \text{Measurement Point X} \leq 1.25\}$



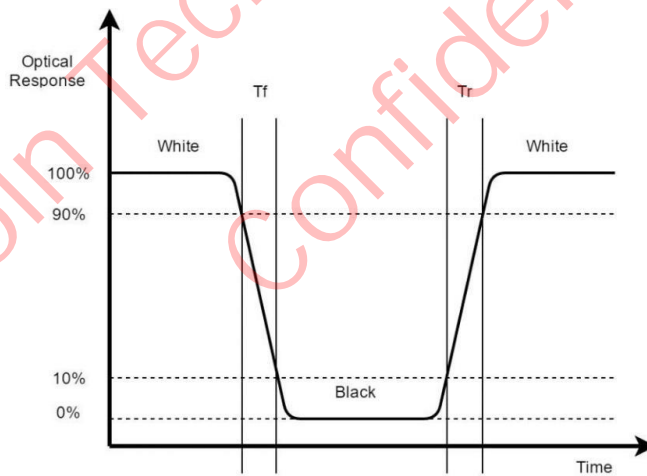
#### Note 4: Viewing Angle

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



#### Note 5: Response Time

Definition of response time as follows below.



**Note 6: 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.

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

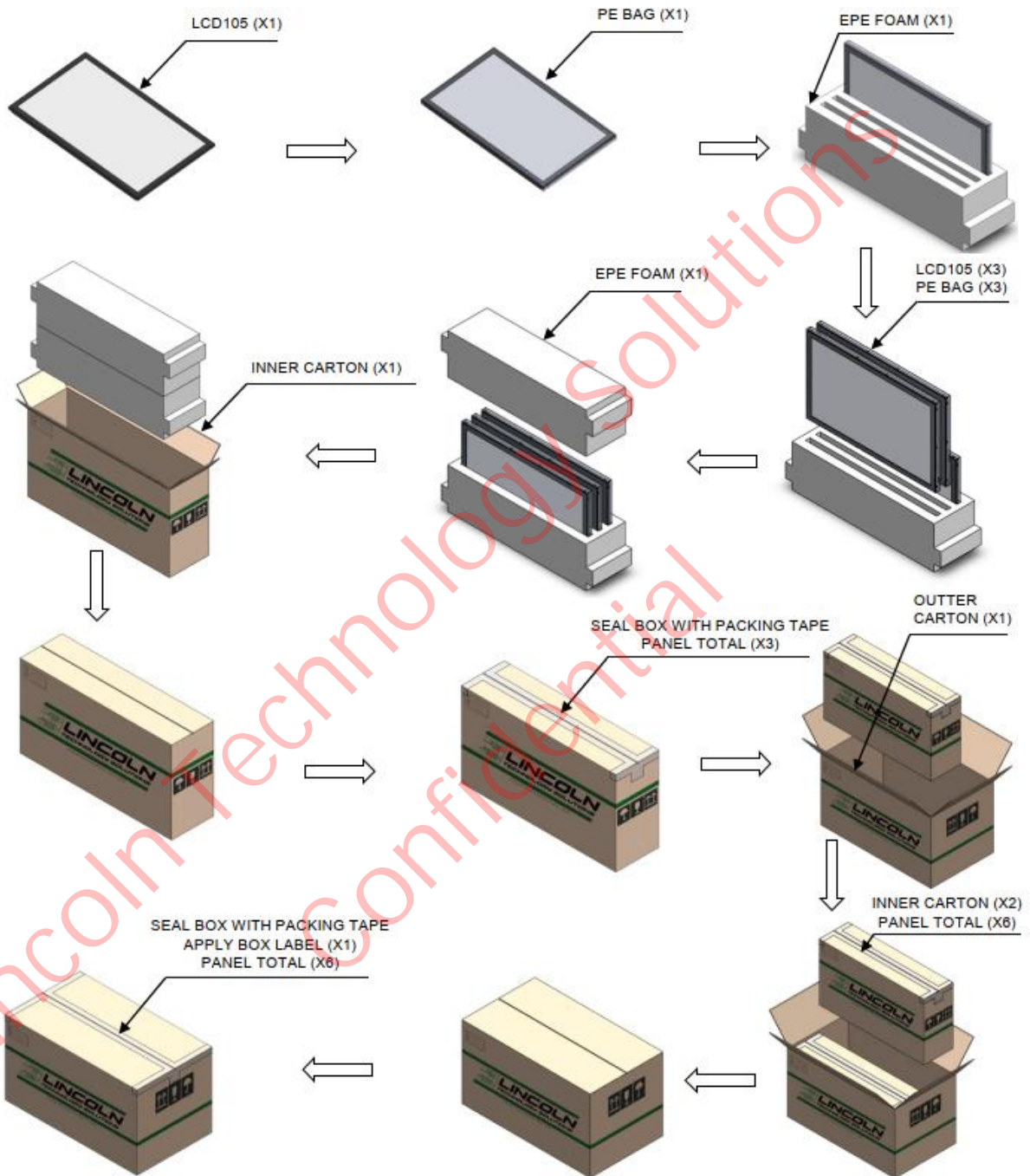


# Reliability

Test	Conditions
Vibration Test	3.0g; 5-100Hz sweeps; 30 minutes on each axis
Shock Test	@ 30gMIN 2x each Axis
ESD	+/- 8kV air; +/- 4kV contact

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# Packaging

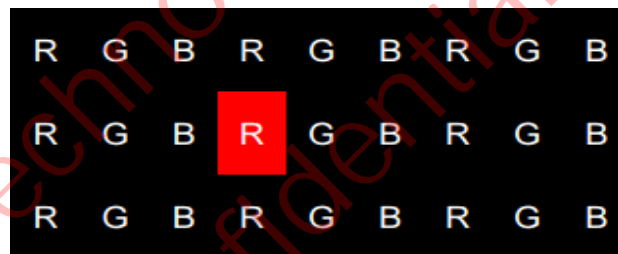
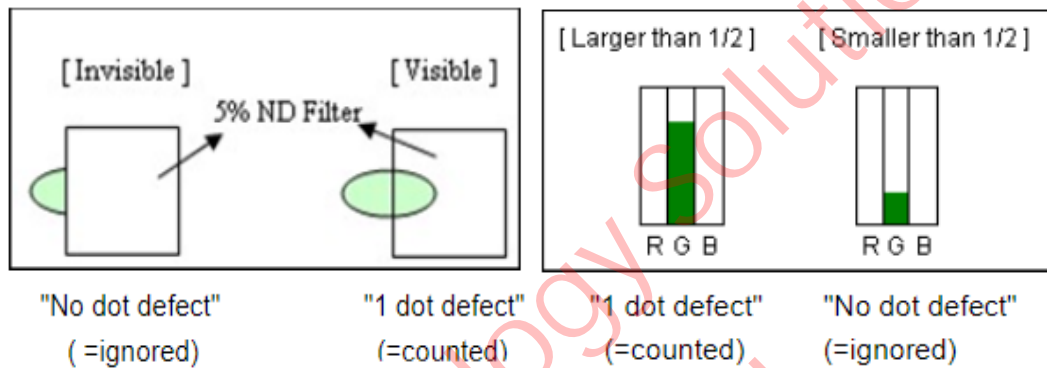


## Quality & Inspection Criteria

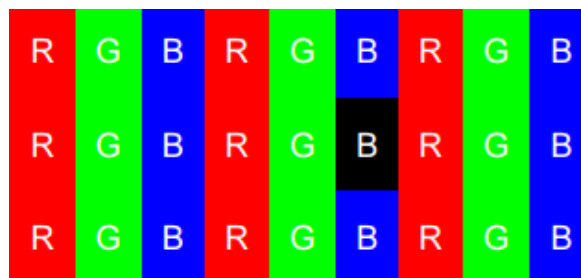
### Terminologies:

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

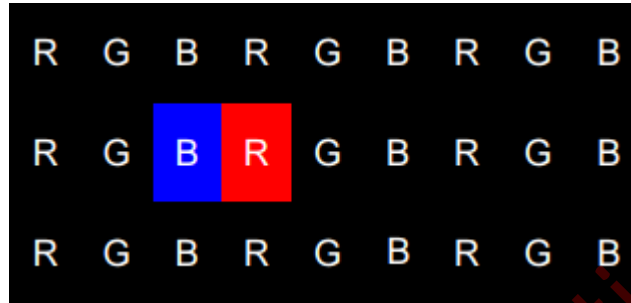
**Bright Dot:** 1 sub-pixel is a dot. Defects should be larger than 1/2 of a sub-pixel. Dots that are not visible through a 5% ND filter or smaller than 1/2 of sub-pixel size will not be counted as a dot defect.



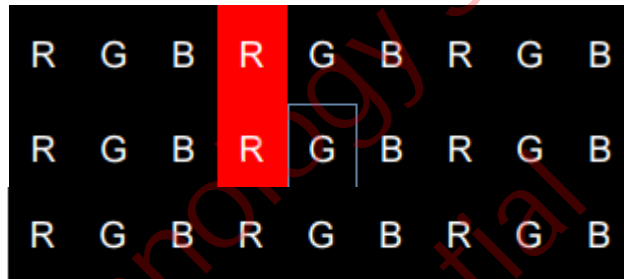
**Dark Dot:** Any single sub-pixel that does not light up in a white screen or another non-black screen is called a dark dot.



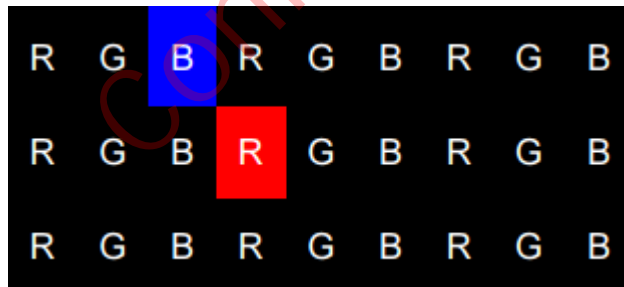
**Two adjacent dots (horizontal direction):** Use the bright dot illustration as an example to demonstrate two horizontal consecutive dots.



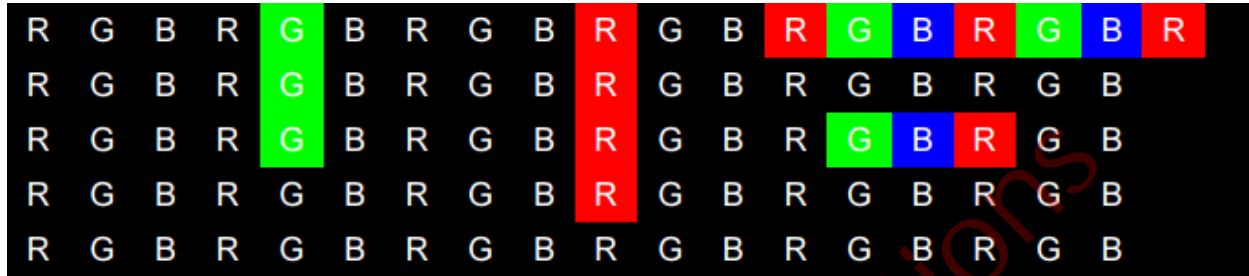
**Two adjacent dots (vertical direction):** Use the bright spot illustration as an example to demonstrate two vertical consecutive dots.



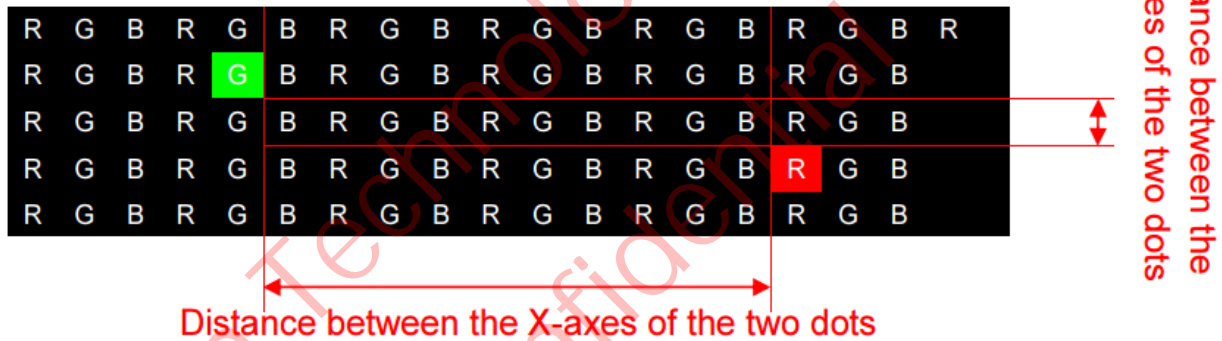
**Two adjacent dots (bevel direction):** Use the bright spot illustration as an example to demonstrate two consecutive dots in the bevel direction.



**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  $\geq 0.5\text{mm}$  are not allowed: for those with diameters under 0.5 mm, 2 are acceptable if the space between them is  $\geq 15\text{mm}$ . Card chromatic aberration ratio versus ND Filter:  $1.0 + 0.3 \text{ standard} = 5\% \text{ ND Filer}$  (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

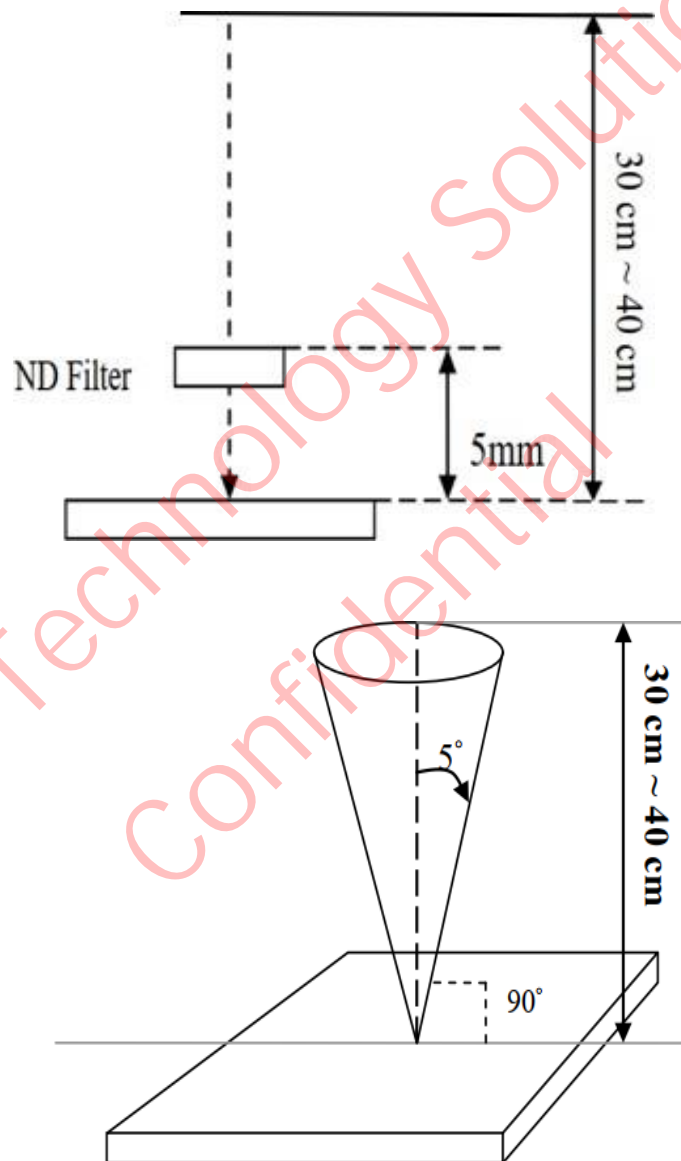
Inspection distance should be  $35\text{ cm} \pm 5\text{ cm}$  with a FujiFilm ND-LCD 5% filter approximately 5cm from the backlight surface.

Viewing angle:  $90^\circ \pm 5^\circ$ .

Room temperature:  $23 \pm 2^\circ\text{C}$

Humidity:  $60 \pm 10\%$

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 $> 30\text{mm}$		
	$D > .5$	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

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