LINCOLN TECHNOLOGY SOLUTIONS

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LCD157-070CTL1ARNTTR1.1

7" WUXGA High Bright Efficient White

In-Cell Touch

1200*1920

Document Rev 1.3

Table of Contents

Revision History

Document Revision

Date	Version #	Description
3/3/2021	R1.0	Initial Release
3/4/2021	R1.1	ID and MIPI init added. Part number correction. Wattage vs NITS added.
4/28/2021	R1.2	Update backlight specifications and storage temperature
11/2/2021	R1.3	Update the backlight connector to ZHR-2, update block diagram and mechanical drawing

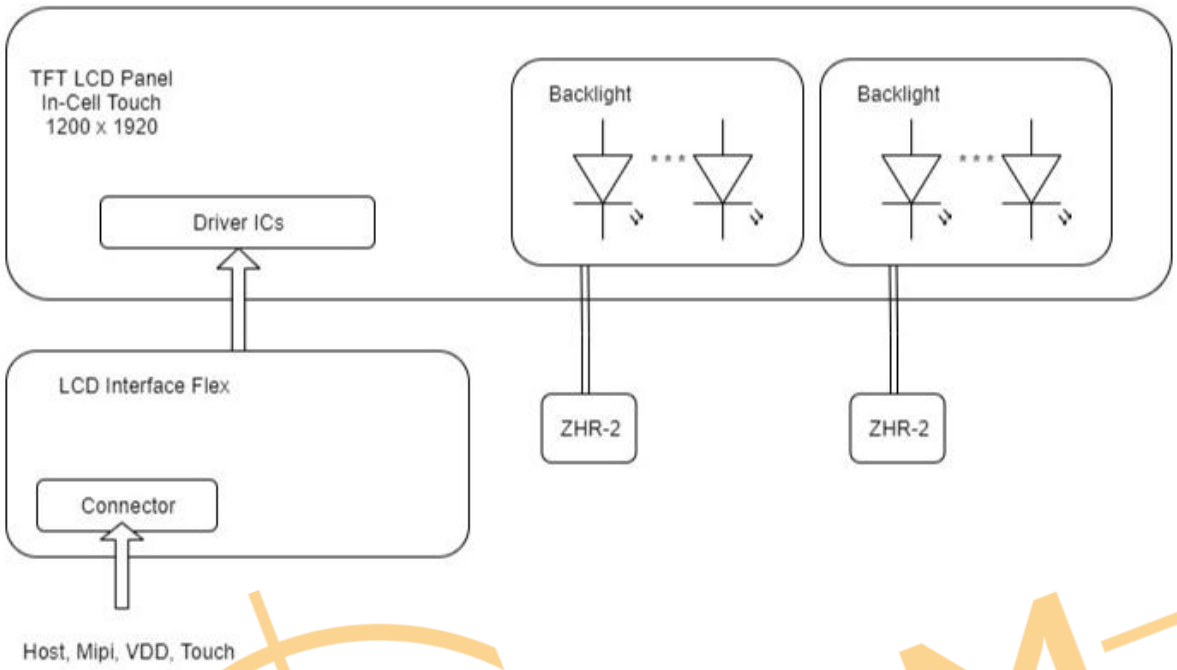
Hardware Revision

Date	Version #	Description
March 2021	R1.0	Production
11/2/2021	R1.1	Update the backlight connector to ZHR-2

General Specifications

Item	Specification	Unit
Outline Dimensions	115.7 X 177.06 X 5.4	mm
Display Size	7.02 Diagonal	inches
Active Area	94.50 X 151.20	mm
Pixel Pitch	0.07875 X 0.07875	mm
Number of Dots	1200 X 1920	-
LCD Type	ADS 8bit + 2bit FRC	-
Backlight Type	LED White	-
Viewing Direction	Free	-
Touch Panel	Capacitive Touch (In-Cell) – FT7250	-
Luminance	2500	cd/m^2
Interface	MIPI	-
Surface Treatment	Cover Lens w/AR	-
Operating Temperature	-20..70	°C

Block Diagram



Pin Out - LCD

External pull up resistor required for TP_SDA and TP_SCL.

Number	Pin Name	I/O	Description
1	NC	-	No connection – Must not connect
2	IOVCC	P	Power supply for system (1.8V)
3	IOVCC	P	Power supply for system (1.8V)
4	GND	P	Ground
5	LCD_RSTN	I	LCD reset signal, Active Low
6	NC	-	No connection
7	GND	P	Ground
8	MIPI_0N	I	MIPI Negative data inputs
9	MIPI_0P	I	MIPI Positive data inputs
10	GND	P	Power ground
11	MIPI_1N	I	MIPI Negative data inputs
12	MIPI_1P	I	MIPI Positive data inputs
13	GND	P	Power ground
14	MIPI_CKN	I	MIPI Negative clock inputs
15	MIPI_CKP	I	MIPI Positive clock inputs
16	GND	P	Power ground
17	MIPI_2N	I	MIPI Negative data inputs
18	MIPI_2P	I	MIPI Positive data inputs
19	GND	P	Power ground
20	MIPI_3N	I	MIPI Negative data inputs

21	MIPI_3P	I	MIPI Positive data inputs
22	GND	P	Power ground
23	TP_SCL	I	TP I2C Clock 1.8V
24	TP_SDA	I/O	TP I2C Data 1.8V
25	GND	P	Power ground
26	TE	O	Tear output
27	PWMO	O	PWM control signal for LED driver (CABC)
28	TP_INT	O	Touch Interrupt 1.8V
29	TP_RST	I	TP reset signal 1.8V
30	GND	P	Power ground
31	NC	-	No connection – Must not connect
32	NC	-	No connection – Must not connect
33	NC	-	No connection
34	VSN	P	Analog supply negative voltage (-5~-6V)
35	VSN	P	Analog supply negative voltage (-5~-6V)
36	NC	-	No connection
37	VSP	P	Analog supply positive voltage (5~6V)
38	VSP	P	Analog supply positive voltage (5~6V)
39	NC	-	No connection – Must not connect
40	NC	-	No connection – Must not connect

Absolute Max Ratings - LCD

Item	Symbol	Value	Unit
Power Supply Voltage for Logic	IOVCC	-0.3 - 4.5	V
Power for Analog Negative	VSN	0 ~ -6.6	V
Power for Analog Positive	VSP	0 ~ +6.6	V
Operating Temperature	Topr	-20 to 70	°C
Storage Temperature	Tstg	-30 to 80	°C

Electrical Characteristics – LCD

LCD includes in-cell touch. IOVCC is the system power for both the LCD IO and the Touch IO.

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Operating Voltage	IOVCC	1.65	1.8	1.95	V	-
Voltage for Analog Negative	VSN	-6.5	-5.5	-4.5	V	-
Voltage for Analog Positive	VSP	4.5	5.5	6.5	V	-
Supply Current	IDD(IOVCC)	-	-	50	mA	Ta = 25 °C
Supply Current	IDD(VSN)	-	-	75	mA	Ta = 25 °C
Supply Current	IDD(VSP)	-	-	75	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

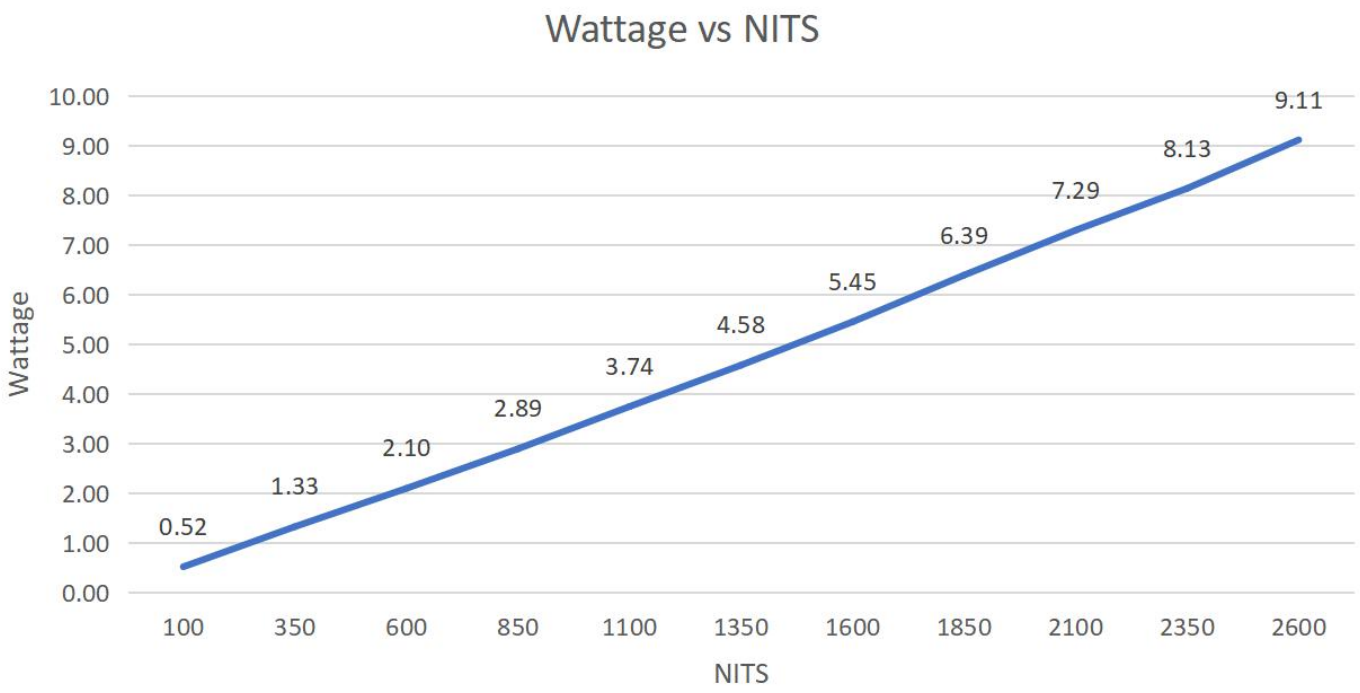
Backlight Specifications

The backlight wiring is 28AWG and has been pinned into a JST-ZH series connector. The part number is ZHR-2. An example mating part number is, S2B-ZR-SM2-TF. The design has 2 LED rails to achieve maximum brightness at high efficiency. The supply current mentioned below is the sum, i.e., 150mA per backlight connector is required for a total of 300mA(typical) for 1500 nits.

Number	Pin Name	I/O	Descrip
1	LEDA	P	LED Anode + connection
2	LEDK	P	LED Cathode - connection

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Voltage	Vf	-	16	19.2	V	If = 240mA
Supply Current	If	-	200	-	mA	Ta = 25C°, 1000 NITS
		-	300	-		Ta = 25C°, 1500 NITS
		-	400	-		Ta = 25C°, 2000 NITS
		-	500*	-		Ta = 25C°, 2500 NITS

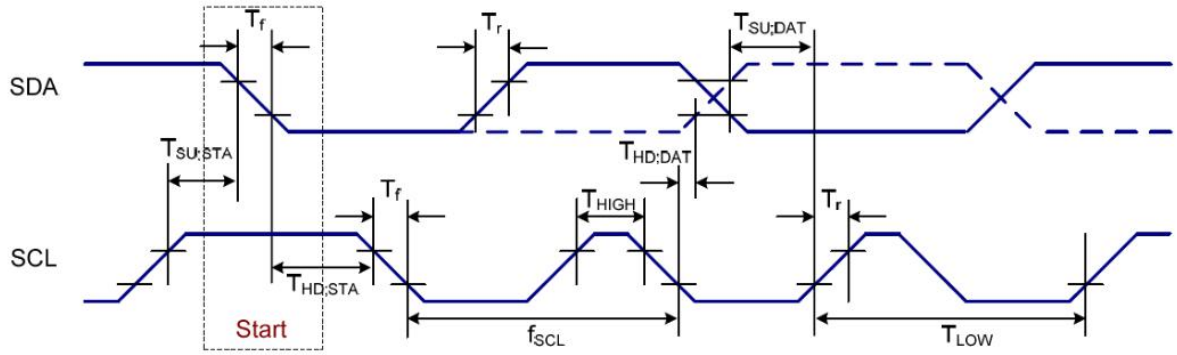
*Thermal considerations apply – DUT stable at room temperature, open air in upright position.



Timing Specifications - LCD

Refer to Focal Tech FT7250

Timing Specifications – PCAP



Symbol	Parameter	Min	Typ	Max	Unit
f_{SCLK}	SCL clock frequency	10	-	400	kHz
T_{LOW}	SCL clock LOW period	1.2	-	-	us
T_{HIGH}	SCL clock HIGH period	0.6	-	-	us
$T_{SU;DATA}$	Data set-up time	250	-	-	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

Symbol	Parameter	Min	Typ	Max	Unit
$T_{SU;STO}$	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

Example:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ID0	1	0	0	1	1	1	0	1
	Decimal Panel part number (157,0x9D)							
ID1	0	0	1	0	0	0	0	1
	BCD Year code: 0x21							
ID2	0	0	1	1	0	1	0	1
	BCD Week code: 0x01-0x53							
ID3	0	0	0	0	0	0	0	0
	Unused register, for future use in case of major rev.							
ID4	0	0	0	0	0	0	0	W_d
	W_d = Bin code for LED							

MIPI Init

The MIPI initialization sequence consists of 2 commands. This initializes touch and graphics.

```
DCS_NoParam(0x11); //Sleep out
delay(300); //Delay 300ms
DCS_NoParam(0x29); //Display On
delay(200); //Delay 200ms
```

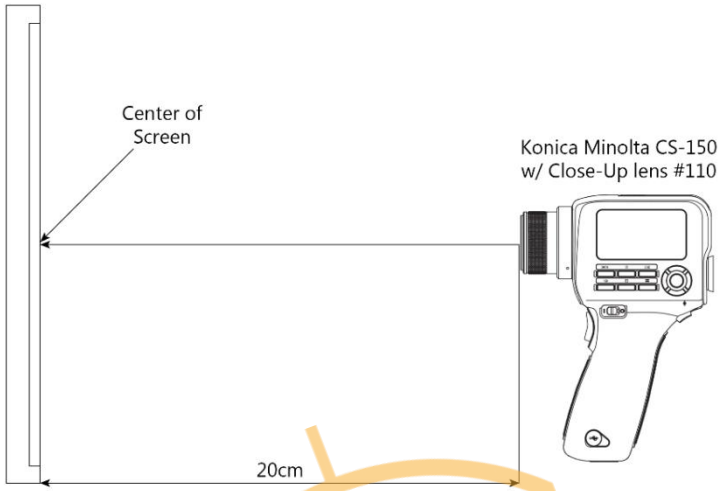
Optical Characteristics

All measurements taken at t=0. Measurements are native with no LUT.

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	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		-	0.6627	-	-	
		Ry		-	0.3391	-	-	
	Green	Gx		-	0.2659	-	-	
		Gy		-	0.6706	-	-	
	Blue	Bx		-	0.1525	-	-	
		By		-	0.0956	-	-	
	White	Wx		-	0.3106	-	-	
		Wy		-	0.3584	-	-	
Luminance		L	Ta = 25 °C	-	2500	-	cd/m2	(1)
Color Gamut Coverage - NTSC				-	80	-	%	
Uniformity		U		80	90	-	%	(2)

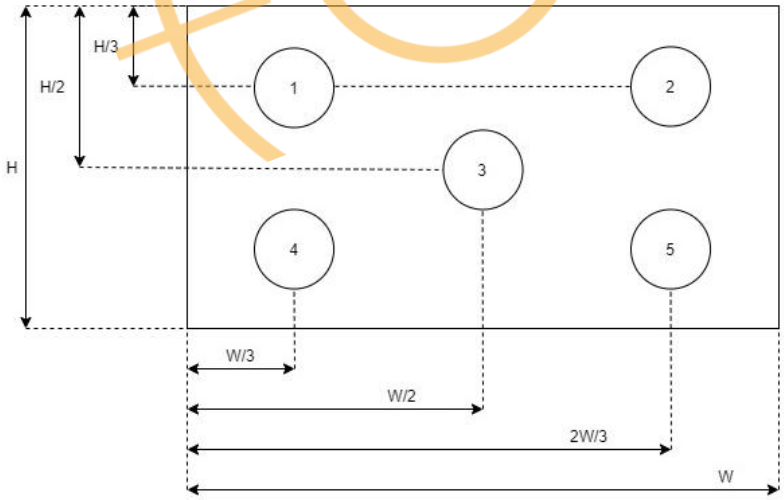
Note 1: Measurement setup

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. Probe is orthogonal to LCD surface.



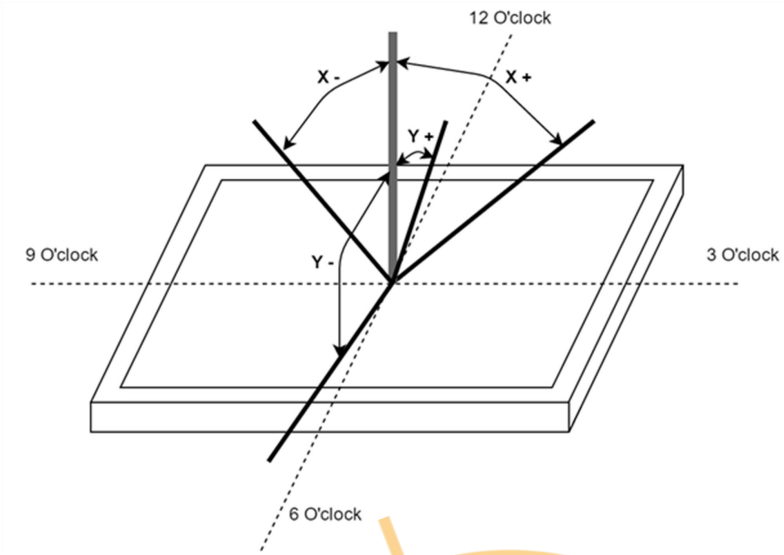
Note 2: Brightness Uniformity

Brightness uniformity = (Minimum Luminance of 5 points / Max Luminance of 5 points) * 100



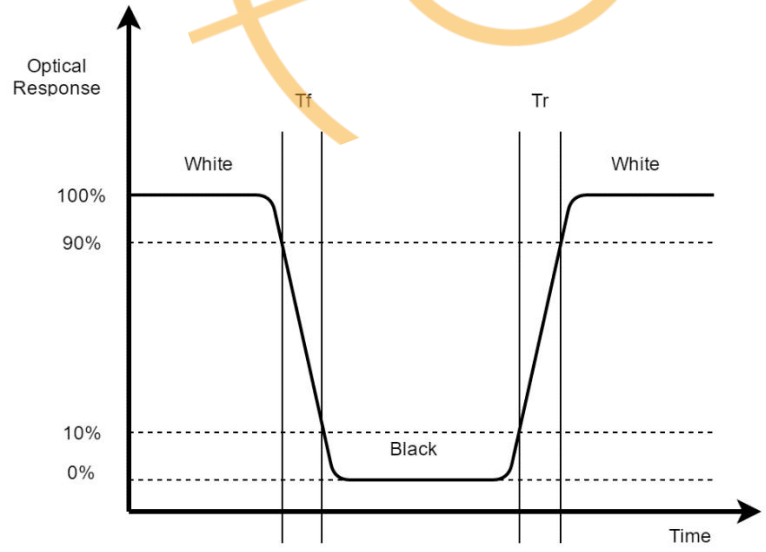
Note 3: Viewing Angle

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



Note 4: Response Time

Definition of response time as follows below.



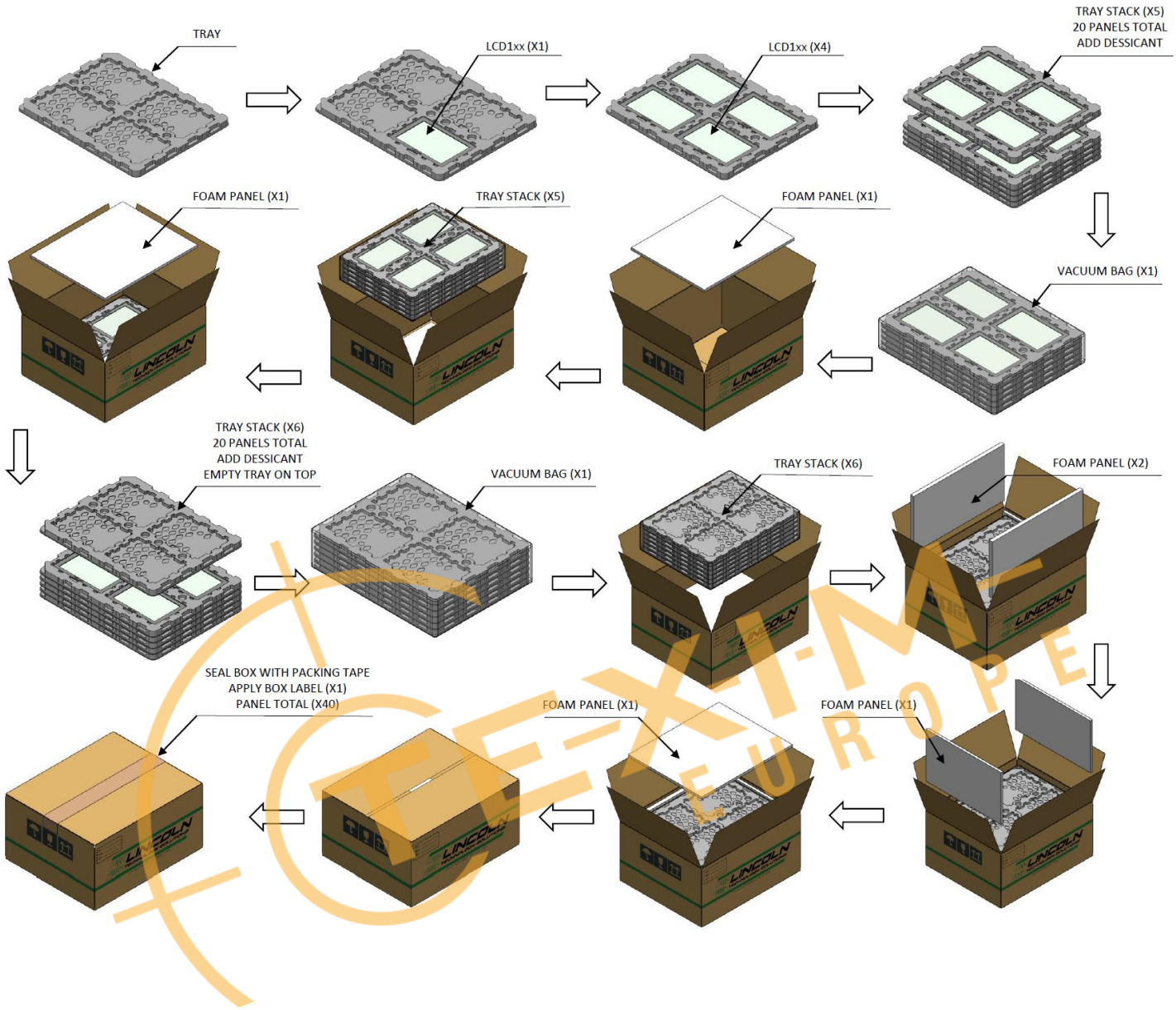
Note 5: Contrast Ratio

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

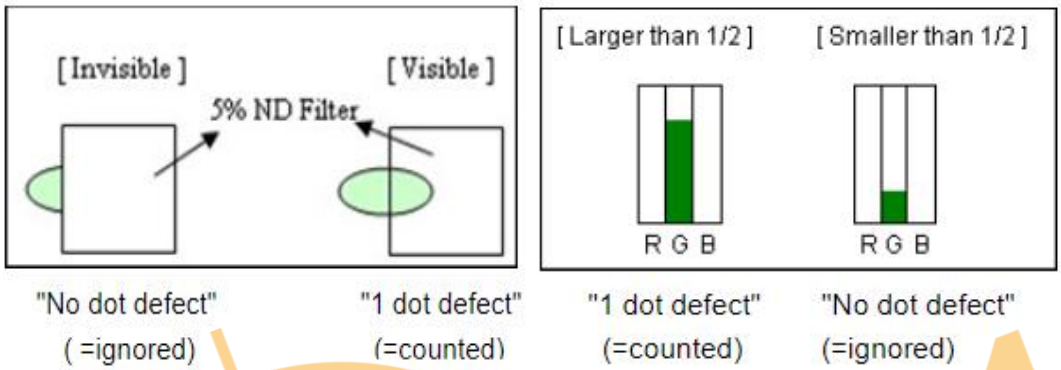


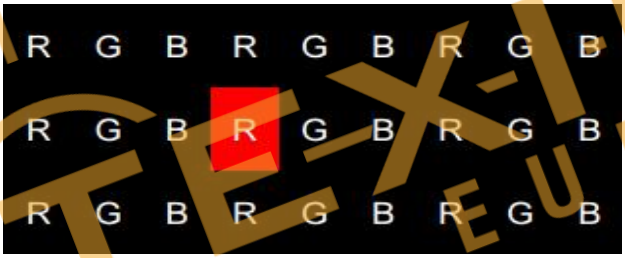
Quality & Inspection Criteria

Terminologies:

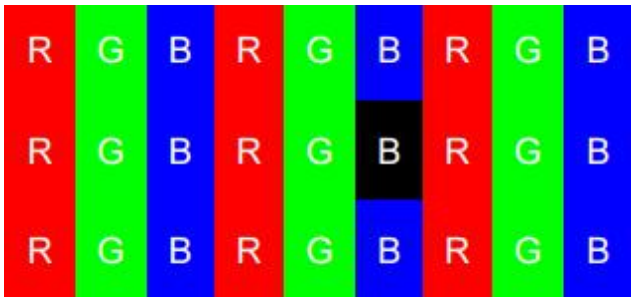
LCD: Liquid Crystal Display; Each pixel contains three dots of R, G, and B (sub-pixel).

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.

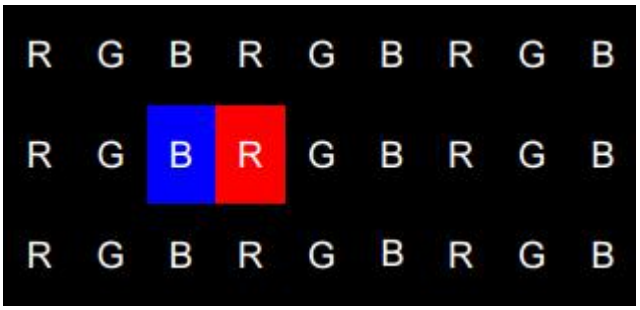




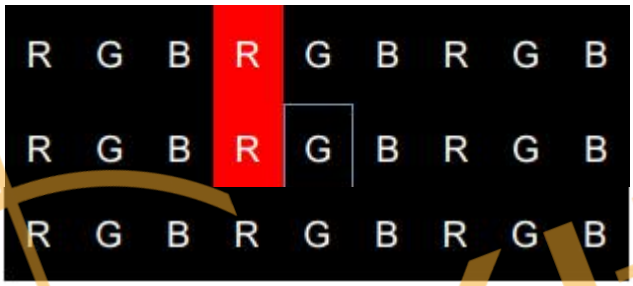
Dark Dot: Any single sub-pixel that does not light up in a white screen or another non-black screen is called a dark dot.



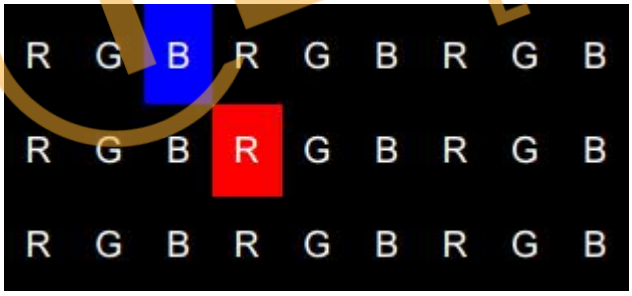
Two adjacent dots (horizontal direction): Use the bright dot illustration as an example to demonstrate two horizontal consecutive dots.



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

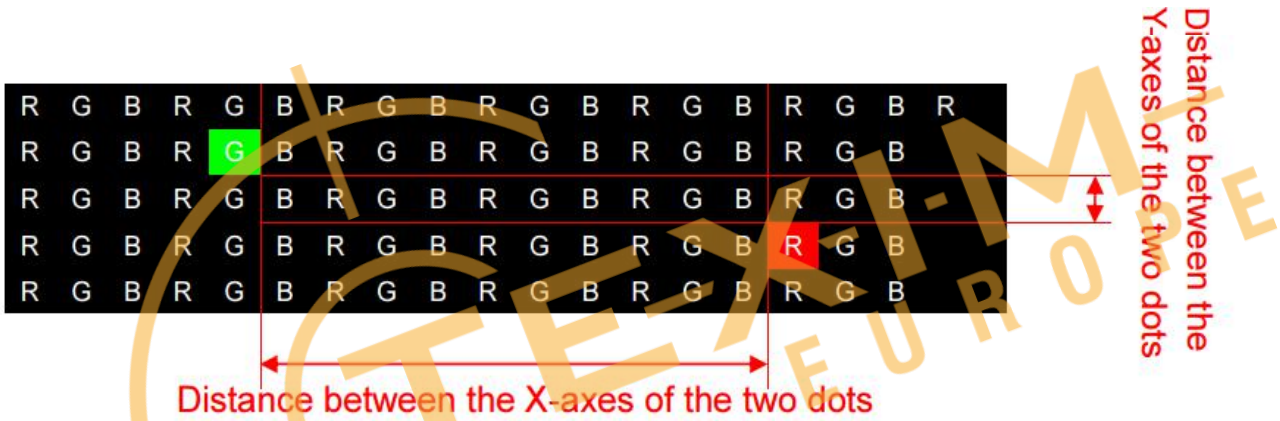


Two adjacent dots (bevel direction): Use the bright spot illustration as an example to demonstrate two consecutive dots in the bevel direction.



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)



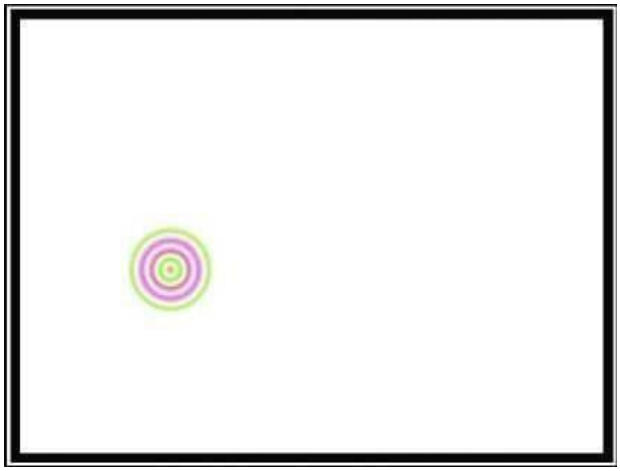
Functional Test

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

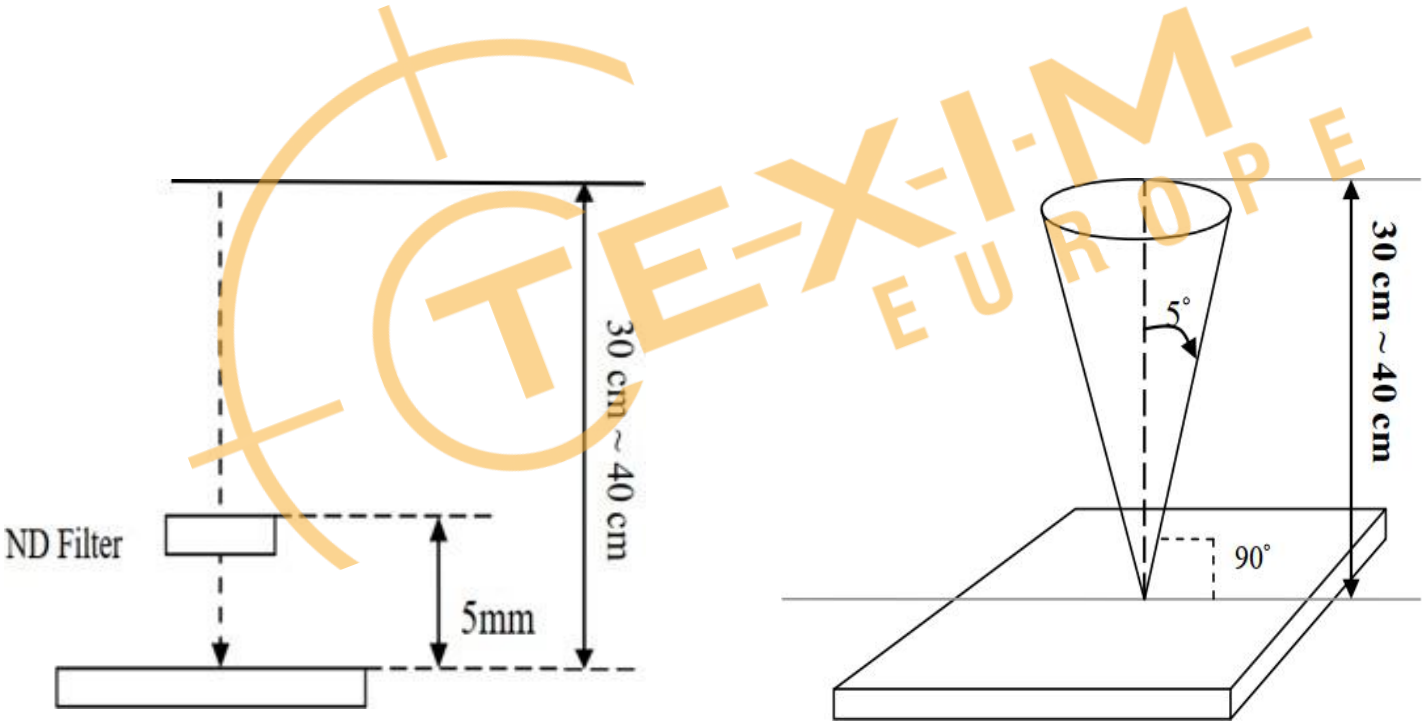
Inspection distance should be 35cm ± 5cm with a FujiFilm ND-LCD 5% filter approximately 5cm from the backlight surface.

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:

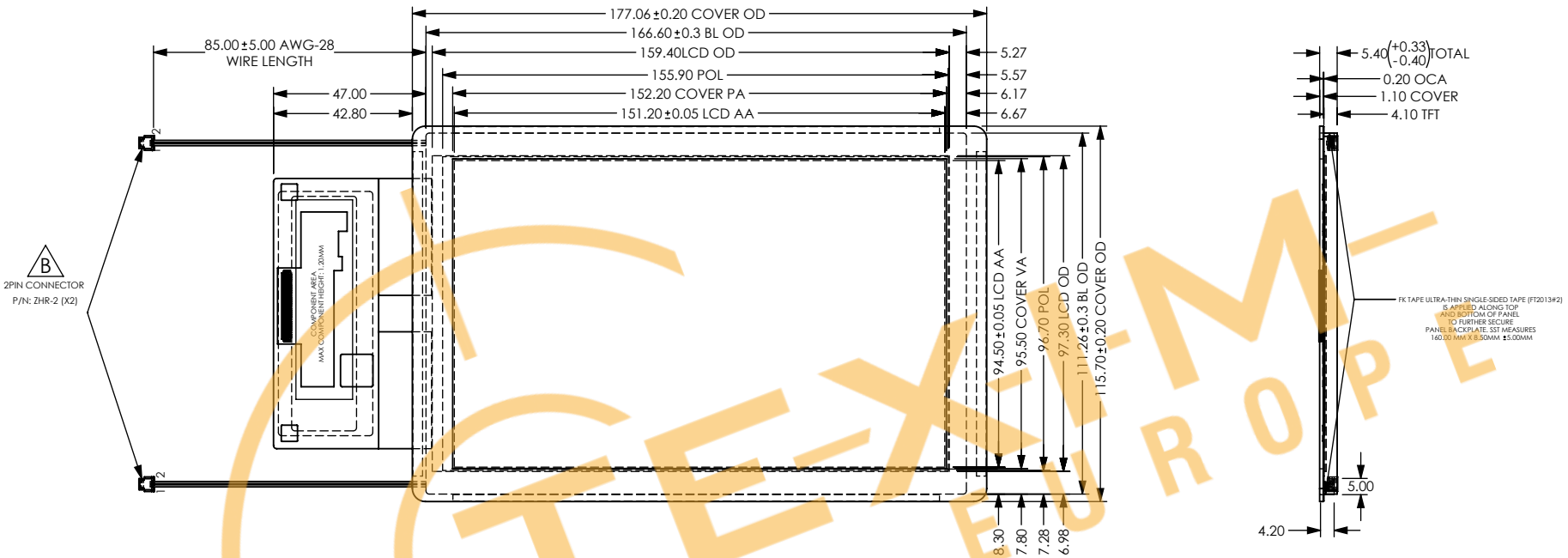
Item	Size	Unit	Acceptance qty.
Unfelt scratch visible with backlight off.	W < 0.05	mm	Ignore
	W > .05 and < .10 L > .3 and < 3.0	mm	4
	W > .10 or L > 3.0	mm	none
	Visible with backlight on		none
Felt scratch	None allowed		
Dent visible with backlight off	D < .2	mm	Ignore
	D > .2 and < .5	mm	5
	Spacing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

GENERAL TOLERANCE TABLE (±MM)	
L ≤ 20	0.1
20<L ≤ 50	0.2
50<L≤ 200	0.25
100<L ≤ 200	0.3
200<L	0.5

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	INITIAL ISSUE.	2/1/2021	JK
C8, 2-B8, 2-D3	B	UPDATED CONNECTOR, REVISED PIN 31, 32, 39 AND 40 PIN DEFINITIONS, REVISED DOUBLE-SIDED TAPE LENGTH.	11/2/2021	JK



DRAWN BY: DAT	DATE 11/2/2021
CHECKED BY: JK	DATE 11/2/2021
MATERIAL: N/A	
FINISH: N/A	DESCRIPTION 7" HB
COMMENTS: ALL DIMENSIONS ARE IN MILLIMETERS.	PART NO. LCD157-070CTL1NCNTTR1.1 / REV. B

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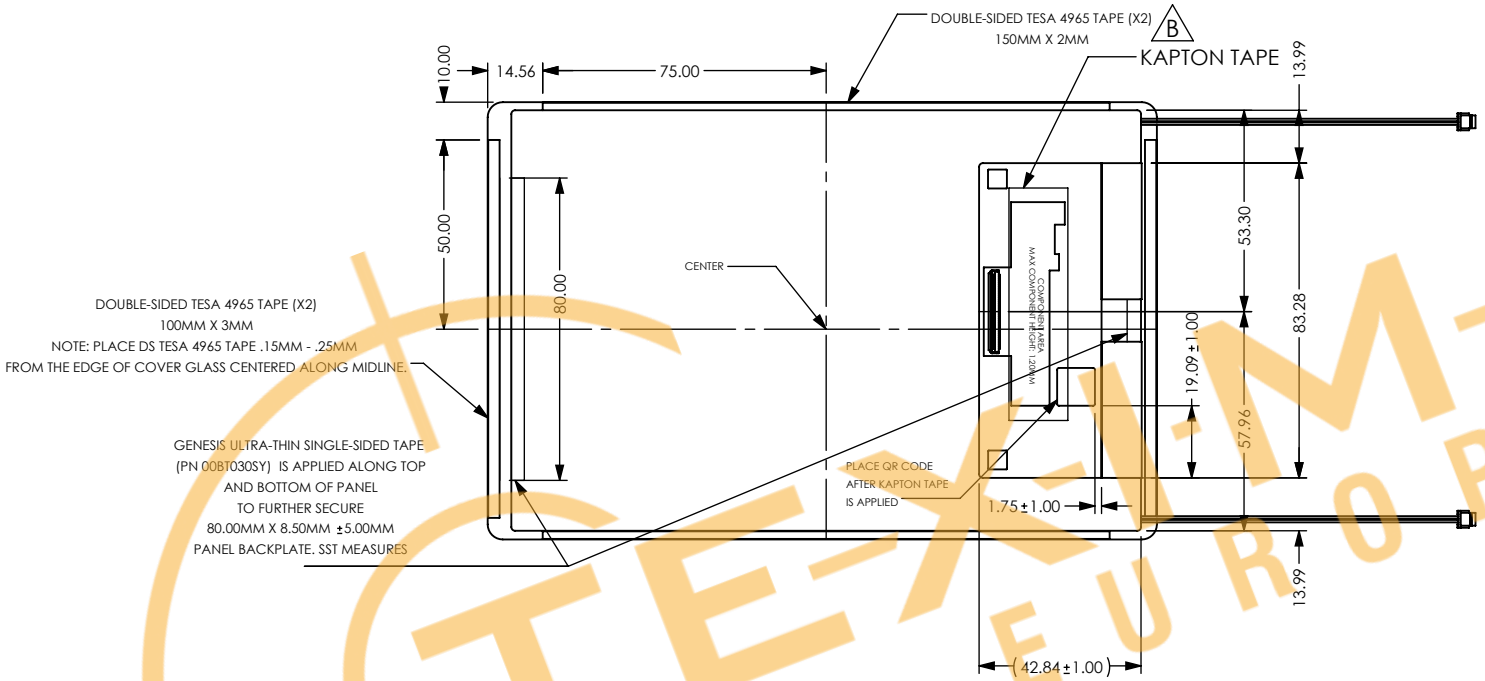
SCALE: 1:2	SHEET 1 OF 2
DO NOT SCALE DRAWING	

GENERAL TOLERANCE TABLE (±MM)	
L ≤ 20	0.1
20<L ≤ 50	0.2
50<L≤ 200	0.25
100<L ≤ 200	0.3
200<L	0.5

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	INITIAL ISSUE.	2/1/2021	JK
1-C8, B8, D3	B	UPDATED CONNECTOR, REVISED PIN 31, 32, 39 AND 40 PIN DEFINITIONS, REVISED DOUBLE-SIDED TAPE LENGTH.	11/2/2021	JK



B

LCD PINOUT TABLE							
PIN	DEFINITION	PIN	DEFINITION	PIN	DEFINITION	PIN	DEFINITION
1	NC	11	MIPI_1N	21	MIPI_3P	31	NC
2	IOVCC	12	MIPI_1P	22	GND	32	NC
3	IOVCC	13	GND	23	TP_SCL	33	NC
4	GND	14	MIPI_CKN	24	TP_SDA	34	VSN
5	LCD_RSTN	15	MIPI_CKP	25	GND	35	VSN
6	NC	16	GND	26	TE	36	NC
7	GND	17	MIPI_2N	27	PWMO	37	VSP
8	MIPI_0N	18	MIPI_2P	28	TP_INT	38	VSP
9	MIPI_0P	19	GND	29	TP_RST	39	NC
10	GND	20	MIPI_3N	30	GND	40	NC

SCALE: 1:2	SHEET 2 OF 2
DO NOT SCALE DRAWING	

DRAWN BY: DAT	DATE 11/2/2021
CHECKED BY: JK	DATE 11/2/2021
MATERIAL: N/A	
FINISH: N/A	
COMMENTS: ALL DIMENSIONS ARE IN MILLIMETERS.	

LINCOLN TECHNOLOGY SOLUTIONS

DESCRIPTION: 7" HB

PART NO. LCD157-070CTL1NCNTTR1.1 | REV. B

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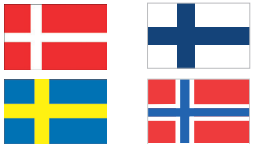
Nordic region



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