LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	TU41210EW1024G768WTL

INTERNAL APPROVALS	
Engineering	**Document Control**
TED CHANG Digitally signed by TED CHANG Date: 2016.10.11 15:57:52 -07'00'	Conner Martin Digitally signed by Conner Martin DN: cn=Conner Martin, o=Densitron Corp., ou=Document Control, email=connor.martin@densitron.com, c=US Date: 2016.10.11 08:42:17 -07'00'

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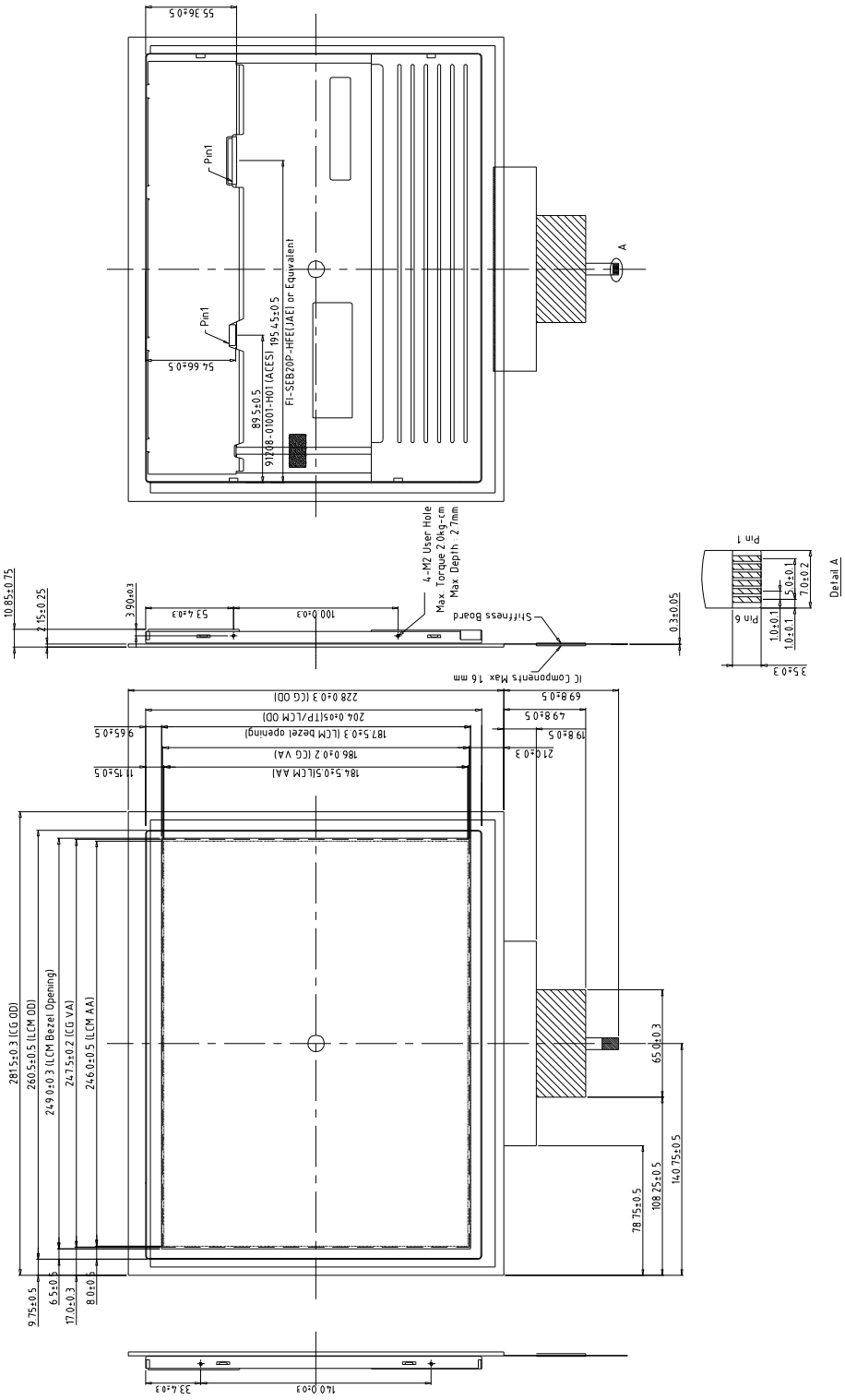
REVISION RECORD

Rev.	Date	Page	Sec.	Comment	ECN No.
A	10/11/16	--	--	New Densitron Release	E5277

1 MAIN FEATURES

ITEM	DESCRIPTION	UNIT
Screen Size	12.1 Diagonal	in
Outline Dimension	281.5 (W) x 228.0 (H) x 10.85 (D)	mm
Display Format	1024 x 768	dots
Viewing Area	247.5 (W) x 186.0 (H)	mm
Active Area	246 (W) x 184.5 (H)	mm
LCD Type	Transmissive / Normally White	--
Viewing Angle	80/80 (H right/left); 70/70 (V right/left)	--
Backlight Type	LED	--
Interface	LCD: LVDS PCT: USB	--
Operating Temperature	-20 ~ 70	°C
Storage Temperature	-30 ~ 80	°C
RoHS Compliant	Yes	--

2 MECHANICAL DRAWING



3 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit	Note
Power Supply Voltage	VCC	Ta=25°C	-0.3	7	V	
Operating Temperature	TOP		-20	70	°C	1
Storage Temperature	TST		-30	80	°C	1,2,3

Note:

1. 90% RH max for Ta < 50°C, and 60% RH for Ta ≥ 50°C

2. In case of a temperature below 0°C, the response time of the liquid crystal (LC) becomes much slower and the color of the panel will appear darker. The level of retardation depends on the temperature due to the LC's characteristics.

3. Only operation is guaranteed at operating temperature. Contrast, response time, and other display qualities are evaluated at +25°C.

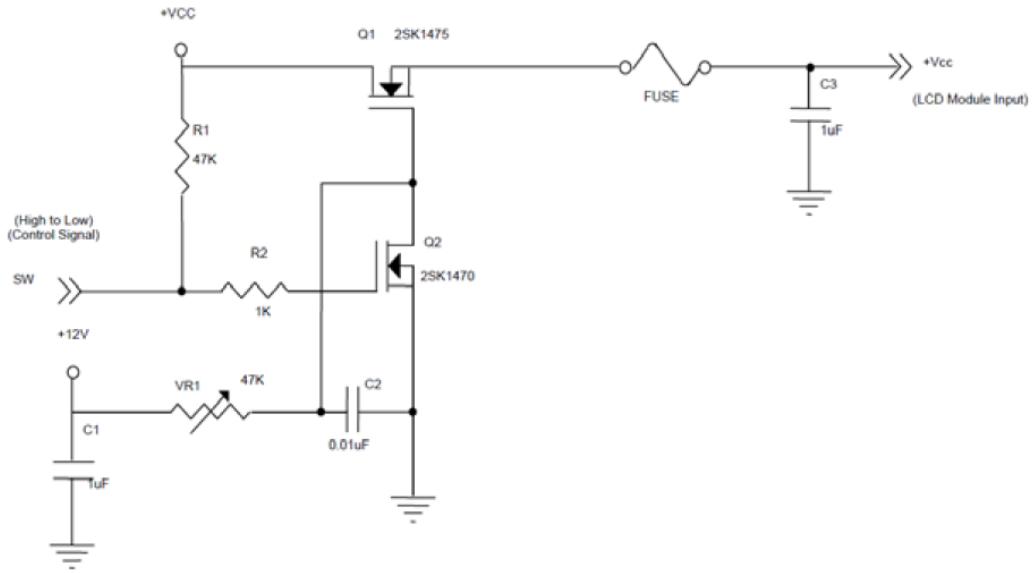
4 ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Power Supply Voltage	V_{CC}		3.0	3.3	3.6	V	1
			4.75	5.0	5.25	V	1
Rush Current	I_{RUSH}		-	-	4	A	2
LVDS differential input voltage	|VID|		100	-	600	mV	
LVDS common input voltage	VICM		0.7	-	1.6	V	
Power Consumption	P_L		-	2.0		W	1

Note:

1. The specified power consumption is under the conditions of Vcc = 3.3V or 5V, Fv = 60Hz.

2. Measurement Conditions:



5 BACKLIGHT CHARACTERISTICS

5.1 LED DRIVING CONDITIONS

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Converter Voltage	V_i	-0.3	18	V	(1) , (2)
Enable Voltage	EN	---	5.5	V	
Backlight Adjust	ADJ	---	5.5	V	

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.

2. Specified values are for lamp (see below)

Ta = 25 ± 2 ºC

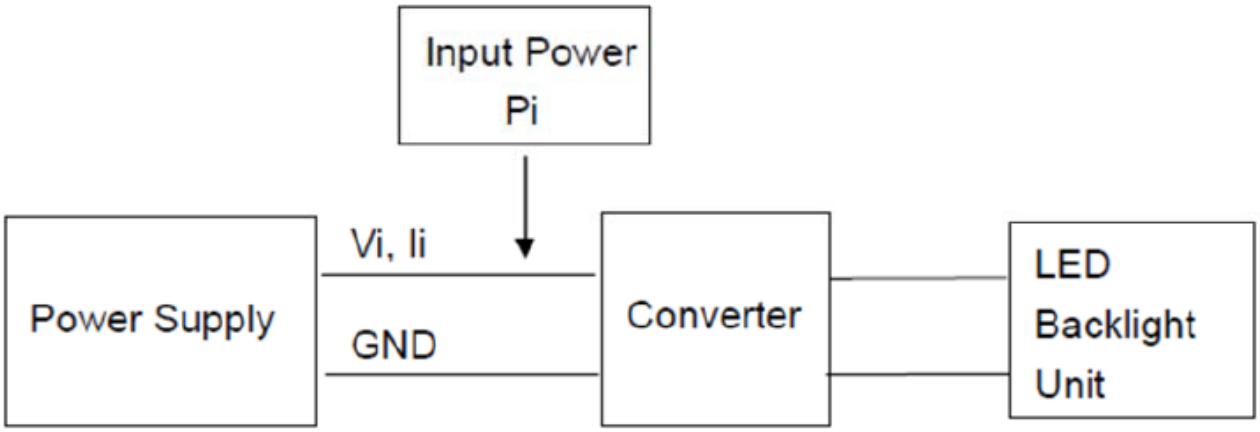
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Power Supply Voltage		V_i	7	12.0	17	V	
Converter Power Supply Current		I_i	0.7	0.83	0.9	A	@ Vi = 12V (Duty 100%)
LED Power Consumption		P_{LED}	-	10	-	W	@ Vi = 12V (Duty 100%)
EN Control Level	Backlight on	-	2.0	3.3	5.0	V	
	Backlight off		0	---	0.8	V	
PWM Control Level	PWM High Level	-	2.0	3.3	5.0	V	
	PWM Low Level		0	-	0.15	V	
PWM Control Duty Ratio		-	10	-	100	%	
PWM Control Frequency		f_{PWM}	190	200	210	Hz	
LED Life Time		L_L	50,000	-	-	Hrs	(2)

Note:

1. LED current is measured by utilizing a high frequency current meter as shown below:

2. The lifetime of the LED is defined as the time when it continues to operate under the conditions at Ta = 25 ± 2°C and duty 100% until the brightness becomes ≤50% of its original value. Operating the LED in a high temperature condition will reduce the life time and lead to a color shift.

5.2 LED CIRCUIT



6 PROJECTED CAPACITIVE TOUCH PANEL

6.1 OPERATING CONDITION

Item	Symbol	Min	Typ.	Max	Unit	Note
Power Supply Voltage	V_{DD}	3.5	5.0	5.5	V	
Power Supply current (Active)	I_{DD}	-	85	-	mA	1
Power Supply current (Low Power)	I_{DD}	-	5	-	mA	
Output High Threshold Voltage	V_{OH}	2.5	-	-	V	
Output Low Threshold Voltage	V_{OL}	-	-	0.8	V	
Differential input sensitivity I(D+)-(D-)I	V_{DI}	0.2	-	-	V	
Differential input command mode range	V_{CM}	0.8	-	2.5	V	
Report Rate	RR	100	-	-	Hz	Single point
		70	-	-		Dual point

Note:

1. This test condition is touched with 10 points.

6.2 PIN ASSIGNMENT

Connector: CVILUX CF25101D0R0-05

Pin No.	Symbol	I/O	Description
1	GND	I	System ground
2	D-	I/O	USB D-
3	D+	I/O	USB D+
4	VDD	I	+5.0V power supply
5	NC	-	No Connection
6	RST	I	External reset signal, active high.

7 INTERFACE TIMING

7.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

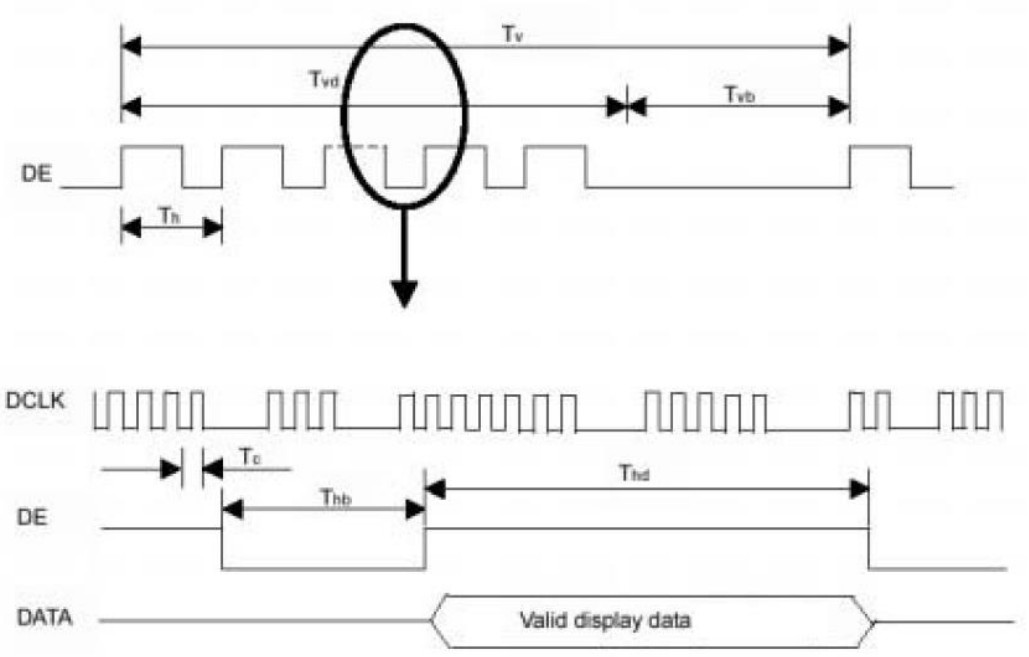
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	Fc	57.5	64.9	74.4	MHZ	
Vertical Active Display Term	Total	Tv	774	806	848	Th	Tv=Tvd+Tvb
	Display	Tvd	-	768	-	Th	-
	Blank	Tvb	6	38	80	Th	-
Horizontal Active Display Term	Total	Th	1240	1344	1464	Tc	Th=Thd+Thb
	Display	Thd	-	1024	-	Tc	-
	Blank	Thb	216	320	440	Tc	-

Note:

1. Since this assembly is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this assembly would operate abnormally.

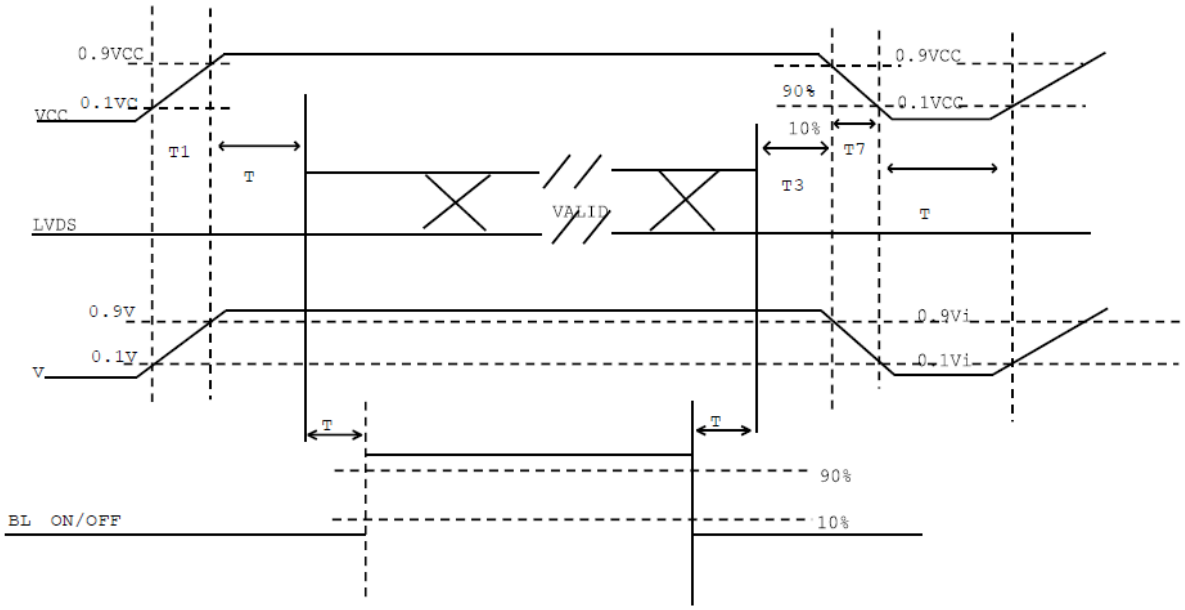
2. Frame rate is 60Hz.

INPUT SIGNAL TIMING DIAGRAM



7.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of an LCD assembly, the power on/off sequence should be conducted as shown in the diagram below.



Note:

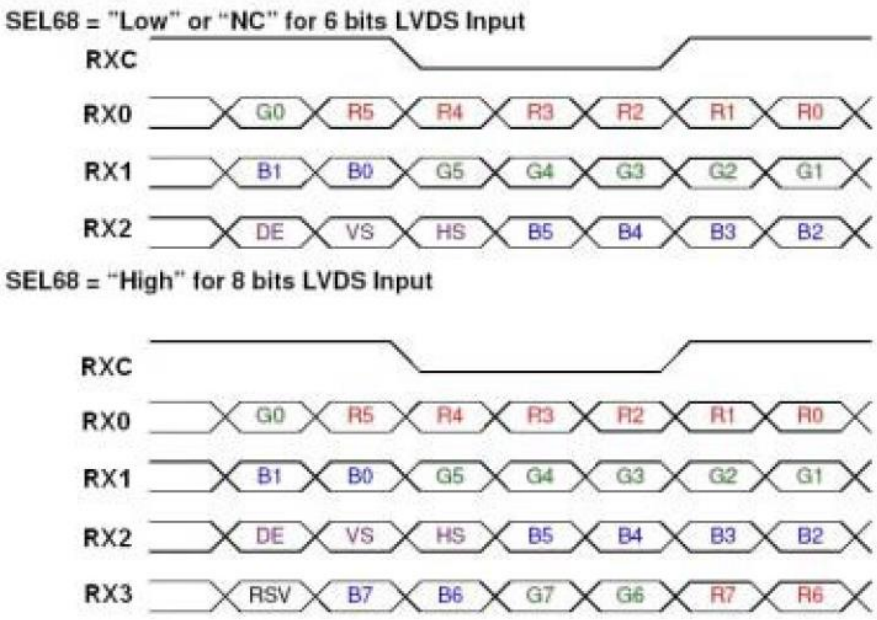
1. Please avoid the floating state of the interface signal at the invalid period.

2. When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0V.

3. The backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms
T7	5	-	300	ms

7.3 INPUT DATA FORMAT



Note:

1. R/G/B data 7: MSB, R/G/B data 0: LSB
2. Please follow PSWG

Signal Name	Description	Remark
R7	Red Data 7 (MSB)	Red-pixel Data
R6	Red Data 6	Each red pixel's brightness data consists of these
R5	Red Data 5	8 bits pixel data.
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0 (LSB)	
G7	Green Data 7 (MSB)	Green-pixel Data
G6	GreenData 6	Each green pixel's brightness data consists of these
G5	GreenData 5	8 bits pixel data.
G4	GreenData 4	
G3	GreenData 3	
G2	GreenData 2	
G1	GreenData 1	
G0	GreenData 0 (LSB)	
B7	Blue Data 7 (MSB)	Blue-pixel Data
B6	Blue Data 6	Each blue pixel's brightness data consists of these
B5	Blue Data 5	8 bits pixel data.
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0 (LSB)	
RXCLKIN+ RXCLKIN-	LVDS Clock Input	
DE	Display Enable	
VS	Vertical Sync	
HS	Horizontal Sync	

3. Output signals from any system shall be low or Hi-Z state when VCC is off.

8 OPTICAL CHARACTERISTICS

8.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25 +/- 2	°C
Ambient Humidity	Ha	50 +/- 10	%RH
Supply Voltage	V_{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Converter Voltage	V_{in}	12	V
Converter Duty		100%	

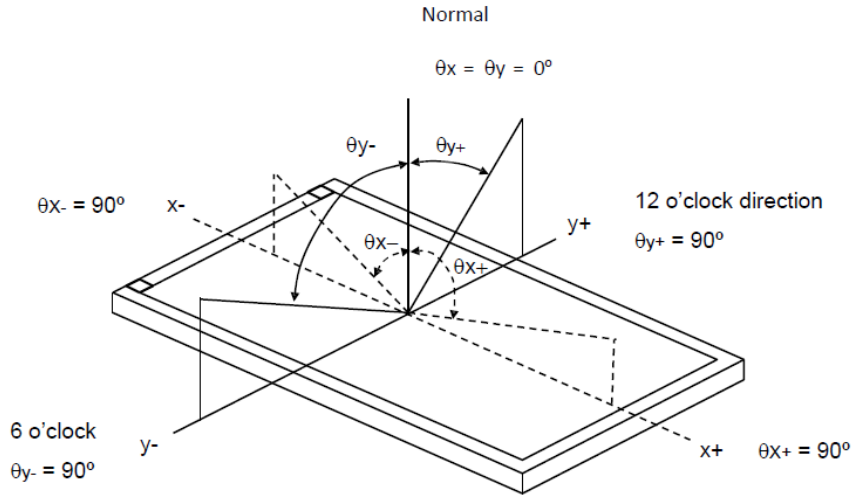
8.2 OPTICAL SPECIFICATION

The relative measurement methods of optical characteristics are shown in 4.2. The following items should be measured under the test conditions described in 4.1 and stable environment shown in note 5.

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity	Red	Rx	θ_X=0°, θ_Y =0° CS-1000	Typ - 0.05	0.625	Typ + 0.05	-	(1), (5)
		Ry			0.358		-	
	Green	Gx			0.324		-	
		Gy			0.604		-	
	Blue	Bx			0.144		-	
		By			0.088		-	
	White	Wx			0.313		-	
		Wy			0.329		-	
Center Luminance of White		L_C		450	510	-	-	(4), (5)
Contrast Ratio		CR		500	700	-	-	(2), (5)
Contrast Ratio in daylight			Sun lamp	100	120	-	-	(7)
Response Time		T_R	θ_X=0°, θ_Y =0°	-	5	10	ms	(3)
		T_F		-	11	16	ms	
White Variation		W	θ_X=0°, θ_Y =0°	-	1.25	1.4	-	(5), (6)
Viewing Angle	Horizontal	$_X$+	CR≥10	70	80	-	Deg.	(1), (5)
		$_X$-		70	80	-		
	Vertical	$_Y$+		60	70	-		
		$_Y$-		60	70	-		

Note:

1. Definition of Viewing Angle (θx, θy)



2. Definition of Contrast Ratio (CR)

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

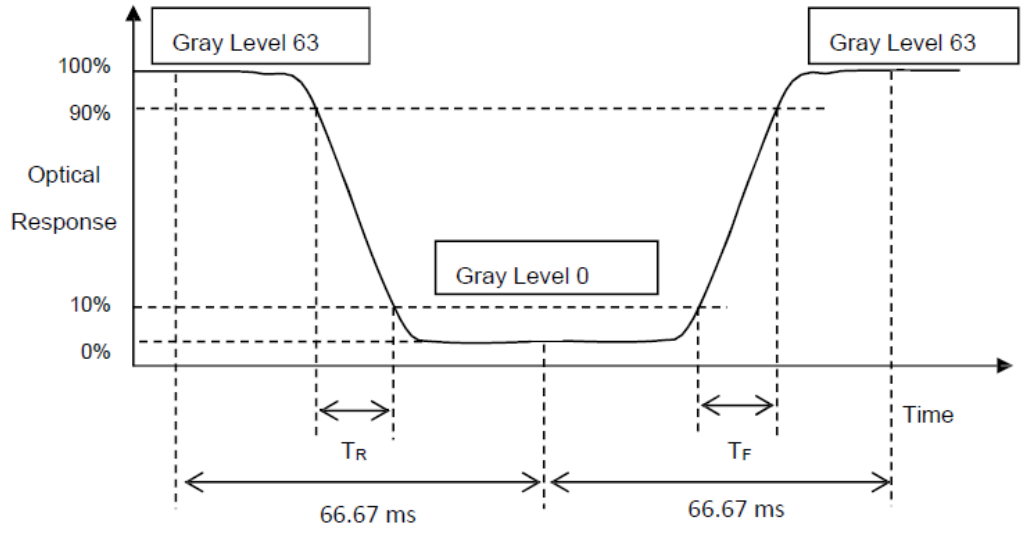
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

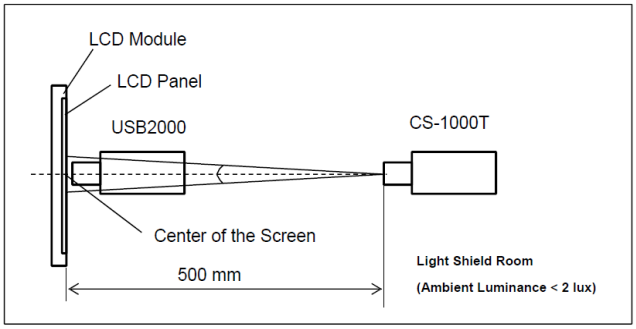
3. Definition of Response Time (T_R, T_F) and measurement method:



4. Definition of Luminance of White (Lc):
Measure the luminance of gray level 63 at center point
Lc = L (5)
L(x) is corresponding to the luminance of the point X in note 6.

5. Measurement setup:

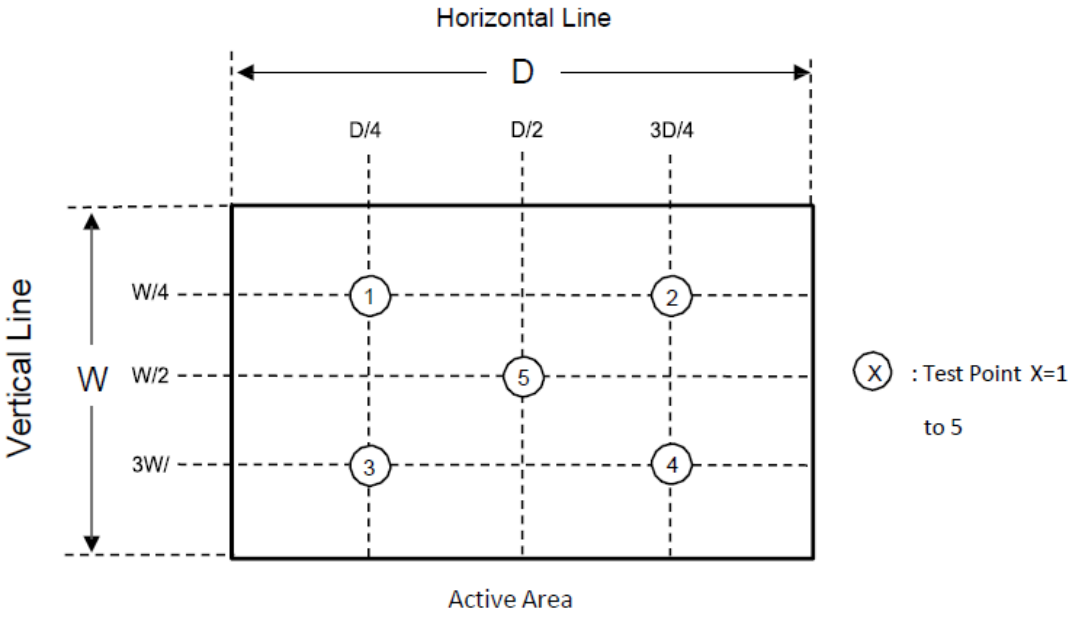
The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting the backlight for 20 minutes in a windless room.



6.

Measure the luminance of gray level 63 at 5 points

$$\delta W = \frac{\text{Maximum [L (1), L (2), L (3), L (4), L (5)]}}{\text{Minimum [L (1), L (2), L (3), L (4), L (5)]}}$$

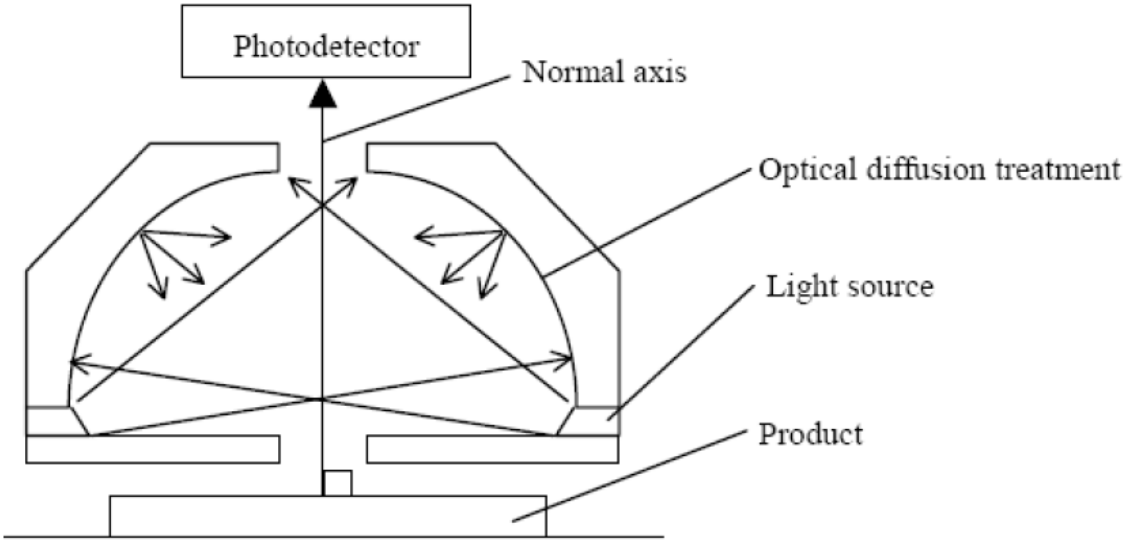


7. Contrast Ratio in daylight

Measuring carried out at backlight unit on

Sun lamp:10000 Lux

Contrast Ratio in daylight=Luminance of white screen/ Luminance of black screen



9 INTERFACE PIN ASSIGNMENT

9.1 LCM PIN ASSIGNMENT

Pin	Name	Description	Remark
1	RX3+	Differential Data Input, CH3 (Positive)	
2	RX3-	Differential Data Input, CH3 (Negative)	
3	NC	NC	
4	SEL68	LVDS 6/8 bit select function control, Low or NC → 6 bit Input Mode High → 8bit Input Mode	Note (3)
5	GND	Ground	
6	RXC+	Differential Clock Input (Positive)	
7	RXC-	Differential Clock Input (Negative)	
8	GND	Ground	
9	RX2+	Differential Data Input , CH2 (Positive)	
10	RX2-	Differential Data Input , CH2 (Negative)	
11	GND	Ground	
12	RX1+	Differential Data Input , CH1 (Positive)	
13	RX1-	Differential Data Input, CH1 (Negative)	
14	GND	Ground	
15	RX0+	Differential Data Input, CH0 (Positive)	
16	RX0-	Differential Data Input, CH0 (Negative)	
17	reLR	Horizontal Reverse Scan Control, Low or NC → Normal Mode. High → Horizontal Reverse Scan	Note (3)
18	reUD	Vertical Reverse Scan Control, Low or NC → Normal Mode, High → Vertical Reverse Scan	Note (3)
19	VCC	Power supply	
20	VCC	Power supply	

Note:

1. Connector Part 076B20-0048RA-G4 or JAE FI-SEP20P-HFE or equivalent.

2. User's connector part no: JAE FI-SE20ME or equivalent.

3. "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "Not connected".

9.2 BACKLIGHT UNIT

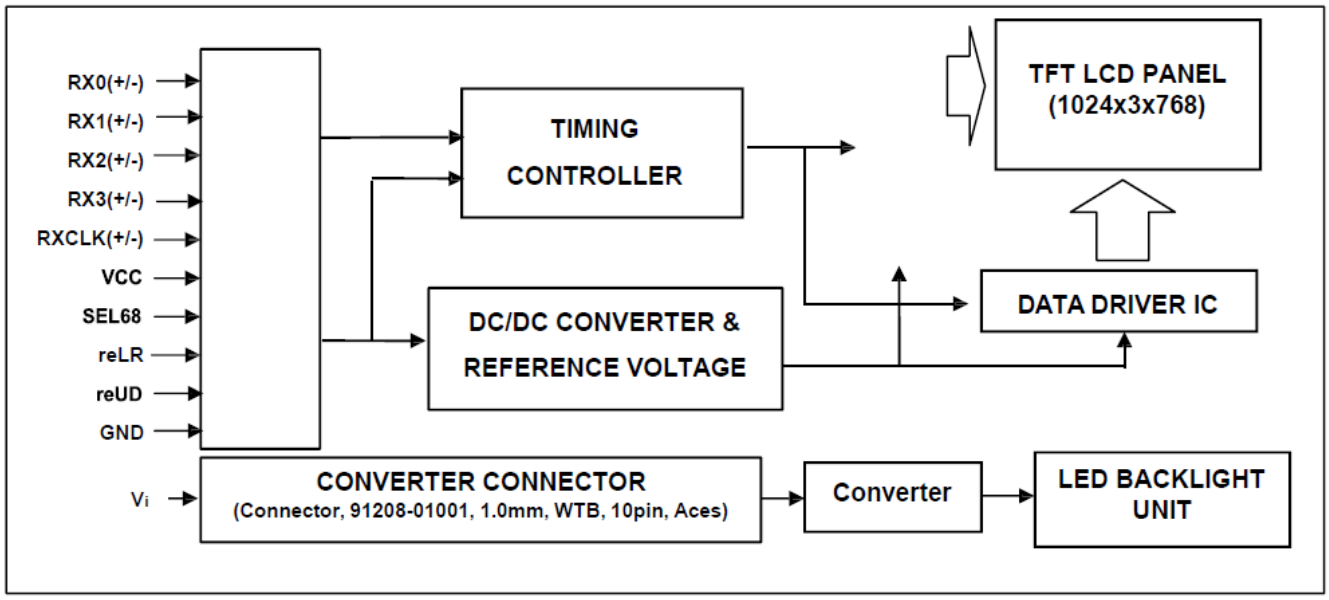
Pin	Name	Description	Remark
1	V_i	Converter input voltage	12V
2	V_i	Converter input voltage	12V
3	V_i	Converter input voltage	12V
4	V_i	Converter input voltage	12V
5	V_{GND}	Converter ground	Ground
6	V_{GND}	Converter ground	Ground
7	V_{GND}	Converter ground	Ground
8	V_{GND}	Converter ground	Ground
9	EN	Enable pin	3.3V
10	ADJ	Backlight Adjust	PWM Diming (190-210Hz, Hi:3.3V_{DC}, Lo:0V_{DC})

Note:

1. Connector Part No: 91208-01001-H01 or equivalent.

2. User's connector Part No: 91209-01011 or equivalent.

10 BLOCK DIAGRAM



11 RELIABILITY

11.1 RELIABILITY TEST

Test Item		Test Condition
Durability Test	High Temperature Storage	Ta= 80˚C 240h
	Low Temperature Storage	Ta=-30˚C 240h
	Temperature Cycle Storage	-30°C for 30 min, then 80°C for 30 min, 100 cycles
	High Temperature Operation	Tp= 70°C 240h
	Low Temperature Operation	Tp= -20°C 240h
	High Temperature & Humidity Operation	Tp= 60°C RH= 90% 240h Non condensing
	Box Drop	1 Corner, 3 Edges, 6 Faces, 66 cm high

TA = Ambient Temperature TP = Panel Temperature

Note:

1. No dew condensation to be observed.

2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removing from the test chamber.

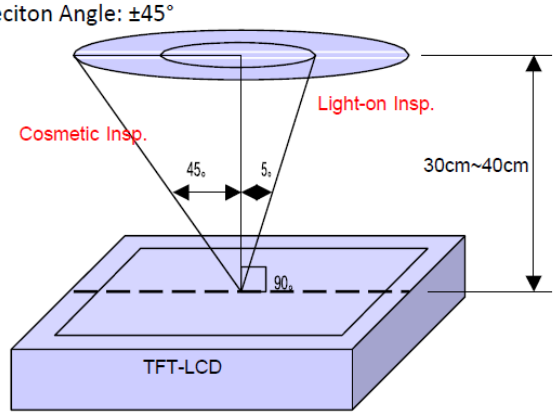
3. No cosmetic or functional defects should be allowed.

4. Total current consumption should be less than twice the initial value.

12 STANDARD SPECIFICATION FOR PRODUCT QUALITY

12.1 DELIVERY INSPECTION STANDARDS

Inspection distance: 35 cm ± 5 cm
Viewing angle: ±45°
Light-on Inspection Angle: ±5°
Cosmetic Inspeciton Angle: ±45°



(Perpendicular to LCD panel surface)

Environmental Conditions

Ambient Temperature		23°C±5°C
Ambient Humidity		55±10%RH
Ambient Illumination	Cosmetic Inspection	400~600 Lux
	Functional Inspection	100~200 Lux

Sampling Conditions

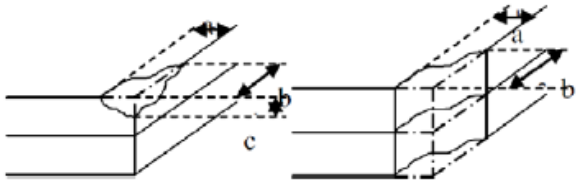
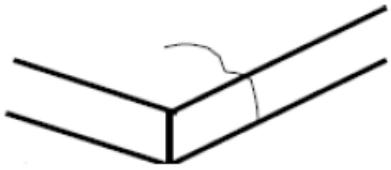
1. Lot size: quantity of shipment lot per model
2. Sampling method:

Sampling Plan		MIL-STD-105E
		Normal Inspection, Single Sampling
		Level II
AQL	Major Defect	0.65%
	Minor Defect	1.5%

3. The classification of Major(MA) and Minor(MI) defects is shown as 7.1.4 Inspection criteria.

12.2 INSPECTION CRITERIA

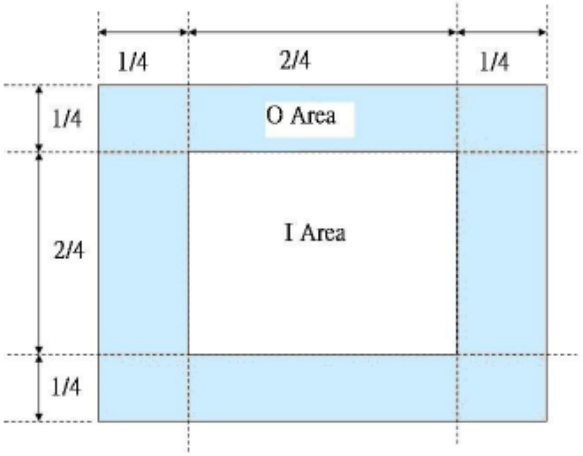
Cosmetic Inspection (Panel):

Item	Judgment Criteria	Classification
Chipping on Panel/Touch Panel	 a≤3.0mm, b≤3.0mm, c≤t (Bottom glass thickness)	MA
Scratch on Panel/Touch Panel *Note-2	W≤0.05 mm and L≤8 mm, Ignored; 0.05mm<W≤0.1mmand L≤10mm, N≤4 W>0.1 mm or L>10 mm, Not allowed	MI
Bubble or Dent on Panel/Touch Panel *Note-3	D≤0.2mm, Ignored; 0.2mm<D≤0.6mm, N≤4 D>0.6mm, Not allowed	MI
Panel/Touch Panel Crack	 Not Allowed	MA
Bezel Oxidation	Not allowed if it rusts continuously over 1 cm (It is out of warranty with rusted tin plate)	MI
Bezel Scratch	L≤20mm , W≤0.3 , N≤7	MI
Metal Squash Dent /Flange(Front Side)	D(W) ≤1 mm , L≤3 mm , N≤4	MI
Polarizer flaw or leak out resin	Defect is defined as the view area.	MI
Outline Dimension	Must be within spec, refer to mechanical drawing	MI

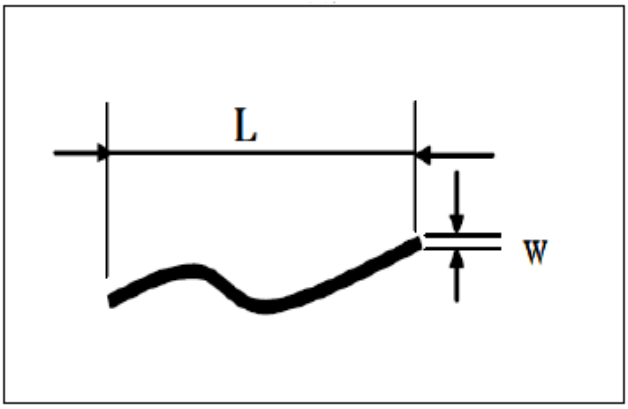
Functional Inspection:

Item	Judgment Criteria			Classification
Point Defect	Bright dot	Random	3	MI
		2 dots adjacent	1	
		3 dots adjacent or more	0	
	Dark dot	Random	3	
		2 dots adjacent	1	
		3 dots adjacent or more	0	
	Total Dot Defect		5	
	Distance	Distance between Bright and Bright dot	L≥15mm	
		Distance between Bright and Dark dot	L≥10mm	
		Distance between Dark dot	L≥5mm	
	(1)It is defined as Point Defect if defect area>0.5dot (2)It is ignored if defect area≤0.5dot (3) 'Weakness will be defined as a bright dot if it can be observed through a 6% ND filter			
Mura	Not allowed if it can be observed through ND Filter 6 %			MI
Foreign Material in spot shape *Note-3	D≤0.15mm, Ignored 0.15mm<D≤0.5mm,N≤4(For LCM), N≤5(For LCM With TP); D>0.5mm, Not allowed			MI
Foreign Material in line or spiral shape *Note-4	W≤0.05mm and L≤5mm ,Ignored 0.05mm<W≤0.1mm, and L ≤ 5mm, N≤4(For LCM) , N≤5(For LCM With TP); W>0.1mm ，L>5mm, Not allowed			MI
Touch panel Malfunction *Note-5	No Malfunction allowed in AA area.			MA

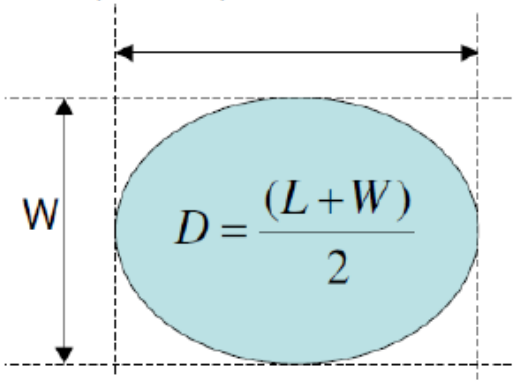
Note-1 I/O Area Definition
Polarizer Scratch



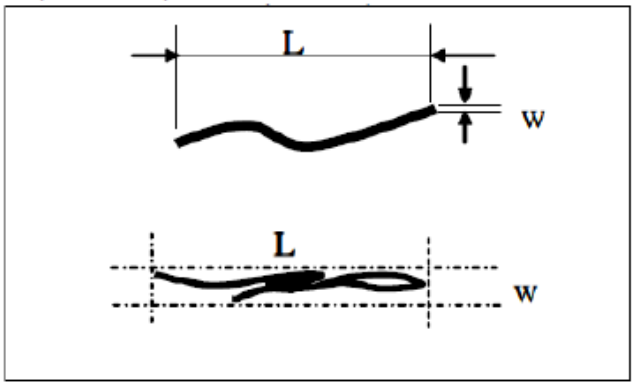
Note-2:



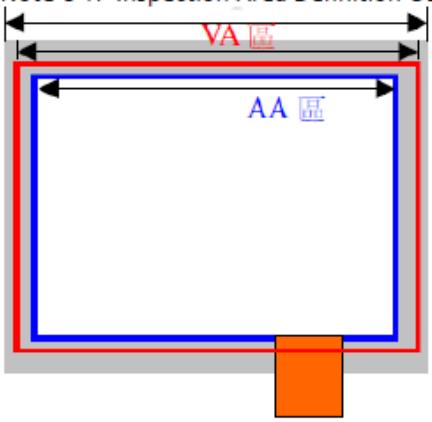
Note-3 Spot Foreign Material
(W ≥ L / 4)



Note-4: Line or Spiral Foreign Material
(W < L / 4)



Note-5 TP Inspection Area Definition OD



13 PART NUMBER LABELLING

All parts will be labelled with the below Part Number.

DENSITRON TU41210EW1024G768WTL *Rev X **COUNTRY *YYMM

** where "Rev X" denotes the current Revision and YY and MM the 2-digit Year and Month of manufacture*
**where "Country" denotes the origin of the manufacture*

14 HANDLING PRECAUTIONS

Safety
If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes.
If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD Cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotriflorothane. Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against Static Charge
As the display uses C-MOS LSI drivers, connect any unused input terminals to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work / assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunlight or high temperature / humidity.

Caution during Operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50% RH.
Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).