

# Product Specification

## Model No: 12936-06

3.2" Memory In Pixel LCD 2.0 Display and Front Light  
Module — Reflective TFT — Monochrome

PRELIMINARY

## Revision History

Rev.	Issued Date	Revised Content	Updated by	ECN #
X1	12/5/23	Initial	Tyler Jackson	2631

PRELIMINARY

## Table of Contents

Revision History .....	2
Table of Contents .....	3
1. General Description .....	4
2. Mechanical Drawing .....	5
3. Electrical Specifications .....	6
3.1. Absolute Maximums .....	6
3.2. Electrical Characteristics .....	6
3.2.1. FLP and LCD Panel Drive .....	6
3.2.2. Power consumption .....	7
3.2.3. LCD Input Signal Characteristics .....	7
3.3. Other Characteristics .....	7
3.4. Pin Assignment .....	8
3.4.1. LCD Pin Assignment .....	8
3.4.2. LED FPC Pin Assignment .....	9
4. Optical Specifications .....	10
5. Reliability Test Requirements .....	13
6. Inspection Specification .....	14
7. Product Marking/Date Code Spec .....	17
8. Product Handling Guidelines .....	18
9. Packaging Spec .....	28
10. Product Return (RMA) Policy .....	28
11. Product Warranty .....	28

# 1. General Description

Azumo part number 12936-06 is a 3.16" monochrome, transfective, active-matrix liquid crystal display (LCD) with integrated front light panel (FLP).

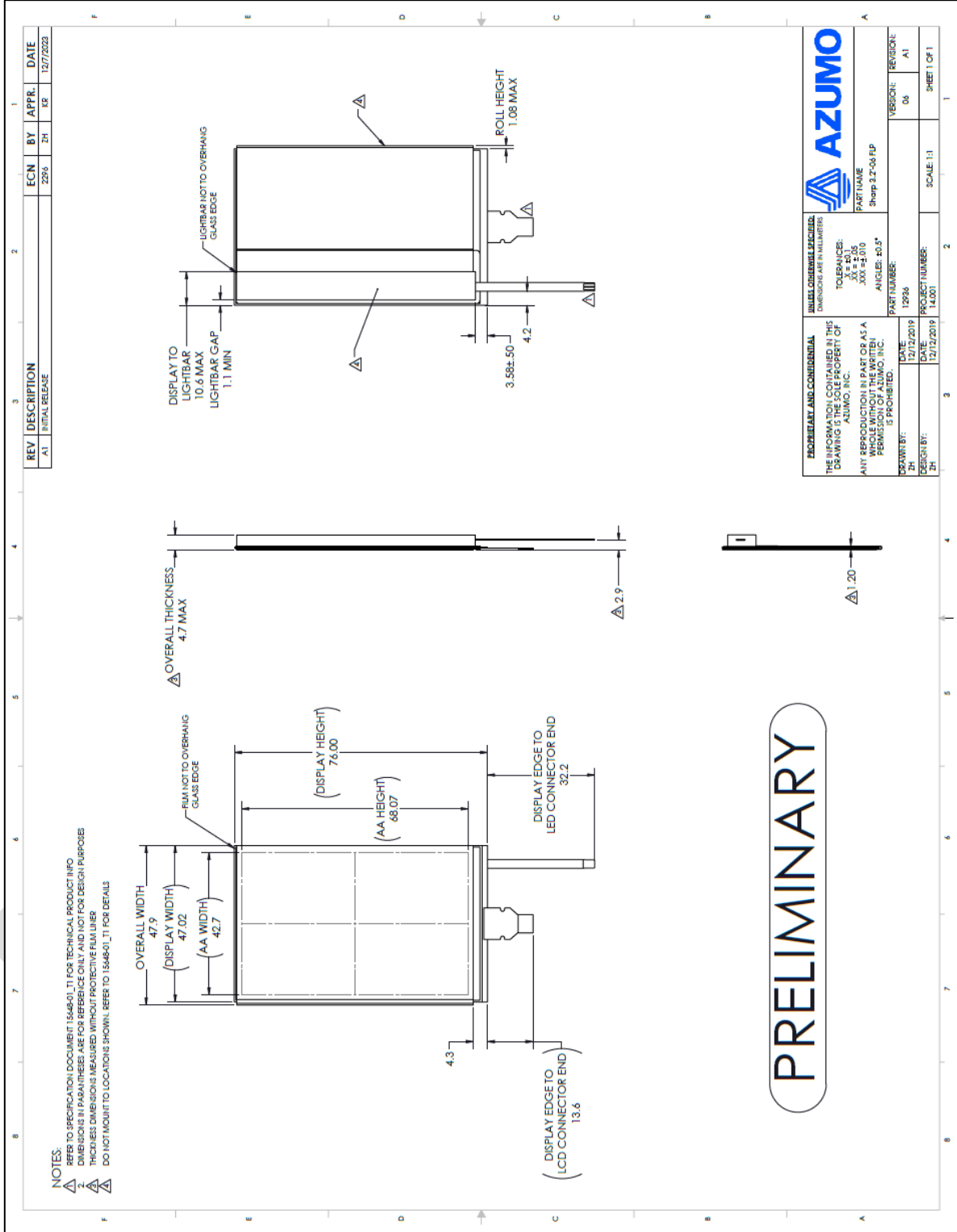
## Features

- Reflective 3.16" LCD (Sharp LS032B7DD02) with an active area consisting of 336 (H) x 536 (V) pixels
- This display features Memory in Pixel (MIP) functionality resulting in lower power usage in comparison with other LCD technologies.
- The OB FLP is optical bonding capable making this display module assembly compatible with cover lens and touch panel bonding.
- The LCD system utilizes Serial Peripheral Interface (SPI) for communication
- The integrated FLP includes a thin flexible light guide film and a lightbar consisting of an LED module and flexible printed circuit.

Table 1. Typical specifications for LCD module.

Technical Specification	Nominal Value	Units	Remark
Resolution	336(H) x 536(V)	pixel	
Active Area	42.7(H) x 68.1(V)	mm	
PPI	200	-	
Liquid Crystal Mode	MIP	-	
Display Mode	Normally white	-	
Illumination color	White	-	
Interface	SPI		
Display Power Consumption (static image)	40	μW	Typical
Display Power Consumption (1 Hz update)	250	μW	Typical
Display Response Time (rise)	10	ms	From black to white
Display Response Time (fall)	20	ms	From white to black
Contrast Ratio with FLP On	12	-	Typical
Contrast Ratio with FLP Off	35	-	Typical
Storage Temperature	-30 to +80	°C	
Operating Temperature	-20 to +70	°C	

## 2. Mechanical Drawing



## 3. Electrical Specifications

### 3.1. Absolute Maximums

Table 2. Absolute maximum ratings for electrical specifications.

Item	Symbol	Min.	Max.	Unit
<b>FLP</b>				
Electrical Power	$P_D$	-	240	mW
Forward Current	$I_F$	-	150	mA
Pulse Forward Current	$I_{FP}$	-	200	mA
Allowable Reverse Current	$I_R$	-	85	
<b>LCD</b>				
Power supply voltage	VDDA	-0.3	+5.8	V
	VDD	-0.3	+5.8	V
Input control signal voltage (High)	$V_{IH}$	-	VDD	V
Input control signal voltage (Low)	$V_{IL}$	-0.3	-	V

### 3.2. Electrical Characteristics

#### 3.2.1. FLP and LCD Panel Drive

Table 3. Recommended operating condition [ $V_{SS}(GND)=0V$ ,  $T_a=+25^\circ C$ ]

Item	Symbol	Min.	Typ	Max	Unit
<b>FLP</b>					
Forward Current	$I_F$	-	60	75	mA
Forward Voltage	$V_F$	-	2.95	-	V
<b>LCD</b>					
Power supply voltage	VDDA	+4.8	+5.0	+5.5	V
	VDD	+4.8	+5.0	+5.5	V
Input control signal	High- $V_{IH}$	+2.70	+3.00	VDD	V
	Low- $V_{IL}$	VSS	VSS	VSS+0.15	V

### 3.2.2. Power consumption

Table 4. LCD Power consumption [Ta=25°C, fSCLK=1MHz, fSCS=1Hz, VDD=+5.0V, VDDA=+5.0V]

Item	Display pattern	Min.	Typ.	Max.	Unit
Hold mode (static)	Black display	-	30	330	μW
Data update mode (1 Hz)	Vertical stripe display	-	250	750	μW

Note: All figures are preliminary and pending final characterization

Table 5. FLP Power Consumption [Ta=+25°C, VLED=3V]

Item	Min.	Typ.	Max.	Unit
FLP LED Power consumption	-	180	240	mW

Note: All figures are preliminary and pending final characterization

\* Minimum power consumption with FLP LED on is characterized as when the LED initially is visible.

### 3.2.3. LCD Input Signal Characteristics

Table 6. Recommended operating conditions [VDDA=+5.0V, VDD=+5.0V, GND=0V, Ta=25°C]

Item	Symbol	Min	Typ	Max	Unit
Frame frequency	fSCS	1	1	10	Hz
Clock frequency	fSCLK	-	1	2	MHz
Vertical Interval	tV	100	-	1000	ms
COM frequency	fCOM	0.5	-	5.0	Hz
EXTCOMIN frequency	fEXTCOMIN	1	1	10	Hz

## 3.3. Other Characteristics

Refer to Sharp LS032B7DD02 Datasheet for the following characteristics inherent to the LCD panel:

1. Input Terminal Names and functions
  - a. Pin description
  - b. Input Signal States
  - c. Recommended circuit
2. Power supply sequence
  - a. On Sequence
  - b. Normal Operation
  - c. Off Sequence
3. Input Signal characteristics
  - a. Input signal timing parameters
4. Signal Timing
5. Input Signal Timing Chart
  - a. Data update mode (1 line)
  - b. Data update mode (multiple lines)
  - c. Hold Mode
  - d. All Clear Mode
  - e. COM inversion
6. Input Signal and Display, Gate address Setting

## 3.4. Pin Assignment

### 3.4.1. LCD Pin Assignment

An FPC connector with 0.5mm pitch is recommended for mating to the LCD FPC.

Table 7. Pin Assignment

Pin	ZIF Pin Define
1	SCLK
2	SI
3	SCS
4	EXTCOMIN
5	DISP
6	VDDA
7	VDD
8	EXTMODE
9	VSS
10	VSSA

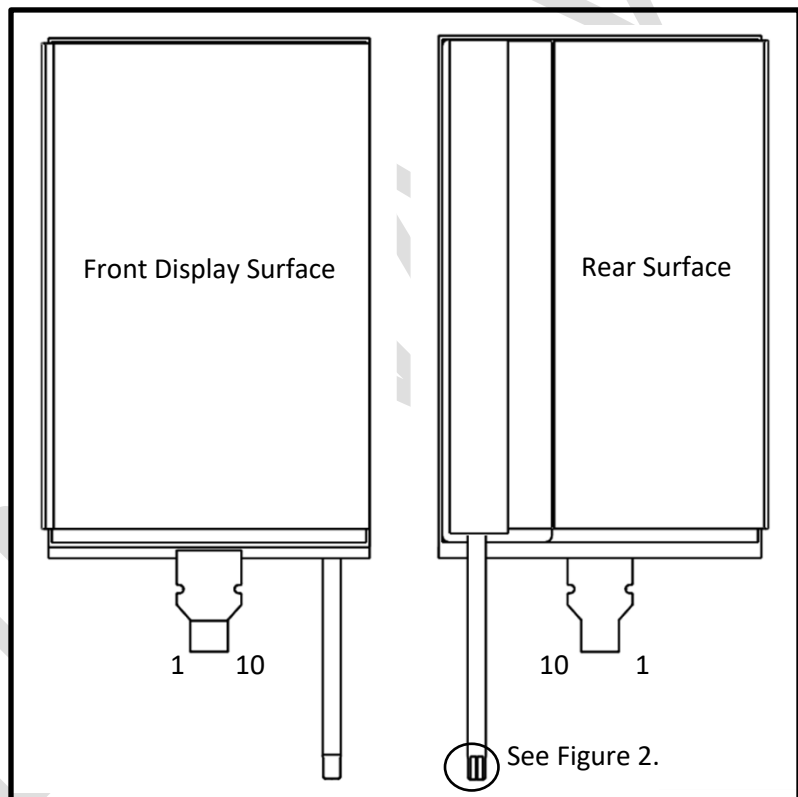


Figure 1. Detail of LCD FPC

Table 8. Recommended connector of LCD FPC.

Product Manufacturer	Series	Part Number	Remark
Panasonic	Y5B	AYF531035	Bottom and Upper
HRS	FH34SRJ	FH34SRJ-10S-0.5SH	Bottom and Upper

### 3.4.2. LED FPC Pin Assignment

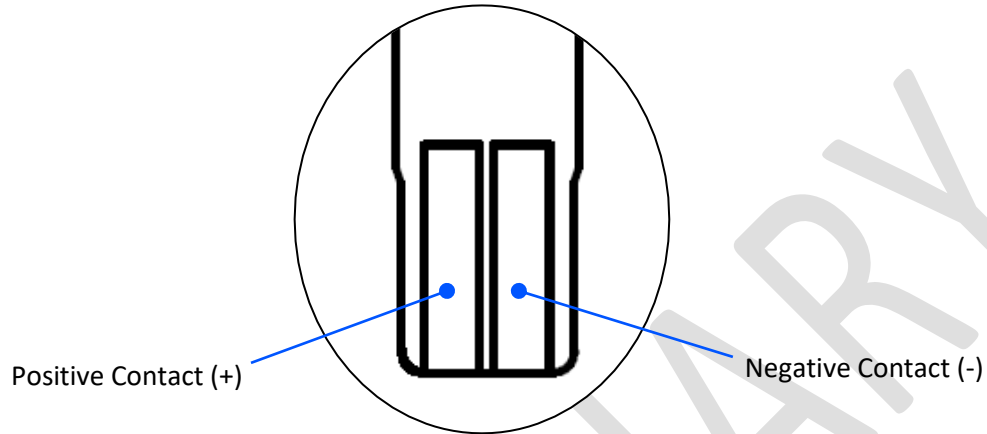


Figure 2. Detail of LED FPC

Table 9. Recommended connector for LED FPC.

Product Manufacturer	Part Number	Contact Style
Molex	505110-0492	Bottom and Upper
TE Connectivity	2328702-4	Bottom and Upper

## 4. Optical Specifications

Optical specifications listed below are measured with Konica Minolta CS100 Chroma Meter, unless otherwise noted:

Table 10. Optical performance when FLP is powered ON. Measurements performed @ Normal to the LCD panel, in a dark room. [Ta=25 °C, VDD=VDDA=5.0V, VLED=3.0V, FLP LED forward current=60mA]

Item	Symbol	Min	Typ	Max	Unit	Remark
Brightness	L	-	42	-	nits	Note 4-4
Brightness uniformity	$\Delta L$	-	34	-	%	Note 4-5
Contrast ratio	CR	-	12	-		Note 4-2
Viewing Angle (CR>2)	$\Theta 11$	-	62	-	deg	Note 4-1
	$\Theta 12$	-	28	-		
	$\Theta 21$	-	52	-		
	$\Theta 22$	-	52	-		

Note: All figures are preliminary and pending final characterization

Table 11. Optical performance when FLP is powered OFF [Ta=25 °C, VDD=VDDA=5.0V]

Item	Symbol	Min	Typ	Max	Unit	Remark
Contrast ratio	CR	20	35	-	-	Note 4-2, Note 4-3
Reflectance	R	10	14	-	%	
Viewing Angle (CR>2)	$\Theta 11$	40	60	-	deg	Note 4-1
	$\Theta 12$	40	60	-		
	$\Theta 21$	40	60	-		
	$\Theta 22$	40	60	-		

Note: All figures are based on native LCD prior to addition of front light panel. To be characterized and updated with front light panel.

Note 4-1: Definition of Viewing Angle

- Measured with Fourier Optics viewing angle instrument, Eldim EZ Contrast XL88

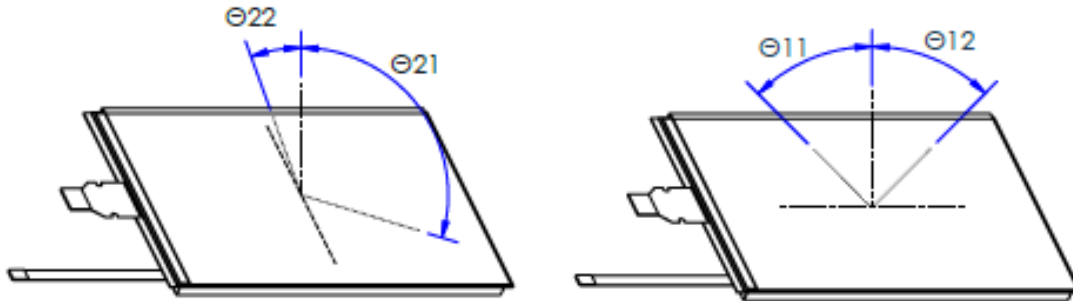


Figure 3. Definition of viewing angle.

Note 4-2: Definition of contrast ratio

$$\text{Contrast Ratio (CR)} = \frac{L_w}{L_k} = \frac{\text{Reflection intensity in white display}}{\text{Reflection intensity in black display}}$$

Note 4-3: Measurement equipment for contrast ratio (CR).

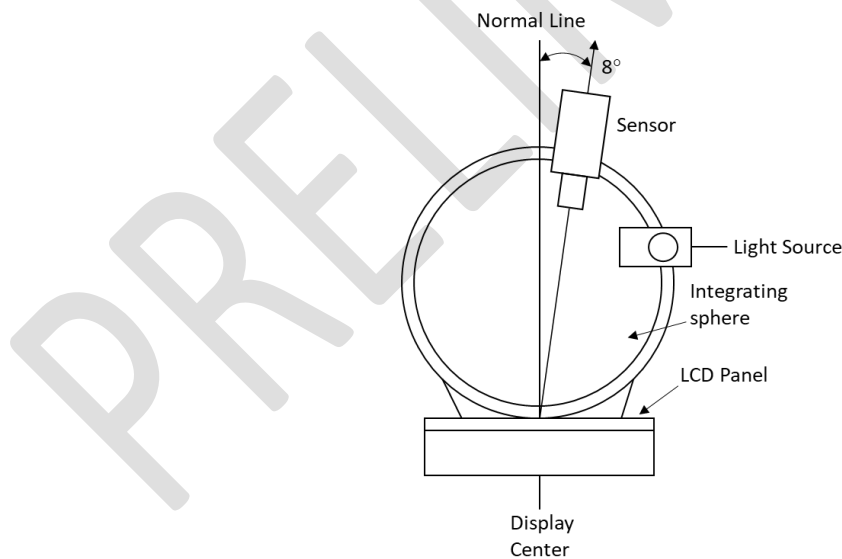


Figure 4. CM700d - Diagram of measurement equipment for contrast ratio

Note 4-4: Definition of Brightness

Brightness (L) is the average measured luminance of 9 testing regions (Section 6, Fig. 3) evenly distributed throughout the display.

Note 4-5: Definition of Brightness Uniformity

$$\text{Brightness Uniformity } (\Delta L) = \frac{L(\text{Min})}{L(\text{Max})} * 100$$

L (Max) = Maximum Luminance in 9 measured testing regions

L (Min) = Minimum Luminance in 9 measured testing regions

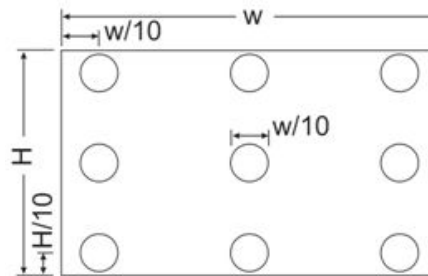


Figure 5. Testing regions for brightness and uniformity.

## 5. Reliability Test Requirements

Table 12. Reliability and Environmental Testing parameters.

	Test item	Test condition	Remark
1	High Temperature Storage	Ta = +80°C, 240hr (Non-operating)	
2	Low Temperature Storage	Ta = -30°C, 240hr (Non-operating)	
3	High Temperature Operation	Tp = 70°C, 240hr	Operating by applying 20mA (@3.0V) to LED FPC of FLP
4	Low Temperature Operation	Tp = -20°C, 240hr	Operating by applying 20mA (@3.0V) to LED FPC of FLP
5	High Temperature and High Humidity Operation	Tp = 40°C, 95%RH for 240hr	Operating by applying 20mA (@3.0V) to LED FPC of FLP
6	Heat Shock Test	Ta = -30°C (1 hour) → +80°C (1 hour) / cycle 5 cycles (Non-operating)	
7	Electrostatic Discharge (ESD)	±200V contact discharge 1 pulse per terminal 150 pF/330Ω (per IEC 61000-4-2) (Non-operating)	
8	Vibration	1.15Grms ,1 Hz ~ 200Hz (per ISTA Proc. 1-G) (Non-operating)	

Note: Above are expected passing test criteria. To be updated.

## 6. Inspection Specification

The following document defines various performance parameters and describes the conditions under which the 12936-01 product is inspected. This document also outlines deficiencies within the FLP which are recognized by Azumo and classify a unit as defective or non-conforming. There shall be no deviations from the following conditions without consent from Azumo.

Table 13. Inspection Parameters and Frequency.

Inspection Parameters			
Item	Inspection Control	Specification/Definition	Specification
1	Room temperature	Temperature for inspection environment	15° - 30° C
2	Room Humidity	Humidity in inspection environment	60% +/- 20%
3	Front Light Drive Current	Current applied to LED during inspection to illuminate the FLP	60mA
4	LCD Supply Voltage	The voltage applied to the LCD during inspection	VDDA @ 5.0V Typ. VDD @ 5.0V Typ. VIH @ 3.0 V Typ.
Optical Performance Inspection			
Item	Inspection Control	Specification/Definition	Inspection Frequency
1	Brightness	Average of measured luminance of 9 testing regions (Fig.5)	100%
2	Brightness Uniformity	Ratio of minimum luminance region to maximum luminance region of 9 testing regions (Fig.5)	100%
3	Contrast Ratio	The ratio of the rLCD display reflective intensity (white/black)	100%

The environment and inspection frequency defined above are followed when inspecting the optical performance of 12936-01 product line.

Table 14. Inspection conditions for Azumo LCD panels.

Inspection conditions			
Item	Inspection Control	Specification/Definition	Specification
1	Distance	The distance the unit is required to be from the eye during inspection.	450mm +/- 25mm
2	Angle	Maximum angle product should be tilted during inspection  Note: The surface of the LCD and the eye of the inspector shall be at $90^{\circ} \pm 5^{\circ}$ prior to rotation.	30° from "normal" along viewing angles (Refer to Section 4, Note 4-1)
3	Duration	The maximum time allowed for inspection	6 seconds
4	LCD State	The condition of the rLCD during inspection	100% white pixel
5	Active Area	The boundaries of the optical inspection with the rLCD display	68.07mm x 42.67mm Sharp Doc. No. IIS125019, Section 9.1
6	Ambient Light Level	Environment for cosmetic inspected	200 lx +/- 25 lx
7	Ambient Light Level	Environment for optical inspected	5 lx +/- 5 lx
8	Ambient light source	Light source utilized during inspection	Fluorescent tube

The environment and inspection conditions outlined above are followed when inspecting the cosmetic and optical characteristics of the 12936-01 product line. All products inspected per the inspection condition defined above are with the protective liner on.

Table 15. Definition of cosmetic defects and functional defects.

Cosmetic Defects			
Item	Defect	Definition	Specification
1	Mechanical	Any dimensional not within part tolerances	Refer to Section 2, "Mechanical Drawing"
2	Chipped LCD	Damage to the LCD edge.	Sharp Doc. No. IIS125019 Section 8.2
3	Cracked LCD	Visible ink bleed-out in the active area of the rLCD	Not allowed
4	Dent and Pit	A physical impression or piercing of the FLP visible during inspection (Reference inspection condition item 2).	Not allowed
5	Particles	Foreign matter found in the FLP or rLCD	Sharp Doc. No. IIS125019 Section 9.3
6	Missing Tab	Units missing the removable tab laminated to the protective cover	Not allowed
Functional Defects			
Item	Defect	Definition	Specification
1	Dead or Static display	A display which does not turn on. A random dot pixel pattern which displays a lot of static (noise) when the LCD is driven	Not allowed
2	Dead or Faulty LED	1) An LED which does not illuminate the FLP. 2) An LED which does not illuminate the FLP to the specified brightness level (Refer to Section 4, "Optical Specifications"). 3) An LED which illuminates the FLP intermittently.	Not allowed
3	Non-Uniformity	A dark region within the active area covering more than 33% of the Active Area (Refer to Inspection condition #5).	Not allowed

Azumo only recognizes the characteristics mentioned above as defects for the 12936-01 product line. Every unit produced undergoes inspection according to the guidelines in the inspection conditions section of this document, with regards to the criteria specified in the defect section above. If a returned product does not match the defects listed or is inspected under different conditions, the Azumo quality team will evaluate and make an assessment on non-conformance.

## 7. Product Marking/Date Code Spec

All Azumo LCD 2.0 products are printed with a 15-digit serial code for identification. The location of the code on the Azumo LCD 2.0 product is shown in "Section 2. Mechanical Drawing". The serial code can also be read by scanning the corresponding QR code.



Figure 6. Details of Azumo product serial code.

## 8. Product Handling Guidelines

The Azumo LCD 2.0 product is composed of a reflective LCD panel (rLCD) and a front light panel (FLP) as shown in Fig. 7 below. The Azumo FLP is a highly engineered thin film light guide that requires knowledgeable handling to avoid unintended damage. The FLP is permanently bonded to the LCD panel through: 1) an optical bonding procedure of the FLP to the active area of the rLCD; 2) a separate roll procedure to bond the light bar to the LCD. Azumo uses different roll configurations to bond the lightbar to the rLCD as shown in Fig. 8. The final Azumo LCD 2.0 display panel is a complete assembly of the FLP to the rLCD as shown in Fig. 9 with the light bar laminated to the back of the LCD display panel. The following handling guide will address the proper handling of both the FLP and the LCD panel.

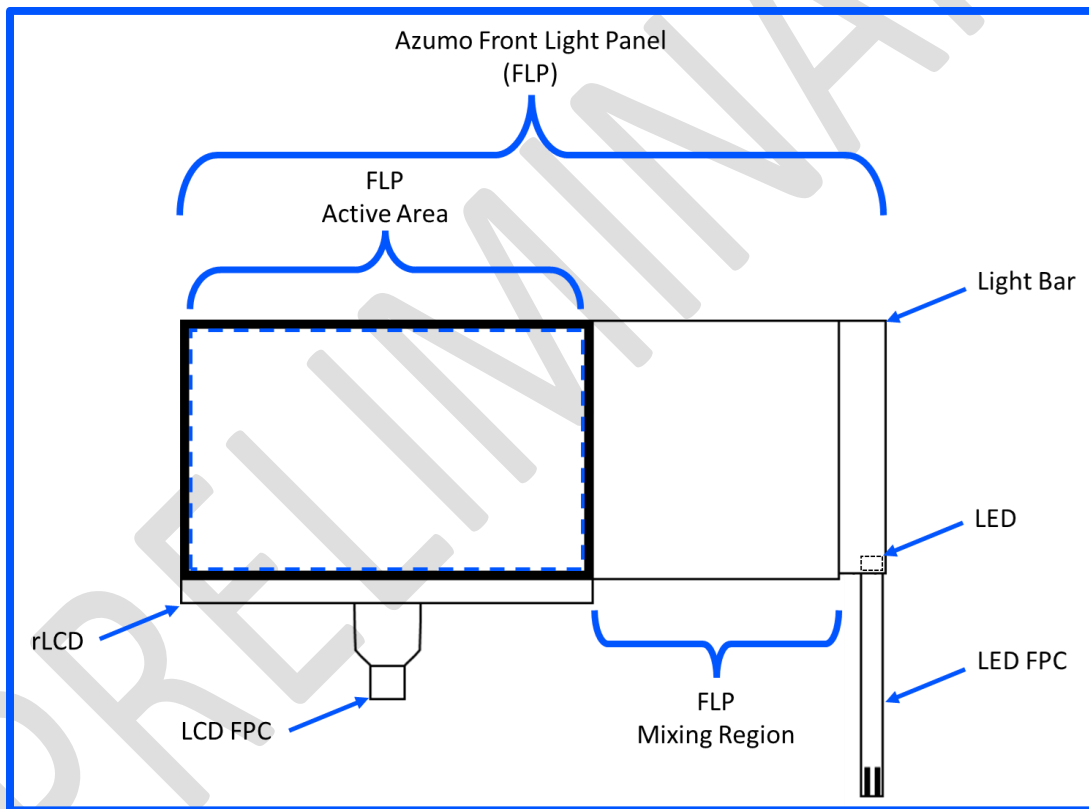


Figure 7. Diagram of Azumo LCD 2.0 FLP in unrolled state.

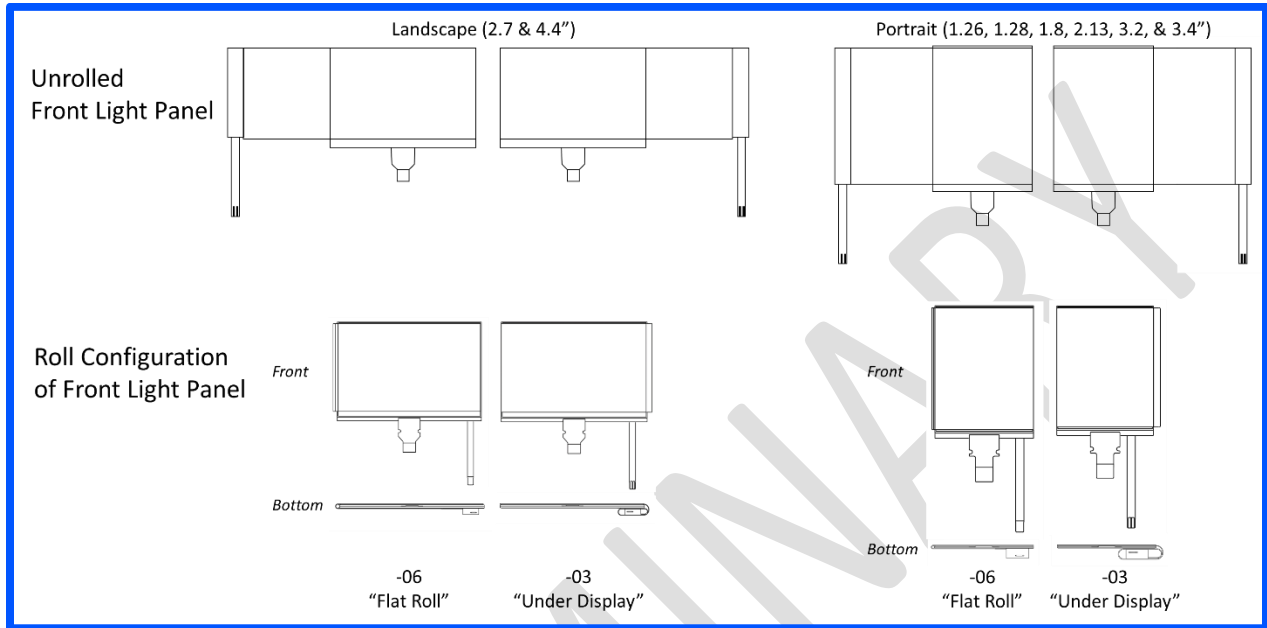


Figure 8. -06 and -03 roll configurations of the Azumo LCD 2.0 FLP

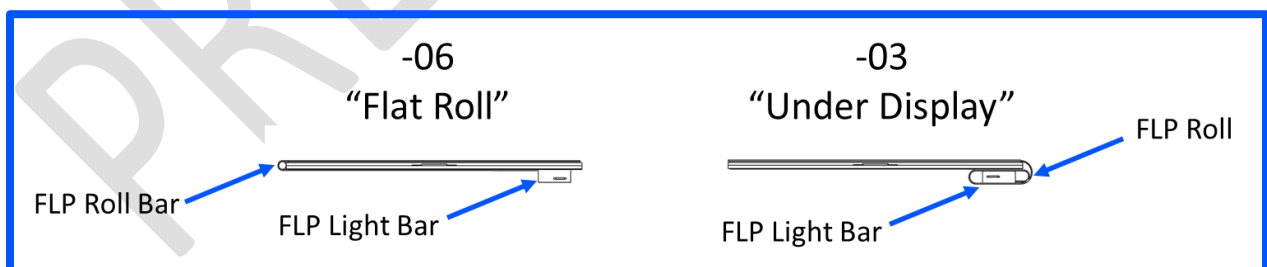


Figure 9. Bottom view of Azumo LCD 2.0 showing different roll configurations.

## General Precautions

1. The application examples in this spec are provided to explain the application and are not intended to guarantee any industrial property right or other rights or license you to use them.
2. Azumo reserves the right to make changes in the specifications, characteristics, data, materials, structures, and other contents described herein at any time without notice to improve design or reliability of the Azumo product.
3. Azumo takes no responsibility for damage caused by improper use of the device.
4. The appropriate design measures should be taken to ensure reliability and safety when Azumo's devices are used.
5. Azumo assumes no responsibility for any damage resulting from the use of the device which does not comply with the instructions and the precautions specified in these specs sheets.

## Front Light Panel Handling Guide

Failure to follow the guidelines outlined below may result in diminished brightness, non-uniform brightness, unintended effects to optical performance, increased power consumption, or a fully inoperable unit.

### *General Guidelines*

1. When removing the Azumo LCD 2.0 product from the packaging tray be careful to:
  - a. Lift Azumo LCD 2.0 product at finger slot (refer to Figure 10).
  - b. Avoid applying excessive pressure to the FLP roll and roll bar
  - c. Avoid direct contact with the FLP active area.
  - d. Avoid bending the LED FPC.
  - e. Avoid bending the LCD FPC.

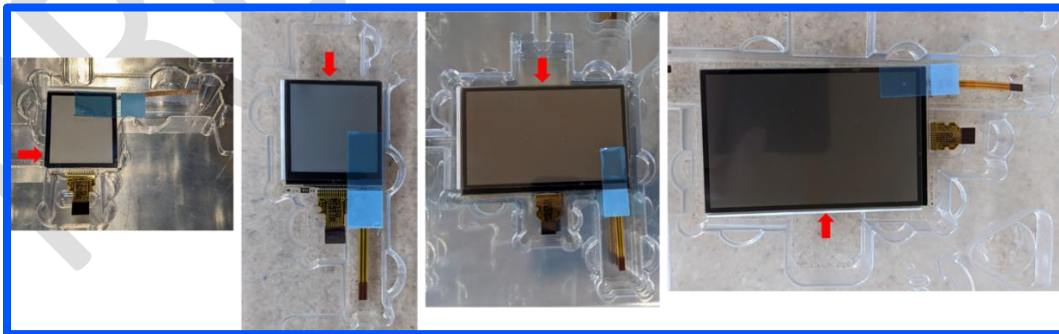


Figure 10. Image of typical packaging tray (1.26", 1.8", 2.7", 3.2") showing finger slot location.

- The protective liner should remain on the front lit display until its removal is necessary for final installation (refer to Figure 11).

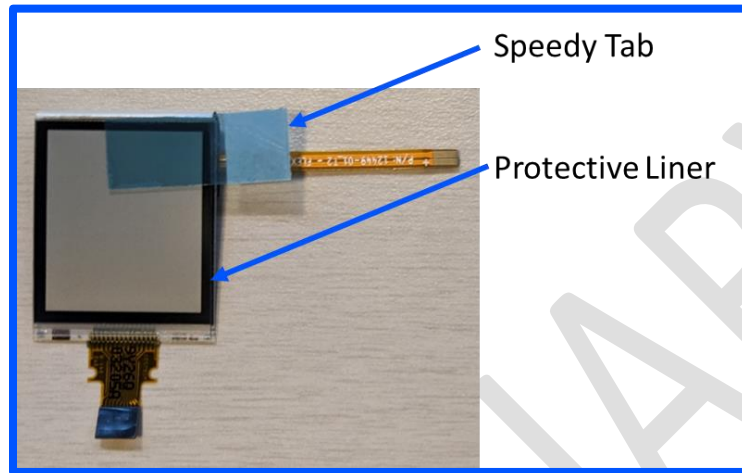


Figure 11. Identification of protective line and speedy tab.

- Do not reapply or reuse the protective liner once removed from the product
- Once the protective liner is removed, do not touch the exposed top layer of the front light film.
- Remove the protective film slowly, using the speedy tab, pulling at a  $\sim 30^\circ$  angle from display surface. Remove under an ESD control device, like an ion blower, in a  $>50\%$  RH environment to reduce the risk of static charge. Refer to Figure 12.

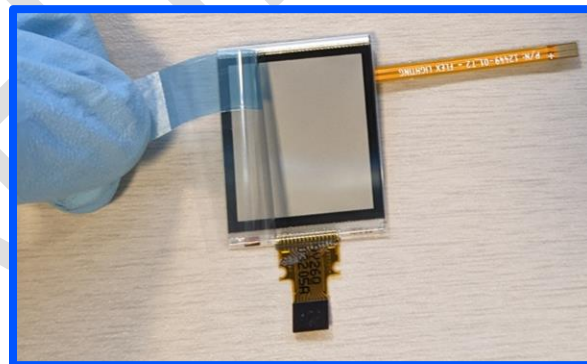


Figure 12. Removal of protective liner using speedy tab.

- Transfer of particulate matter or liquids, particularly oils, to the top layer of the front light film can result in uneven lighting performance.
- Clean room grade gloves are recommended when handling units.
- When handling the product, grasp onto the LCD edges that are not covered by the FLP (see Fig. 13).
- The Azumo LCD 2.0 product should never be held/carried/handled by either the LED or LCD FPC.

10. Avoid resting the Azumo LCD 2.0 product on the top layer of the FLP (active area).

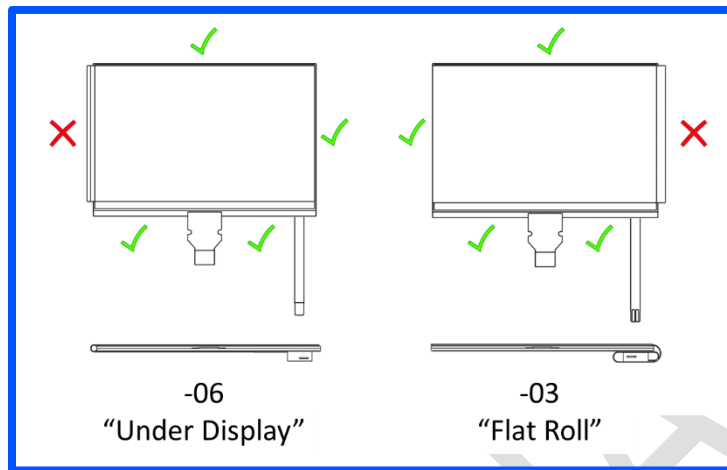


Figure 13. Identification of edges to be used for handling and mounting Azumo LCD 2.0 in final product.

#### ESD Precautions

1. Standard ESD precautions should be followed when handling Azumo front lit displays.
2. Both the front light LED and the LCD are susceptible to ESD damage if handled improperly.

#### Handling Precautions for thin film light panel

1. Ensure there is adequate clearance within the intended device for the rolled portion of the front light film. The film is flexible and can be rolled or curved to fit into custom applications, but hard creases or physical damage can reduce optical performance.
2. Avoid creating deep scratches or gouges in the FLP, which can negatively impact brightness and uniformity.

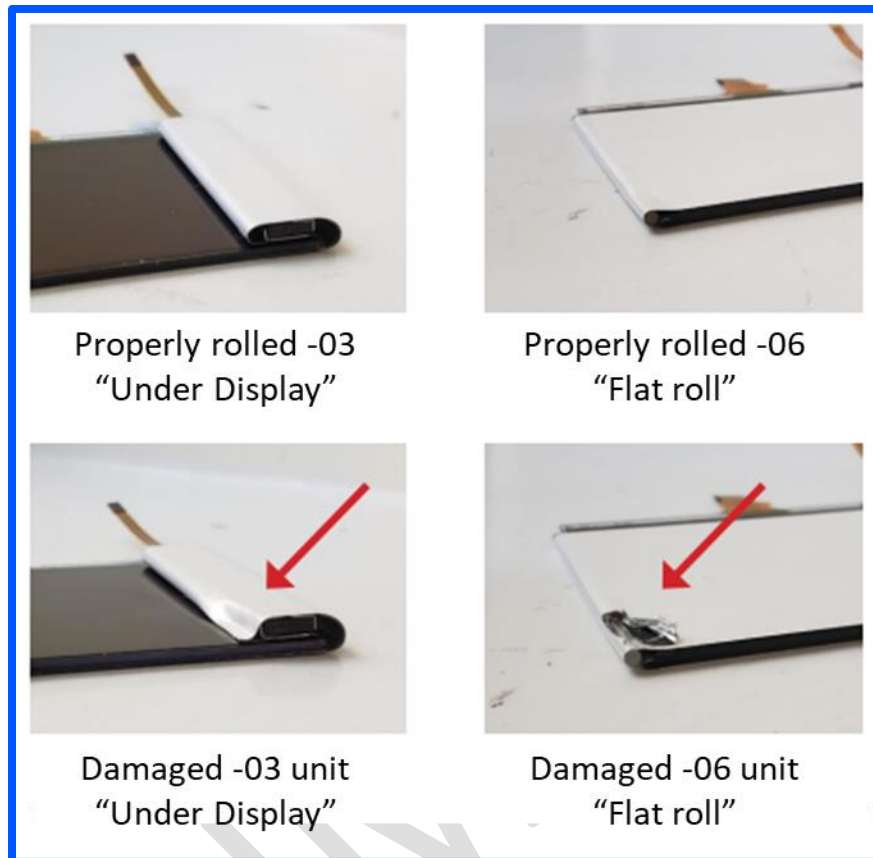


Figure 14. Examples of damage to FLP roll.

#### Handling Precautions for LED FPC

1. The LED flexible printed circuit (FPC) is a simple flexible circuit with a single LED soldered to its end as shown in Fig. 15. Extreme care should be employed when handling the LED FPC as excessive pulling, bending, or twisting can cause the FPC to become detached from the lightbar.

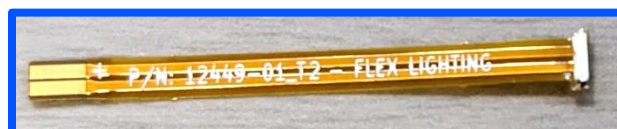


Figure 15. Azumo LCD 2.0 FLP LED FPC

2. Refer to the Azumo data sheet for LED FPC polarity, max current ratings, and connector options.
3. Avoid twisting the LED FPC in such a way that would strain the LED FPC connection to the lightbar

4. Avoid pulling on the LED FPC in such a way that would strain the LED FPC connection to the lightbar.
5. When designing a connector layout for the LED FPC, avoid routing the LED FPC in such a way that produces strain at the lightbar connection. It is recommended to provide the LED FPC ample strain relief as close to the light bar connection as possible. Refer to Fig. 16.
6. At the insertion or removal of the LED FPC from its connector in the final assembly, do not excessively rotate, twist, tilt, or bend the LED FPC. The attachment of the LED FPC at the FLP light bar is very sensitive and improper handling may cause FLP failure.

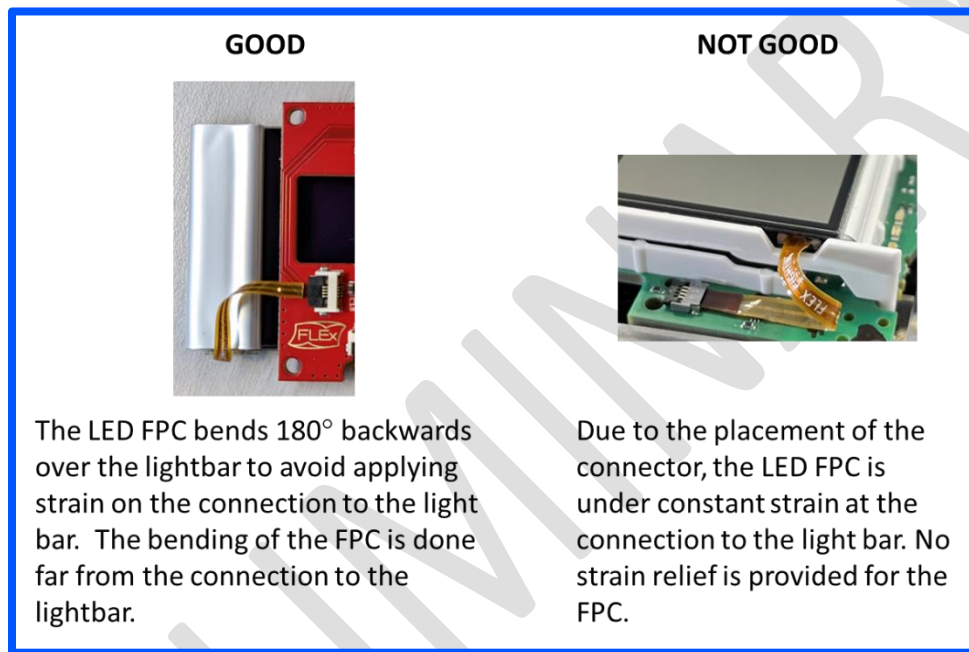


Figure 16. Recommended connector layout and routing for LED FPC.

#### Other Notes

1. Operation outside specified environmental conditions cannot be guaranteed.
2. Operating outside specified environmental conditions may affect optical performance of Azumo LCD 2.0.
3. LED thermal derating curves should be employed when operating outside specified environmental conditions.
4. Do not operate the LCD panel outside of electrical specification, otherwise, the LCD panel may be damaged.
5. To avoid unintended damage to the front light film, only use blunt tipped tools around LCD panel.
6. To ensure product performance within stated specifications, use product within warranty period.
7. Avoid extended exposure to direct sunlight.
8. Do not expose FLP to oils, water, fluids, epoxies, etc.
9. Do not expose FLP to VOCs.

10. Do not delaminate the FLP from the LCD display panel.
11. Do not adjust the position of the lightbar or any components of the FLP.
12. Do not pull on any part of FLP roll or reorient the FLP film in any way.
13. Disassembling the LCD module will cause permanent damage to the module. Do not disassemble the module. Do not pry components apart.
14. Avoid contact with the active area of the product.
15. Do not rest the product on its face or allow any contact of the face with other objects.
16. To avoid build up of static electricity, the protective liner should be removed slowly.

#### *Final product integration*

1. Avoid close proximity of Azumo LCD 2.0 assembly to concentrated heat sources while always adhering to the environmental requirements.
2. Do not bond to lightbar.
3. Do not apply epoxy or any other adhesive to the Azumo LCD 2.0 assembly.
4. Follow the specifications outlined in the LCD display panel manufacturer's data sheet for proper handling of the LCD FPC.
5. Mount the Azumo LCD 2.0 product within its final assembly by providing support along the back of the LCD panel and/or along the hard edges of the LCD panel glass not covered by the FLP, as shown in Fig. 7. Avoid mechanical contact with FLP.
6. The product should be integrated behind a transparent protective plate (cover glass) to protect the FLP and LCD in the final product. An air gap should separate the product from the protective plate.
7. Mechanical support of the LCD panel in the final product should be carefully designed to avoid stresses that exceed specifications on glass surface.
8. The Azumo LCD 2.0 product should be installed flat, without twisting or bending.
9. Do not allow the LCD display panel to be contacted with excessive pressure in any direction.

#### *Handling Precautions for Storage*

1. Do not stack more than 2 boxes high.
2. Boxes should always be oriented properly as indicated on the outside of the box.
3. Packaging trays should always be oriented 180° from the trays above and below.
4. Do not leave LCD panels in the packaging trays longer than the warranty period.
5. After opening the package, do not leave the LCD panel in direct sun or under strong ultraviolet light. Store in dark place and protect the LCD from direct sunlight or fluorescent light.
6. Store in normal room temperature and humidity as much as possible.
7. Storage in the environment of oxidation or deoxidation gas and the use of such materials as reagent, solvent, adhesive, resin, etc. may cause corrosion and discoloration of Azumo LCD 2.0 products.
8. Always store the Azumo LCD 2.0 products so that it is free from external pressure.
9. The polarizer surface should not come in contact with any other objects. It is advised to store the Azumo LCD 2.0 products in the trays in which they were shipped.
10. Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
11. Avoid storing the Azumo LCD 2.0 product on its face (active area).
12. Do not crash, shake or jolt the Azumo LCD 2.0 assembly.

## LCD Display Panel Handling Guide

### *General Guidelines*

1. Handle with care. Dropping or contact against hard objects may cause cracks or chips in the glass.
2. Special care should be employed when handling the sharp edges of the LCD display panel.
3. Do not scratch the surface of the polarizer. Prevent touching it with any hard material, and from being pushed or rubbed.
4. When handling the LCD display panel use fingerstalls or protective gloves to maintain optimal quality of LCD display panel.
5. Water droplets on the polarizer must be wiped off immediately. Clean condensation or moisture from any source immediately.
6. Do not leave the LCD display panel in direct sun or under ultraviolet light.
7. To clean LCD panel surface, wipe clean with absorbent cotton or soft cloth. If further cleaning is needed, use IPA and wipe clean lightly on surface only.
8. Do not use organic solvents on the LCD panel. Do not directly touch the LCD panel with finger. When the terminals need cleaning, they should be wiped by a soft cloth or cotton swab without directly touching by hand.
9. Avoid contact with oil or any greasy substances.
10. Do not put or attach anything to the LCD panel active area to avoid leaving marks.
11. Do not touch the display with bare hands.
12. Avoid exposure of LCD FPC to light. When mounting the LCD module in the final product, the enclosure should shield the LCD FPC from direct light.
13. Exercise care to minimize corrosion of the LCD FPC. Do not touch LCD FPC with bare hands.
14. Do not put a seal or an adhesive material on the panel surface.
15. Do not use chloroprene rubber in close proximity to the LCD panel.
16. The LCD panel is susceptible to mechanical stress. Place the panel on a flat surface to avoid stress caused by twist, bend, etc. When transporting the LCD panels, secure them on a flat tray to avoid mechanical stress.
17. Avoid pressing LCD panel in any direction.
18. As this LCD panel is composed of electronic circuits, it is sensitive to electrostatic discharge. Handle with care using caution for the following:
  - a. Protect the LCD panel from static electricity.
  - b. Since this module uses CMOS LSI, give the same careful attention to the ESD as you would for an ordinary CMOS IC.
  - c. Any unused input terminal should be connected to Vdd or Vss. Do not input any signals before power is turned on, and ground your body, work/assembly area, and assembly equipment to protect against static electricity.
  - d. Operators must wear anti-static clothing to prevent electrostatic charge up to and discharge from human body. Operators should wear ground straps.

- e. Process equipment such as conveyors, soldering iron, working bench, and containers may generate electrostatic charge up and discharge. Equipment must be grounded through 100Mohms resistance. Use ion blower.
  - i. When soldering the terminal of the LCD module, make sure the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach the LCD module, the screwdriver should be of ground potentiality.
- f. To reduce the generation of static electricity, be careful that the air in the working environment is not too dry. (A relative humidity of 50-60% is recommended).

*Handling Precautions for LCD FPC*

1. Refer to LCD display panel manufacturer's data sheet for LCD FPC minimum bend radius as well as bending direction and cycle restrictions.
2. At the insertion or removal of the LCD FPC from its connector in the final assembly, be sure not to excessively rotate, tilt, or bend the LCD FPC. The traces on the LCD FPC are very sensitive and improper handling may cause LCD failure.

## 9. Packaging Spec

To Be Added

## 10. Product Return (RMA) Policy

To Be Added

## 11. Product Warranty

To Be Added

PRELIMINARY