PREPARED BY : DATE	S H A R P	SPEC No. LCP-02011 FILE No. ISSUE: Aug. 29. 2002 PAGE: 20 pages
	SPECIFICATION	TFT LIQUID CRYSTAL DISPLAY GROUP
DEVICE T MODE	SPECIFICATION FOR FT−LCD modu L No. LQ038B7DB01	1 e
□ CUSTOMER'S A _DATA _BY	PROVAL PRESENTED BY H. NAKATSUJI DEPARTMENT GENER/ ENGINEERING DEPT MOBILE LCD DESIGN MOBILE LIQUID CR SHARP CORPORATION	AL MANAGER I N CENTER YSTAL DISPLAY GROUP N

# RECORDS OF REVISION

MODEL No: LQ038B7DB01

SPEC No : LCP-02011

DATE	REVISED	PAGE	SUMMARY	NOTE
2002.08.29	LCP-02011	-	-	1st Issue
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# (1) Application

This specification applies to color TFT-LCD module, LQ038B7DB01.

# (2) Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor), named AD-TFT(Advanced TFT). It is practicable in both transmissive-type and reflection-type modes. It is composed of a color TFT-LCD panel, driver ICs, an FPC, a front sealed casing and a back sealed casing. It isn't composed control circuit. Graphics and texts can be displayed on a  $320 \times 3 \times 480$  dots panel with 262,144 colors by supplying. Optimum view angle is 6 o'clock.

# (3) Mechanical specifications

Table 1			
Parameter	Units	Remarks	
Screen size (Diagonal)	cm		
Display active area	52.8 (H) ×79.2 (V)	mm	
	320(H)×480(V)		
Pixel format	(1  pixel = R+G+B  dots)	pixels	
Pixel pitch	$0.055$ (H) $\times 0.165$ (V)	mm	
Pixel configuration	R,G,B vertical stripe		
Display mode	Normally white		
Unit outline dimension	64.9(W)×92.3(H)×2.0(D)	mm	[Note3-1]
Mass	25±5	g	
Surface treatment	Clear Hard Coat		

## [Note 3-1]

Excluding protrusion. For detailed measurements and tolerances, please refer to Fig. 1.

# (4) Pixel configuration



# (5) Input / Output terminal

Table	2	

Pin No.	Symbol	I/O	Description	Remarks
1	VDD	-	Power supply of gate driver (high level)	
2	NC	-		
3	MOD	Ι	Control signal of gate driver	[Note5-1]
4	SPS	Ι	Start signal of gate driver	
5	CLS	Ι	Clock signal of gate driver	
6	NC	-		
7	VEE	-	Power supply of gate driver (low level)	
8	VCOM	Ι	Common electrode driving signal	
9	SPL	I/O	Sampling start signal	
10	R0	Ι	RED data signal (LSB)	
11	R1	Ι	RED data signal	
12	R2	Ι	RED data signal	
13	R3	Ι	RED data signal	
14	R4	Ι	RED data signal	
15	R5	Ι	RED data signal (MSB)	
16	G0	Ι	GREEN data signal (LSB)	
17	G1	Ι	GREEN data signal	
18	G2	Ι	GREEN data signal	
19	G3	Ι	GREEN data signal	
20	G4	Ι	GREEN data signal	
21	G5	Ι	GREEN data signal (MSB)	
22	B0	Ι	BLUE data signal (LSB)	
23	B1	Ι	BLUE data signal	
24	B2	Ι	BLUE data signal	
25	В3	Ι	BLUE data signal	
26	B4	Ι	BLUE data signal	
27	В5	Ι	BLUE data signal (MSB)	
28	VSHD	-	Power supply of digital	
29	DGND	-	Ground (digital)	
30	PS	Ι	Power save signal	
31	LP	Ι	Data latch signal of source driver	
32	DCLK	Ι	Data sampling clock signal	
33	VSHA	-	Power supply (analog)	
34	V0	Ι	Standard voltage to generate gray scale voltage	
35	V1	Ι	Standard voltage to generate gray scale voltage	
36	V2	Ι	Standard voltage to generate gray scale voltage	
37	V3	Ι	Standard voltage to generate gray scale voltage	
38	V4	Ι	Standard voltage to generate gray scale voltage	
39	AGND	-	Ground (Analog)	

[Note5-1] See section(7-1)-(A) "\*Cautions when you turn on or off the power supply".

# (6) Absolute Maximum Ratings

#### Table 3

Parameter	Symbol	Condition	Ratings	Unit	Remark
Power supply(source/Analog)	VSHA	Ta=25°C	-0.3~+7.0	v	
Power supply(source/Digital)	VSHD	Ta=25°C	-0.3~+7.0	v	
Power supply (gate)	VDD	Ta=25°C	-0.3~+35.0	V	
Power supply (gate)	VDD-VEE	Ta=25°C	-0.3~+35.0	V	
Input voltage (Analog)	VIA	Ta=25°C	-0.3~VSHA+0.3	V	[Terminal]]
Input voltage (Digital)	VID	Ta=25°C	-0.3~VSHD+0.3	V	[Terminal2]
Operating temperature	Topp	—	-10~60	°C	[Note6-1]
(panel surface)					
Storage temperature	Tstg	—	-30~75	°C	[Note6-1]

[Terminal①] V0,V1,V2,V3,V4

 $[Terminal \textcircled{0}] MOD, SPS, CLS, SPL, R0 \sim R5, G0 \sim G5, B0 \sim B5, LP, DCLK, PS$ 

[Note6-1] Humidity: 95%RH Max.(at Ta  $\leq 40^{\circ}$ C). Maximum wet-bulb temperature is less than 39°C (at Ta > 40°C). Condensation of dew must be avoided.

#### (7) Electrical characteristics

#### 7-1) Recommended operating conditions

Table 4		-		(	GND=0V	-	
Para	meter	Symbol	Min.	Тур.	Max.	Unit	Remarks
Supply voltage for	source driver	VSHA	+4.5	+4.8	+5.5	V	
(Analog)							
Supply voltage for	source driver	VSHD	+2.7	+3.3	+3.6	V	
(Digital)							
Standard input vol	tage	V0~V4	0	-	VSHA	V	[Note 7-1]
Supply voltage	High voltage	VDD	+12.3	+13.0	+13.7	V	
for gate driver	Low voltage	VEE	-10.5	-10.0	-9.5	v	
Input voltage for S	ource driver (Low)	VILS	GND	-	0.2VSHD	v	[Note 7-2]
Input voltage for So	ource driver (High)	VIHS	0.8VSHD	-	VSHD	v	[Note 7-2]
Input current for S	ource driver (Low)	IILS	-	-	30	μA	[Note 7-2]
	1. (11. 1)	IIHS1	-	-	30	$\mu A$	[Note 7-3]
Input current for So	ource driver (High)	IIHS2	-	-	1200	μA	[Note 7-4]
Input voltage for G	ate driver (Low)	VILG	GND	-	0.2VSHD	V	[Note 7-5]
Input voltage for G	ate driver (High)	VIHG	0.8VSHD	-	VSHD	V	[Note 7-5]
Input current for G	ate driver (Low)	IILG	-	-	15	μA	[Note 7-5]
Input current for C	ate driver (High)	IIHG	-	-	15	$\mu A$	[Note 7-5]
Common electrode	VCOMAC	-	±2.4	±2.5	Vp-p	[Note 7-6]	
driving signal	DC component	VCOMDC	+0.1	+1.1	+2.1	V	[Note 7-6]

\*Cautions when you turn on or off the power supply

(1) Turn on or off the power supply with simultaneously or the following sequence.

Turn on  $\cdots$  VSHD  $\rightarrow$  VSHA  $\rightarrow$  VEE  $\rightarrow$  VDD

Turn off  $\cdots$  VDD  $\rightarrow$  VEE  $\rightarrow$  VSHA  $\rightarrow$  VSHD

- <sup>(2)</sup> The input signal of "MOD" Terminals (Pin No.3) must be low voltage when turning on the power supply, and it is held until more than double vertical periods after VCC is turned on completely. After then, it must be held high voltage until turning off the power supply.
- [Note 7-1] These are standard input voltages for gray scale. When VCOM is alternated polarity, these voltage should be alternated polarity. V0 (black) is different polarity alternating signal of VCOM. V4 (white) is the same polarity alternating signal of VCOM. Center voltage of each standard input voltage shift positive way for LCD characteristics (V0→V1→V2→V3→V4). This sift amount is adjusted so as to no flicker of each standard input voltage after DC bias voltage of VCOM and V0 is adjusted.
- [Note 7-2] DCLK,SPL,LP,PS,R0~R5,G0~G5 and B0~B5 terminals are applied.
- [Note 7-3] DCLK,SPL,LP,R0~R5,G0~G5 and B0~B5 terminals are applied.
- [Note 7-4] PS terminal is applied.
- [Note 7-5] MOD,CLS and SPS terminals are applied.
- [Note 7-6] VCOMAC should be alternated on VCOMDC every 1 horizontal period and 1 vertical period. VCOMDC bias is adjusted so as to minimize flicker or maximum contrast every each module.

# 7-2) Timing Characteristics of input signals

Table 5 AC Characteristics (1)(VSHA=+4.8V, VSHD=+3.3V, Ta=25°C)

Paramete	er	Symbol	Min.	Typ.	Max.	Unit	Remark
Clock fre	quency of source driver	Fck	9.3	-	12.1	MHz	
	Rising time of clock	Tcr	-	-	20	ns	
	Falling time of clock	Tcf	-	-	20	ns	DCLK
	Pulse width (High level)	Tcwh	40	-	-	ns	
	Pulse width (Low level)	Tcwl	40	-	-	ns	
	Frequency of start pulse	Fsp	25.8	-	33.7	kHz	
G	Setup time of start pulse	Tsusp	15	-	-	ns	SPL,SPR
Source	Hold time of start pulse	Thsp	10	-	-	ns	
driver	Pulse width of start pulse	Twsp	-	-	1.5/fck	ns	[Note 7-7]
	Setup time of latch pulse	Tsulp	20	-	-	ns	
	Hold time of latch pulse	Thlp	20	-	-	ns	LP
	Pulse width of latch pulse	Twlp	60	-	-	ns	
	Setup time of PS	Tsups	0	-	-	μs	DC
	Hold time of PS	Thps	0	-	-	$\mu$ s	PS
Set up ti	ne of data	Tsud	15	-	-	ns	R0~R5,G0~G5
Hold time	e of data	Thd	10	-	-	ns	, B0∼B5
	Clock frequency	Fcls	25.8	-	33.7	kHz	
	Pulse width of clock(Low)	Twlcls	5	-	(1/fcls)-25	μs	
	Pulse width of clock(High)	Twhcls	25	-	-	μs	
	Rising time of clock	Trcls	-	-	100	ns	CLS
	Falling time of clock	Tfcls	-	-	100	ns	
Gate	Setup time of clock	Tsucls	3	-	-	μs	
driver	Hold time of clock	Thels	0	-	-	μs	
	Frequency of start pulse	Fsps	52		68	Hz	
	Setup time of start pulse	Tsusps	100	-	-	ns	
	Hold time of start pulse	Thsps	300	-	-	ns	SPS
	Rising time of start pulse	Trsps	-	-	100	ns	
	Falling time of start pulse	Tfsps	-	-	100	ns	
Vcom	Setup time of Vcom	Tsuvcom	3	-	-	μs	Vcom
	Hold time of Vcom	Thvcom	1	-	-	$\mu$ s	

[Note 7-7] There must be only one up-edge of DCLK (includes Tsusp and Thsp time) in the period of SPL="Hi".



Fig.(a) Horizontal timing chart



Fig.(b) Vertical timing chart

## 7-3) Power consumption

Measurement condition : SPS=60Hz, CLS=29.76kHz, SPL=29.76kHz, DCLK=10.71MHz

The term of PS="Lo" in one horizontal period  $\cdots$  30.1  $\mu$  sec(322DCLK) Ta=25°C

Table 6								
Parame	eter	Symbol	Conditions	MIN	TYP	MAX	Unit	Remarks
Source	Analog	ISHA	VSHA=+4.8V	-	11	19	mA	【Note 7-11】
current	rrent Digital ISHD		VSHD=+3.3V	-	2.9	5.0	mA	【Note 7-11】
Gate	High	IDD	VDD=+13.0V	-	0.1	0.2	mA	[Note 7-12]
current	Low	IEE	VEE=-10.0V	-	-0.1	-0.2	mA	[Note 7-12]

[Note 7-11] Vertical stripe pattern alternating 21 gray scale (GS21) with 42 gray scale (GS42) every 1 dot. [Note 7-12] 64-Gray-bar vertical pattern (GS0  $\sim$  GS63 for horizontal way)

# $(\,8\,)$ Input Signals, Basic Display Color and Gray Scale of Each Color

# Table 7

	Colors &						Dat	ta sig	nal											
	Gray scale	Gray	R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
		Scale																		
	Black	_	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	_	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
в	Green	—	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
asic	Cyan	—	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
colo	Red	—	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
r	Magenta	—	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	—	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\sim$	Û	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jray	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sca	Û	$\checkmark$				$\mathbf{b}$					٦							$\mathbf{k}$		
le oi	Û	$\checkmark$									1									
f red	Brighter	GS61	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Û	GS62	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS63	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	Û	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ray (	Darker	GS2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Scal	Û	$\checkmark$				$\mathbf{b}$					٦							$\mathbf{k}$		
e of	Û	$\checkmark$									1									
gree	Brighter	GS61	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
n	Û	GS62	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Green	GS63	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	仓	GS1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
iray	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sca	仓	$\checkmark$		_			_	_		_	1		_	_		_			_	
le of	Û	$\checkmark$									1							$\mathbf{k}$		
bleu	Brighter	GS61	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
L	Û	GS62	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Bleu	GS63	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

0 : Low level voltage 1 : High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. According to the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

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#### (9) Optical characteristics

9-1) Reflective mode

Table 8	Table 8 Ta=25											
Paramete	r	Symbol	Condition	Min.	Тур.	Max.	Unit	Remarks				
Viewing angle		θ 21,22		25	35	-	degree	[Note 9-1,2]				
range		θ 11	$CR \ge 2$	30	40	-	degree					
		θ 12		30	40	-	degree					
Contrast ratio		CR		4	8	-		[Note 9-2]				
Response	Rise	τr		-	20	40	ms	[Note 9-3]				
time	Fall	τd	0 0°	-	35	70	ms					
White chromaticity		х	$\theta = 0$	0.26	0.31	0.36		[Note 9-4]				
		у		0.29	0.34	0.39						
Reflection	ratio	R		6	9	_		[Note 9-5]				

\*The measuring method of the optical characteristics is shown by the following figure.

\*\*A measurement device is Otsuka luminance meter LCD5200. (With the diffusion reflection unit.)



Measuring method (a) for optical characteristics

# 9-2) Transmisive mode

Table 9	5°C							
Parameter		Symbol	Condition	Min.	Тур.	Max.	Unit	Remarks
Viewing angle		θ21,22		30	40	-	degree	[Note 9-1,2]
range		θ11	CR≥2	30	40	-	degree	
		θ12	1	40	50	-	degree	
Contrast ratio		CR		40	60	-		[Note 9-2]
Response	Rise	τr		-	20	40	ms	[Note 9-3]
time	Fall	τd	0 00	-	35	70	ms	
Chromaticity shift		⊿x	$\theta = 0^{\circ}$	-	0.05	-		
		⊿у		-	0.05	-		
Transmisiv	ity	Т		2.3	3.3	-	%	

\* The measuring method of the optical characteristics is shown by the following figure.

\* A measurement device is TOPCON luminance meter BM-5(A).(Viewing cone 1)



Measuring method (b) for optical characteristics

[Note 9-1] Viewing angle range is defined as follows.



6 o'clock direction

### Definition for viewing angle

[Note 9-2] Definition of contrast ratio:

The contrast ratio is defined as follows:

Photo detector output with all pixels white(GS63)

Contrast ratio(CR)= -

Photo detector output with all pixels black(GS0)

VCOMAC=4.8Vp-p,V0=4.0Vp-p,V9=-4.0Vp-p

[Note 9-3] Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



[Note 9-4] A measurement device is Minolta CM-2002.

[Note 9-5] Definition of reflection ratio

Reflection ratio = Light detected level of the reflection by the LCD module Light detected level of the reflection by the standard white board (10) Display quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standards for TFT-LCD.

#### (11) Mechanical characteristics

11-1) External appearance

See Fig. 1

11-2) FPC characteristics

# ①Specific connector

FF0239SS1(JAE)

<sup>(2)</sup> Bending endurance of the bending slits portion(See Fig.1) :

I .Bending slit (1)

No line of the FPC is broken for the bending test (Bending radius=0.6mm and  $angle=90^{\circ}$ ) in 30 cycles.

II . Bending slit 2

No line of the FPC is broken for the bending test by human hand (Bending radius=0mm and angle=180°) in 2 cycles.

- (12) Handling Precautions
  - 12-1) Insertion and taking out of FPC

Be sure insert and take out of the FPC into the connector of the set after turning off the power supply on the set side.

12-2) Handling of FPC

FPC shall be bent only slit portion. The bending slit ①shall be bent uniformly on the whole slit portion with bending radius larger than 0.6mm ,and only inner side (back side of the module).

Don't bend it outer side (display surface side).

Don't give the FPC too much force, for example, hanging the module with holding FPC.

- 12-3) Installation of the module
  - ① On mounting the module, be sure to fix the module on the same plane. Take care not to warp or twist the module.
  - <sup>(2)</sup> In case that no protective plate is attached on the panel surface, pay attention to the following points. In order to avoid the electrostatic discharge, design the cabinet with grounded conductive sheet inside and cover the module include edge of the polarizer with it

#### 12-4) Precaution when mounting

- 1 The polarizer can be easily scratched. Handle it with sufficient care.
- (2) If water droplets and oil attaches to it for a long time, discoloration and staining occurs. Wipe them off immediately.
- ③ Glass is used for the TFT-LCD panel. If it is dropped or bumped against a hard object, it may be broken. Handle it with sufficient care.
- ④ As the CMOS IC is used in this module, pay attention to static electricity when handling it. Take a measure for grounding on the human body.

12-5) Others

① The liquid-crystal is deteriorated by ultraviolet rays. Do not leave it in direct sunlight and strong ultraviolet rays for many hours.

- ② If it is kept at a temperature below the rated storage temperature, it becomes coagulated and the panel may be broken. Also, if it is kept at a temperature above the rated storage temperature, it becomes isotropic liquid and does not return to its original state. Therefore, it is desirable to keep it at room temperature as much as possible.
- ③ If the LCD breaks, don't put internal liquid crystal into the mouth. When the liquid crystal sticks to the hands, feet and clothes, wash it out immediately.
- ④ Wipe off water drop or finger grease immediately. Long contact with water may cause discoloration or spots.
- (5) Observe general precautions for all electronic components.
- (6) VCOM must be adjusted on condition of your final product. No adjustment causes the deterioration for display quality.
- ⑦ Static image should not be displayed more than 5 minutes in order to prevent from occurrence of residual image.

#### (13) Forwarding form

- a) Piling number of cartons: MAX. 20
- b) Package quantity in one cartons: 50 pcs.
- c) Carton size:  $503mm(W) \times 373mm(D) \times 78mm(H)$
- d) Total mass of 1 carton filled with full modules: 2400 g

Fig.2 shows packing form.

#### Environment

(1)Temperature	: 0~40°C	
(2)Humidity	: 60%RH or less (at 40°C)	
	No dew condensation at low temperature and high humidity.	
(3)Atmosphere	: Harmful gas, such as acid or alkali which bites electronic	
	components and/or wires, must not be detected.	
(4)Period	: about 3 months	
(5)Opening of the package	: In order to prevent the LCD module from breakdown by	
	electrostatic charges, please control the room humidity	
	over 50%RH and open the package taking sufficient	
	countermeasures against electrostatic charges, such as	
	earth, etc.	

	Table 10			
No.	Test items	Test conditions		
1	High temperature storage test	Ta=+75°C 240h		
2	Low temperature storage test	Ta=-30°C 240h		
3	High temperature and high humidity operating test	Tp=+40°C, 95%RH 240h (But no condensation of dew)		
4	High temperature operating test	Tp=+60°C 240h		
5	Low temperature operating test	Tp=-10°C 240h		
6	Electro static discharge test	$\pm 200V \cdot 200 \text{pF}(0\Omega)$ 1 time for each terminals		
7	Shock test	980 m/s <sup>2</sup> , 6 ms ±X, ±Y, ±Z 3 times for each direction (JIS C0041, A-7 Condition C)		
8	Vibration test	Frequency range: 10Hz~55Hz Stroke: 1.5 mm Sweep: 10Hz~55Hz X,Y,Z 2 hours for each direction (total 6 hours) (JIS C0040, A-10 Condition A)		
9	Heat shock test	Ta=-30°C $\sim$ +75°C / 5 cycles (1h) (1h)		

(14)Reliability Test Conditions for TFT-LCD Module

[Note] Ta = Ambient temperature, Tp = Panel temperature

[Check items] In the standard condition, there shall be no practical problems that may affect the display function.

### (15) Others

15-1) Indication of lot number

The lot number is shown on a label. Attached location is shown in Fig.1 (Outline Dimensions).

Indicated contents of the label



15-2) Used Regulation of Chemical Substances Breaking Ozone Stratum

Substances with the object of regulation : CFCS, Carbon tetrachloride, Halon

1,1,1-Trichloro ethane (Methyl chloroform)

- (a) This LCD module, Constructed part and Parts don't contain the above substances.
- (b) This LCD module, Constructed part and Parts don't contain the above substances in processes of manufacture.
- 15-3) If some problems arise about mentioned items in this document and other items, the user of the TFT-LCD module and Sharp will cooperate and make efforts to solve the problems with mutual respect and good will.



PPC chauld be bended only bending clit. PPC should be bended larger than 0.6 in radius. Tolerance is  $\pm 0.4$  except when specified. Take care in set design to hide the scratches and bubbles appeared on the polarizer or other frame area which is located outside of active area.

Fig1. Outline dimensions



Fig2. Package Form