SHARP

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Technical Literature
For
TFT-LCD Module

Model No. LS012B7DD01

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Display Device Business Division
SHARP CORPORATION

SHARP

RECORDS OF REVISION			
DATE	**REF.PAGE PARAGRAPH DRAWING No.**	**REVISED No.**	**SUMMARY**
June.18. 2013			1st issue
Oct.10.2013	Page9. Module drawing. ,Page21 Module drawing ,Page25.Module drawing	B	Outline of the FPC was changed by customer's requirement.

NOTICE

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[For handling and system design]

(1) Handle with care as glass is used in this LCD panel. Dropping or contact against hard object may cause cracks or chips.

(2) Be careful to handle this LCD panel in order to avoid injury yourself by panel`s edge as this panel is made of glass and might be a sharp edge.

(3) Do not scratch the surface of the polarizer as it is easily damaged.

(4) Water droplets on the polarizer must be wiped off immediately as they may cause color changes, or other defects if remained for a long time.

(5)Do not leave the LCD panel in direct sun or under ultraviolet ray.

(6) To clean LCD panel surface, wipe clean with absorbent cotton or soft cloth. If further cleaning is needed, use IPA (isopropyl alcohol) and wipe clean lightly on surface only. Do not use organic solvents as it may damage the LCD panel terminal area which uses organic material. Also, do not directly touch with finger. When the terminals cleaning are needed, those should be wiped by a soft cloth or a cotton swab without directly touching by hand.

(7) Do not expose gate driver, etc. on the panel (circuit area outside panel display area) to light as it may not operate properly. Design that shields gate driver, etc. from light is required when mounting the LCD module.

(8) To avoid circuit failure, do not touch panel terminal area.

(9) Support for the LCD panel should be carefully designed to avoid stress that exceeds specification on glass surface.

(10) When handling LCD module and assembling them into cabinets, be noted that storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, and etc. which generate these gasses, may cause corrosion and discoloration of LCD modules.

(11)To avoid picture uniformity failure, do not put a seal or an adhesive material on the panel surface.

(12) Do not use chloroprene rubber as it generates chlorine gas and affects reliability in LCD panel connective area.

(13) Protective film is attached to the surface of polarizer on LCD panel to prevent scratches or other damages. Remove this protective film before use. In addition, do not attach the protective film which is removed from LCD module again. When the LCD panel which has the reattached protective film is needed to storage for a long time, the polarizer might have a damage with picture quality failure.

(14) Panel is susceptible to mechanical stress and such stress may affect the display. Place the panel on flat surface to avoid stress caused by twist, bend, etc.

(15) When transporting LCD panels, secure them in LCD panel tray to avoid mechanical stress. The tray should be conductive to protect LCD panels from static charge.

Material used in set or epoxy resin (amine type hardening agent) from packaging, and silicon adhesive (dealcoholized or oxime) all release gas which may affect quality of polarizer. Do confirm compatibility with user materials.

(16) As this LCD module is composed electronic circuits, it is sensitive to electrostatic discharge of 200V or more. Handle with care using cautions for the followings:

- Operators

  Operators must wear anti-static wears to prevent electrostatic charge up to and discharge from human body.

- Equipment and containers

  Process equipment such as conveyer, soldering iron, working bench and containers may possibly generate electrostatic charge up and discharge. Equipment must be grounded through 100Mohms resistance. Use ion blower.

- Floor

  Floor plays an important role in leaking static electricity generated in human body or equipment. If the floor is made of insulated material (such as polymer or rubber material), such static electricity may charge. Proper measure should be taken to avoid static electricity charge (electrostatic earth: 100Mohms).There is a possibility that the static electricity is charged to them without leakage in case of insulating floor, so the electrostatic earth:$1\times10^{8}\Omega$ should be made.

- Humidity

  Humidity in work area relates to surface resistance of the persons or objects that generate electrostatics, and it can be manipulated to prevent electrostatic charge. Humidity of 40% or lower increases electrostatic earth resistance and promotes electrostatic charging. Therefore, the humidity in the work area should be kept above 40%. Specifically for film peeling process or processes that require human hands, humidity should be kept above 50% and use electricity removal blower.

- Transportation/Storage

  Containers and styroform used in transporation and storage may charge electrostatic (from friction and peeling) or electrostatic charge from human body, etc. may cause containers and styroform to have induced charge. Proper electrostatic measure should be taken for containers and storage material.

[For operating LCD module]

(1) Do not operate the LCD panel under outside of electrical specification. Otherwise LCD panel may be damaged.

(2) Do not use the LCD panel under outside of specified driving timing chart. Otherwise LCD panel may not have proper picture quality.

(3) A still image should be displayed less than two hours, if it is necessary to display still image longer than two hour, display image data must be refreshed in order to avoid sticking image on LCD panel.

(4) If LCD module takes a static electricity, as the display image which is written into pixel memory might not be displayed, Data update should be executed frequently.

(5) It is neither a breakdown nor a defective indication though very slight change in black level might be periodically seen in a black part on the black display image according to the source of light (angle of the luminance and the source of light).

[Precautions for Storage]

(1) After opening the package, do not leave the LCD panel in direct sun or under strong ultraviolet ray. Store in dark place.

(2) In temperature lower than specified rating, liquid crystal material will coagulate. In temperature higher than specified rating, it isotropically liquifies. In either condition, the liquid crystal may not recover its original condition. Store the LCD panel in at or around room temperature as much as possible.

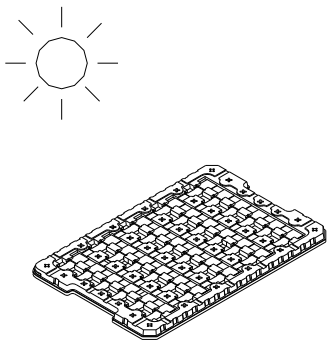
Also, storing the LCD panel in high humidity will damage the polarizer. Store in normal room temperature as much as possible.

(3) Keeping Method

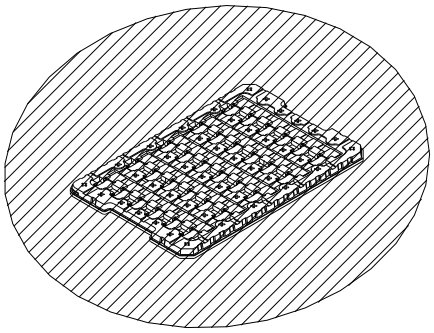
a. Don't keeping under the direct sunlight.

b. Keeping in the tray under the dark place.

NG



GOOD



[Other Notice]

(1) Operation outside specified environmental conditions cannot be guaranteed.

(2) As power supply (VDD-GND) impedance is lowered during use, bus controller should be inserted near LCD module as much as possible.

(3) Polarizer is applied over LCD panel surface. Liquid crystal inside LCD panel deteriorates with ultraviolet ray. The panel should not be left in direct sun or under strong ultraviolet ray for prolonged period of time even with the polarizer.

(4) Disassembling the LCD module will cause permanent damage to the module. Do not disassemble the module.

(5) If LCD panel is broken, do not ingest the liquid crystal from the broken panel. If hand, leg, or clothes come in contact with liquid crystal, wash off immediately with soap.

(6) ODS (specific chlorofuorocarbon, specific halon, 1-1-1 trichloroethane, carbon tetrachloride) are not used or contained in material or all production processes of this product.

(7) Observe all other precautionary requirements in handling general electronic components.

Discarding liquid crystal modules

LCD Panel : Dispose of as glass waste. This LCD module contains no harmful substances.
The liquid crystal panel contains no dangerous or harmful substances.
This liquid crystal panel contains only an extremely small amount of liquid crystal (approximately 100mg) and therefore it will not leak even if the panel should break.
Its median lethal dose (LD50) is greater than 2,000 mg/kg and a mutagenetic (Aims test: negative) material is used.

Contents

1. Scope of application

This specification applies to TFT-LCD module LS012B7DD01

2. Outline

This TFT-LCD module is an active matrix LC display (LCD: liquid crystal display) module with CG silicon (CG-Si: Continuous Grain-Silicon) and thin film transistors (TFT: Thin Film Transistor). This TFT-LCD module is such that black and white 2 value display is possible in a 184x38 dot panel.

3. Features

- Active matrix drive system
- Transflective type, black and white display with 1.17" screen. (184x38 dot structure)
- Low power consumption using pixel memory panel (normally white).
- The interface system uses serial interface (3 wire system).
- Lightweight, thin and compact.
- High reflectance (with slight transmissivity)

4. Mechanical specification

Table 4-1 Module mechanical specification table

Item	Specification	Unit
Screen size(diagonal)	2.9686[1.17"]	cm
Active display area	29.072(H)×6.004(V)	mm
Dot structure	184(H)×38(V)	Dot
Dot pitch	0.158(H)×0.158(V)	mm
Pixel array	Square	—
Module outline dimensions (not including protruding parts)	35.1W)×11.0(H)×0.741(D) (NB)	mm
Mass	0.6 (TYP)	g
Surface hardness	At least 3H (initial)	Pencil hardness

NB) Please refer to Figure 5-1 (Page.25) for the detailed dimensions, tolerance.

5. Structure

5-1 Makeup

This LCD module is made up of an LCD panel, polarizer (Front, Rear), LCD-FPC

The outline dimensions are shown in Figure 5-1(Page.25).

5-2 LCD-FPC performance

①Suitable connector

F.C.I. 59453-08111F 8 pin (0.5mm pitch)

②FPC flex resistance

Flexure tests are carried out with a flexure radius=R0.6mm、flexure angle =90°and there should be no breakage after less than 10 times.

③LCD-FPC circuit diagram

The LCD-FPC circuit diagram is shown in Figure 5-2.

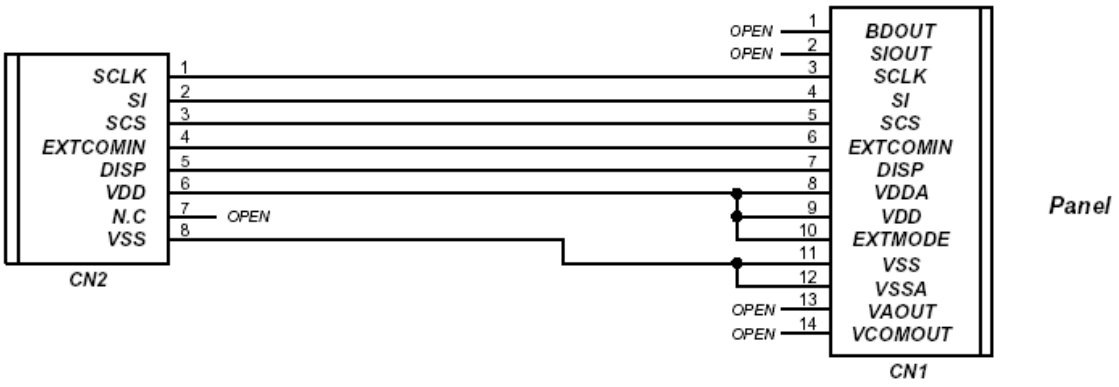
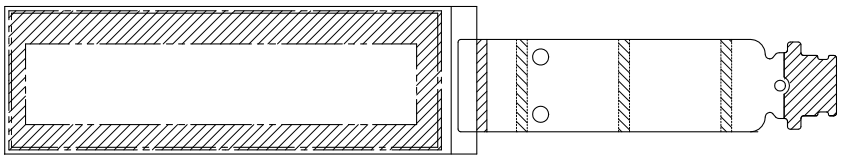


Figure 5-2 LCD-FPC circuit diagram

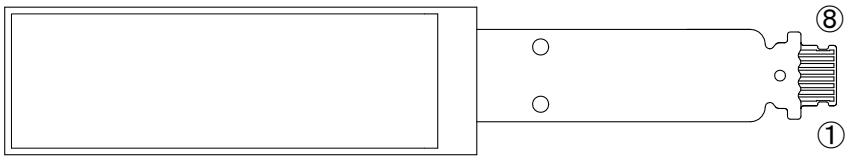
6. Input pin specification

Table 6-1 Input pin names

No.	Code	I/O	Voltage	Signal name
1	SCLK	I	0/3.0 (V)	Serial clock signal
2	SI	I	0/3.0 (V)	Serial input signal
3	SCS	I	0/3.0 (V)	Chip select signal
4	EXTCOMIN	I	0/3.0 (V)	COM inversion polarity input pin
5	DISP	I	0/3.0 (V)	Display ON/OFF switching signal
6	VDD	I	3(V)	Power source (logic, analog)
7	NC	—	—	—
8	VSS		0(V)	GND



Display surface



Rear surface

Figure 6-1 Input pin layout

7. Absolute maximum ratings

Table 7-1 Module input absolute maximum ratings

Item	Code	Rating	Unit	Notes
Supply voltage for logic	VDD	-0.3～+3.6	V	
Input signal voltage	V_{IN}	-0.3～VDD	V	(*2)
Operation temperature(panel temperature)	Topr	-10 ~ +70	°C	(*1)
Storage temperature	Tstg	-20 ~ +80	°C	(*1)

(NB) VSS pin＝0V unless otherwise indicated.

(*1) Do not allow condensation.

(*2) Applies to SCS, SCLK, SI, DISP and EXTCOMIN signals.

8. Electrical specification

8-1 Recommended operation range

Table 8-1 Recommended operation range (Ta＝25°C, VSS pin＝0V)

Item	Code	Conditions	Min	Typ	Max	Unit	Notes
Power supply voltage for driver	VDD		2.7	3.0	3.3	V	
Input signal voltage (High)	V_{INHI}		VDD-0.1	－	VDD	V	(*1)
Input signal voltage (Low)	V_{INLO}		VSS	－	VSS+0.1	V	(*1)

(*1) Applies to SCS, SCLK, SI, DISP and EXTCOMIN signals.

8-2 DC electrical characteristics

Table 8-2-1 DC electrical characteristics 1

(Ta=25℃, SCS, SCLK, SI, DISP, EXTCOMIN=3.0V, VDD=3.0V, VSS pin=0V)

Item	Code	Drive	Min.	Typ	Max.	Unit	Notes
Current consumption 1	P_{VDD1}	(*1)		－	15	μA	
Current consumption 2	P_{VDD2}	(*2)		－	150	μA	

(*1) The display pattern is such that there is no image update with the all black display.
SCS=SCLK=SI=L , EXTCOMIN=60Hz

(*2) The display pattern is such that there is continuous image data update with the vertical stripe (1 dot interval) display. Data update mode
SCLK=1MHz , EXTCOMIN=60Hz

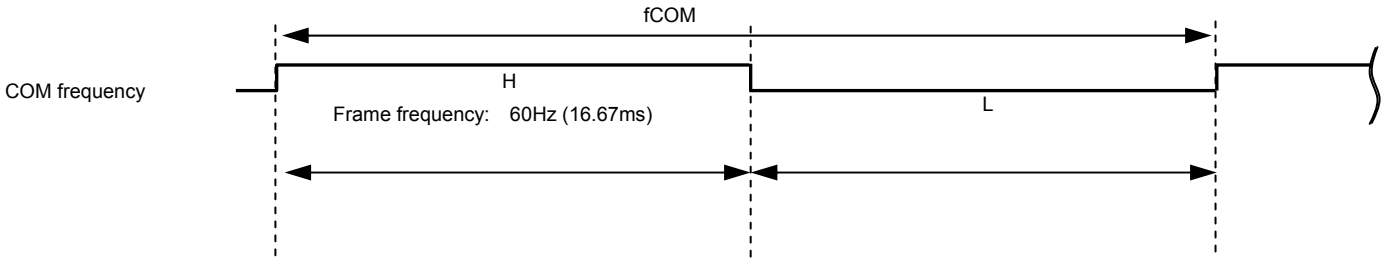


Fig A

8-3 Operation characteristics

Table 8-3 Operation signals

(Ta=25℃, SCS, SCLK, SI, DISP, EXTCOMIN=3.0V, VDD=3.0V, VSS pin =0V)

Pin name	Item	Code	Min	Typ.	Max	Unit	Notes
SCS	Frame frequency	fSCS	56	60	63	Hz	
SCLK	Clock frequency	fSCLK	-	0.5	1	MHz	
-	Vertical period	tV	15.87	16.67	17.86	msec	
-	COM frequency	fCOM	28	30	31.5	Hz	

8-4 Input signal characteristics

Table 8-4 Input signals (Ta=25℃, SCS, SCLK, SI, DISP, EXTCOMIN=3.0V, VDD=3.0V, VSS pin=0V)

Pin name	Item	Code	Min	Typ.	Max	Unit	Notes
SCS	SCS rise time	trSCS			70	nsec	
	SCS fall time	tfSCS			70	nsec	
	SCS Hight width	twSCSH	232			μsec	Data update mode
			24			μsec	Display mode
	SCS Low width	twSCSL	2			μsec	
	SCS set up time	tsSCS	6			μsec	
	SCS hold time	thSCS	2			μsec	
SI	SI rise time	frSI			50	nsec	
	SI rise time	trSI			50	nsec	
	SI set up time	tsSCS	250			nsec	
	SI hold time	thSI	525			nsec	
SCLK	SCLK rise time	trSCLK			50	nsec	
	SCLK fall time	tfSCLK			50	nsec	
	SCLK Hight width	twSCLKH	450	950		nsec	
	SCLK Low width	twSCLKL	450	950		nsec	
EXTCOMIN	EXTCOMIN frequency	fEXTCOMIN		60	63	Hz	(*1)
	EXTCOMIN rise time	trEXTCOMIN			70	nsec	
	EXTCOMIN fall time	tfEXTCOMIN			70	nsec	
	EXTCOMIN Hight width	twEXTCOMIN	2			μsec	
DISP	DISP rise time	trDISP			70	nsec	
	DISP fall time	tfDISP			70	nsec	

(*1) Please make the EXTCOMIN frequency less than the frame rate frequency.

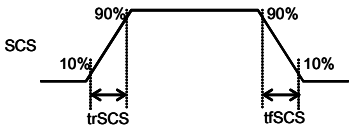
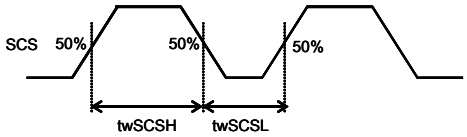
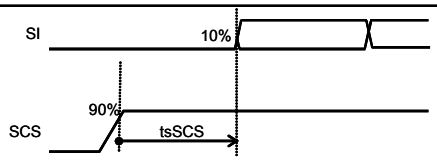
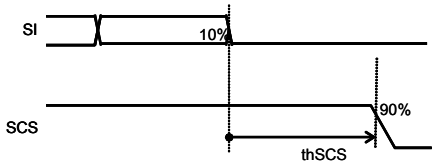
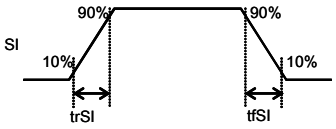
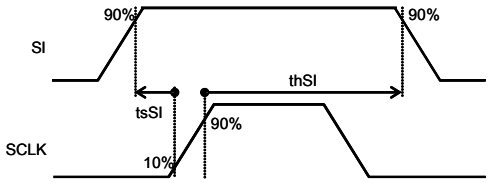
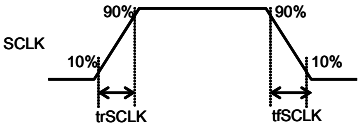
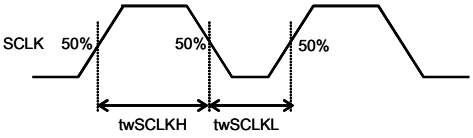
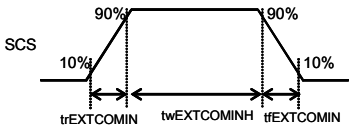
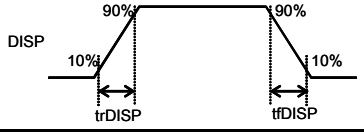
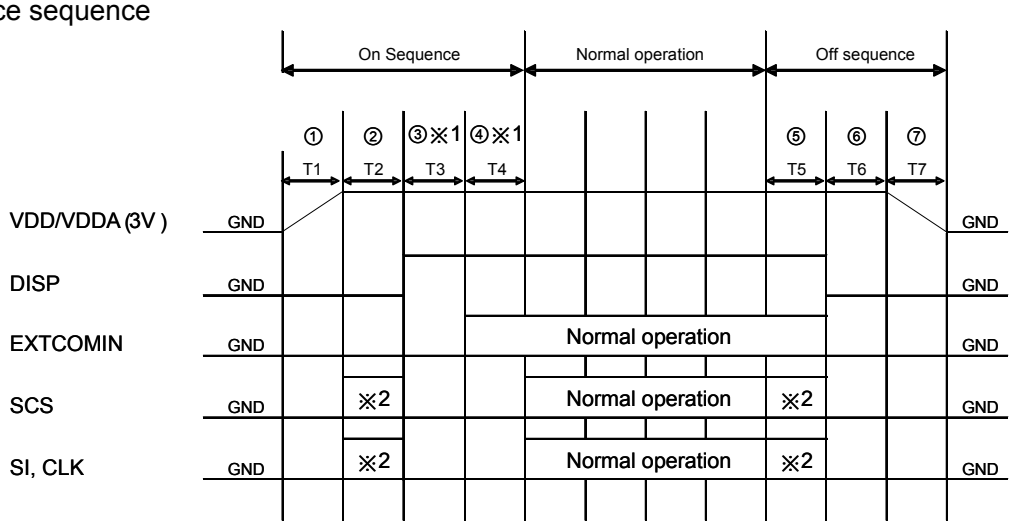
Pin Name	Item	Symbol	Waveform	Notes
SCS	SCS rise time	trSCS		
	SCS fall time	tfSCS		
	SCS High width	twSCSH		
	SCS Low width	twSCSL		
	SCS set-up time	tsSCS		
	SCS hold time	thSCS		
SI	SI rise time	trSI		
	SI fall time	tfSI		
	SI Set-up time	tsSI		
	SI Hold time	thSI		
SCLK	SCLK rise time	trSCLK		
	SCLK fall time	tfSCLK		
	SCLK High width	twSCLKH		
	SCLK Low width	twSCLKL		
EXTCOMIN	EXTCOMIN rise time	trEXTCOMIN		
	EXTCOMIN fall time	tfEXTCOMIN		
	EXTCOMIN High width	twEXTCOMINH		
DISP	DISP rise time	trDISP		
	DISP fall time	tfDISP		

Figure 8-4 Input signal timing characteristics diagram

9. Recommended sequence

9-1 Power source sequence



※ Refer to timing chart and AC timing characteristics for detail

※ 1. (3) and (4) may be opposite (however, TCOM polarity inversion will not occur even with EXTCOMIN between DISP="L". Also, when DISP and EXTCOMIN are simultaneously started up, allow 30us or more before SCS starts up (It may be less than 60us).

※ 2. Setting value for pixel memory initialization

SCS=Driving accordingly to clear pixel internal memory method (use all clear flag or write all screen white)

S1=M2 (all clear flag) = "H" or write white

SCLK: Normal Driving

[ON Sequence]

(1) 3V rise time (depends on IC)

(2) Pixel memory initialisation.

T2: at least 1 frame.

Use M2 (all clear flag) to initialise (at least once). Or write whole screen white.

(3) Release time for initialisation of TCOM latch T3: 30us or more

Time required to release COM latch circuit which is initialized using DISP signals

(4) TCOM polarity initialisation time T4: 30us or more

Time required initialising TCOM polarity accordingly to EXTCOMIN input

[Normal Operation]

Duration of normal driving

[Off Sequence]

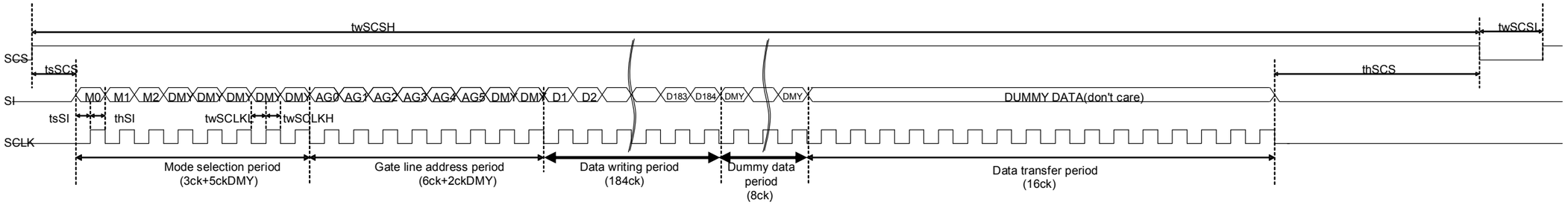
(5) Pixel memory initialisation time T5: at least 1 frame

(6) VCOM initialisation time T6: 30us or more

(7) 3V falling time (Depends on IC)

NB:Please contact Sharp before changing this sequence.

9-2 Timing chart



M0: Mode flag. Set for “H”. Data update mode (Memory internal data update)
When “L”, display mode (maintain memory internal data).
M1: It can be “H” or “L”.
M2: All clear flag.
All Clear Mode, set to “L”. Refer to ‘All clear timing chart’
D1-D184: Image data. “L” = black display. “H” = white display.
DUMMY DATA: Dummy data. It can be “H” or “L” (“L” is recommended.)

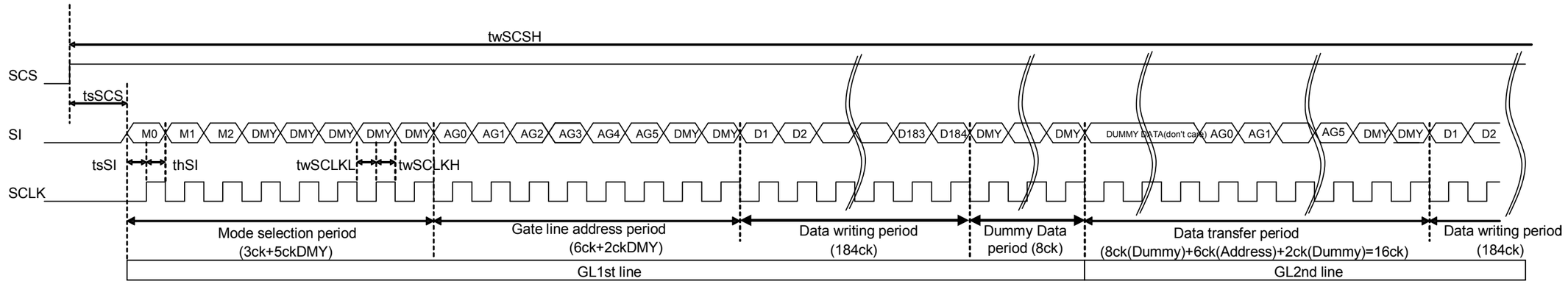
※ Data write period
Data is being stored in 1st latch block of binary driver on panel.
※ Data transfer period
Data written in 1st latch is being transferred (written) to pixel internal memory circuit.

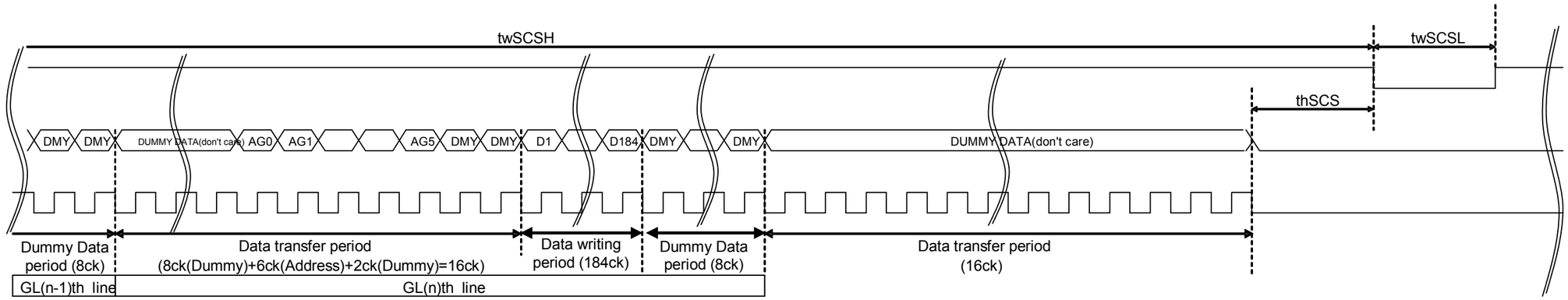
Gate line address selection table

GL	AG0	AG1	AG2	AG3	AG4	AG5
1	1	0	0	0	0	0
2	0	1	0	0	0	0
3	1	1	0	0	0	0
4	0	0	1	0	0	0
5	1	0	1	0	0	0
6	0	1	1	0	0	0
7	1	1	1	0	0	0
8	0	0	0	1	0	0
:	:	:	:	:	:	:
31	1	1	1	1	1	0
32	0	0	0	0	0	1
33	1	0	0	0	0	1
34	0	1	0	0	0	1
35	1	1	0	0	0	1
36	0	0	1	0	0	1
37	1	0	1	0	0	1
38	0	1	1	0	0	1

Data Update Mode (Multiple Lines)

Updates arbitrary multiple lines data. (M0="H", M2＝"L")



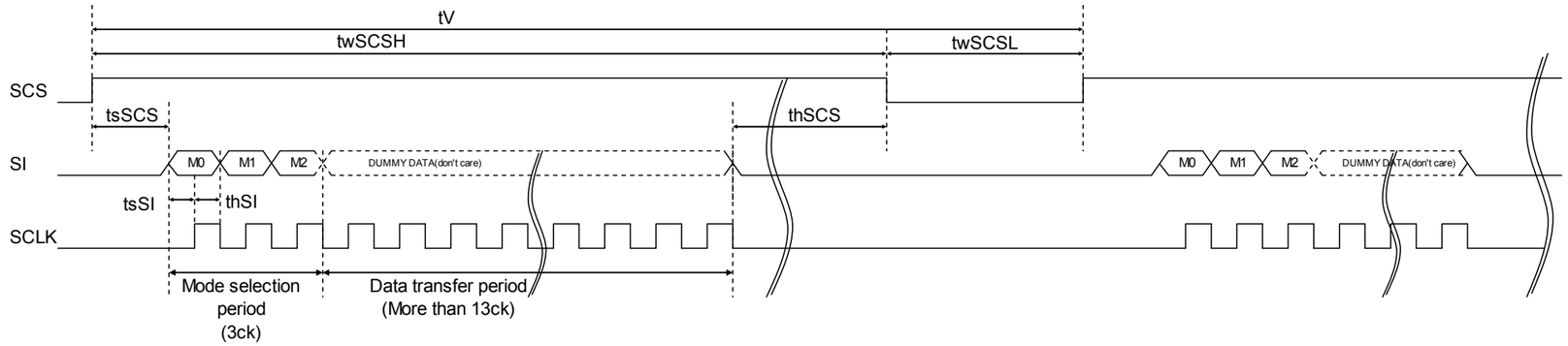


M0: Mode flag. Set for "H". Data update mode (Memory internal data update)
When "L", display mode (maintain memory internal data).
M1: It can be "H" or "L".
M2: All clear flag.
All Clear Mode, set to "L". Refer to 'All clear timing chart'
D1-D184: Image data. "L" = black display. "H" = white display.
DUMMY DATA: Dummy data. It can be "H" or "L" ("L" is recommended.)

※ Data write period
Data is being stored in 1st latch block of binary driver on panel.
※ Data transfer period
For example, during GL2 line data transfer period, GL 2nd line address is latched and GL 1st line data is transferred from 1st latch to pixel internal memory circuit at the same time.

Display Mode

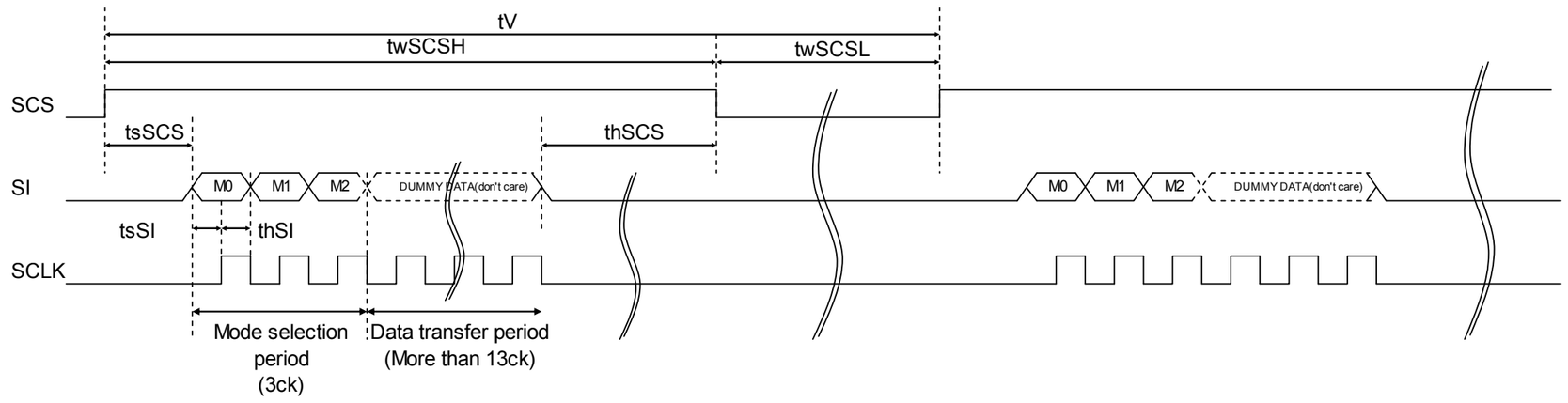
Maintains memory internal data (maintains current display). (M0="L", M2＝"L")



M0: Mode flag.
When "L", display mode (maintain memory internal data).
Set for "H". Data update mode (Memory internal data update)
M1: It can be "H" or "L".
M2: All clear flag.
All Clear Mode, set to "L".Refer to 'All clear timing chart'
DUMMY DATA: Dummy data. It can be "H" or "L" ("L" is recommended.)

All Clear Mode

Clears memory internal data and writes white. (M0="L", M2＝"H")

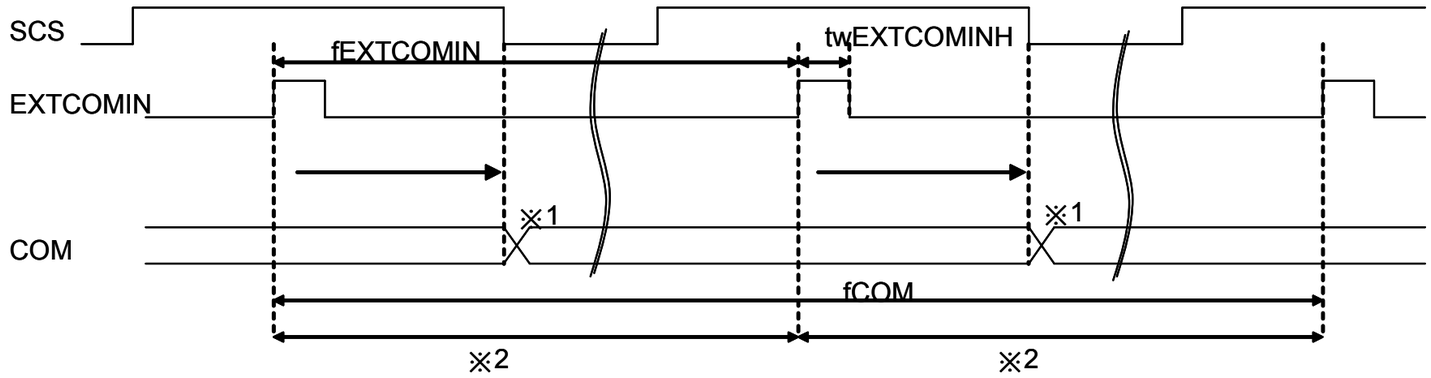


M0: Mode flag.
Set it "L".
M1: It can be "H" or "L".
M2: All clear flag.
Set it "H"
DUMMY DATA: Dummy data. It can be "H" or "L" ("L" is recommended.)

COM Inversion

EXTCOMIN has 2 timing conditions:

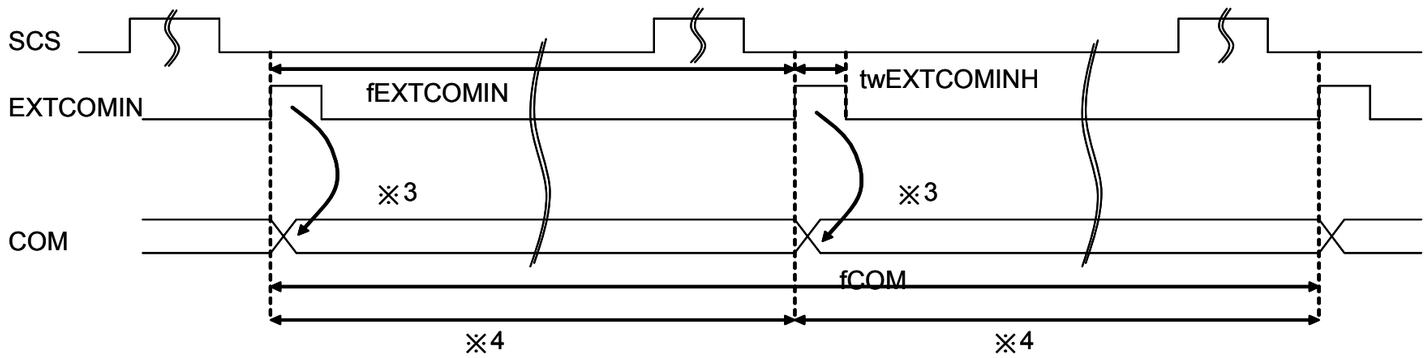
(1): The EXTCOMIN input during high period of the SCS signal



※ 1: LC inversion polarity has been set by the falling edge of SCS signal.

※ 2: The period of EXTCOMIN should be constant.

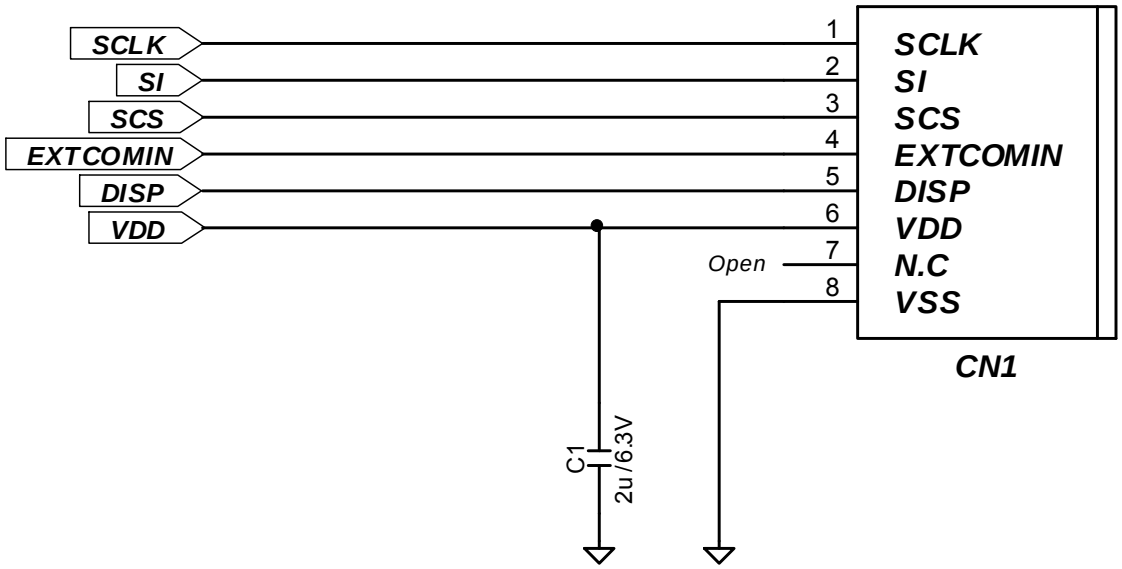
(2): the EXTCOMIN input during low period of the SCS signal



※ 3: LC inversion polarity has been set by the rising edge of EXTCOMIN.

※ 4: The period of EXTCOMIN should be constant.

10. Example of external circuit



*Above circuit and parts are only recommendation

For actual use, please evaluate their conformity with your system and design.

(Capacitor pressure resistance can be larger than resistance indicated above.)

Figure 10-1 External circuit diagram (recommended)

11. Optical specification

11-1 Optical characteristics

(a)Reflection characteristics

Table 11-1: Reflection optical characteristics (Ta = 25°C)

Item		Code	Conditions	Min	Typ	Max	Unit	Notes
Reflectance			θ=0°	12	15	—	%	11-2(b),(e)
Contrast ratio		CR	θ=0°	18	22	—	—	11-2(c),(e)
Viewing angle		θ11	Co≥2	50	60	—	degrees	11-2(a),(d)
		θ12		50	60	—		
		θ21		50	60	—		
		θ22		50	60	—		
Chromaticity	White	Wx	θ=0°	—	0.31	—	-	11-2(e)
		Wy		—	0.33	—		
Transmissivity			θ=0°		(0.25)	—	%	

11-2 Measurement method

(a) The viewing angle direction is defined as shown below.

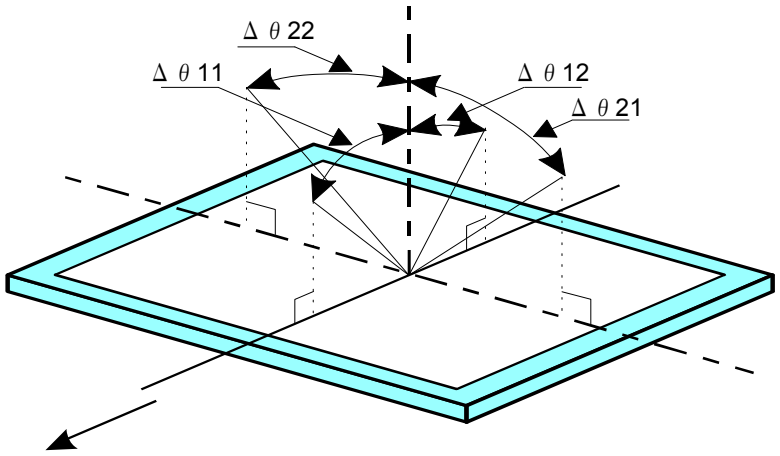


Figure 11-1 Definition of viewing angle direction

(b)Reflectance is defined as shown below.

$$Reflectance = \frac{Reflected\ luminance\ of\ white\ display}{Reflected\ luminance\ of\ calibrated\ diffuse\ white\ standard}$$

(c)The reflection contrast ratio is defined with the following equation.

$$Reflection\ contrast\ ratio = \frac{Reflected\ luminance\ of\ white\ display}{Reflected\ luminance\ of\ black\ display}$$

(d)Reflection Viewing angle

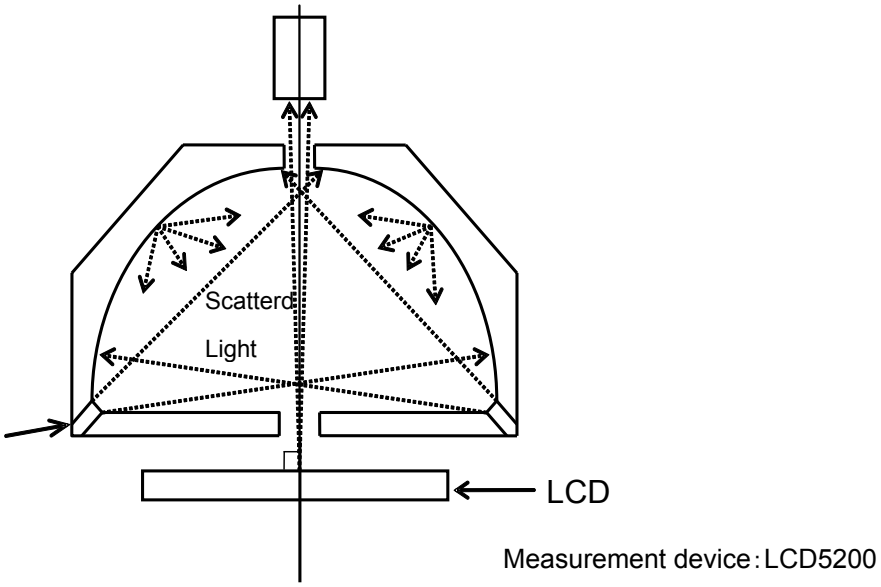


Figure 11-2 Reflection mode viewing angle measurement method

(e)Reflection Reflectance/contrast /chromaticity

-Measured with Minolta spectrophotometer CM2002.

-Based on light source (D65).

12. Display quality

The standard for LCD module display quality is based on the shipping inspection standards.

13. Shipping

13-1 Lot number display

Displayed by printing. The display position is shown in Figure 13-1 outline dimension diagram.

Incjet print contests: TBD

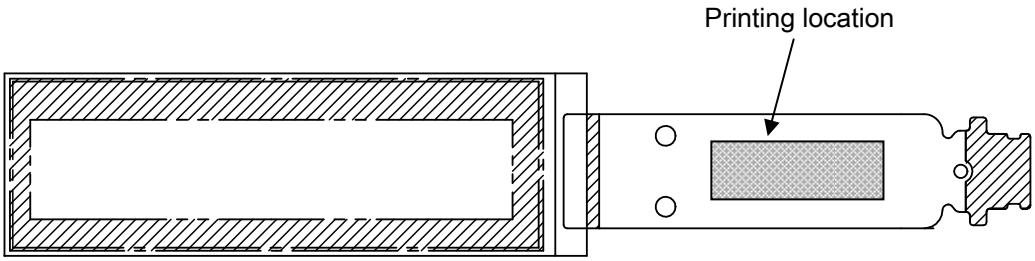


Figure 13-1 Lot number printing position

13-2 Carton storage conditions

(1) Max number stacked: TBD

Max number stored: TBD pcs /carton

(2) Environment

・Temperature: 0～40˚C

・Humidity: Less than 60%RH (at 40˚C)

There should be no condensation at low temperatures even with high humidity.

・Atmosphere: No toxic gases that significantly corrode the electronic parts and wiring material such as acid and alkali should be detected.

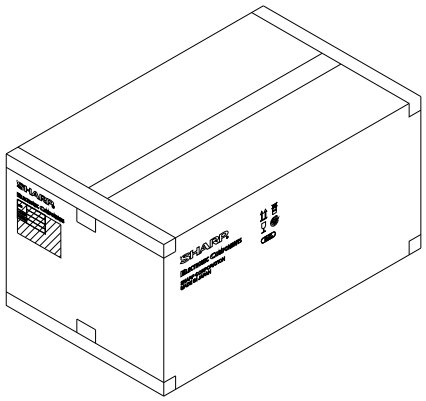
・Period: Around 3 months

・Unpacking: In order to prevent electrostatic damage to TFT modules, room humidity should be made over 50% RH and take effective measure such as use of earth when opening the package.

13-3 Packing

The packing method is shown in Figure 13-2.

The packaging is designed such that the module does not break during transit.



Packageing size : TBD

Figure 13-2: packing condition

14. Reliability test conditions

14-1 Reliability test items

Table 14-1 Reliability test items

	Test items	Test contents	Notes
1	High temperature storage	Ta=80°C 240h (Non-operating)	
2	Low temp. storage	Ta=-20°C 240h (Non-operating)	
3	High temp. high humidity operation	Tp=40°C /95%RH 240h	
4	High temp. operation	Tp=70°C 240h	
5	Low temp. operation	Tp=-10°C 240h	
6	Thermal shock	Ta=-20°C (1h)～+70°C (1h)/cycle＝ 5cycles (Non-operating)	
7	Electrostatic resistance	±200V,200pF(0Ω) Once each pin	

【NB】Ta=ambient temperature, Tp=panel temperature

(Evaluation method)

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

15. TFT-LCD module handling

15-1 Inserting the FPC in the connector and removing

When inserting the FPC in the connector and then when removing, be sure to turn the set side power OFF.

15-2 FPC handling

(1) The fold of the FPC (R) should be at least 0.6mm and R should be uniform.
Please do not fold the FPC towards the front polarizer side in the connection part with the LCD panel.

(2) Please do not hold the FPC and swing the LCD module or apply too much strength to the FPC.

15-3 Module handling

(1) When adhering the module to a device, contact with the driver or conductive part of the substrate can cause electrical ln leakage.

(2) When attaching, please fix such that it is on the same level and make sure there is no stress such as warping or twisting on the module. When pressing the LCD surface after embedding, please take care that excess mechanical stress is not applied to the LC module.

(3) In a set design that has no protective sheet in the panel front part for reducing surface reflection, when static electricity is applied to the panel peripheral part, there is the risk of electrostatic damage of the module so please design such that it is surrounded by the set cabinet up to the peripheral part of the polarizer and such that a conductive sheet or the like grounded to the rear side thereof is adhered to absorb static electricity. (Refer to Figure 15-1)

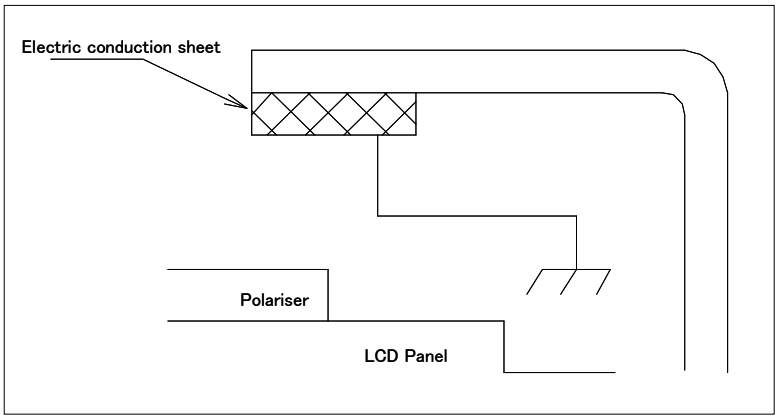


Figure 15-1 Design example

16. Other

If any problems occur with the Sharp specification items or any other items, efforts will be made to improve in cooperation. When making any changes that are likely to have a significant effect on the quality and reliability, advance contact will be made to gain approval.

Outline dimention

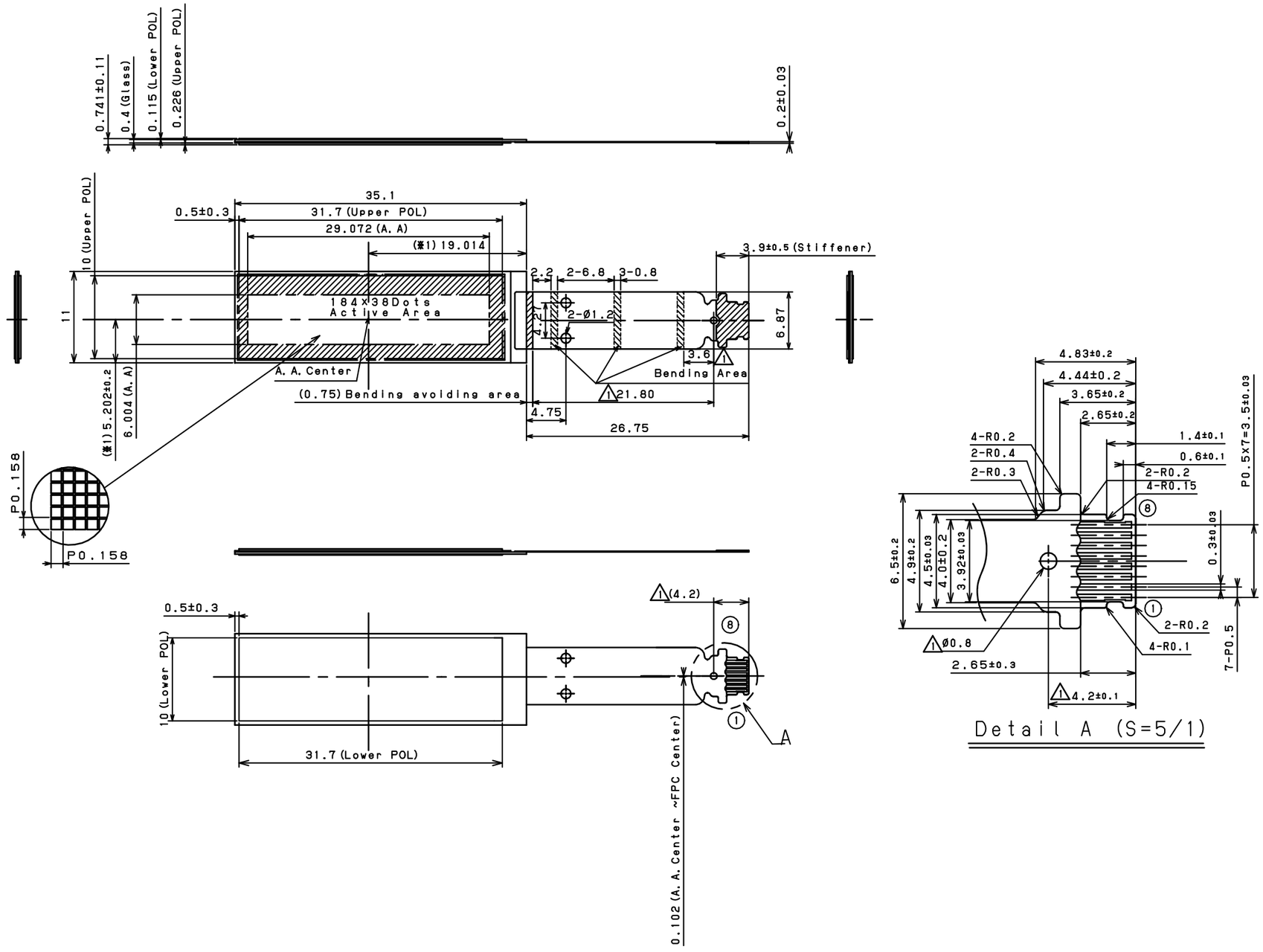


Figure 5-1 Outline dimensions diagram