

PREPARED BY : DATE K. Fudaba : 1. Mar. 2005	<h1 style="text-align: center;">S H A R P</h1> <p style="text-align: center;">MOBILE LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION</p> <h2 style="text-align: center;">S P E C I F I C A T I O N</h2>	SPEC No. LCP-05001
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		Design Center I MOBILE LCD GROUP

DEVICE SPECIFICATION FOR

T F T - L C D m o d u l e

MODEL No. **LS020B8UD****

☐ CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED

BY

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SHARP CORPORATION

RECORDS OF REVISION

MODEL No : LS020B8UD**

SPEC No : LCP-05001

[illegible]

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(1) Application

This literature applies to LS020B8UD**.

(2) Overview

This module is a color reflective and active matrix LCD module incorporating CG silicon TFT (Thin Film Transistor), named AD-TFT(Advanced TFT). It is composed of a color TFT-LCD panel, driver ICs, an FPC, a back light and a back sealed casing.

Graphics and texts can be displayed on a $176 \times 3 \times 220$ dots panel with 65,536 colors by supplying.

Optimum view angle is (1:30 o'clock). An inverted display mode is selective in the vertical and the horizontal direction.

(3) Mechanical specifications

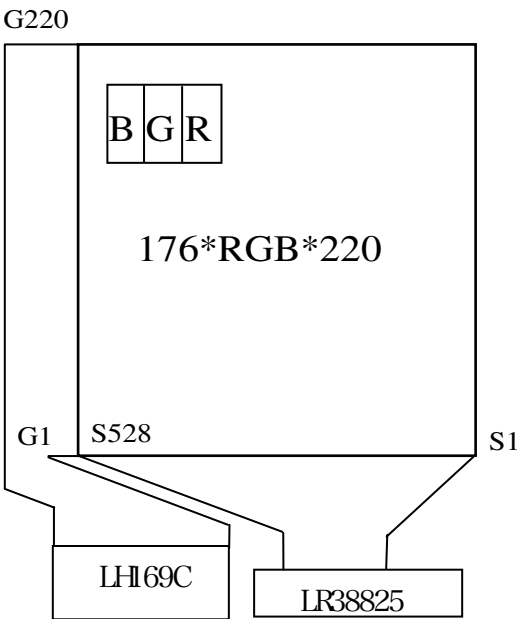
Table 1

Parameter	Specifications	Units	Remarks
Screen size (Diagonal)	6.65 [2.0"] Diagonal	cm	
Display active area	31.68 (H) \times 39.60 (V)	mm	
Pixel format	176(H) \times 220(V) (1 pixel = R+G+B dots)	pixels	
Pixel pitch	0.060 (H) \times 0.180 (V)	mm	
Pixel configuration	R,G,B vertical stripe	—	
Unit outline dimension	39.0(W) \times 51.6(H) \times 3.3 (D)	mm	【Note3-1】
Mass	9.7	g	(TYP.)
Surface hardness	3H	—	

【Note 3-1】

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

(4)Pixel configuration



(5)Input/Output terminal

5-1)TFT-LCD panel driving section

Table2

Pin No.	Symbol	I/O	Description	Remarks
1	VERSION1	-	GND	-
2	LED+	-	LED Anode	-
3	LED -	-	LED Cathode	-
4	BUS0	I	Bus interface	L:8bit/H:16bit
5	LCDINT	O	Interrupt request to the host bus	-
6	VSS	-	GND	-
7	D15	I/O	Data bus(MSB)	-
8	D14	I/O	Data bus	-
9	D13	I/O	Data bus	-
10	D12	I/O	Data bus	-
11	D11	I/O	Data bus	-
12	D10	I/O	Data bus	-
13	D9	I/O	Data bus	-
14	D8	I/O	Data bus	-
15	VSS	-	GND	-
16	D7	I/O	Data bus	-
17	D6	I/O	Data bus	-
18	D5	I/O	Data bus	-
19	D4	I/O	Data bus	-
20	D3	I/O	Data bus	-
21	D2	I/O	Data bus	-
22	D1	I/O	Data bus	-
23	D0	I/O	Data bus(LSB)	-
24	NRD	I	Read control input pin	“L” active
25	NWR	I	Write control input pin	“L” active
26	RS	I	Register select input pin	-
27	NCS	I	Chip select input pin	“L” active
28	NRES	I	Reset signal input pin	“L” active
29	VSS	-	GND	-
30	VEE	-	VEE power supply	-
31	VDD	-	VDD power supply	-
32	VERSION2	-	GND	

Used connetion:0.5mm pitch ZIF FPC connector

Correspondable connector: FF14-32A-R13B (DDK)

(Note1) For unused Data Bus(D15~D8), connect to VSS.

(Note2)If don't use “LCDINT” pin, leave it open.

(6) Absolute Maximum Ratings

Table 3

Ta=25°C

Parameter	Symbol	Condition	Ratings	Unit	Remark
Supply voltage for LCD	VDD	—	-0.3~+4.0	V	
Supply voltage for Logic	VEE	—	-0.3~+4.0	V	
Input voltage (Digital)	VIN	—	-0.3~VDD+0.3	V	【Note6-1】
LED Power dissipation	P _{D LED}	—	397	mW	【Note6-2】
LED current	IL	—	23	mA	
Operating temperature (panel surface)	T _{op}	—	-10~60	°C	【Note6-3】
Storage temperature	T _{stg}	—	-20~70	°C	

【Note6-1】 [Terminal] NRES,RS,NCS,NWR,NRD,D0~D15, BUS0

【Note6-2】 Specification for LED per 1pcs

【Note6-3】 Humidity: 95%RH Max.

(at Ta ≤ 40°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

A) TFT-LCD panel driving section

Table 4

VSS=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Applicable Pin
Supply voltage for LCD	VDD-VSS	Ta=-10~60 °C	2.8	3.0	3.3	V	VDD
Supply voltage for Logic	VEE-VSS		2.8	3.3	3.6	V	VEE
Input leakage current(1)	I _{LI1}	Ta=-10~60 °C VIN= VSS or VDD	-	-	10	μA	【note7-1】
Input leakage current(2)	I _{LI2}		-10	-	-	μA	
”H” level input voltage	V _{IH}	Ta=-10~60 °C	0.7VEE	-	-	V	
”L” level input voltage	V _{IL}		-	-	0.3VEE	V	
”H” level output voltage	V _{OH}	Ta=-10~60 °C I _{OH} =-1.00μA, I _{OL} =1.00μA	0.8VEE	-	-	V	【note7-2】
”L” level output voltage	V _{OL}		-	-	0.2VEE	V	

【note7-1】 Input mode of D0~D15pins, NRES, RS, NRD, NWR, NCS, BUS0

【note7-2】 Output mode of D0~D15 pins, LCDINT

B) Back light driving section

Table 5

Ta=25 °C

Parameter	Symbol	MIN	TYP	MAX	Units	Remarks terminal
LED voltage	V _{L1-VL2}	—	12.6	13.5	V	
LED current	I _L	—	20	—	mA	
Power consumption	W _L	—	252	270	mW	【Note 7-3】

【Note 7-3】 Calculated reference value($I_{L(TYP)} \times (V_{L1} - V_{L2})$)

7-2)Power consumption

Table 6

Ta=25 °C

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit	Remarks
Current consumption	PD1	VDD=3.0V	-	10	20	mW	【Note 7-4】
	PD2	VEE=3.3V VSS=0V	-	60	120	μW	【Note 7-5】

【Note 7-4】 Measurement Conditions

frame frequency= 60 Hz

No Host CPU access, 65k-color mode

Grayscale pattern

【Note 7-5】 Measurement Conditions

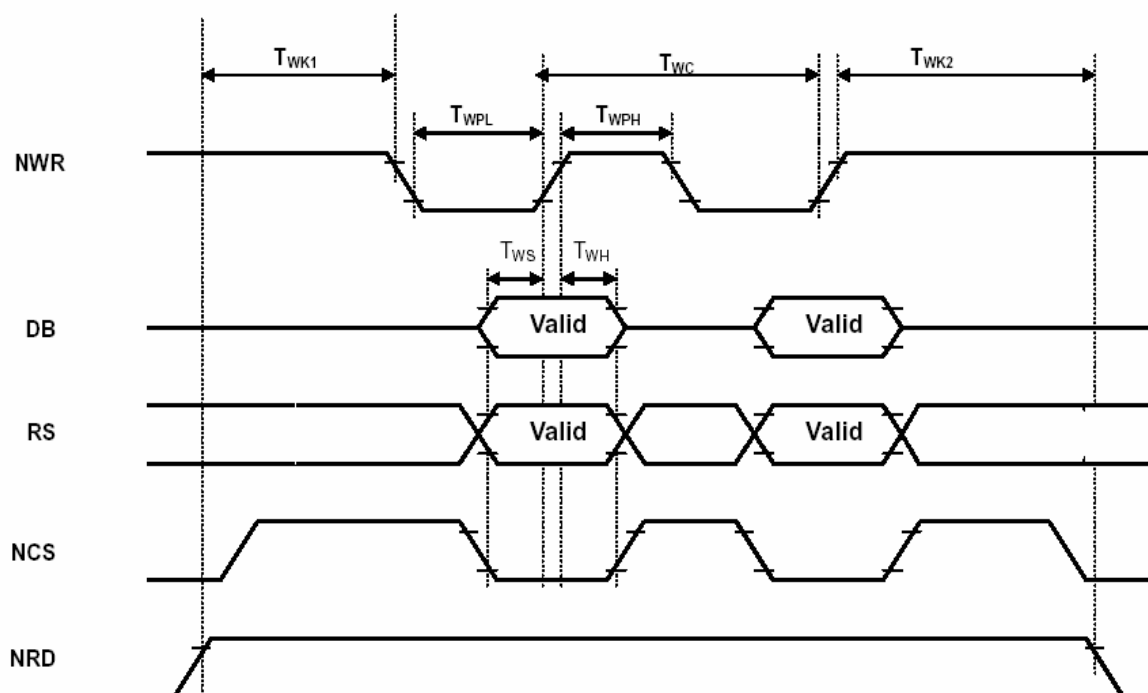
Stand-by mode (Oscillation OFF/ Display OFF)

No Host CPU access

4.7V applied to 3 LED's in series.

7-3) Timing diagrams of input signals(80-family MPU access)

a)Write timing



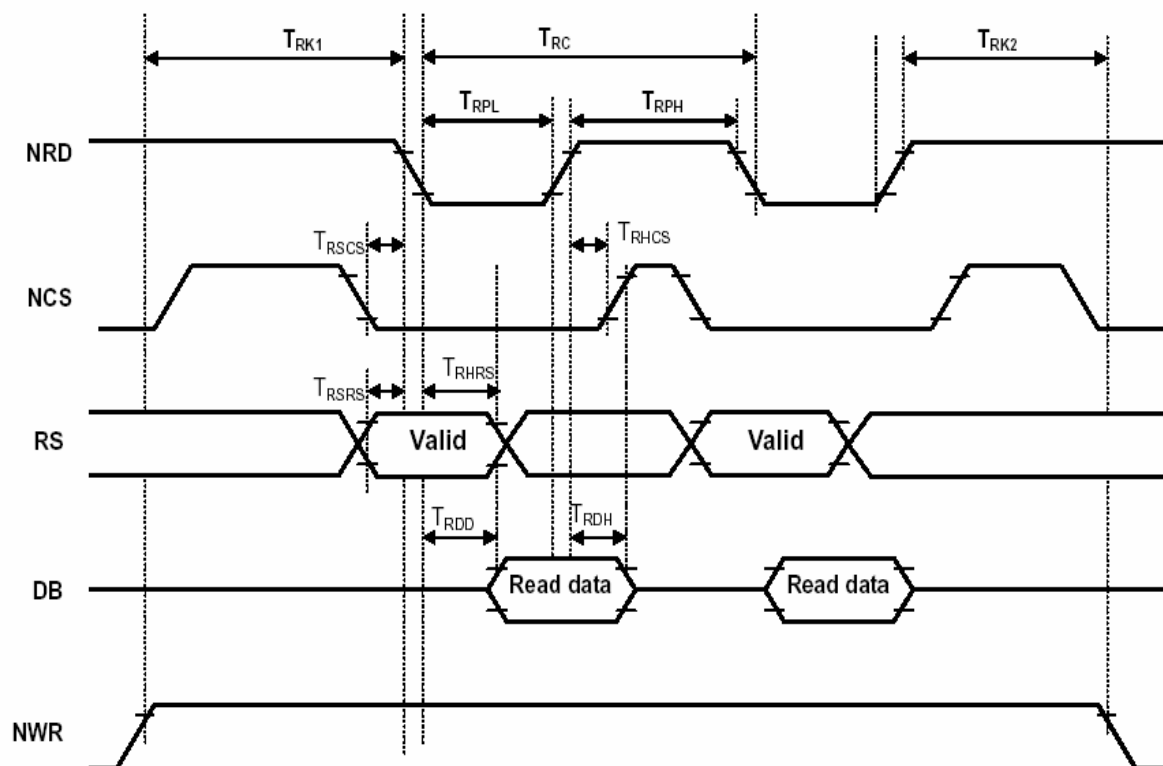
Symbol	Description	Min.	Max.	Note
T_{WPL}	Low period of NWR	60 ns	-	
T_{WPH}	High period of NWR	80 ns	-	
T_{WC}	Prohibit time re-writing	140 ns	-	
T_{WS}	Set up time of DB, RS and NCS to the NWR rising.	50 ns	-	
T_{WH}	Hold time of DB, RS and NCS to the NWR rising.	0 ns	-	
T_{WK1}	Required time from the read cycle to write cycle	300 ns	-	
T_{WK2}	Required time from the write cycle to read cycle	300 ns	-	

Condition: VEE=3.0V , Ta=25°C

Note) All timing is rated on 10 on 90 % of VEE voltage.

Fig 1-a Interface timing chart(write)

a)Read timing



Symbol	Description	Min.	Max.
T_{RPL}	Low period of NRD	100ns	-
T_{RPH}	High period of NRD	100ns	-
T_{RC}	Prohibition time for re-reading	200ns	
T_{RSRS}	Set up time of RS to NRD falling	50ns	-
T_{RSCS}	Set up time of NCS to NRD falling	50ns	-
T_{RHRS}	Hold time of RS from NRD falling	50ns	-
T_{RHCS}	Hold time of NCS from NRD rising	50ns	-
T_{RDD}	Time from NRD falling to confirmation of DB output	-	80ns
T_{RDH}	Time from NRD rising to confirmation of DB output	5ns	-

Condition: VEE=3.0V , Ta=25°C

Note)All timing is rated on 10 on 90 % of VEE voltage.

Fig 1-b Interface timing chart(read)

(8)Power sequence

8-1) Power On sequence

	Register	Data(h)	Remarks
Power On (VDD,VEE)			VDD should power on within 200ms after VEE.
↓			Power will be stable.
Soft ware reset	FD	FD	
↓			
Soft ware reset	FD	FD	
↓ Wait=50ms			
Gate reset	E0	01	
↓			
TG parameter refresh	7F	01	
↓ Wait=5 μ s			
Gate reset release	E0	00	
↓			
TG parameter refresh	7F	01	
↓ Wait=5 μ s			
Host reset enable	1B	04	
↓			
Host reset	FE	FE	
↓			
Host reset	FE	FE	
↓ Wait=5 μ s			
EEPROM control	EE	00	
↓			
Panel bank	EF	00	
↓			
Host interface control resister setting	10	0C	
↓			
VRAM access area setting register	12	00	(X direction/start and pointer)
↓			
VRAM access area setting register	13	00	(Y direction/start and pointer)
↓			
VRAM access area setting register	15	AF	(X direction/end)
↓			
VRAM access area setting register	16	DB	(Y direction/end)
↓			
Address auto increment setting register	18	05	
↓			
Display color setting register	88	00	
↓ Wait=5 μ s			
Display displaying setting register	7E	04	
↓			
Display displaying setting register	7E	05	
↓			
V sync parameter transfer flag	7F	01	
↓ Write VRAM			
Display on	80	01	

8-2) Power OFF sequence

	Register	Data(h)	Remarks
CPU bank active	EF	00	
↓			
Host reset enable	1B	04	
↓			
Host reset	FE	FE	
↓			
Host reset	FE	FE	
↓			
Display setting	7E	04	
↓			
DC setting	E3	04	
↓			
DC setting	E4	04	
↓			
DC off setting	E2	01	
↓			
Display off	80	00	
↓			
Gate reset	E0	01	
↓			
TG parameter refresh	7F	01	
↓ Wait=5 μ s			
Gate reset release	E0	00	
↓			
TG parameter refresh	7F	01	
↓ Wait=5 μ s			
Oscillator stop	01	01	
↓			
Power Off (VDD,VEE)	—	—	VEE should power off within 200ms after VDD.

(9)Optical characteristics

9-1)Not driving the Back light condition

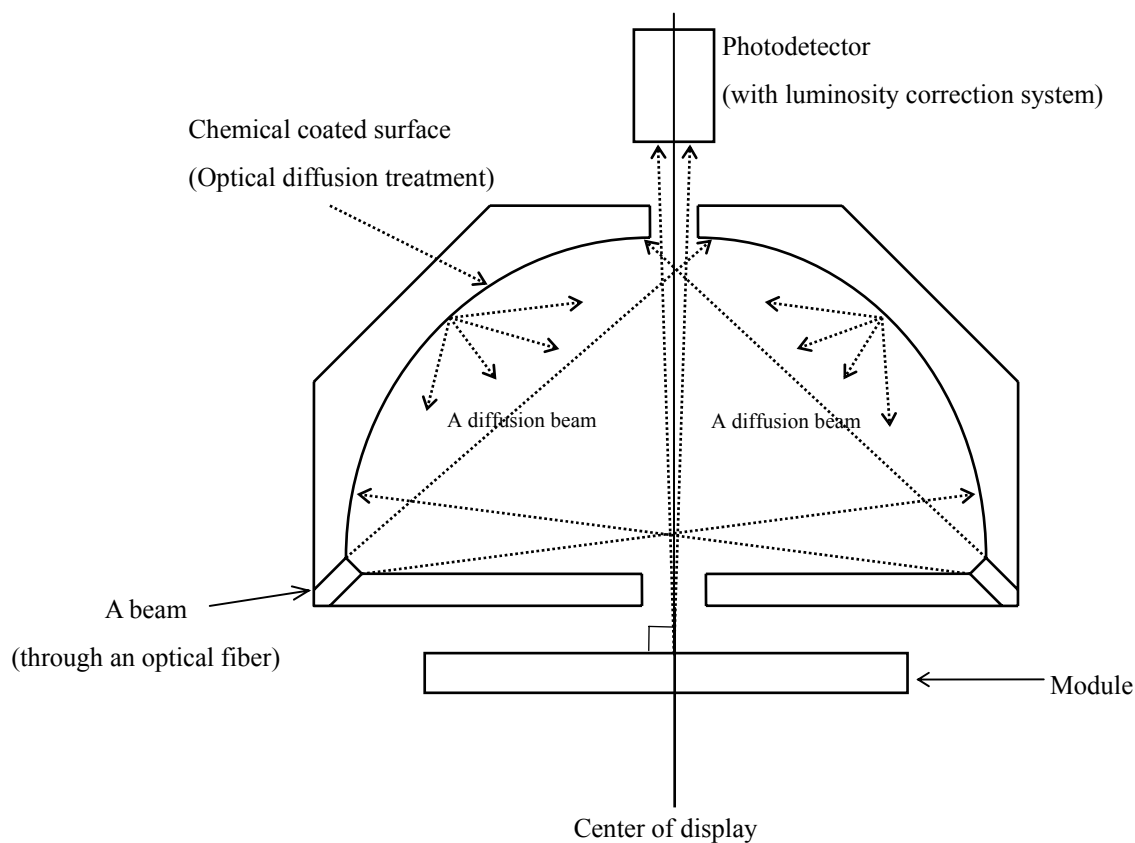
Table 7 VDD=3.0V、VEE=3.3V

Ta=25°C

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing angle range		$\theta_{21,22}$	$CR \geq 2$	35	-	-	degree	[Note 9-1,2]
		θ_{11}		35	-	-	degree	
		θ_{12}		35	-	-	degree	
Contrast ratio		CRmax	$\theta = 0^\circ$	10	-	-	-	[Note 9-2,4]
Response time	Rise	τ_r	$\theta = 0^\circ$		15	25	ms	[Note 9-3]
	Fall	τ_d			25	35	ms	
White chromaticity		x	$\theta = 0^\circ$	0.290	0.310	0.330	-	[Note 9-4]
		y		0.310	0.330	0.350	-	
Red chromaticity		x		0.401	0.421	0.441	-	
		y		0.309	0.329	0.349	-	
Green chromaticity		x		0.283	0.303	0.323	-	
		y		0.358	0.378	0.398	-	
Blue chromaticity		x		0.210	0.230	0.250	-	
		y		0.229	0.249	0.269	-	
Reflection ratio		R	$\theta = 0^\circ$	7	-	-	%	[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)Driving the Back light condition

Table 8 VDD=3.0V、VEE=3.3V

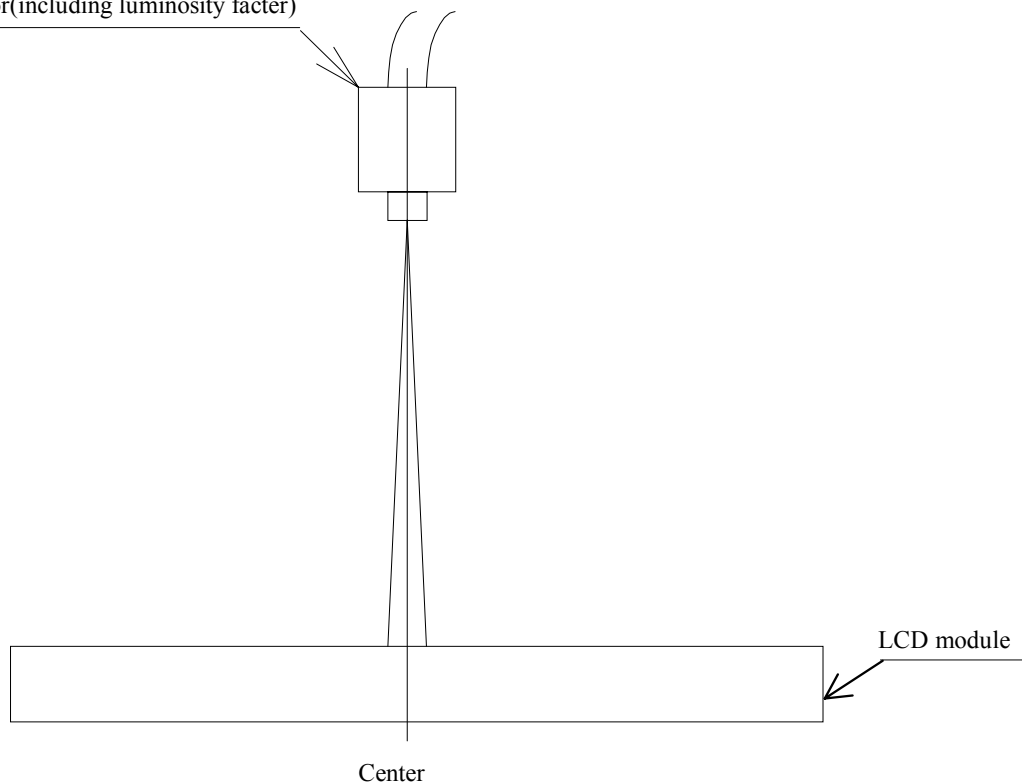
Ta=25°C

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing angle range	θ11	CR≥5	30	35	-	degree	[Note 9-1,2]
	θ12		35	40	-	degree	
	θ21		30	35	-	degree	
	θ22		20	25			
Contrast ratio	Crmax	θ = 0°	60	80	-	-	[Note 9-2]
Response time	Rise	θ = 0°	-	20	25	ms	[Note 9-3]
	Fall		-	35	50	ms	
White chromaticity	x	θ = 0°	-	0.306	-	-	
	y		-	0.324	-	-	
Red chromaticity	x		-	0.535	-	-	
	y		-	0.331	-	-	
Grren chromaticity	x		-	0.327	-	-	
	y		-	0.505	-	-	
Blue chromaticity	x		-	0.146	-	-	
	y		-	0.149	-	-	
Brightness	Y	θ = 0°	90	120	-	cd/m ²	IL=20mA
Uniformity			80	-	-	%	[Note 9-6]
NTSC ratio			-	30	-	%	

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

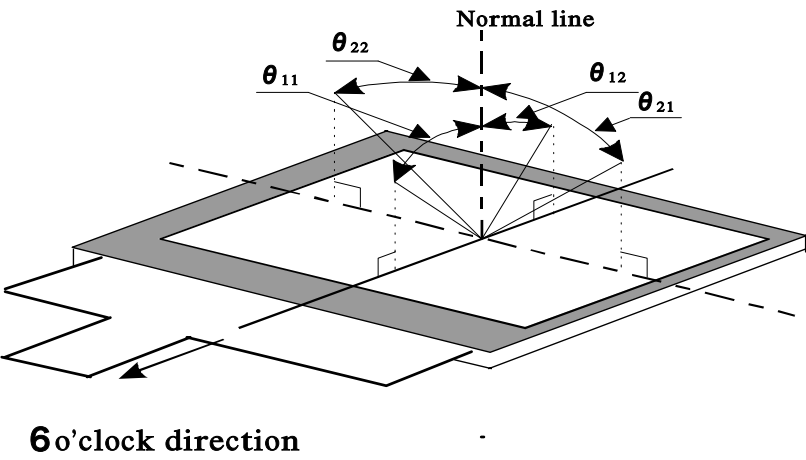
* A measurement device is TOPCON luminance meter BM-3(A).(Viewing cone 1)

Photodetector(including luminosity factor)



Measuring method (c) for optical characteristics

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



Definition for viewing angle

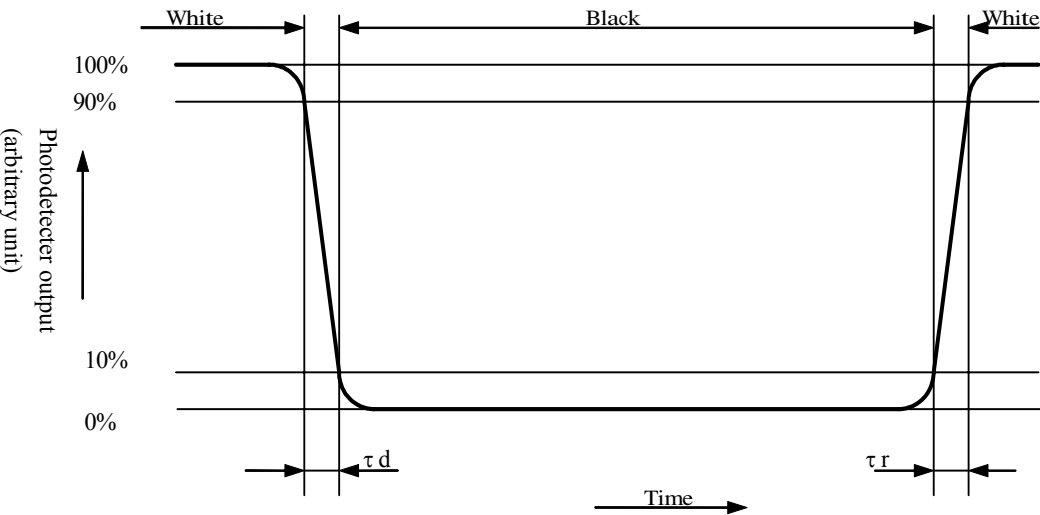
[Note 9-2] Definition of contrast ratio:

The contrast ratio is defined as follows:

$$\text{Contrast ratio (CR)} = \frac{\text{Photodetector output with all pixels white (GS63)}}{\text{Photodetector output with all pixels black (GS0)}}$$

[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.

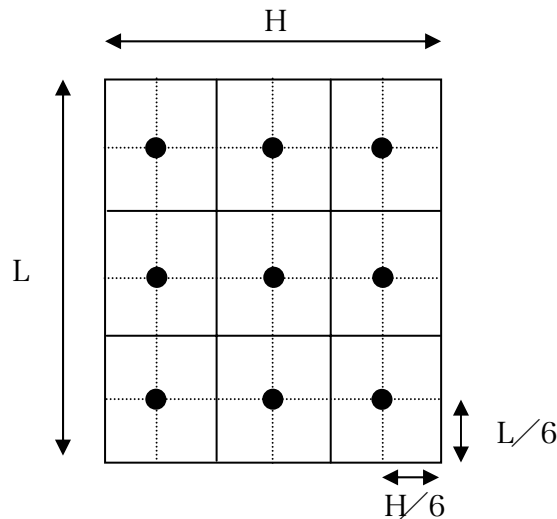
[Note 9-5] Definition of reflection ratio

$$\text{Reflection ratio} = \frac{\text{Light detected level of the reflection by the LCD module}}{\text{Light detected level of the reflection by the standard white board}}$$

[Note 9-6] Definition of Uniformity

$$\text{Uniformity} = \frac{\text{Minimum brightness}}{\text{Maximum brightness}} \times 100(\%)$$

The brightness should be measured on 9 spots of the display as follows.



(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 (for LCD panel) characteristics

(1) Specific connector

FF14-32A-R13B (DDK)

(2) Bending endurance of the bending slits portion

No line of the FPC is broken for the bending test (Bending radius=0.6mm and angle=90°) in 30 cycles.

(12) Handling Precautions

12-1) Insertion and taking out of FPCs

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 FPCs

The FPC for LCD panel shall be bent only slit portion. The bending slit shall 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 FPCs too large force, for example, hanging the module with holding FPC.

12-3) Installation of the module

On mounting the module, be sure to fix the module on the same plane. Taking care not to warp or twist the module.

12-4) Precaution when mounting

- (1) If water droplets and oil attaches to it for a long time, discoloration and staining occurs. Wipe them off immediately.
- (2) 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.

(3) 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.

(13) Reliability Test Conditions for TFT-LCD Module

Table 12

No.	Test items	Test conditions	
1	High temperature storage test	Ta=+70°C	240h
2	Low temperature storage test	Ta=-20°C	240h
3	High temperature and high humidity operating test	Tp=+40°C , 95%RH (But no condensation of dew)	240h
4	High temperature operating test	Tp=+60°C	240h
5	Low temperature operating test	Tp=-10°C	240h
6	Electro static discharge test	±200V・200pF(0Ω) 1 time for each terminals	
7	Shock test	980 m/s ² , 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=-20°C~+70°C / 50cycles (1h) (1h)	

【Note】 Ta = Ambient temperature, Tp = Panel temperature

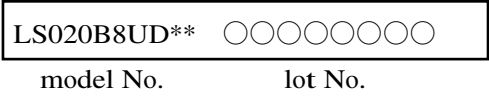
【Check items】 Test No.1~9 : In the standard condition, there shall be no practical problems that may affect the display function.

(14) Others

14-1) 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



14-2) Used Regulation of Chemical Substances Breaking Ozone Stratum

Substances with the object of regulating : 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.

14-3) 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.

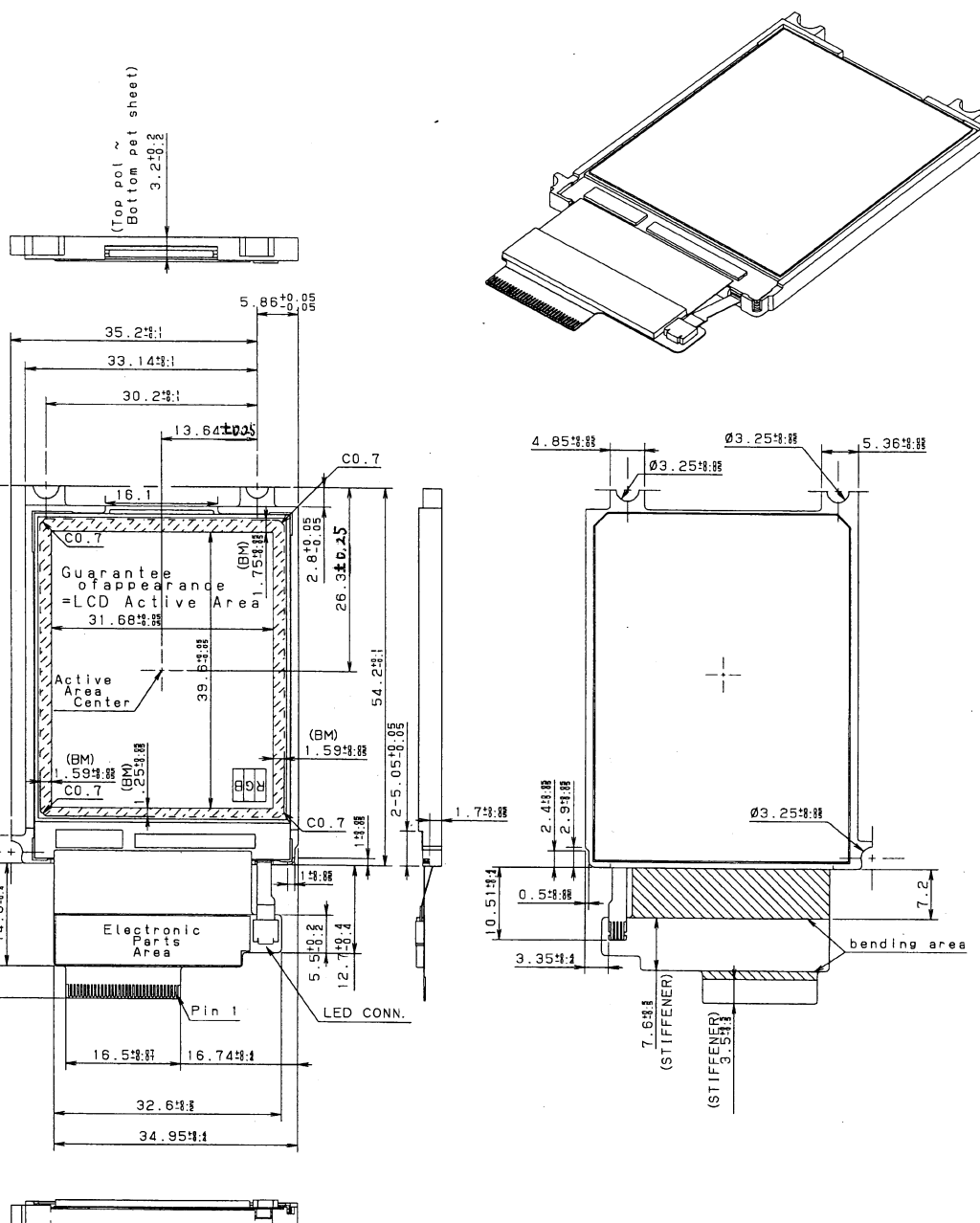
(15) Forwarding form

- a) Piling number of cartons : 8 deep
- b) Package quantity in one cartons : 200(pcs)
- c) Carton size : (w) 525×(D) 360×(H) 225 (mm)
- d) Total mass of 1 carton filled with full modules : approximately 5.8 (Kg)






Conditions for storage

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.



- General tolerance is ± 0.5
- Guarantee of appearance = LCD Active Area
- LCD-FPC should bended only bending area.
- LCD/LED-FPC bend larger than 0.6 in radius.
- Take care in set design to hide the scratches and bubbles appeared on the polarizer or other frame area which is located outside of guarantee area.
- The light of Back Light is leaking from BM outside, please light shielding by the set.
- The tolerance of module width are exclude warp of frame.

6					ORIGINAL MODEL	LS020B8UD**	
4					画面サイズ, 他	Dots: 176 (RGB) x220	
3					ACTIVE AREA SIZE . ETC	P=0.18	
2					尺度 1/1	日付 DATE	17/Dec/2004
1					SCALE	単位 mm	名称 Outline dimension
改 訂 日					担当	名称 NAME	ユーザ－ USER
改 訂 記 事 REVISION							
設計 DESIGNER	製図 DRAFTER	検図 DSN CK	検図 DSN CK	承認 ENG APPD		ユーザ－ USER	図番 DRAWING NO.
W. Kawabuchi							
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					1 MOBILE LCD DESIGN CENTER 11		