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DEVICE SPECIFICATION FOR

CG-Silicon TFT-LCD module

MODEL No. **LS035B7UG01C**

☐ CUSTOMER'S APPROVAL

DATA

BY

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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) Epoxy resin (amine series curing agent), silicone adhesive material (dealcoholization series and oxime series), tray forming agent (azo compound) etc, in the cabinet or the packing materials may induce abnormal display with polarizer film deterioration regardless of contact or noncontact to polarizer film.Be sure to confirm the component of them.

(7) Use after you examine it fully because when liquid crystal is included into the product, stress such as a twist is added, and it becomes the cause which glass broken and brightness occasion unevenness occur in when condition is taken.

(1) Application

This literature applies to LS035B7UG01C.

(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.

Graphics and texts can be displayed on a 320×3×480 dots panel with 262,144 colors by supplying.

Optimum view angle is 1:30 o'clock (direction: driver on the top).

(3) General specifications

Table 1. Description

Parameter	Specifications	*Remarks
LCD Type	Normally White, Transflective ECB TFT	
Screen size (Diagonal)	3.54"	
Pixel format	320(H)×480(V) (1 pixel = R+G+B dots) …RGB vertical stripe	
Pixel pitch	0.052（H）×0.156（V）mm	
Top Polarizer	Anti Reflection(LT4), Hard coat 34%-Haze in adhesive	
Interface	MPL＆SPI	
Display active area	49.92(H)×74.88(V) mm	
Unit outline dimension	55.22(W)×82.88(H)×1.85(D) mm (Typ.)	【Note3-1】
Mass	13.5 gram (Typ.)	
BTB connector on the FPC	SMK CPB7324-0250F(receptacle), 24Pin	

*Remarks

【Note 3-1】

Excluding protrusion. For detailed measurements and tolerances, please refer to Drawing No.LDM-03336A.

(4)Input/Output terminal

4-1)TFT-LCD panel driving section

The pin connections are provide in Table2. The interface connector is a 24pin board-to-board connector mounted on the FPC tail.

Table2. Pin Assignment

Pin No.	Symbol	I/O	Description	Remarks
1	VDDA	-	Display voltage	5.8V typical
2	LED-	-	LED Cathode	
3	GND	-	Ground	
4	LED+	-	LED Anode	
5	MPL_PD_N	I	MPL Link Power Down	Active Low
6	NC	-	No connect	
7	FLM	O	First Line Marker (XFER)	PE parity error for MPL interface testing
8	IND	O	Timing back to MLB	340kHz
9	RESET	I	Reset	Active Low
10	GND	-	Ground	
11	GND	-	Ground	
12	SCS	I	SPI Chip Select	Active Low
13	MD0	I	MPL DATA	MPL Interface
14	SCLK	I	SPI DATA	
15	GND	-	Ground	
16	SDI	I	SPI DATA In	
17	MC	I	MPL CLK	MPL Interface
18	SDO	O	SPI DATA Out	
19	GND	-	Ground	
20	NC	-	No Connect (Open)	
21	MD1	I	MPL DATA	MPL Interface
22	VDDD	-	Logic Power Supply	1.8V
23	GND	-	Ground	
24	VDD_DC	-	DC to DC Power Supply	3.0V

Used BTB receptacle connector (LCM side) : 0.4mm pitch CPB7324-0259E (SMK)

Corresponding connector (User side) : CPB7424-0250F (SMK)

Recommended MPL transmitter: LM2512A(National Semiconductor)

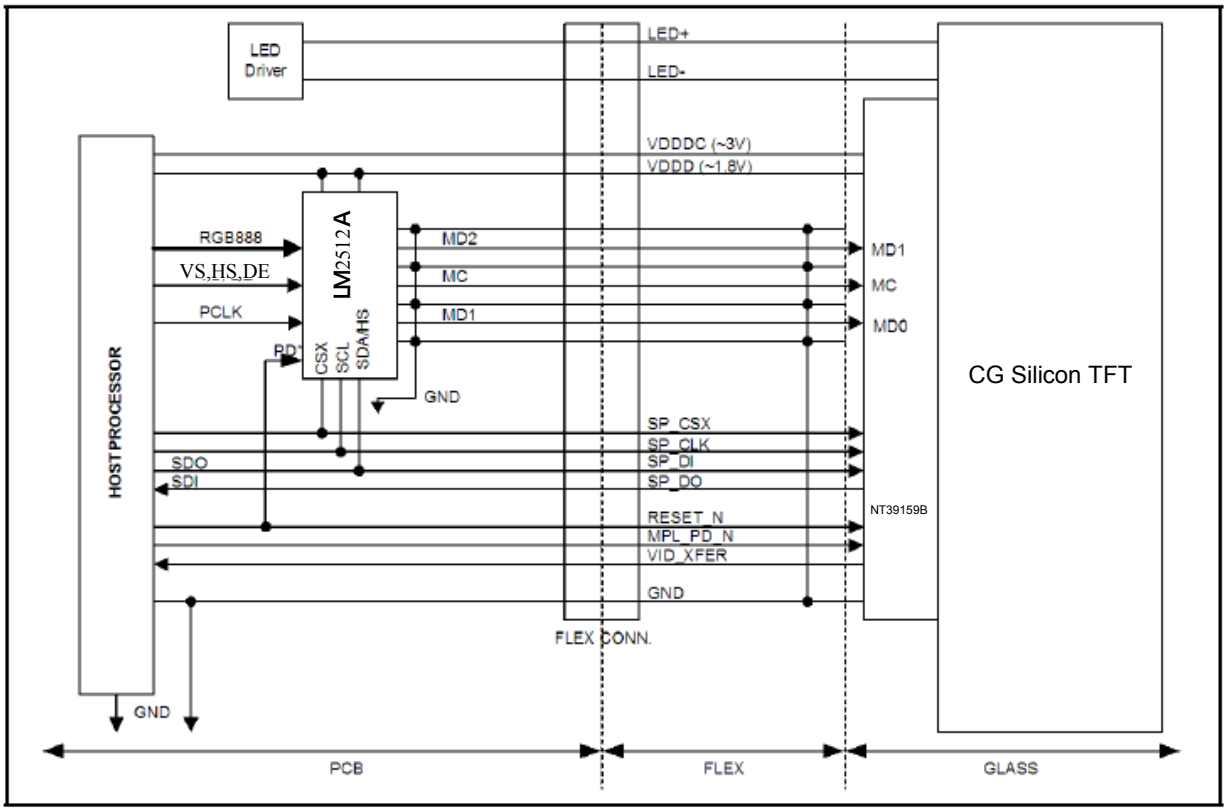


Figure1. MPL1 signal connections

(5)Absolute Maximum Ratings

Table 3. Absolute Maximum Rating

Parameter	Symbol	Ratings	Unit	Remark
Supply voltage for LCD	V_{DDDC}	−0.3～+4.0	V	
Supply voltage for Logic I/O	V_{DDD}	−0.3～+2.5	V	
VDDA Voltage	V_{DDA}	6.0	V	
Logic Input Voltage	V_{IN}	-0.3<V_{IN}<V_{DDD}+0.3		【Note3-1】
LED Power Consumption	P_{LED}	120	mW	【Note3-2】
LED current	I_{LED}	35	mA	
Operating temperature (panel	T_{op}	−20～+70	℃	【Note3-3】
Storage temperature	T_{stg}	−30～+80	℃	
Humidity	H	5% ～ 95%	RH	

*Remarks
【Note3-1】Applies to RESET, SCS, SCLK, SDI, SDO, and FLM.
【Note3-2】Applies for each LED individually
【Note3-3】Humidity: 95%RH Max, non-condensing>40℃

(6)Block Diagram & Window Address

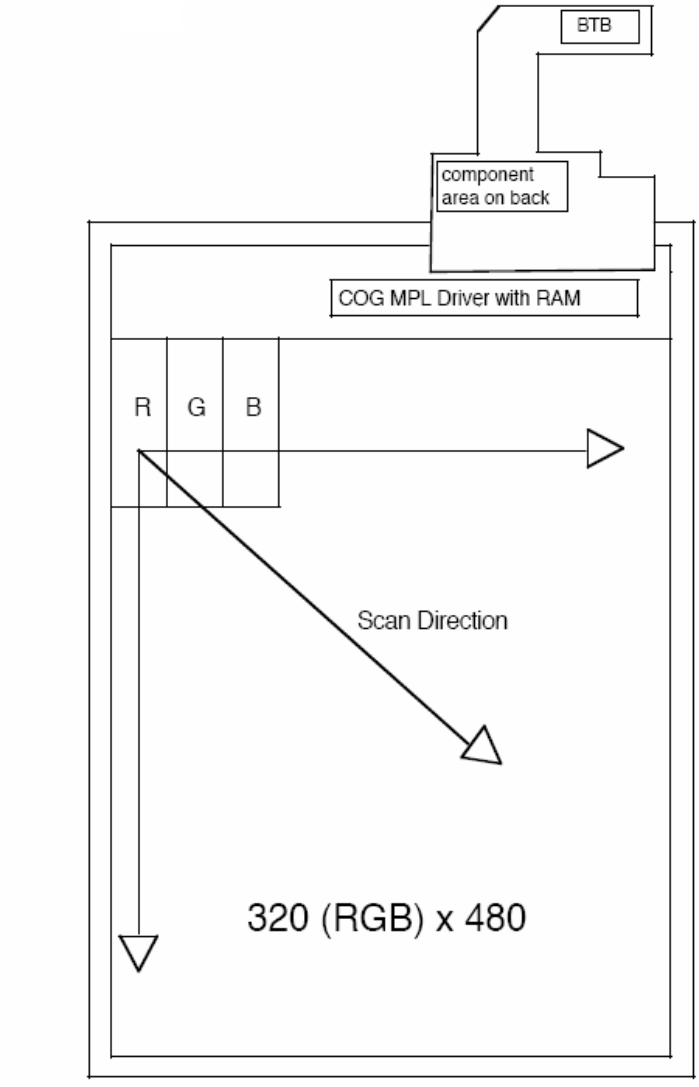


Figure2. Display Block diagram

*please refer to Drawing No.LDM-03336A.

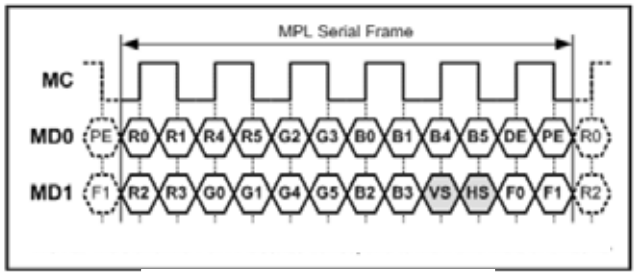
(7)Color Input Reference & Data Transfer

The Brightness of each primary color (R,G,B) is based on the 6-6-6 bit gray scale data respectfully input for the color. The display outputs 18-bit color data. The higher the binary input, the brighter the color. Table3 below provides a reference for color versus data input.

Table4. Color vs DATA

Colors & Gray Scale	Gray scale Levels	Data Signal																	
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
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
Green	--	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Cyan	--	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Red	--	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
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
⇑ Darker	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
⇑	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
⇓	↓				↓					↓						↓			
⇓ Brighter	↓				↓					↓						↓			
⇓	GS61	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	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
⇑ Darker	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
⇑	GS2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
⇓	↓				↓					↓						↓			
⇓ Brighter	↓				↓					↓						↓			
⇓	GS61	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
	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
⇑ Darker	GS1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
⇑	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
⇓	↓				↓					↓						↓			
⇓ Brighter	↓				↓					↓						↓			
⇓	GS61	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
	GS62	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Blue	GS63	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

<Transfer 24-bit to 18-bit Dithered, 2 MD Lane, RGB Transaction>



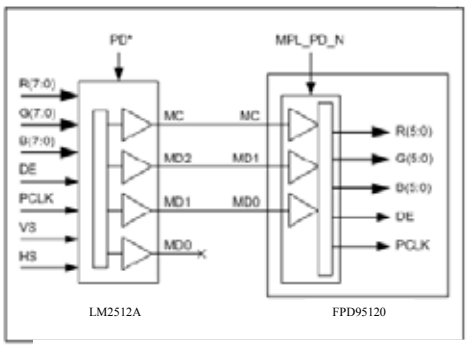


Figure3. MPL Data Frame* **Figure4. 2 Lane MPL Interface**

*MD0 and MD1 of NT39159 correspond to MD1 and MD2 of LM2512A

(8)Electrical characteristics

8-1) Recommended operating conditions

a) TFT-LCD panel driving section

Table 5. Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
LCD Supply Voltage	VDDDC-VSS	2.85	3.0	3.15	V	
Logic I/O Voltage	VDDD-VSS	1.65	1.80	1.95	V	【Note8-2】
VDDA Voltage	VDDA	5.68	5.80	5.92	V	
VDDA ripple Voltage		–	–	25	mV	【Note8-6】
Panel Input Current	IDDDC +IDDD	–	9	10	mA	【Note8-1】
LED Input Current	I_{LED}	–	20	25	mA	
VDDA current	IVDDA	–	5.5	–	mA	
"H" Level Input Voltage	V_{IH}	0.8VDDD	–	–	V	【Note8-2】
"L" Level Input Voltage	V_{IL}	–	–	0.2VDDD	V	
"H" Level Output Voltage	V_{OH}	0.8VDDD	–	–	V	
"L" Level Output Voltage	V_{OL}	–	–	0.2VDDD	V	
Driver Power Supply Stability		–	–	250	ms	【Note8-5】
Inrush Current (3V supply)				200	mA	
MPL Line Impedance		45	55	60	Ohm	
Power, MPL full refresh	P MPL	–	53	–	mW	【Note8-1】
Power, Backlight	P B	–	384	420	mW	【Note8-3】
Power, Sleep mode	P S	–	–	60	μW	【Note8-4】

*Notes

【Note 8-1】 Conditions : VDDDC=3.0V ,VDDD=1.8V , VDDA=5.8V , T=25℃, 60Hz frame rate/frequency, Black fill pattern is displayed, and line inversion used.

【Note 8-2】 Input mode of RESET,SCS,SCLK and SDI. Output mode of SDO and FLM

【Note 8-3】 LED Backlight assumptions;3.2V_f , 20mA, 6LED's.

【Note 8-4】 VDDDC&VDDD are present ; RESET is high.

【Note 8-5】 Time from VDDDC＆VDDD applied until driver power supplies are stable.

【Note 8-6】 VDDA generated circuit is introduced in Figure5.(Reference)
SHARP is using this VDDA generated circuit for LCM display inspection's MP line (setup).

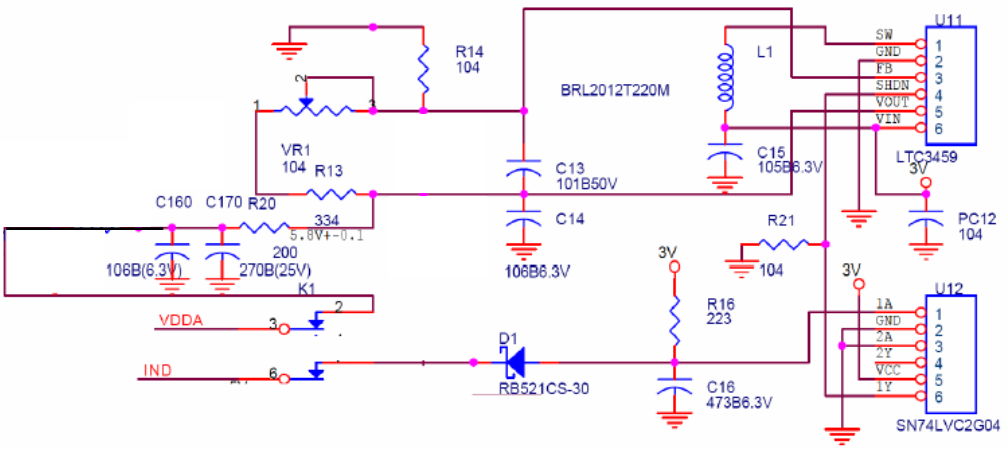


Figure5. (Reference) V_{DDA} generated circuit

8-2) Timing diagrams of input signals

a) Write/Read timing

The system input timing characteristics are provides in Table 5 and illustrated in Figure6.

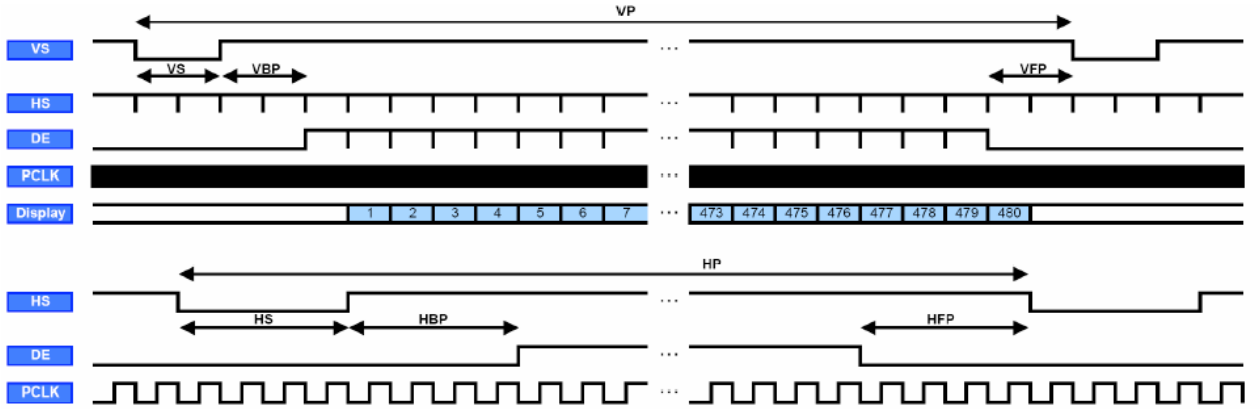


Figure6. Timing Characteristics

Table 6. Interface Timing Characteristics

Item	Symbol	Timing	unit	Notes
Vertical cycle	VP	492	Line	【Note8-6】
Vertical low pulse width	VS	4	Line	
Vertical front porch	VFP	4	Line	
Vertical back porch	VBP	4	Line	
Vertical display area	VDISP	480	Line	
Horizontal cycle	HP	366	clk	
Horizontal low pulse width	HS	4	clk	
Horizontal front porch	HFP	22	clk	
Horizontal back porch	HBP	20	clk	
Horizontal display area	HDISP	320	clk	
Pixel Clock	fPCLK	10.80	MHz	
	tPCLK	92.6	ns	

*Notes

【Note 8-6】VDD=2.85~3.15V, VEE=1.65~1.95V

(9)Software Flow & Register Settings

9-1) Software Flow

The LCM for LS035B7UG01 displays all follow the basic software flowchart illustrated Figure7 and in the following Tables.

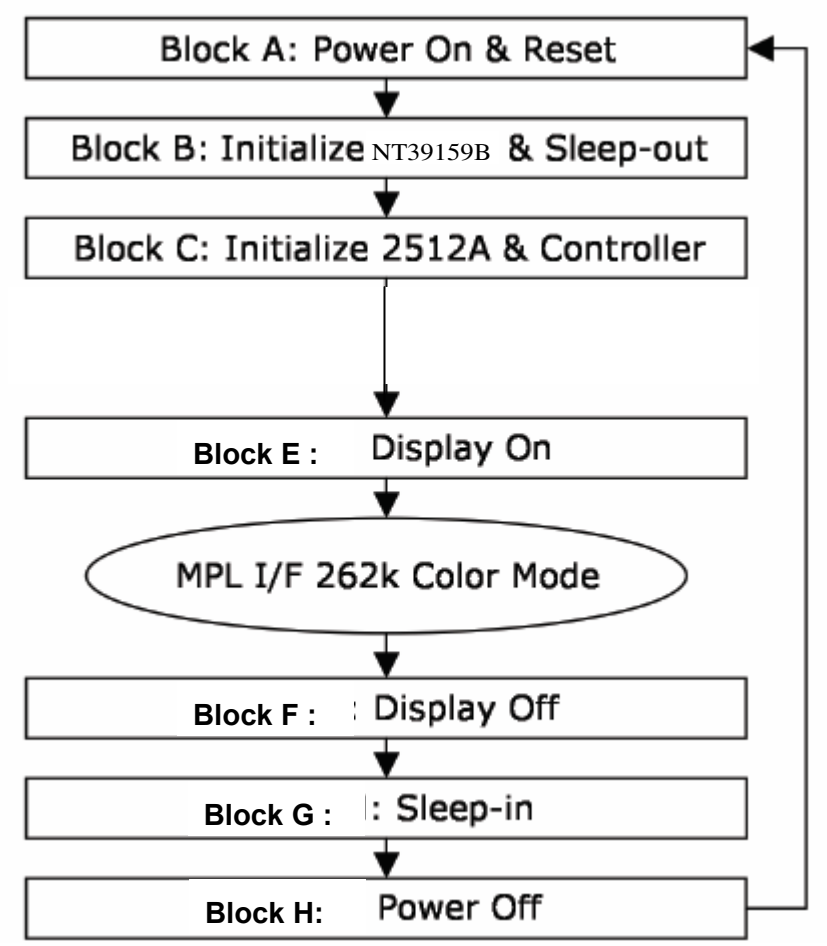


Figure7. Software Flowchart

9-2) Register Settings

Table7. Block A: Power On&RESET

Step	Operation
1	Power switched on to VDDD&VDDDC simultaneously
2	MPL_PD_N=0 "L"
3	PWRDWN_2512A=0 "L" (LM2512A Power OFF)
4	RESET=1 "H ➔ L"
5	Delay 10ms
6	RESET=0 "L ➔ H"
7	PWRDWN_2512A=1 "L ➔ H" (LM2512A Power ON)
8	Delay 10ms

Power to VDDDC and VDDD are switched on simultaneously.

The sequence for power on is shown in Figure8.

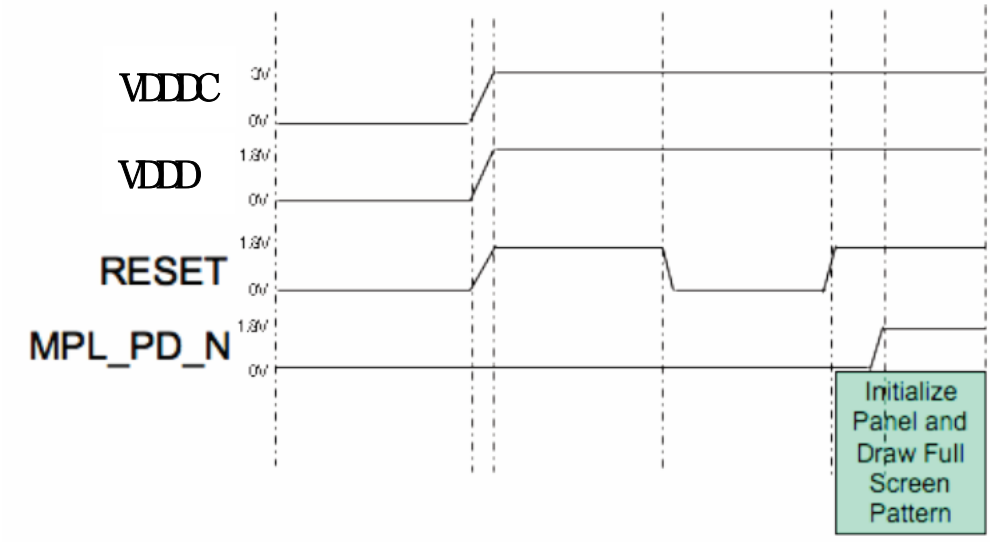


Figure8. Power On Sequence

Table8. Block B: Initialize NT39159B&Sleep-out

Step	Regster / Command	Parameter / Setting	Operation
1	DE= " L ➔ H "		
2	Turn on LCD Signals (RGB interface from controller to LM2512A)		
3	5F	01	Command Mode
4	Delay 10ms		
5	OP 11h	—	Sleep Out
6	MPL_PD_N= 1 " H "		

Table9. Block C: Initialize LM2512A&Controller

Step	Regster / Command	Parameter / Setting	Operation
1	MPL_PD_N=1 " H "		
2	2512A 16h	FFh	Unlock LM2512A (locks NT39159B)
3	2512A 00h	10h	Enable access to LM2512A registers
4	2512A 0Ah	02h	Forces 2 Lane Config
5	2512A 08h	01h	Bipass dithering
6	2512A 02h	00h	Red ram address
7	2512A 03h	00h	Red ram data
8	2512A 04h	00h	Green ram address
9	2512A 05h	00h	Green ram data
10	2512A 06h	00h	Blue ram address
11	2512A 07h	00h	Blue ram data
12	2512A 01h	10h	MPL slow edge rate
13	2512A 16h	00h	Unlock NT39159B (Locks LM2512A)
14	Delay 1 ms		

Table10. Block D: Display Settings (MTP Data)

Step	Regster / Command	Parameter / Setting		Operation
1	1D	94		SCAN
2	1E	17		INVERSION_MODE
3	1F	11		CKH1_HI_PM
4	20	11		CKH_HI_PM
5	21	04		CKH_NOV_PM
6	22	09		DE_CKH1_PM
7	23	01		DE_GOE_RE_PM
8	24	C8		MODE
9	25	11		CKH1_HI
10	32	11		CKH_HI
11	33	04		CKH_NOV
12	34	09		DE_CKH1
13	35	01		DE_GOE_RE
14	37	91		DE_CKV
15	3B	00		DE_VCOM
16	3C	01		STV_CTL
17	3D	91		DE_CKV_PM
18	3E	00		DE_VCOM_PM
19	3F	A8		COL_OFFSET
20	40	Dx		OSC_PER_LINE_LSB
21	41	Fx		LINE_PER_FRAME_LSB
22	42	01		OPL_LPF_MSBS
23	43	00		VDDGR_ADJ
24	44	00		VDD_ADJ
25	45	00		GVDD_ADJ
26	46	00		VCOMDC_ADJ
27	47	Bin1	31	VCOMH_ADJ
		Bin2	28	
		Bin3	17	
		Bin4	0B	
28	48	41		VCOML_ADJ
29	49	00		VX_RISE
30	4A	01		VX_FALL

31	4B	00		VCOM_MODE
32	52	C0		GAMMA_CFG1
33	55	03		BLANK
34	60	A1		WRID1
35	61	D1		WRID2
36	62	2B		WRID3
37	63	00		PWCTR1
38	64	07		PWCTR2
39	65	00		PWCTR3
40	66	08		PWMCTRL1
41	67	26		PWMCTRL2
42	68	Bin1	1004700300F00F0170	GAMCTRP0
		Bin2	0004710301F00F03BA	
		Bin3	3005421301F0050273	
		Bin4	0017321305D00400D8	
43	69	Bin1	4F7037F601FF000007	GAMCTRN0
		Bin2	4F6037F703FF0001AB	
		Bin3	4E5327F402F5000137	
		Bin4	4E5406F700D400058D	
44	6A	Bin1	1004722200F00F01D0	GAMCTRP1
		Bin2	0005720401F00F03D6	
		Bin3	6007751201A00700B1	
		Bin4	4007640003800600E8	
45	6B	Bin1	5D5037F601FF00000D	GAMCTRN1
		Bin2	3F5027F703FF00016D	
		Bin3	5E2007F100A700011B	
		Bin4	7F3107F3008600038E	
46	6C	Bin1	2007717700F20F0104	GAMCTRP2
		Bin2	1007715704F20F033A	
		Bin3	7007310701F9050020	
		Bin4	4007000406D6030088	
47	6D	Bin1	086007F501FF020040	GAMCTRN2
		Bin2	0A6007F603FF0204A3	
		Bin3	0F6407F000F5090102	
		Bin4	3F7707F300D3060688	

One of the 4th gannma curve set (Bin1,2,3,4) is applied to each LCM.
Adjusting driven voltage for LC is covered acceptable optical specification.

Table11. Block E: Display On

Step	Regster / Command	Parameter / Setting	Operation
1	OP DEh	—	Enter Register Access Mode
2	50	01	CAL_SEL Setting(Continuous)
3	5F	01	Command Mode
4	Delay 10ms		
5	OP 29h	—	Display On command (alternatively write setting 00h to register 55h to blank in register Access mode)
6	Turn Backlight On		

Table12. Block F: Display Off

Step	Regster / Command	Parameter / Setting	Operation
1	Turn Backlight Off		
2	5F	01	Command Mode
3	Delay 10ms		
4	OP 28h	—	Display off
5	Delay 40ms		

Table13. Block G: Sleep In

Step	Regster / Command	Parameter / Setting	Operation
1	5F	01	Command Mode
	Delay 10ms		
2	OP 10h	-	Sleep in
3	Delay 70ms		

Table14. Block H: Power Off

Step	Regster / Command	Parameter / Setting	Operation
1	Turn off LCD Signals (RGB interface from controller to LM2512A)		
2	DE= " H ➔ L "		
3	MPL_PD_N = 0 " H ➔ L "		
4	Delay 100ms		
5	RESET =1 " H ➔ L "		
6	Delay 1ms		
7	PWRDWN_2512A=0 " Sleep Mode "		
8	Power down simultaneously or 3V supply first then 1.8V logic		

Power to VDDC and VDDD is removed.

The sequence for power on is shown in Figure9.

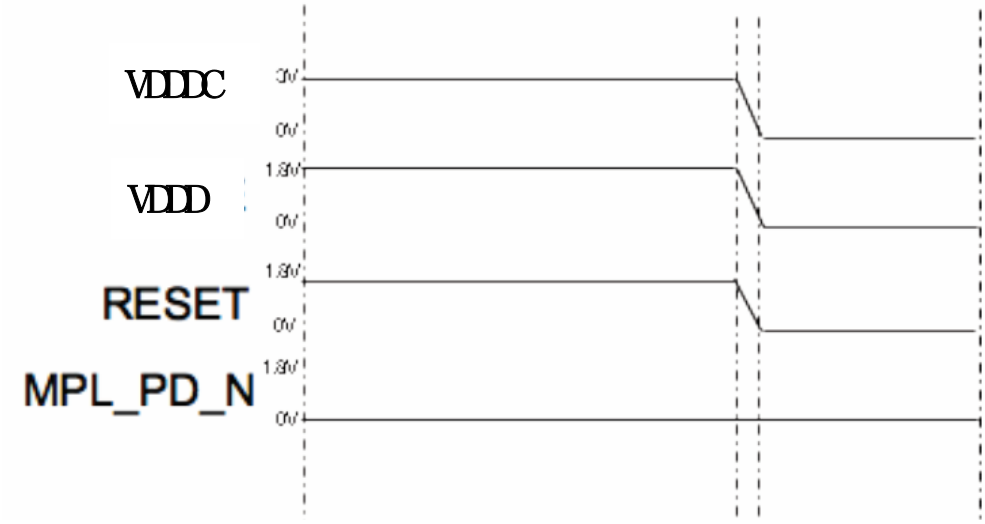


Figure9. Power Off Sequence

(10)Optical characteristics

10-1)Not driving the Back light condition

Table 15. Optical Characteristics – Backlight OFF

VDDDC=3.0V、VDDD=1.8 V、VDDA=5.8V Ta=25°C

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing angle range	θ_{LEFT}	CR≥2	45	–	–	°(degree)	[Note 10-1,2]
	θ_{UP}		45	–	–		
	θ_{RIGHT}		45	–	–		
	θ_{DOWN}		45	–	–		
Contrast ratio	CR	Optimal	6	8	–	–	[Note 10-1,2]
Reflectivity	R	Optimal	1.15	1.8	2.5	%	[Note 10-5]
Response rise time	τ r	θ =0°	–	5	7	ms	[Note 10-4]
Response fall time	τ d	Ta=25℃	–	10	11	ms	
White Chromaticity	X	CIE	0.290	0.310	0.330	--	[Note10-3]
	Y		0.316	0.336	0.356	--	
Red Chromaticity	X	CIE	0.398	0.425	0.452	--	
	Y		0.297	0.322	0.347	--	
Green Chromaticity	X	CIE	0.275	0.300	0.325	--	
	Y		0.375	0.395	0.415	--	
Blue Chromaticity	X	CIE	0.196	0.227	0.258	--	
	Y		0.193	0.227	0.261	--	

* The display is oriented landscape with this driver in the upper side.

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

* A measurement device is DMS diffuse measurement system.

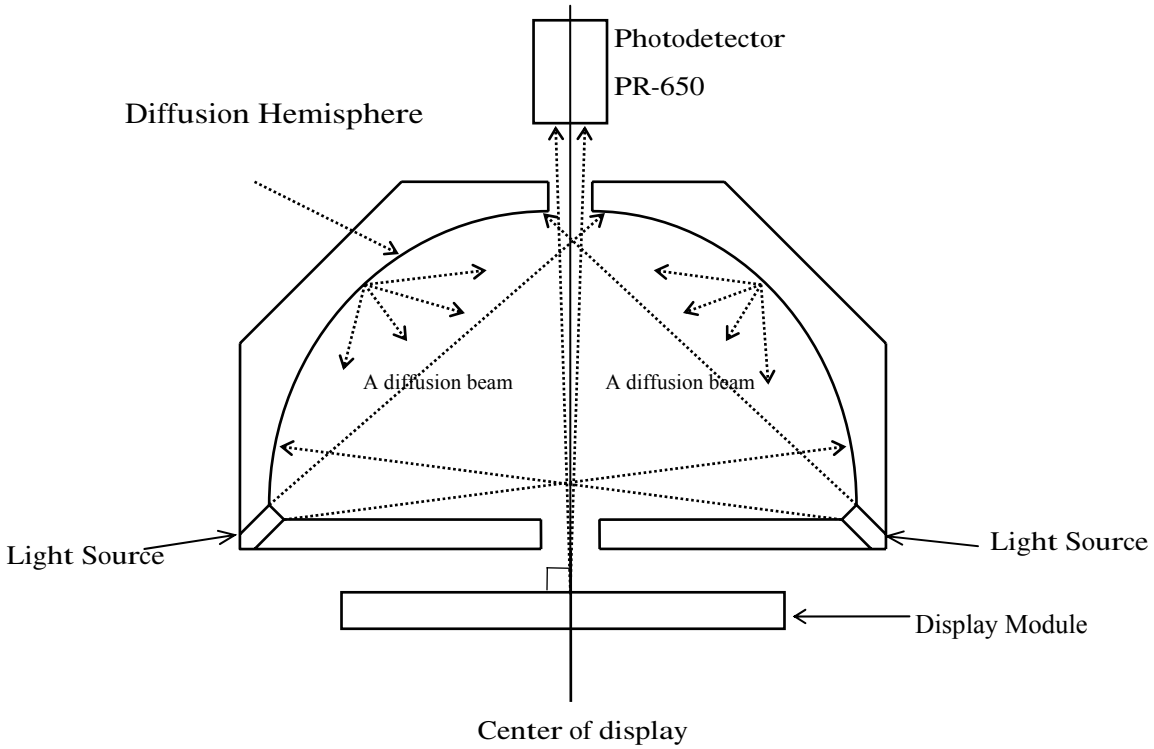


Figure10. Measuring method for reflective optical characteristics

10-2)Driving the Back light condition

Table 16. Optical Characteristics – Backlight ON

VDDDC=3.0V、VDDD=1.8 V、VDDA=5.8V Ta=25°C

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Remarks
Contrast Viewing Angle Range	θ_{LEFT}	CR≥10	50	60	—	Degrees	[Note 10-1,2]
	θ_{UP}		50	60	—		
	θ_{RIGHT}		50	60	—		
	θ_{DOWN}		45	55	—		
	$\theta_{1:30}$		50	60	—		
	$\theta_{4:30}$		50	60	—		
	$\theta_{7:30}$		45	55	—		
	$\theta_{10:30}$		50	60	—		
No High Gray Level Inversion Angle (White Level)	θ_{LEFT}	High Gray Level = lighter shades	50	60	—	Degrees	[Note 10-1,2]
	θ_{UP}		50	60	—		
	θ_{RIGHT}		50	60	—		
	θ_{DOWN}		50	60	—		
	$\theta_{1:30}$		45	55	—		
	$\theta_{4:30}$		50	60	—		
	$\theta_{7:30}$		25	35	—		
	$\theta_{10:30}$		50	60	—		
No Low Gray Level Inversion Angle (Black Level)	θ_{LEFT}	Low Gray Level = darker shades	50	60	—	Degrees	[Note 10-1,2]
	θ_{UP}		45	55	—		
	θ_{RIGHT}		50	60	—		
	θ_{DOWN}		50	60	—		
	$\theta_{1:30}$		30	40	—		
	$\theta_{4:30}$		50	60	—		
	$\theta_{7:30}$		50	60	—		
	$\theta_{10:30}$		50	60	—		
Contrast ratio	CR	Optimal	150	180	—	--	[Note10-1,2]
Brightness	Y	Optimal	450	550	—	cd/m_2	
Brightness Uniformity	Y	Optimal	85	-	—	%	[Note 10-6]
Gamma	γ	Optimal	—	2.2	—		
Blue Shift (including RGB gamma correction)	Δx	Optimal	—	—	0.030		
	Δy	Optimal	—	—	0.050		
Flicker	F	Optimal	—	—	6	%	[Note 10-7]
Cross Talk	D_{SHA}	Optimal	—	—	4	%	[Note 10-8]
Viewing Direction			—	7:30	—	o'clock	[Note 10-1]
Response rise time	τr	θ = 0° Ta = 25°C	—	6	8	ms	[Note 10-4]
Response fall time	τd		—	17	20	ms	
White Chromaticity	X	CIE	—	0.312	—	--	
	Y		—	0.338	—	--	

Red Chromaticity	X	CIE	–	0.609	–	--	
	Y		–	0.355	–	--	
Green Chromaticity	X	CIE	–	0.326	–	--	
	Y		–	0.560	–	--	
Blue Chromaticity	X	CIE	–	0.150	–	--	
	Y		–	0.122	–	--	

* The display is oriented landscape with his driver in the upper side.

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

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

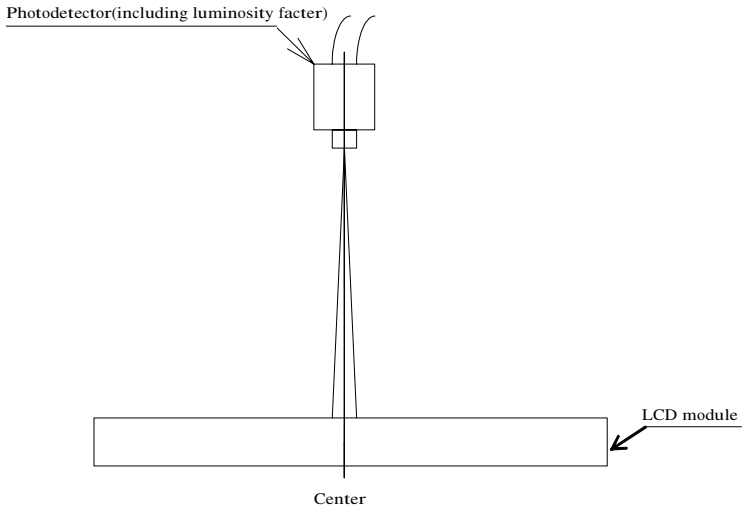


Figure11. Measuring method for transmitance optical characteristics

***Remarks**

[Note 10-1] Viewing angle range is defined as follows.

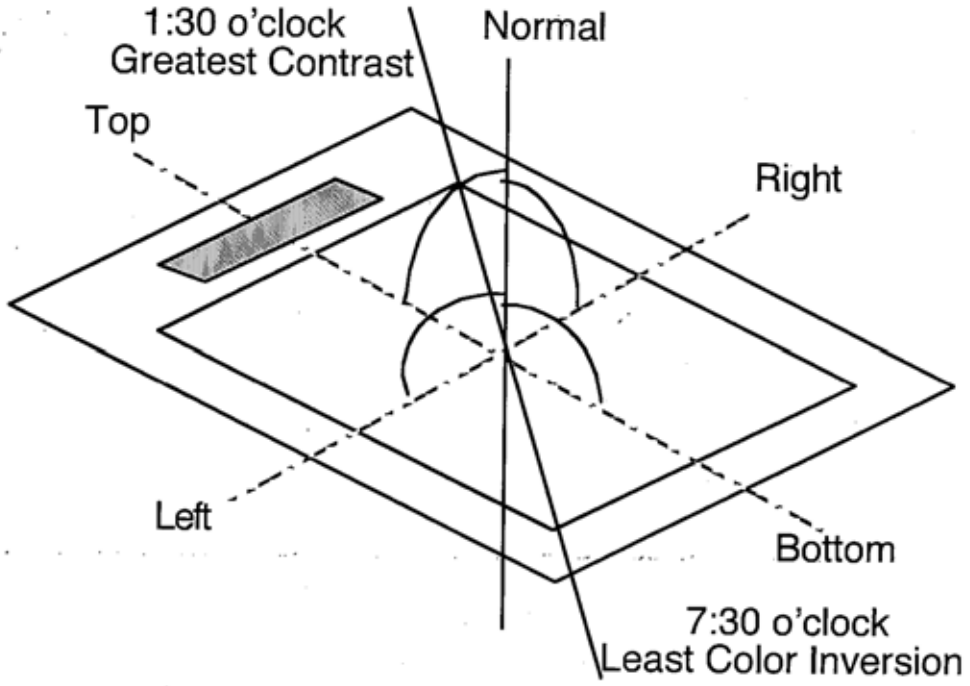


Figure12. Definition for viewing angle

[Note10-2] Definition of contrast ratio:

The contrast ratio is defined as follows:

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

[Note10-3] A measurement device is Minolta CM-2002.

[Note10-4] 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".

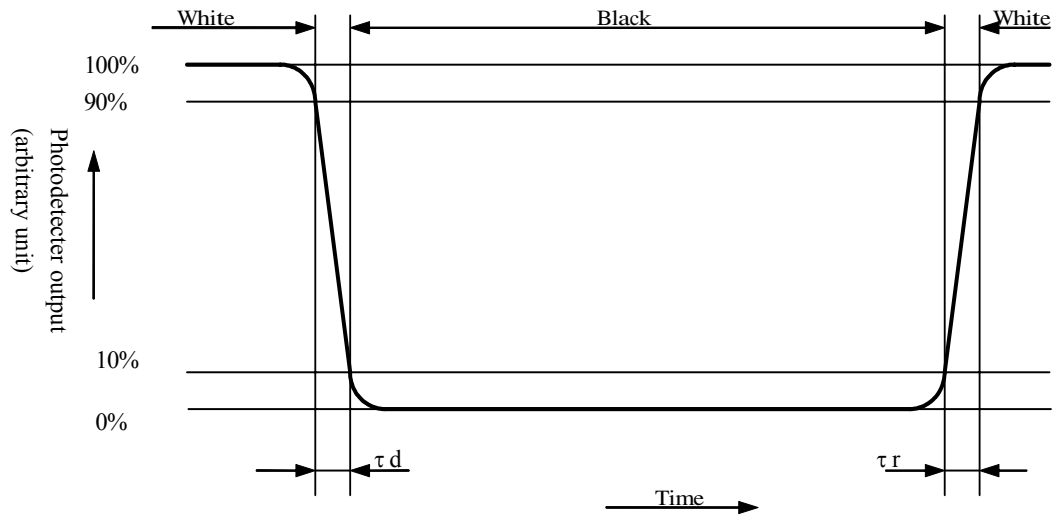


Figure13. Response Time Diagram

[Note10-5] Definition of reflection ratio

$$\text{Reflectivity} = \frac{\text{Light level of reflection from display with all white pixels}}{\text{Light level of reflection from reflective standard}}$$

[Note10-6] Definition of Brightness & Brightness Uniformity

$$\text{Brightness Uniformity} = \frac{\text{Minimum Luminance for any of the 9 points with all white pixels}}{\text{Maximum brightness for any of the 9 points with all white pixels}} \times 100(\%)$$

The brightness should be measured on 13spots of the display as follows.

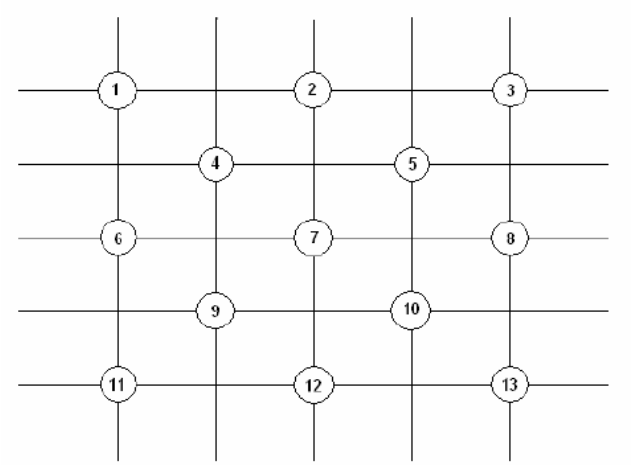


Figure14. Brightness measurement points

[Note10-7] Flicker

The Flicker level is measured with horizontal stripes with every other line black and middle gray(V31).

And , Flicker is measured in the center of the active area of the LC display.

The flicker is the ratio of the power in the frequency spectrum at 30Hz(Px) to the power at 0Hz(P0) in percent:

$$\text{Flicker} = \frac{\text{The power in the frequency spectrum at 30Hz (Px)}}{\text{The power in the frequency spectrum at 0Hz (P0)}} \times 100\%$$

The frame frequency of the panel is set to 60Hz and VDD is set to 3.0V.

[Note10-8] Cross-Talk

To perform crosstalk measurement, two luminance values are measured at the center spot with 50×50 pixels.

The cross-talk, D_{SHA}, is defined as:

$$D_{SHA} = \left(\frac{(L_B - L_A)}{L_B}\right) x100\%$$

Where, L_A = Luminance in Pattern A

L_B = Luminance in Pattern B.

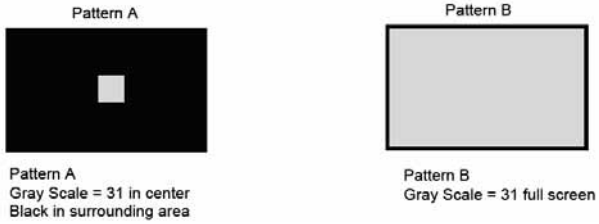


Figure15. Cross-talk measurement

(11)Display quality

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

(12)Mechanical characteristics

12-1) External appearance

See Drawing No.LDM-03336A

12-2) FPC bending characteristics

(1)Specific connector

CPB7324-0250F (SMK)

(2)Bending endurance of the bending slits portion

This FPC guarantees the folding number of times in each place.

Bend Area A : +90° ～-90° 3 cycles

Bend Area B : +180° ～0° 3 cycles

Bend Area C : +90° ～-90° 3 cycles

Must not bend it except for three territories.

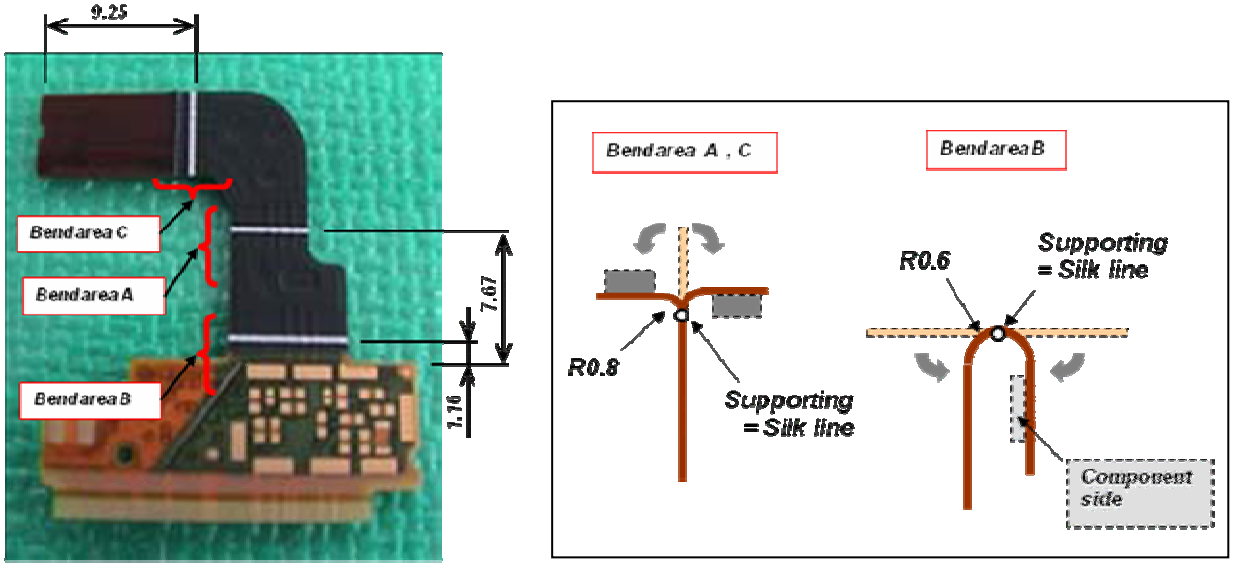


Figure16. FPC bending Area (A,B,C)

(13)Handling Precautions

13-1) 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.

13-2) 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.

13-3) 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.

13-4) 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.

13-5) 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.

(14) Reliability Test Conditions for CGS TFT-LCD Module

Table 17. Reliability Test Conditions

No.	Test items	Test conditions	
1	Low Temperature Storage Test	Ta=－30℃	240h
2	High Temperature Storage test	Ta=+80℃	240h
3	High Temperature and High Humidity Storage Test	Ta=+60℃ , 90%RH	240h
4	Thermal Shock Storage Test	Ta=－30℃:15min～80℃:15min	50cycles
5	Low Temperature Operating Test	Ta=－20℃	240h
6	High Temperature Operating Test	Ta=+70℃	240h
7	High Temperature and High Humidity Operating Test	Ta=+50℃ , 90%RH	240h
8	Four Corner Test	Ta=+50 10%RH, Ta=+50℃ 90%RH Ta=+10 10%RH, Ta=+10℃ 90%RH	72h
9	Electrostatic Discharge Test	250V 200pF,(MM method)1 time for each terminal including EEPROM programming test point	
10	Shock Test	At least 5000G in a half sine pulse of 0.50+/－0.20ms at each 6 sides (MIL-STD-202F Method 213B,test condition A)	
11	Vibration Test	3G from 5-500Hz random for 30 minutes (MIL-STD-202F , method A)	

【Note】Ta = Ambient temperature

【Check items】Test No.1～11 ：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 printed in the position shown in Drawing No.LDM-03336A. (Outline Dimensions).

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

Substances with the object of regulating : CFCS, Carbon tetrachloride.
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.

(16) Forwarding form

a) Piling number of cartons : 8deep

b) Package quantity in one cartons : 320 (pcs)

c) Carton size : (w) 525×(D) 360×(H) 225 (mm)

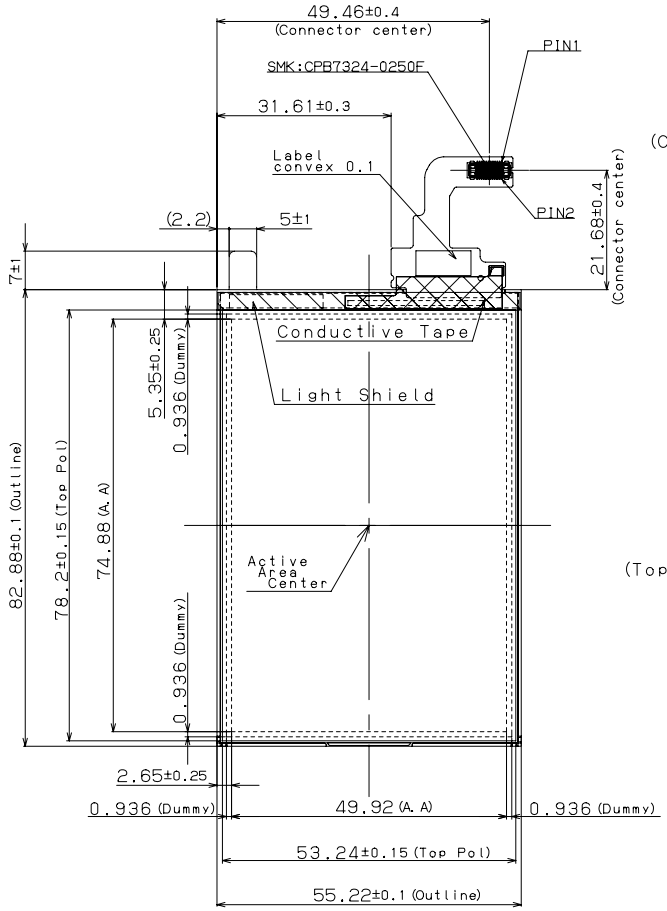
d) Total mass of 1 carton filled with full modules : approximately9.8 (Kg)

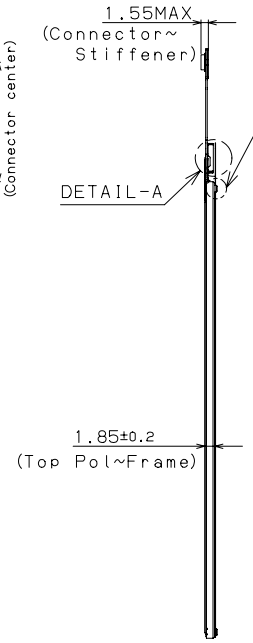
Conditions for storage

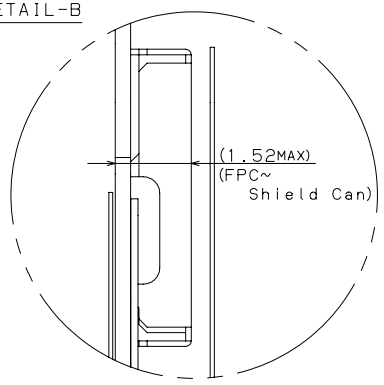
Environment

(1)Temperature	: 0～40℃
(2)Humidity	: 60%RH or less (at 40℃) 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.

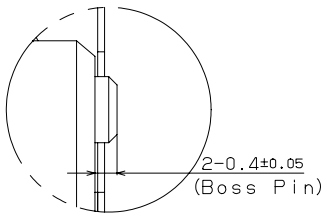
SHARP



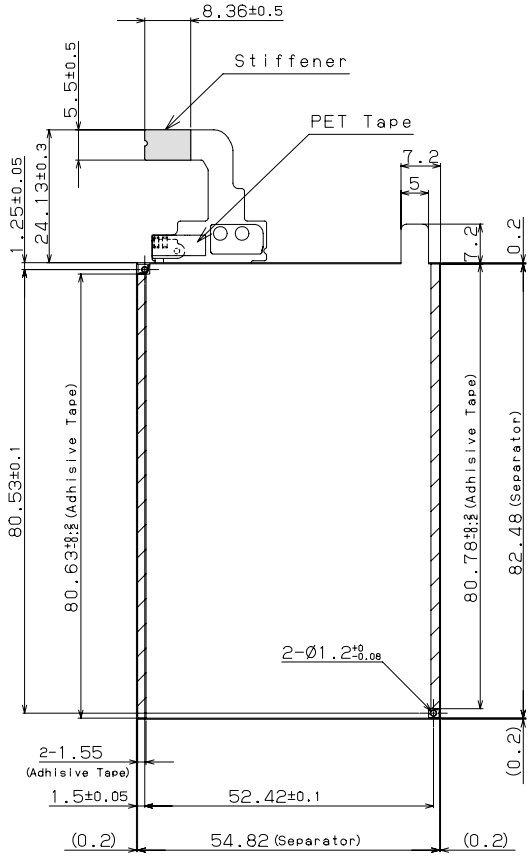




DETAIL-A
(S=10/1)



DETAIL-B
(S=10/1)



CONFIDENTIAL
TENTATIVE

- The light of Back Light is leaking from Guarantee of appearance outside, please light shielding by the set.
- Guarantee of appearance = LCD Active Area +0.8mm all around.
- 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.
- General tolerance is ±0.5mm
- LCD-FPC bend radius: Min. 0.6mm
- The tolerance of module width are exclude warp of case.

7							
6							
5							
4							
3							
改訂日		改訂記事 REVISION				担当	
設計 DESIGNER	製図 DRAFTER	検図 DSN CK	検図 DSN CK	承認 ENG APPD	シャープ株式会社		
Y. TAKAO	Y. KINOSHITA	H. KAWAGUCHI			MB液晶第2事業本部 第1開発部		
					SHARP CORPORATION		

ORIGINAL MODEL	LS035******
画面サイズ ACTIVE AREA SIZE	90.0(3.54")
	P0.156mm 320RGBx480
尺度 SCALE 1/1	日付 DATE 2008.07.03.
単位 Unit mm	名称 NAME 3.54 LCD Moduel Outline
	ユーザー USER For Standard
原紙サイズ A3	図番 DRAWING NO LDM-03336A