TFT-Display Datenblatt

Modell LB043WV2-SD01

Kurzdaten

Hersteller	LG Display
Diagonale	4,3” / 10,9cm
Format	15:9
Auflösung	800x480
Backlight	LED / 600cd/m²
Interface	RGB
Touchscreen	nein
Temperatur	-30…+85°C (Betrieb)

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Product Specification

SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(●) Final Specification

Title	LB043WV2-SD01

BUYER	*open market*
MODEL	*Industrial*
CUSTOMER P/N	-

SUPPLIER	*LG Display Co.,Ltd.*
MODEL	*LB043WV2*
SUFFIX	*SD01*

공급 업체 승인	구분	검토자	확인자	승인자
	소속/성명	LGD / 김종윤Y	LGD / 구태훈SY	LGD / 홍순걸SS
	서명		2012. 3. 14	2012 3. 14

하기 부품에 대해 승인원의 내용을 보증합니다.

Revision History

Revision	Date	Contents of Revision Change	Remark
1.0	12.03.14	Specification Release	All pages

Table of Contents

◈ *Caution & Handling Precaution*

- ▶ *Safety*
- ▶ *Installation in Assembly*
- ▶ *Transportation and Storage*

1. General Description

The **LB043WV2-SD01** *model is a Color TFT(Main) LCD supplied by LG Display.*
This Module has a **4.3 inch** *diagonally measured active display area with 480(RGB)X800 resolution.*
Each pixel is divided into Red, Green and Blue sub-pixels and dots which are arranged in vertical stripes.

The LCD color is determined with 16.7M colors signal for each pixel.
The **LB043WV2-SD01** *has been designed to apply the interface method that enables low power, high speed, and high contrast.*
The **LB043WV2-SD01** *is intended to support applications where thin thickness, wide viewing angle and low power are critical factors and graphic displays are important.*

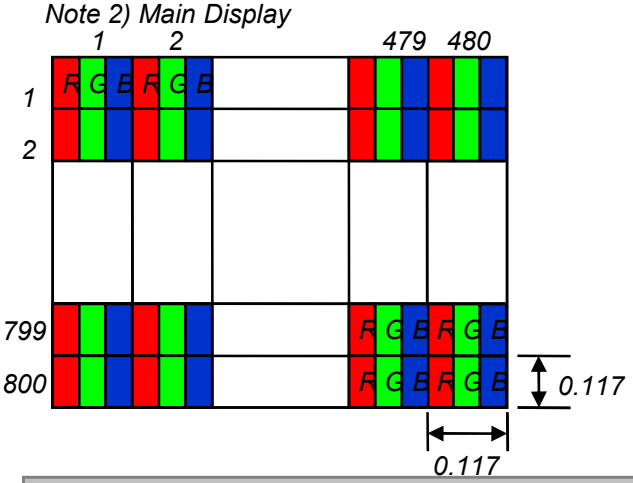
2. General Features

Item	Main Display	Remark
Display Mode	Normally Black, Transmissive	
Viewing Direction	Wide View Angle	
Driving Method	a-si TFT Active Matrix	
Inversion Type	Column Inversion	Note1
Input Signals	24Bit RGB I/F	
Outside Dimensions	60.06mm(W) × 102.87mm(H) × 1.95mm(D)	
Active Area	56.16mm(W) × 93.6mm(H)	
Number of Pixels	480× RGB× 800 Pixels	Note 2)
Pixel Pitch	0. 117mm × 0.117mm (217ppi)	Note 2)
Pixel Arrangement	RGB Vertical stripes	Note 2)
Drive IC	LG4572B 22.35(H) × 1.45(V) × 0.25(D)	
Weight	32g	

Note 1)

Available Column, 1-dot, 2-dot inversion

Note 2) Main Display



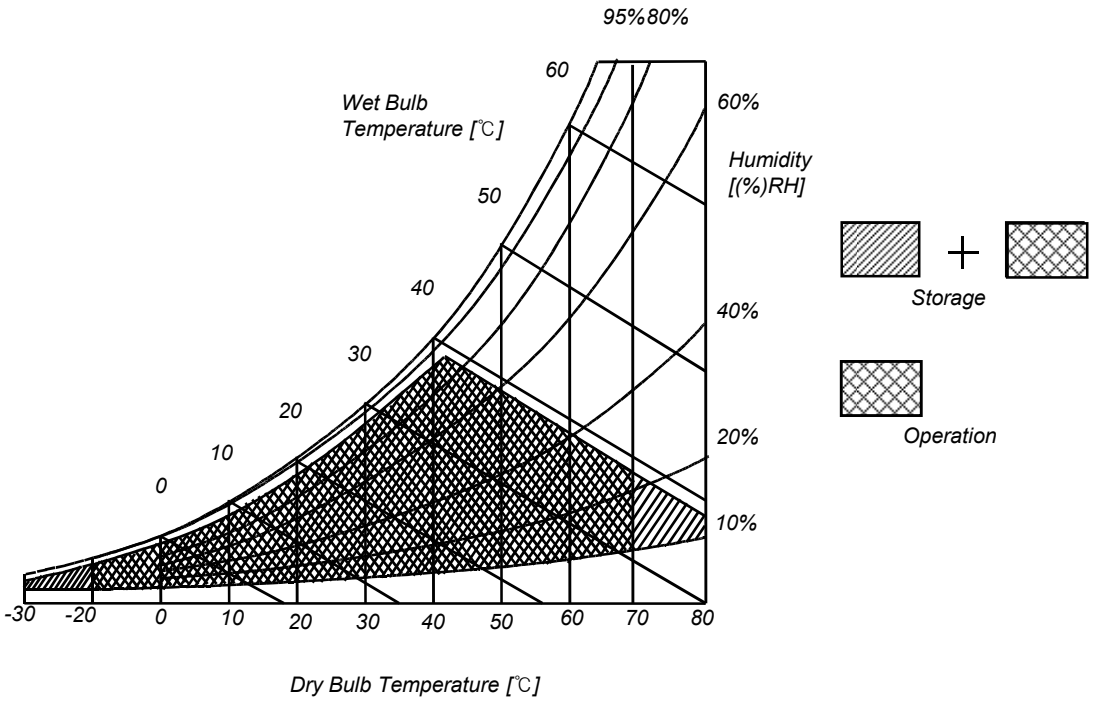
3. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause operation or damage to the unit.

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power for Analogue Circuit	Vcc	-0.3	2.8	3.3	V	VCC
Power for Logic Circuit	IOVcc	-0.3	1.8	3.3	V	IOVCC
LED Forward Current	I_F	-	20	25	mA	Per LED
LED Reverse Voltage	V_R	-	-	5	V	Per LED
LED Permissible Loss	P_D	-	-	120	mW	Per LED
Storage Humidity	Hstg	10	-	90	%RH	Note 1), 2)
Storage Temperature	T_{STG}	-30	-	80	°C	Note 1), 2)
Operating Ambient Humidity	H_{OP}	10	-	90	%RH	Note 1), 2)
Operating Ambient Temperature	T_{OP}	-20	-	70	°C	Note 1), 2)

Note 1) Temp. ≤ 60℃ , 90% RH MAX.
Temp. > 60℃ , Absolute humidity shall be less than 90% RH at 60℃.

Note 2) The diagram below indicates the peripheral environment of the module.
The wet bulb temperature should be kept under 39 °C and there should be no compensation.
If the LSI is used above these absolute maximum ratings, it may become permanently damaged.



4. Electrical Specification

4.1. Main Display

(Ta=25℃)

Properties		Sym.	Min	Typ.	Max	Unit	Note
Power for VDD Generation		VCC	2.6	2.8	3.3	V	
Power for Logic Circuit		IOVCC	1.65	1.8	3.3	V	
Power for Analog Circuit		VCI	2.6	2.8	3.3	V	
Power for BLU Driving		VBAT	-	3.3	-	V	20mA/LED
Logic Input Voltage		V_{IL}	-0.3	-	0.2× IOVCC	V	
		V_{IH}	0.8× IOVCC	-	IOVCC	V	
I/O Leakage Current		I_{LI}	-1	-	1	μA	
Current Consumption	Normal Display	I_{CI}	-	30	60	mA	Note 3.
	Standby Mode	I_{STB}	-	0.5	1	mA	
	BLU Driving	IBAT	-	40	-	mA	20mA@Chip (2String)
Power Consumption	Normal Display	P_{CI}	-	85	198	mW	Note 3.
	Standby Mode	P_{STB}	-	1.4	3.3	mW	

Note 3)

1. *The recommended operating conditions refers to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be without the absolute maximum ratings.*
   Accordingly, please make sure that the module is used within this range.
   And these current values are measured under the condition that all device are stopped, each component is stable and logic signal is input.

2. *All the unused input terminals have to be connected to VCC or GND. Please select appropriate one which meet the function required by unused terminal.*

3. *Power Consumption*
   1) *Display IC standstills while LCD is in the sleep mode.*
      The sleep mode means VCI is supplied and then oscillator off .
      And these values are not peak current but constant current.

   2) *In standby mode, display operation is completely halted and VCC is ON (VBAT is OFF)*

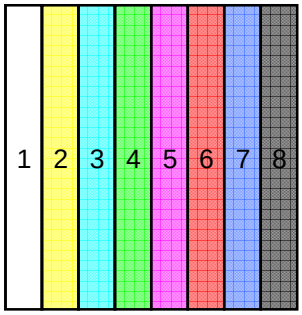
   3) *In standby mode, power consumption measurement is based on 1.8V logic voltage.*

   4) *Input VCC & IOVCC Voltage : 2.8V & 1.8V*
      - Test Equipment : Oscilloscope TDS5104 (Maker : Tektronix)

   5) *Measure the current after set up a current meter on VCI Line.*
      - Test Equipment : Multi-Tester 85III (Maker : FLUKE)
      - Display Tester : WLT-1000A (Using recommend LGD Initial code)
      - Resolving Power : 1/100 mA

   6) *Measure Power Consumption of the display pattern, the "Color-Bar".*
      (These peak value is Black pattern in whole area)

      1. *White*
      2. *Yellow*
      3. *Light blue*
      4. *Green*
      5. *Purple*
      6. *Red*
      7. *Blue*
      8. *Black*



5. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 5 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 500mm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

5.1. Main Display

(T_A = 25 ˚C)

Spec	Parameter	Symbol	Condition	Values			Unit	Notes
				Min	Typ	Max		
With Backlight LED ON	Contrast Ratio	C/R	θ =0˚	700	1,000	-		Fig.1
	Luminance	BP	θ=0˚	450	600	-	cd/m²	Fig.2
	Luminance Uniformity	ΔL	θ =0˚	70	80	-	%	Fig.2
	Response Time	Tr+Tf	θ =0˚	-	40	60	ms	Fig.3
	Viewing Angle	Φ=180˚	CR>10	-	80	-	˚	Fig.4
		Φ=0˚		-	80	-	˚	
		Φ=90˚		-	80	-	˚	
		Φ=270˚		-	80	-	˚	
	CIE Color Coordinate 1931	Wx	θ =0˚	0.270	0.310	0.350		Fig.1
		Wy		0.290	0.330	0.370		
		Rx	θ =0˚	0.600	0.640	0.680		
		Ry		0.298	0.338	0.378		
		Gx	θ =0˚	0.292	0.332	0.372		
		Gy		0.570	0.610	0.650		
		Bx	θ =0˚	0.105	0.145	0.185		
		By		0.010	0.050	0.090		
Color Gamut			θ =0˚	65	70	-	%	

5.2. LED Specification

- *LED Part Name : SWCA07*
- *Maker : SEOUL SEMICONDUCTOR*
- *Luminous Intensity : 2.4~2.6cd, Color Rank : D2S, F2S, LED current value = 20mA (per chip)*

▣ Electro-Optical characteristics

(T_A = 25 ˚C)

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	Rank Z28	V_F	I_F =20mA	2.8	-	3.0	V
	Rank Z30	V_F		3.0	-	3.2	
	Rank Z32	V_F		3.2	-	3.4	
	Rank z30	V_F		3.0	-	3.4	
Reverse Current		I_R	V_R=5V	-	-	50	μA
Luminous Intensity*1	Rank S24H	I_V	I_F =20mA	2400	-	2500	mcd
	Rank S25H			2500	-	2600	
Viewing Angle *2		$2\theta_{1/2}$	I_F =20mA	120			deg.
Life time*3		-	Ta=25℃ I_F = 20mA	15,000	-	-	hr

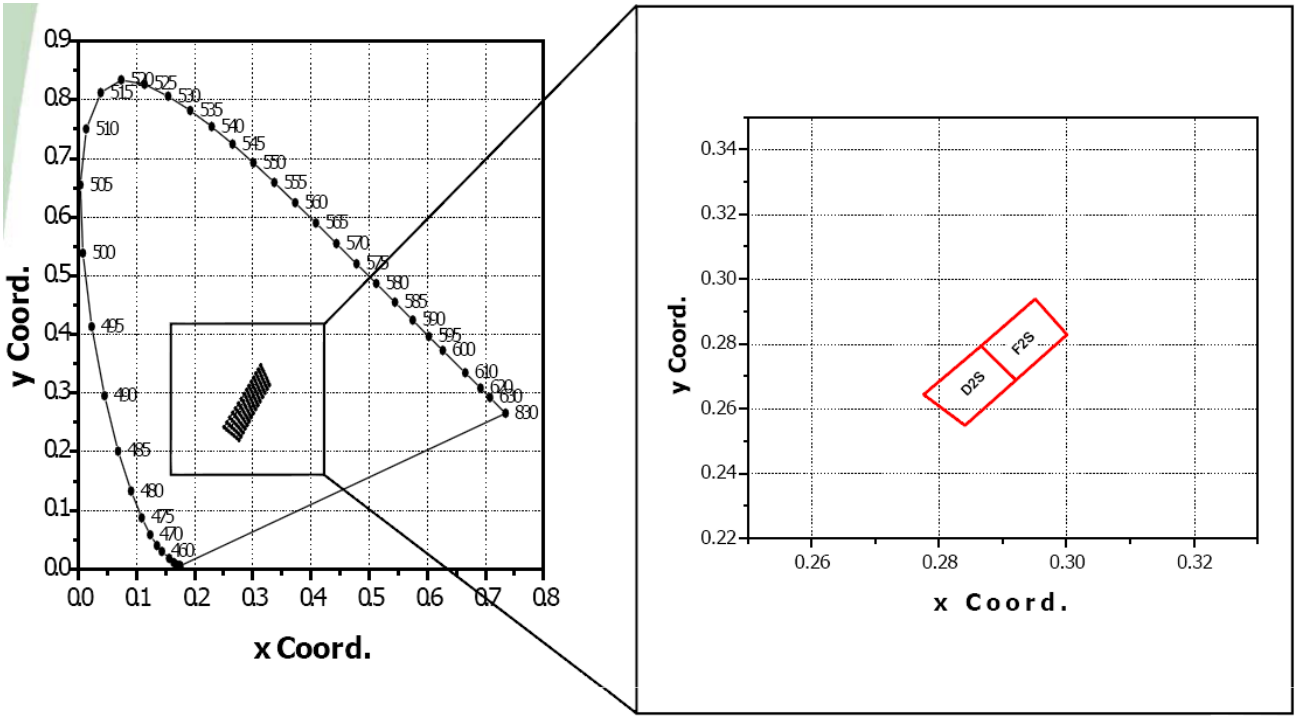
▣ Absolute Maximum Ratings

(T_A = 25 ˚C)

Parameter	Symbol	Value	Unit
Power Dissipation	P_D	*120*	*mW*
Forward Current	I_F	*30*	*mA*
Pulse Forward Current	I_{FM} *2	*100*	*mA*
Reverse Voltage	V_R	*5*	*V*
Operating Temp.	T_{OPR}	*-30 to 85*	*˚C*
Storage Temp.	T_{STG}	*-40 to 100*	*˚C*
Junction Temp.	$T_{J\,max}$	*125*	*˚C*

- *1. Care is to be taken that power dissipation does not exceed the absolute maximum rating of the product.*
- *2. I_{FM} was measured at $T_W \leq 0.1$msec of pulse width and D ≤ 1/10 of duty ratio.*

▣ Color Coordinate of LED



▣ Color Rank

Parameter Symbol		Value Unit	
x	*y*	*x*	*y*
0.2775	*0.2645*	*0.2865*	*0.2795*
0.2865	*0.2795*	*0.2950*	*0.2940*
0.2920	*0.2690*	*0.3000*	*0.2830*
0.2840	*0.2550*	*0.2920*	*0.2690*

** Measurement Uncertainty of the Color Coordinates is ±0.005*

◈ Measurement System

Notes :

1. *Contrast Ratio(CR) is defined mathematically as :*

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

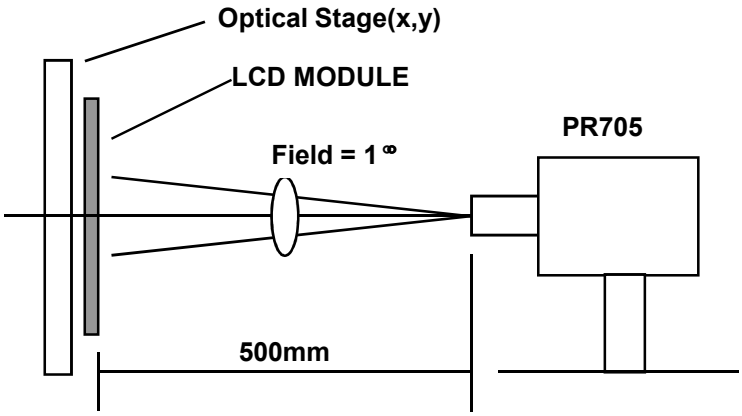
2. *Surface luminance is the center point across the LCD surface 500mm from the surface with all pixels displaying white. For more information see FIG 1.*

3. *Response time is the time required for the display to transition from white to black (Rising Time, Tr) and from black to white (Falling Time, Tf). For additional information see FIG 3.*

4. *Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.*

FIG. 1 Optical Characteristic Measurement Equipment and Method

▶ Test procedure



<Transmissive Mode>

- *Measurement System (Test Procedure) With backlight turned on*
- *Measuring Instrument: PR705 made by PHOTO RESEARCH*
- *Measuring Field : 1°*
- *Environment: Inside a darkroom*

Fig. 2 Measurement Points for Luminance

▶ *Luminance Uniformity*

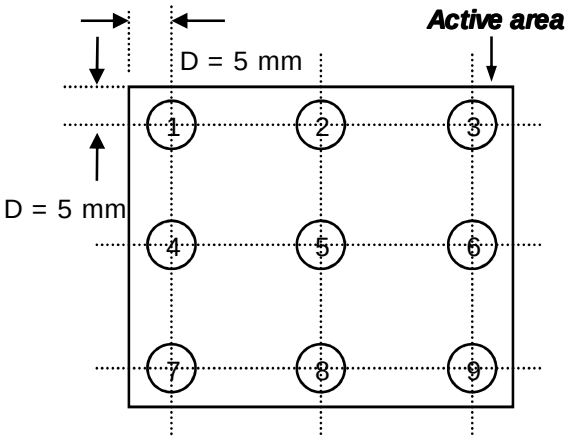
*Use FIG.1(Test Procedure) under Measurement System with the backlight turned on, the luminance uniformity should be obtained from the next expression, when white raster (white : gradation level L63) is displayed: (* LED Current = 20mA@Chip)*

Luminance Uniformity = Lmin / Lmax X100 (%)

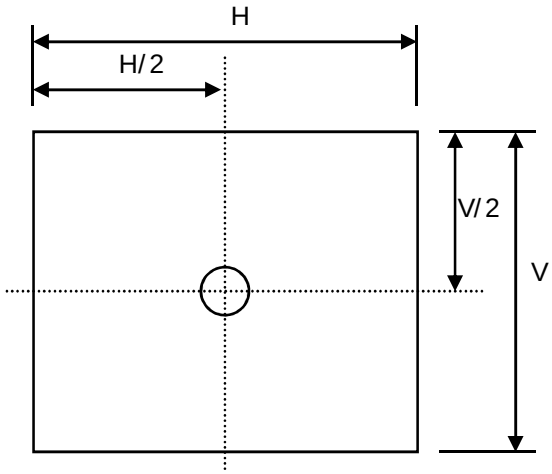
, Lmin = Minimum luminance point
Lmax – Maximum luminance point

▶ *Luminance*

Use FIG.1(Test Procedure) under Measurement System with the backlight turned on to measure the luminance when white raster (white: Gradation level L63) is displayed.



<Measuring point for luminance uniformity>



<Measuring point for luminance>

FIG. 3 The 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".

Response Time = Rising Time(Tr) + Falling Time(Tf)
- Rising Time(Tr) : Full White 10% → Full White 90% Transmittance.
- Falling Time(Tf) : Full White 90% → Full White 10% Transmittance.

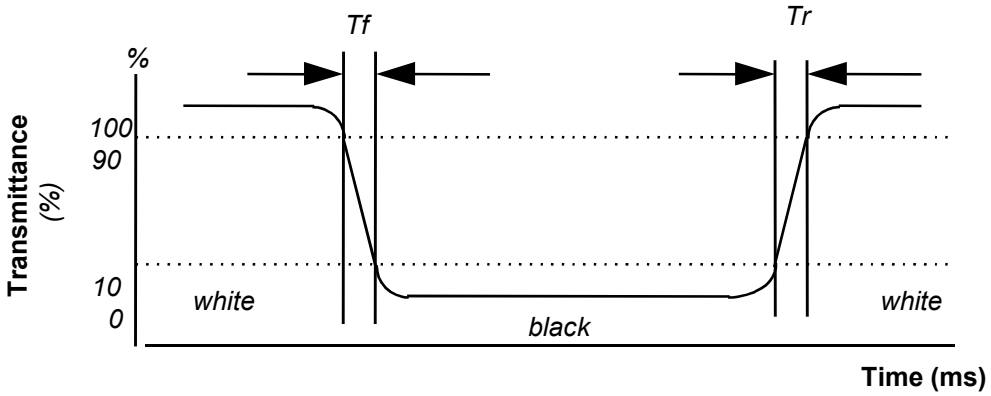
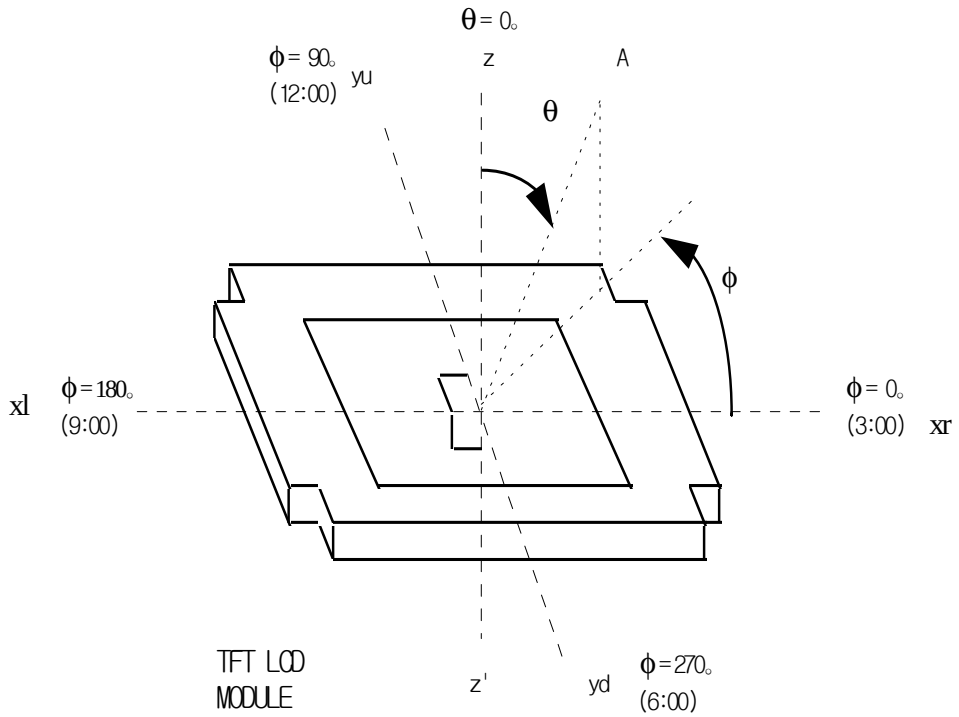


FIG. 4 The Definition of Viewing Angle

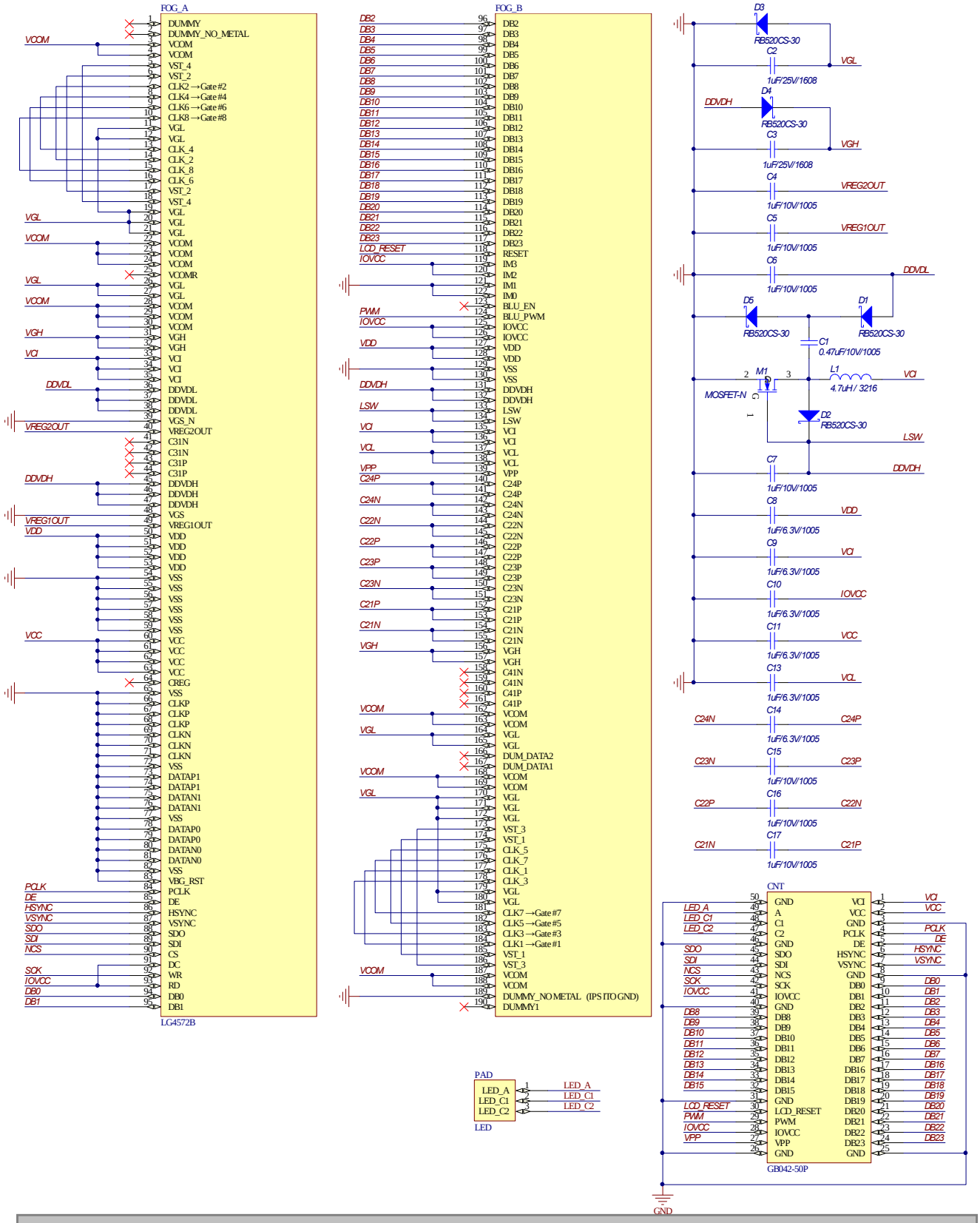
Use Fig. 1(Test Procedure) under Measurement System to measure the contrast from the measuring direction specified by the conditions as the following figure.

<dimension of viewing angle range>



6. Schematic

6.1 Main FPCB



7. Part List

7. 1. Module Part List

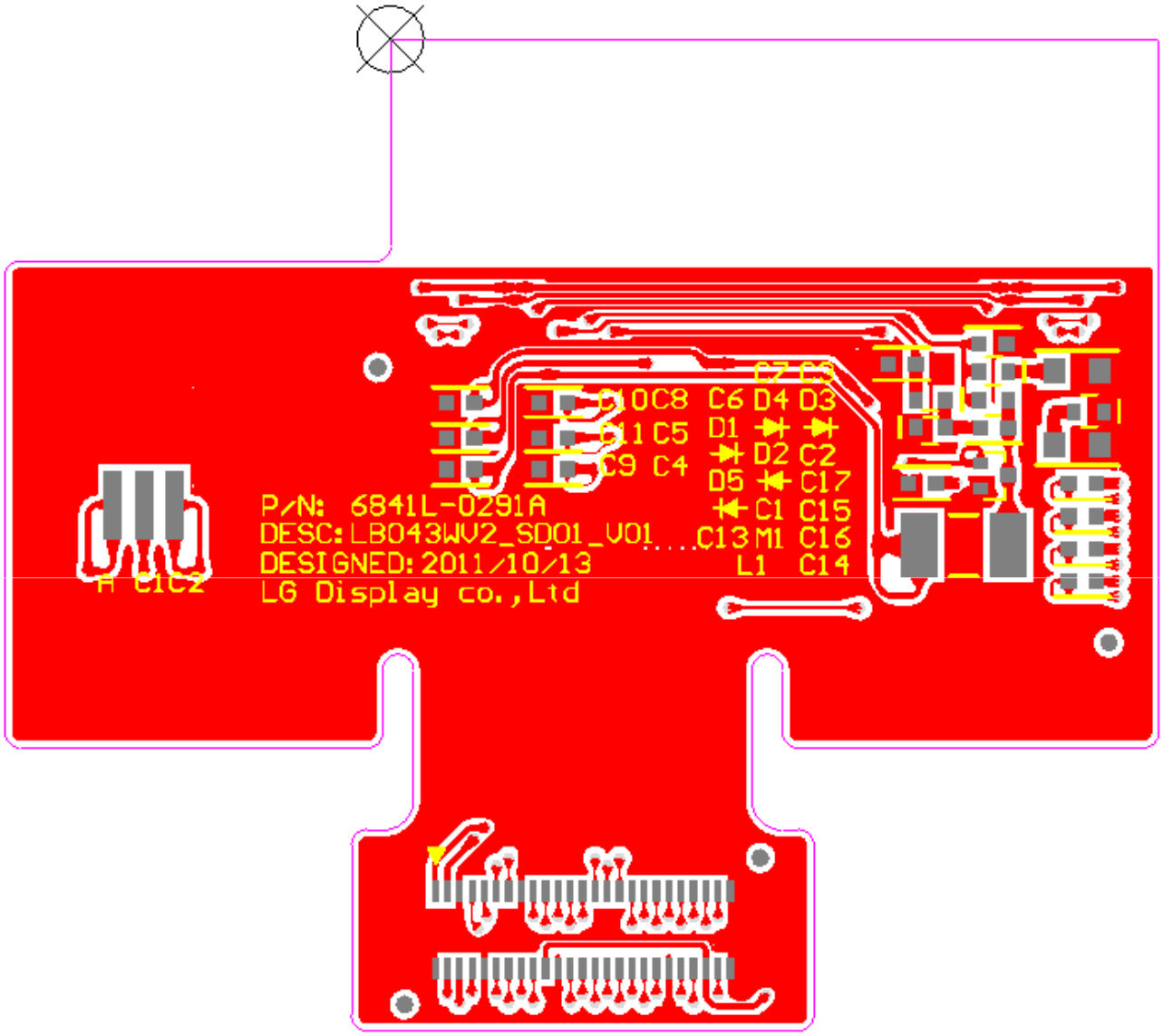
No	Part Name	Specification	Maker	EA	Note
1	PANEL	4.3" WVGA (480*800) IPS	LGD	1	
2	LDI	LG4572B	LGE SIC	1	
3	UPPER POL	58.56× 95.8× 0.135t, ARC + Haze 44%	Nitto	1	
4	LOWER POL	58.56× 96.35× 0.135t, Haze 13%	Nitto	1	
5	ACF (COG)	2mm/1Roll	Sony,Hitachi	-	
6	ACF (FOG)	1mm/1Roll	Sony, Hitachi	-	
7	UV	QREN-S595	Quleap	-	
8	FPCB	0.15T 2-Layer	Newflex	1	
9	AG DOT	NSP-B500	나노테크	-	
10	BLU	LB043WV2-SD01 BLU (1-Way, 10-LED, Insert mold)	KJP	1	
11	Insulation Tape	36.5× 12× 0.063	서브원	1	
12	Remove Tape	12× 6× 0.17	서브원	1	

7. 2. SMT Part List on FPCB

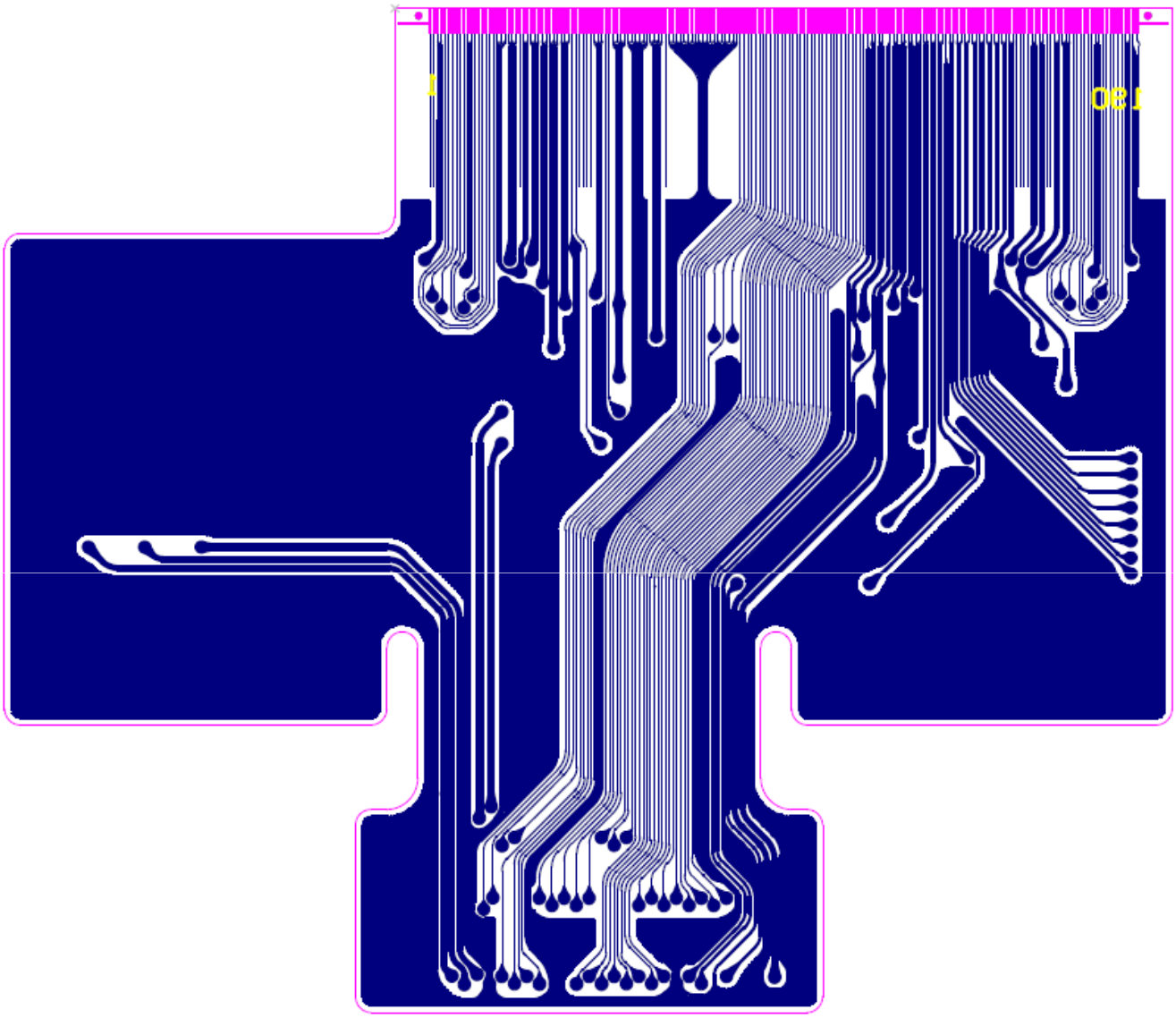
No	Part Name	Specification	Maker	EA	Note
1	CHIP CAPACITOR	0.47uF, 10V, 1005	삼성전기 /태양유전 /Murata/TDK /AVX_Kyocera /STC	1	C1
2		1uF, 25V, 1608, 0.55T		2	C2, C3
3		1uF, 10V, 1005		7	C4~C7, C15~C17
4		1uF, 6.3V, 1005		7	C8~14
5	SCHOTTKY DIODE	RB520CS-30	ROHM/LRC	5	D1 ~ D5
6	INDUCTOR	4.7uH / 3216	삼화	1	L1
7	N-MOSFET	RUM003N02GT2L	ROHM	1	M1
8	CONNECTOR	50Pin [Plug] : GB042-50P-H10-E3000	LS엠트론	1	J1

8. FPCB Layout

8.1. Main Top Layer

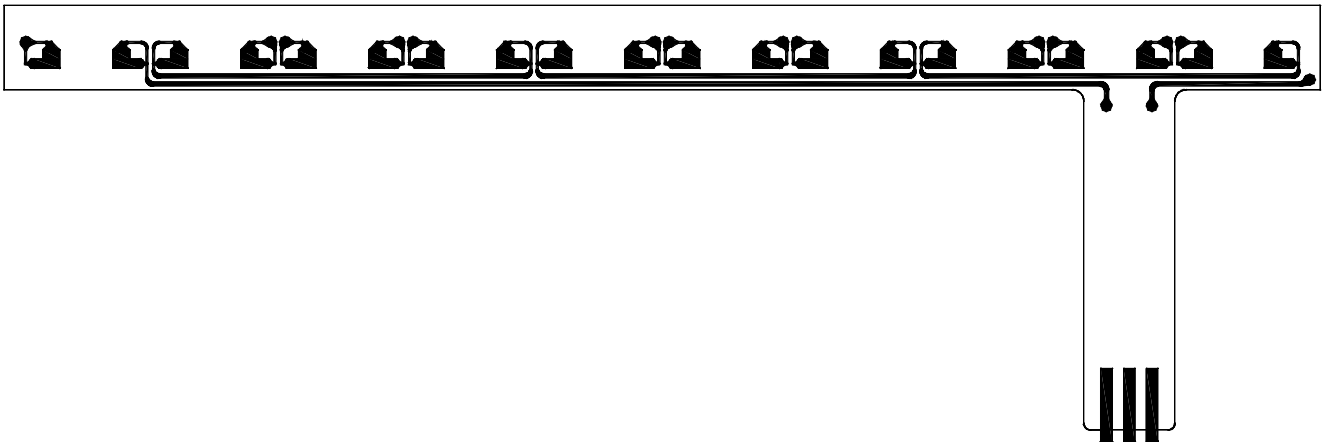


8.2. Main Bottom Layer

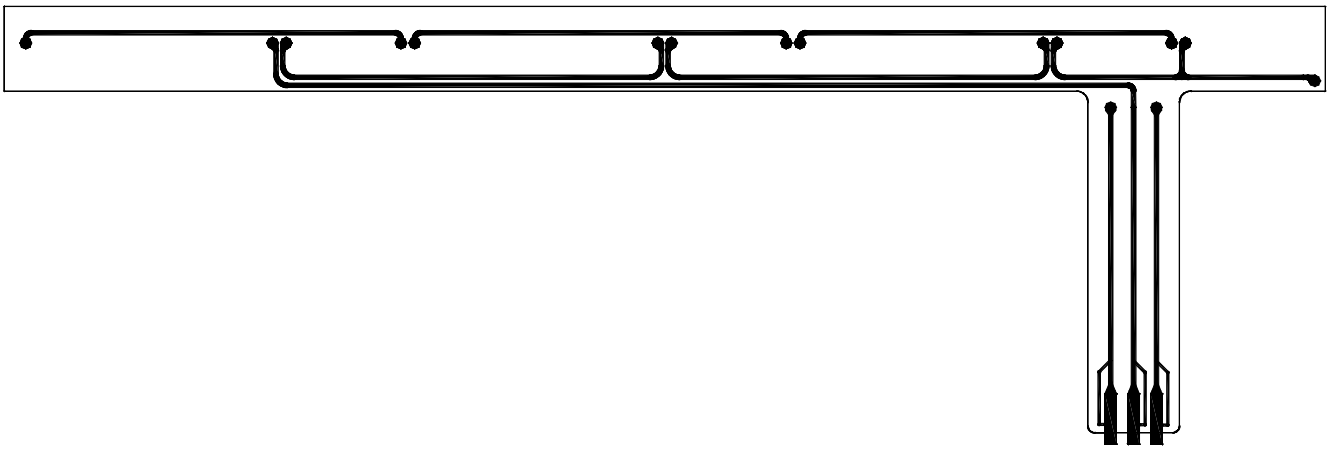


8.3. BLU LED Layer

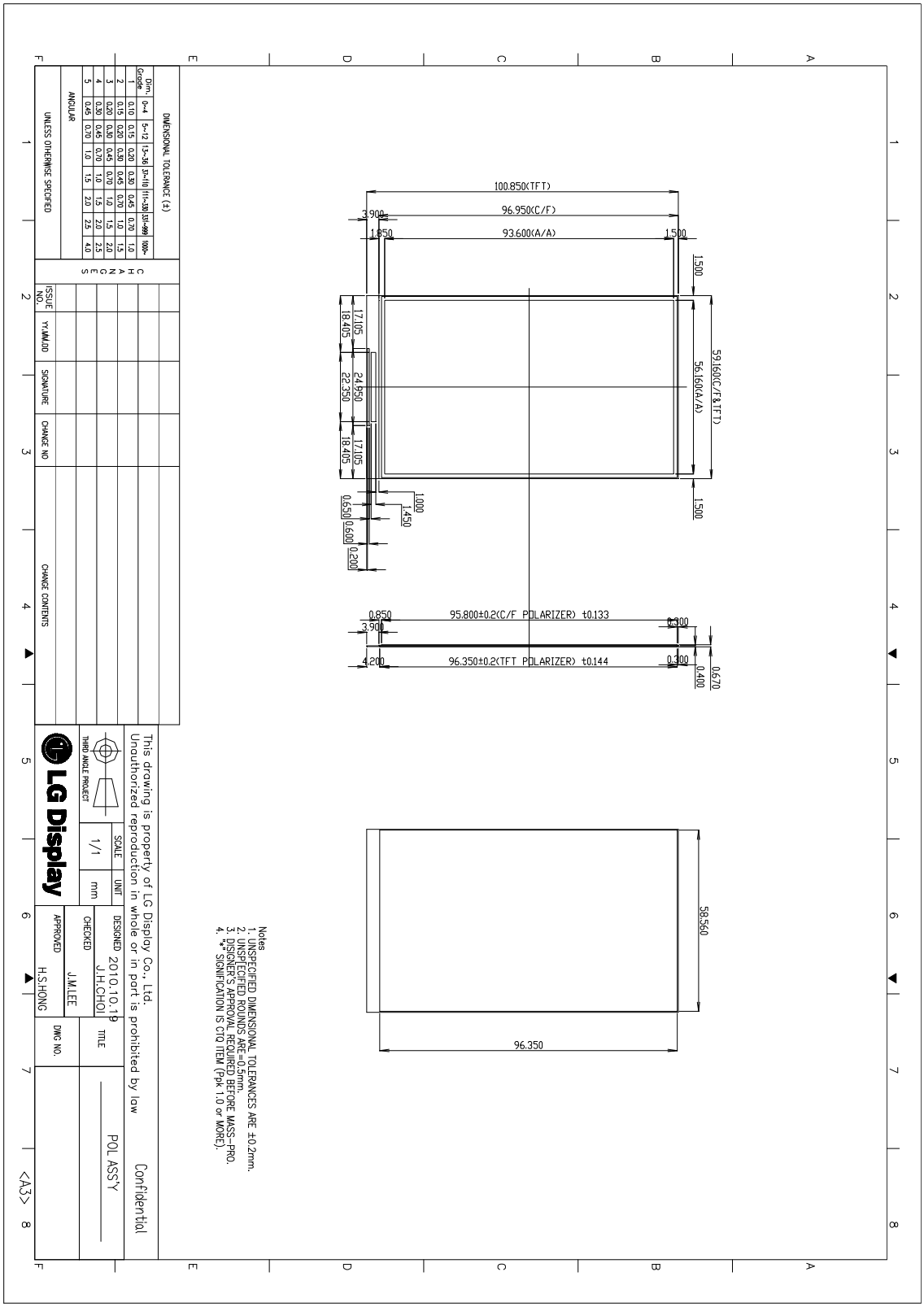
8.3.1 Top Pattern



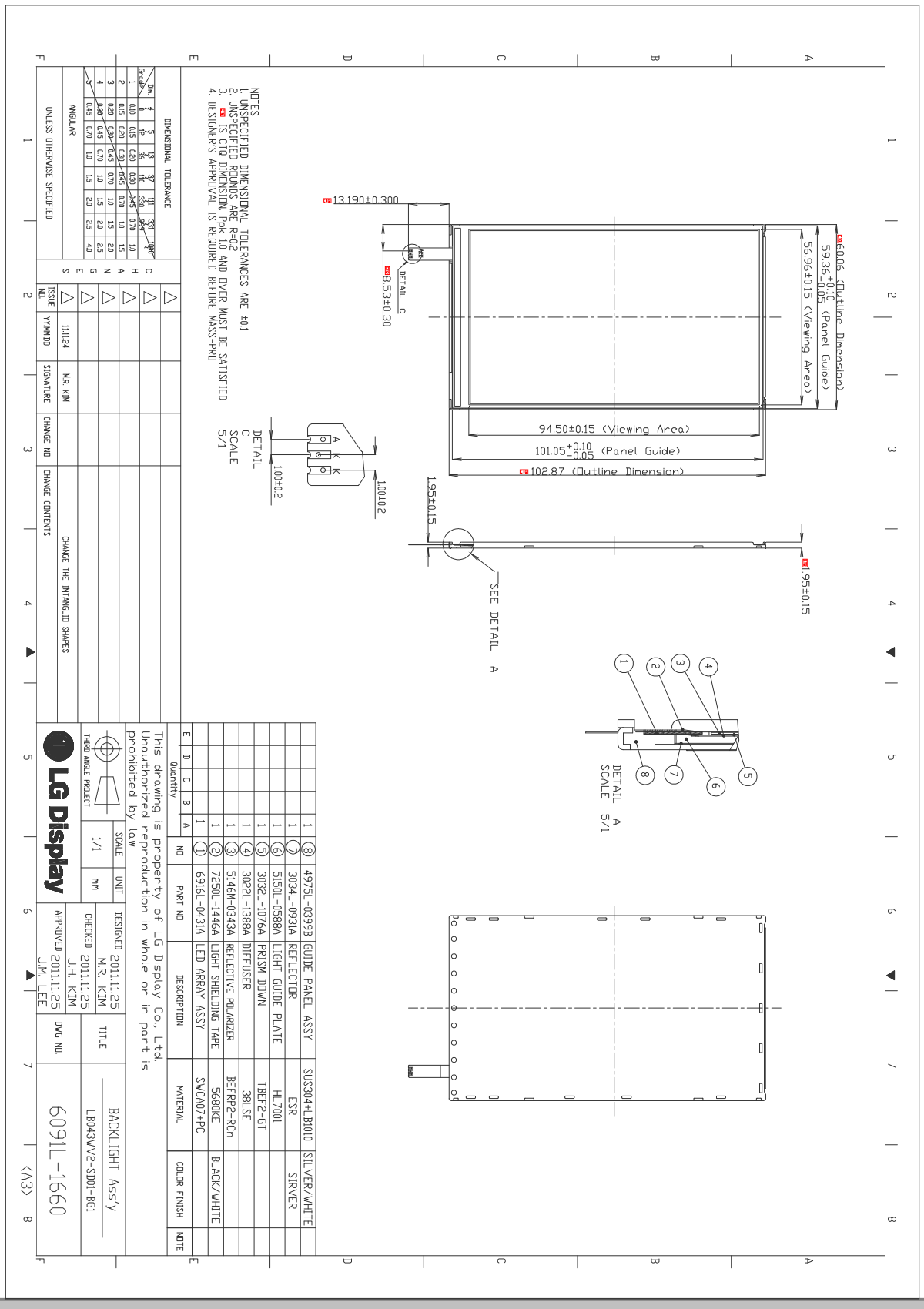
8.3.2 Bottom Pattern



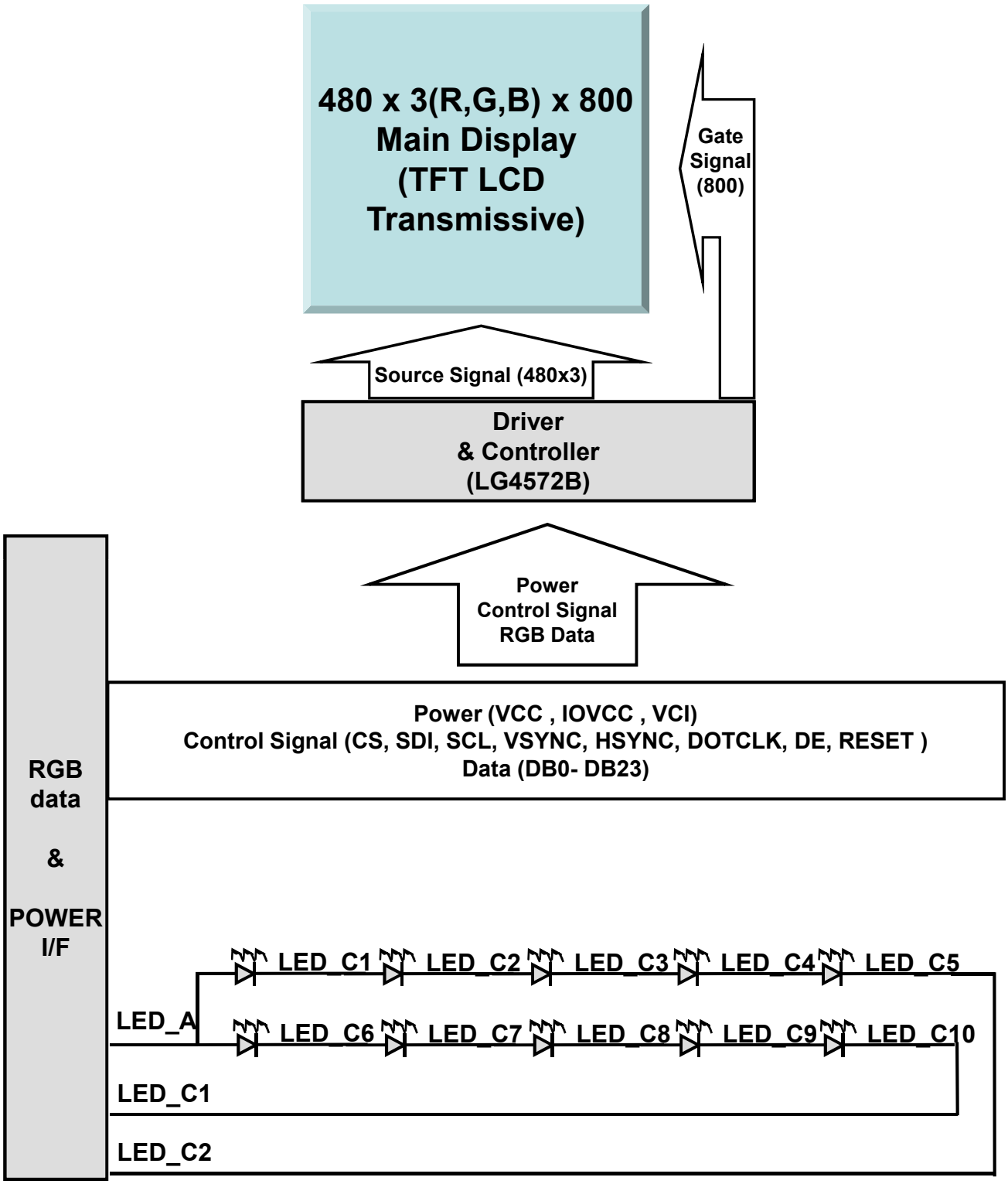
9. Panel Layout



10. BLU Layout



11. Block Diagram



12. Pin Description

12.1. Input Signal and Power

-. Connector : 50Pin B to B → GB042-50P-H10-E3000 (Maker : LS Mtron)

Pin No.	Symbol	Description	Remark
1	VCI	I	Power supply for internal analog circuits
2	VCC	I	Power supply for internal regulator circuits
3	GND	-	Ground
4	PCLK	I/O	Pixel Clock
5	DE	I/O	Data Enable
6	HSYNC	I/O	Horizontal Sync
7	VSYNC	I/O	Vertical Sync
8	GND	-	Ground
9	DB0	I/O	DATA BUS
10	DB1	I/O	DATA BUS
11	DB2	I/O	DATA BUS
12	DB3	I/O	DATA BUS
13	DB4	I/O	DATA BUS
14	DB5	I/O	DATA BUS
15	DB6	I/O	DATA BUS
16	DB7	I/O	DATA BUS
17	DB16	I/O	DATA BUS
18	DB17	I/O	DATA BUS
19	DB18	I/O	DATA BUS
20	DB19	I/O	DATA BUS
21	DB20	I/O	DATA BUS
22	DB21	I/O	DATA BUS
23	DB22	I/O	DATA BUS
24	DB23	I/O	DATA BUS
25	GND	-	Ground

Pin No.	Symbol	Description	Remark
26	GND	-	Ground
27	VPP	I	OTP(Open, only use for LCD)
28	IOVCC	I	Power supply for internal logic circuits
29	PWM	O	Backlight Control (CABC)
30	LCD Reset	I	Reset Control
31	GND	-	Ground
32	DB15	I/O	DATA BUS
33	DB14	I/O	DATA BUS
34	DB13	I/O	DATA BUS
35	DB12	I/O	DATA BUS
36	DB11	I/O	DATA BUS
37	DB10	I/O	DATA BUS
38	DB9	I/O	DATA BUS
39	DB8	I/O	DATA BUS
40	GND	-	Ground
41	IOVCC	I	Power supply for internal logic circuits
42	SCK	I	Serial Clock (SPI)
43	NCS	I	Serial Chip Select
44	SDI	I	Serial Data Input
45	SDO	O	Serial Data Output
46	GND	-	Ground
47	LED_Cathode	I	LED Cathode connection
48	LED_Cathode	I	LED Cathode connection
49	LED_Anode	I	LED Anode connection
50	GND	-	Ground

12.2. Relation between Input Signal and Color

COLOR	DISPLAY	DATA SIGNAL																								GARY SCALE LEVEL
		RED								GREEN								BLUE								
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	
BASIC COLOR	BLACK	0	0	0	0	0	0	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	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
	.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	.	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253
	LIGHT	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	G1
	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	G2
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	.	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	G253
	LIGHT	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	B1
	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	B2
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252
	.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	B253
	LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	B254
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B255

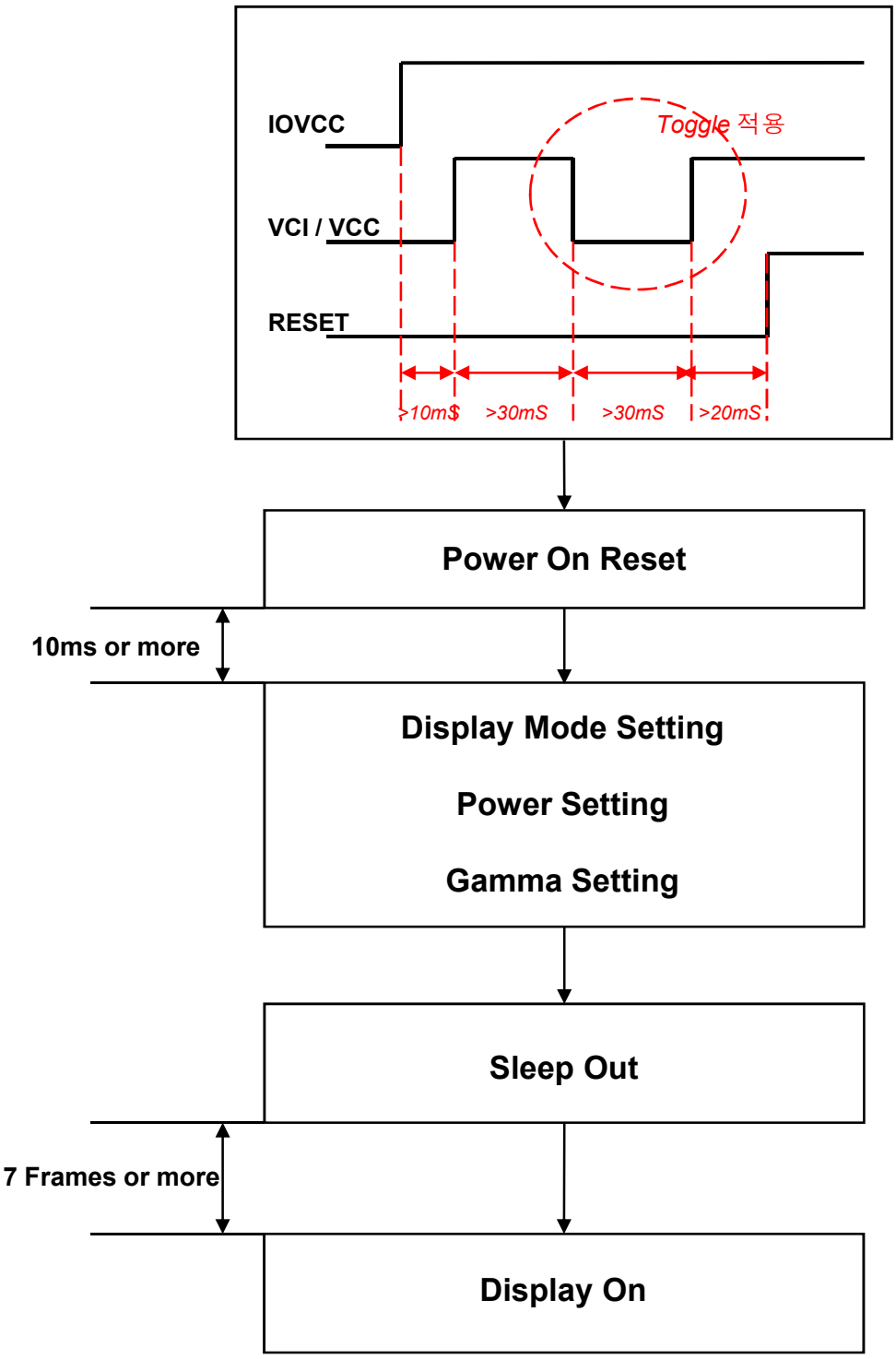
Note) Gray definition

Rn : RED Gray, Gn : GREEN Gray, Bn : BLUE Gray (n = Gray Level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

13. Register Values

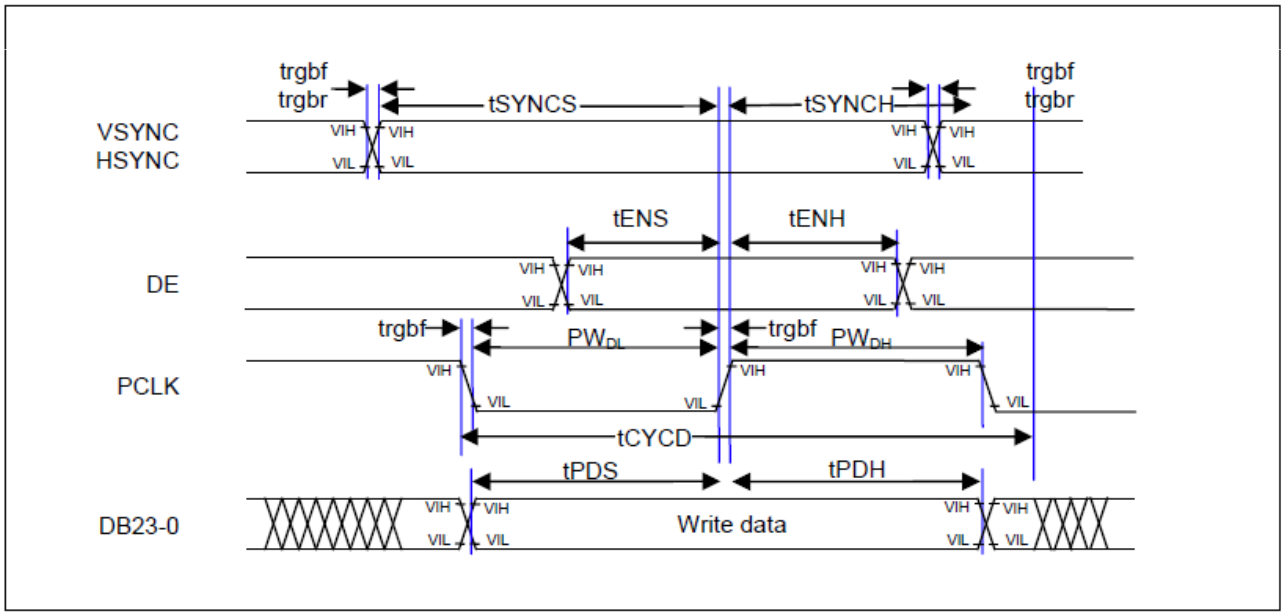
13.1 Flow Chart



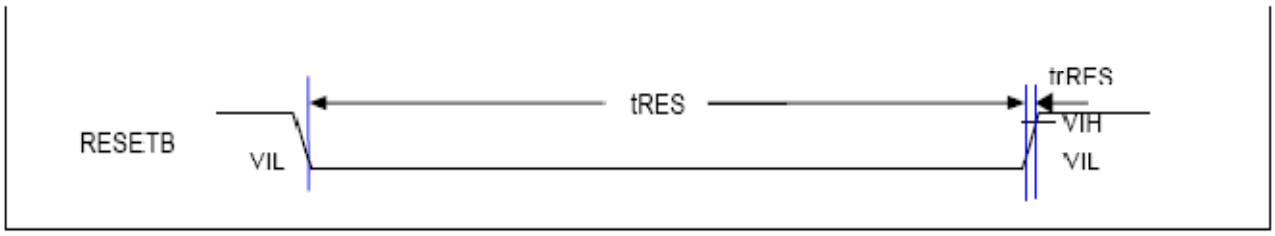
14. Timing Characteristics

14.1. RGB I/F Characteristics

Item	Symbol	Unit	Min	Typ	Max
VSYNC/HSYNC setup time	tSYNCS	ns	10	-	-
VSYNC/HSYNC hold time	tSYNCH	ns	10	-	-
DE setup time	tENS	ns	10	-	-
DE hold time	tENH	ns	10	-	-
PCLK "Low" level pulse width	PWDL	ns	20	-	-
PCLK "High" level pulse width	PWDH	ns	20	-	-
PCLK cycle time	tCYCD	ns	40	-	-
Data setup time	tPDS	ns	10	-	-
Date hold time	tPDH	ns	10	-	-
PCLK, VSYNC, HSYNC, DE rise/fall time	trgbr, trgbf	ns	-	-	13



14.2. Reset operation

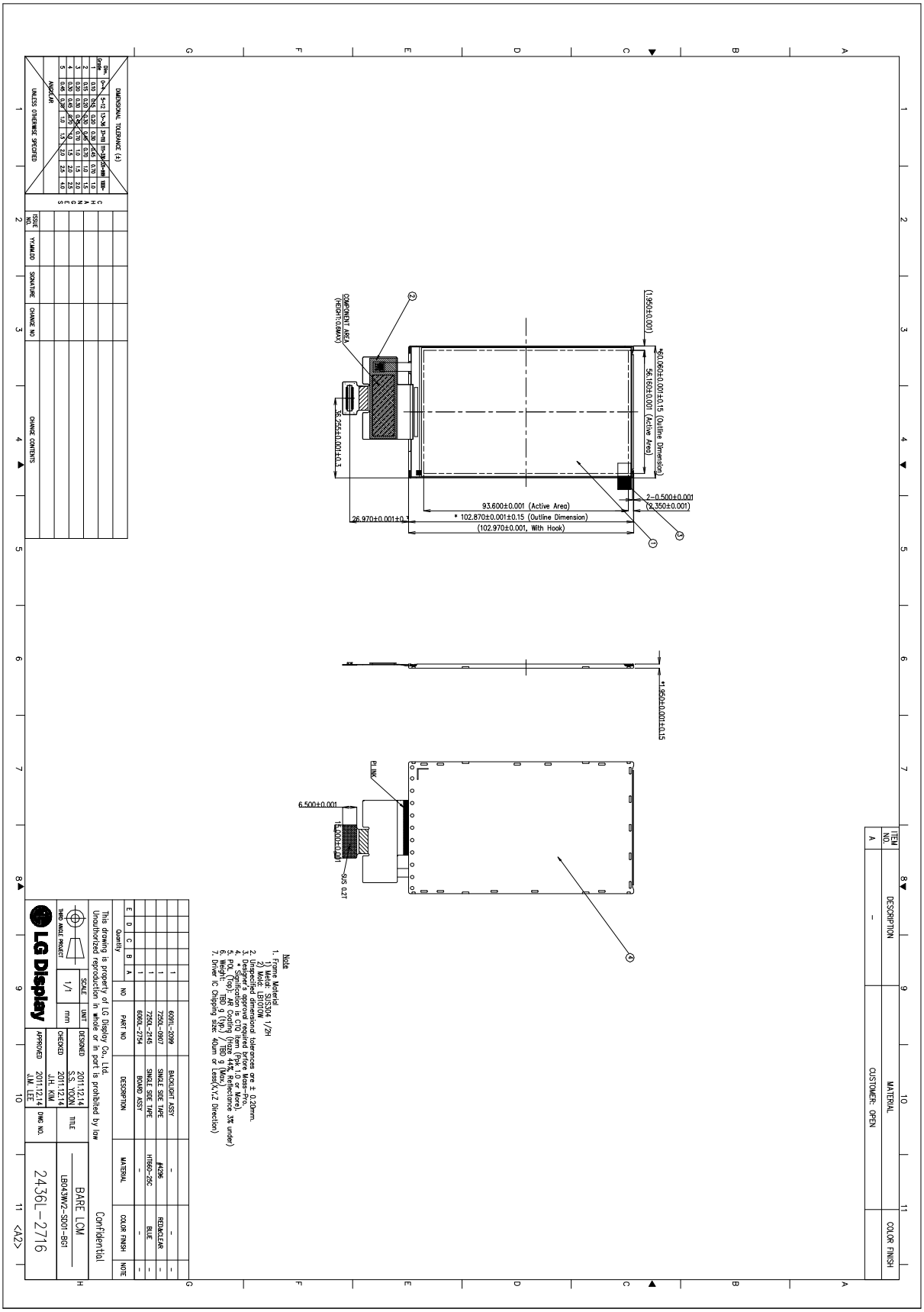


(Condition : IOVcc = 1.65~3.3V, Vcc(Vci) = 2.5~3.3V, Ta=25℃)

Reset Timing Characteristics

Item	Symbol	Unit	Min	Typ	Max
Reset "Low" level width	t_{RES}	ms	1	-	-
Reset rise time	t_{rRES}	us	-	-	10

15. Outline Dimension



16. Packing

16.1. Designation of Lot Mark

Byte	1	2	3	4	5	6	7	8	9	10

1. Factory Code

Byte	1	2

Mark		Description	Mark		Description
M	3	Gumi	X	P	Dasol
X	C	KRems	X	T	H&H
X	U	Tovis (Dalian)	J	1	LGD (Yantai)
X	L	Raygen (Yantai)	X	K	Dasol (Yantai)

2. Lot Type

Byte	3

Mark	Desc.
N	Normal
R	Rework
G	GIB
P	Packing

3. Year/Month/Data of Production

Byte	4	→ Year : 0~9
Byte	5	→ Month : 1~C (Except I/O)
Byte	6	→ Date : 1~X (Except I/O)

4. Serial Number : 0001 ~ Z999 (Except I/O)

Byte	7	→ 0~Z (Except I/O)
Byte	8	→ 0~9
Byte	9	→ 0~9
Byte	10	→ 0~9

17. Reliability and Inspection Standard

17.1. Reliability

No	Test Item	Test Conditions	Remark
1	High Temperature Operation	70℃ , 96 Hr	
2	Low Temperature Operation	-20℃, 96 Hr	
3	High Temperature and High Humidity Operation	60℃, 90% RH, 96 Hr	
4	Low Temperature Storage	-30℃, 96 Hr	
5	High Temperature Storage	80℃, 96 Hr	
6	Thermal Shock	-30℃, 80℃(30Min) 20clcye	
7	Vibration Test	Random truck & air 1.5Grms	1Hr
8	Drop Test	76cm / 3Corner / 6Face, 1clcye	Packaged in a box
9	Electrostatic withstanding voltage	Air : 0Ohm 200pF ± 200V	
		Contact : 0Ohm 200pF ± 200V	
10	Mechanical Test	LCM 3 Point Bending : 9.1kgf (weibull 10%)	
		Panel 4 Point Bending : -	측정치 참조 관리
		D-IC 3 Point Bending : 350Mpa (weibull 10%)	

17.2. Fault Judgment Criteria

TFT- LCD Module should be at room temperature for 8 hours when the display quality test is over.
There should be no particular change which might affect the practical display function
and the display quality test should be conducted under normal operating condition.

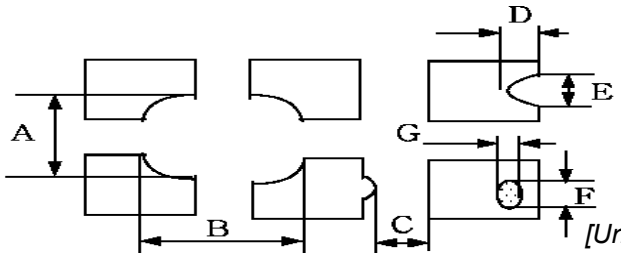
After Completing the reliability tests, leave the samples under the room temperature and (25℃, 40%RH) for the following inspection items.

(1) No clearly visible defects or deterioration of display quality allowed.
(2) Contrast ratio should be at least 50% of initial value.
(3) No function-related abnormalities.
(4) Current consumption must not exceed 2 times of initial value.
(5) R, G and B color area must be at least 70% of initial value.

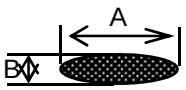
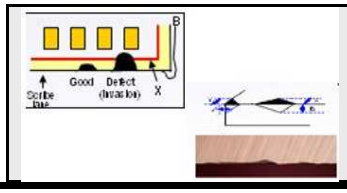
17.3. Inspection Standard for Main LCD

No	Item	Criterion for Defects	Defect type
1	Non Lighting	Nothing	Major
2	Irregular Operation	Nothing	Major
3	Short	Nothing	Major
4	Open	Nothing	Major

Product Specification

<table>
<tr><th>No</th><th>Item</th><th>Criterion for Defects</th><th>Defect type</th></tr>
<tr><td>5</td><td>Dot (Pixel) Defect</td><td>
<table>
<tr><td>Item</td><td>Bright Dot</td><td>Dark Dot</td></tr>
<tr><td>Acceptable No.</td><td>0</td><td>2</td></tr>
</table>
Note 1) Case of Dot defect is below
① Bright Dot (white spot) : “0”
② Dark Dot (black spot) : “2” (In case of Dark Dot on Main TFT LCD)
- NG if there’s full Dot defect.
- Damaged less than half size of sub-pixel is not counted as defect
- Dots darker than half size of sub-pixel are not defined as bright dot defect
</td><td>Minor</td></tr>
<tr><td>6</td><td>Foreign material / particle</td><td>
<table>
<tr><td></td><td>Size Φ (mm)</td><td>Acceptable number</td></tr>
<tr><td rowspan="3">Circle</td><td>Φ ≤ 0.10</td><td>Ignore (note1)</td></tr>
<tr><td>0.10 < Φ ≤ 0.20</td><td>1</td></tr>
<tr><td>0.20 < Φ</td><td>0</td></tr>
</table>
Note 1) Particle specification is applied either dark or bright.
2) If any tendency appears, particle specification may be changed by the conference.
</td><td>Minor</td></tr>
<tr><td>7</td><td>Black/White Line</td><td>
<table>
<tr><td>Length (mm)</td><td>Width (mm)</td><td>Acceptable number</td></tr>
<tr><td>Linear L≤2.0</td><td>W ≤0.03
0.03 < W ≤0.05</td><td>Ignore(note 2)
1</td></tr>
</table>
</td><td>Minor</td></tr>
<tr><td>8</td><td>Back Light</td><td>① No light is rejectable
② Flickering and abnormal lighting are rejectable
※ In case of the model with back light (E/L, LED)</td><td>Major</td></tr>
<tr><td>9</td><td>Display Pattern</td><td>


[Unit : mm]
<table>
<tr><td>A+B / 2 ≤ 0.30</td><td>0 < C</td><td>D+E / 2 ≤ 0.25</td><td>F+G / 2 ≤ 0.25</td></tr>
</table>
Note : 1) Acceptable up to 3 damages
2) NG if there’re two or more pinholes per dot
</td><td>Minor</td></tr>
<tr><td>10</td><td>Blemish & Foreign matters
Size :
Φ=(A+B)/2</td><td>
<table>
<tr><td>Size Φ (mm)</td><td>Acceptable number</td></tr>
<tr><td>Φ ≤ 0.10</td><td>Ignore</td></tr>
<tr><td>0.10 < Φ ≤ 0.20</td><td>1</td></tr>
<tr><td>0.20 < Φ</td><td>0</td></tr>
</table>
</td><td>Minor</td></tr>
</table>

<table>
<tr><th>No</th><th>Test Item</th><th>Criterion for Defects</th><th>Remark</th></tr>
<tr><td>11</td><td>Scratch on Polarizer
  </td><td><table><tr><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable number</th></tr><tr><td>W ≤ 0.02
0.02 < W ≤ 0.03
0.03 < W</td><td>L < 1.0
L ≤ 1.0
-</td><td>Ignore
1
0</td></tr></table></td><td>Minor</td></tr>
<tr><td>12</td><td>Bubble in Polarizer & Protection Film</td><td><table><tr><th>Size Φ (mm)</th><th>Acceptable number</th></tr><tr><td>Φ ≤ 0.10
0.10 < Φ ≤ 0.20
0.20 < Φ</td><td>Ignore (note1)
1
0</td></tr></table></td><td>Minor</td></tr>
<tr><td>13</td><td>Stains on LCD Panel Surface</td><td>Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning too are rejectable.</td><td>Minor</td></tr>
<tr><td>14</td><td>Rust in Bezel</td><td>Rust which is visible in the bezel is rejectable.</td><td>Minor</td></tr>
<tr><td>15</td><td>Defect of land surface Contact</td><td>Evident crevices which is visible are rejectable.</td><td>Minor</td></tr>
<tr><td>16</td><td>Parts Mounting</td><td>① Failure to mount parts
② Parts not in the specifications are mounted
③ Polarity, for example, is reversed</td><td>Major
Major
Major</td></tr>
<tr><td>17</td><td>Parts Alignment</td><td>① LSI, IC Lead width is more than 50% beyond pad outline.
② Chip component is off center and more tan 50% of the leads is off the pad outline.</td><td>Minor
Minor</td></tr>
<tr><td>18</td><td>Conductive Foreign matter</td><td>① On open space(GND, manual solder) solder ball is allowed up to Φ0.1mm(1EA).
② In case of shield space is allowed up to Φ0.2mm(1EA)</td><td>Major</td></tr>
<tr><td>19</td><td>Faculty PWB correction</td><td>① Due to PWB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair ; 2 or more places are corrected per PWB
② Short circuited part is cut, and no resist coating has been performed.</td><td>Minor
Minor</td></tr>
<tr><td>20</td><td>Drive IC Chipping</td><td> 
Scribe Line 침범 없을 것(Red Line)
X,Y(모서리)≤50um
A,B(중앙) ≤40um
Top Side Spec.
Back Side Spec.</td><td>Minor</td></tr>
</table>

Caution AND Handling Precaution

To avoid causing extended damages such as accidents resulting in injury or death, fire accidents, or social damages or social damages if the LCD module fails, , LG Display is always endeavor to maintain sufficient quality of the LCD module in process of designing and manufacturing.

Please pay attention to the followings when you use this TFT LCD Module.

** We can not guarantee to yellowish phenomenon that occurs when directly Bonding Touch window or Touch panel on the this LCD Module.*

Safety

1) DISASSEMBLING OR MODIFICATION

Do not disassemble or modify the modules. Sensitive parts inside LCD module may be damaged, and dusts or scratches may mar the displays. Toshiba Matsushita Display Technology does not warrant the modules, if customer disassembled or modified them.

2) BREAKAGE OF LCD PANEL

Do not Ingest liquid crystal material, Do not Inhale this material, and Do not Permit this material to contact the skin, if glass of LCD panel is broken. If liquid crystal material contacts the skin, mouth or clothing, take the following actions immediately.

In case contact to the eye or mouth, rinse with large amount of running water for more than 15 minutes. In case contact to the skin or clothing, wipe it off immediately and wash with soap and large amount of running water for more than 15 minutes. The skin or closing may be damaged if liquid crystal material is left adhered. In case ingestion, rinse out the mouth well with water. After spewing up by drinking large amount of water, get medical treatment.

3) GLASS OF LCD PANEL

Be careful with chips of Grass that may cause injuring fingers or skin, when the glass is broken.

4) ABSOLUTE MAXIMUM RATINGS

Do not exceed the absolute maximum rating values under the worst probable conditions caused by the supply voltage variation, input voltage variation, variation in parts' constants, environmental temperature, etc., otherwise LCD module may be damaged.

5) POWER PROTECTION CIRCUIT

Employ protection circuit for power supply, whenever the specification specifies it.
A suitable protection circuit should be applied, based on each system design.
A fuse is not fitted to this module. Therefore, without a suitable power-supply protection device, dust or partial circuit failure may cause overheating and/or burning , which may lead to injury.

6) DISPOSAL

Always comply with all applicable environmental regulations, when disposing of the LCD.

7) EDGES OF PARTS

Be careful with edges of glass parts and metal frame, it may cause injuring.
For designing the system, give special consideration that the wiring and parts do not touch those edges.

8) RECOMMENDED OPERATING CONDITIONS

Don't exceed "the recommended operation conditions" in this specification. The performance and quality of the LCD module are warranted only when the LCD module is used within "the recommended operation conditions". To use the LCD module over "the recommended operation conditions" may have bad influence on the characteristics and reliability of the LCD module and may shorten the life of the LCD module.

Therefore, when designing the whole set, not to be over "the recommended operation conditions", you should fully take care of supply voltage change, characteristic of connection parts, serge of input-and-output line , and surrounding temperature.

Installation in Assembly

1. ESD (ELECTRO-STATIC DISCHARGE) PREVENTION

The circuit used in LCD module is very sensitive to ESD. The following caution should be taken when installing LCD module to an enclosure of the system in order to prevent damage of circuit used in LCD module.

1) HUMIDITY

Ambient humidity of working area is recommended to be higher than 50%(RH) in order to avoid ESD.

2) GROUNDING

- *Person handling LCD modules should be grounded with wrist band.*
- *Tools like soldering iron and screw drivers and working benches should be grounded.*
- *Grounded electro-conductive mats are recommended to be covered on the floor of working area and surface of working benches.*
- *The grounding should be done through a resister of 0.5~1Mohms in order to prevent spark of ESD.*

3) Be careful with touching metal portion of testing instruments in order to prevent unnecessary ESD.

4) Do not touch the electrode area of PCB and electrical parts like LSI, capacitor, connector pin, etc.

5) IONIZER

Using ionizer (an antistatic blower) is recommended at working area in order to reduce electro-static voltage.

6) REMOVING PROTECTION FILM

When removing protection film from LCD panel, peel off the tag slowly (more than one second) while blowing with ionizer toward the peeling face to minimize ESD which may damage electrical circuit.

2. DUST AND STAIN PREVENTION

1) WORKING AREA

Reduce dust level in working area. Especially the level of metal particle should be decreased, otherwise electrical circuit in LCD module may be damaged due to short circuit by metal particles.

2) FINGER PRINT

Use finger stalls or soft and dust-free gloves in order to keep clean appearance of LCD module when handled for incoming inspection and assembly.

3) PROTECTION FILM

LCD module may be shipped with "protection film" on LCD panel in order to prevent from scratches and dust. It is recommended to remove the film at later process of assembling.

4) WIPING OFF DUST ON THE PANEL

When LCD panel becomes dirty, wipe the panel surface off softly with absorbent cotton or another soft cloth. If necessary, breathe upon the panel surface and then wipe off immediately and softly again. Be careful not to spill organic solvents into the inside of LCD module. The solvents may damage driver IC and PCB area used inside module. The polarizer laminated to LCD panel and adhesives may be damaged by the solvents, so do not use any organic solvents for wiping off LCD panel.

5) ADHESIVE ON LCD PANEL

Be careful not to attach adhesive, grease, etc., on LCD panel, because it is difficult to remove them without any damages on LCD panel.

6) WATER SPOTS ON THE PANEL

Avoid the dewing or water condensation.
Wipe off a spot or spots of water or mist on LCD panel softly with absorbent cotton or another cloth as soon as possible if happened, otherwise discoloration or stain may be caused. And, damage may occur if water penetrates the inside.

3. INSTALLING LCD MODULE TO THE ENCLOSURE

1) INSTALLING LCD MODULE TO THE ENCLOSURE

Do not bend or twist LCD module even momentarily when the LCD module is installed into the system. Bending or twisting the LCD module may cause permanent damage.
When the FPC is bent, the radius of FPC curvature must be more than value of recommendation to prevent bending and twisting forces from affecting the connection of FPC.
Even temporary bending or twisting sometimes causes damage.

2) INTERFACE

Do not fasten screws, with catching interface FPC between LCD module and the enclosure.
This may cause bending of LCD module, or become the cause of a failure by damaging FPC.

4. MECHANICAL FORCES

1) CARRY

Hold the side of the plastic frame when you carry an LCD module by hand. If an LCD is carried using the FPC, it is likely to be damaged and the LCD will then malfunction. If you turn on the LCD with a broken FPC, it may cause smoke or burning.
Protection (eg gloves) for fingers and hands is recommended to avoid injury by broken glass.

2) STRONG MECHANICAL SHOCK

Avoid strong mechanical shock, such as dropping the LCD from the work bench, or knocking it against a hard object.
These may cause the glass panel to crack, or cause other mis-operation.

3) EXCESSIVE FORCE

Avoid applying excessive force, like pushing the surface of LCD panel. This may cause scratches or breakage of the panel, or a failure of the module.

4) SCRATCHES ON THE PANEL

Do not put heavy object such as tools, books, etc., and do not pile up LCD modules.
Be careful not to touch the surface of the polarizer with any hard and sharp object. These parts are so sensitive and can easily be scratched, even if protected by a film.

5)Connector

When inserting or disconnecting the connector into a connector of the LCD module, care should be taken to ensure that no strong external force is applied to the connector on the LCD module side.
A strong external force applied to the connector or the FPC may damage their connections.
When assembling a module into a system, pay extra attention to ensure that no part such as the FPC etc. should be caught between the case of the system and the module. Make sure that the input signal connector of a module is securely and correctly connected to the connector on the system, not skewed, or incompletely connected.
Inputting a signal etc. into the module with connectors incorrectly inserted may cause a circuit component or components to malfunction.

6) FPC

When inserting or disconnecting the connector of the LCD module into a connector of the system, care should be taken to ensure that no strong external force is applied to the FPC on the LCD module side. A strong external force applied to the FPC may damage their connections.
When assembling a module into a system, pay extra attention to ensure that no part such as the FPC etc. should be caught between the case of the system and the module.
Make sure that the input signal connector of a module is securely and correctly connected to the connector on the system, not skewed, or incompletely connected. Inputting a signal etc. into the module with connectors incorrectly inserted may cause a circuit component or components to malfunction. Be careful not to pull or damage the FPC cables, to avoid mechanical damage in FPC and connection part of FPC and cell.

5. OPERATION

1) POWER SUPPLY

Power supplies should always be turned off during the assembly process.
Do not connect or disconnect the power cables and connectors with power applied to LCD module. This may cause damage to the LCD module circuit.
In operating module at the inspection process, and so on, the supply voltage and signals of driving device must satisfy the sequence of power supplies and signals described in this specifications.

2) GAS

Do not expose the LCD module to any gas which is not normally contained in the atmosphere, it may cause mis-operation or defects.

3) USED FOR LONG TERM

When a LCD module is used for a long term, the characteristics of LCD module might be changed and it may be out of the standard of "4.3 Optical Specifications" due to LED discoloration.
LED has the characteristics of shifting optical characteristics by the long term use.

Transportation and Storage

1) TEMPERATURE

Do not store LCD modules in a high temperature and high humidity condition, higher than 35ºC and 70%(RH) for a long term, meaning about one month or more, otherwise this may deteriorate the quality of the display. When you unavoidably store LCD modules for a long time, store between 0 and 35ºC, with a relative humidity 70% or lower.

2) LOW TEMPERATURE

Be careful not to leave it where the temperature is below specified storage temperature because the liquid crystal of the display panel may be damaged.

3) ULTRA VIOLET RAY

Store LCD module without exposure to direct sunlight or fluorescent lamps in order to prevent the module from strong ultra violet ray.

4) CLEANLINESS

Keep the LCD module in clean place, because any dust, hard particle may damage the polarizer, or dust invades the inside of the LCD module.

5) CONDENSATION OF WATER

The modules should be stored under a condition where no condensation of water is allowed. It may cause mis-operation or defects. Be especially careful not to make a module work under the condition that condensation of water appears.

6) PACKAGING

When you must re-package a LCD module after it has been removed from the original packaging, it is recommended to re-pack using the original package box and package material.