



TO : (주)햄팩스

DATE : JUNE. 21. 2007

*VODATECH TFT-LCD*

**MODEL NO. : VMS350GF04**  
**Preliminary**

Customer Approval

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Approved by : \_\_\_\_\_

**R&D Center Division**

**VODA TECH. Co. Ltd.**

**Revision History**

Data	Rev. No.	Page	Summary
2007.06.21	000	-	- Preliminary

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## General Description

### \* Description

VMS350GF01 is a TM (Transmissive) type color active matrix TFT (Thin Film Transistor) liquid crystal display(LCD) that uses amorphous silicon TFT as a switching devices.

This model is composed of a TFT(Thin Film Transistor) LCD(Liquid Crystal Display) module, driver circuit , back-light unit.

The resolution of a 3.5" contains 320(H) x RGB x 240(V) pixels and can display up to 16M colors.

### \* Features

- TM (Transmissive) type and back-light with 6 LED's are available.
- TN(Twist Nematic) mode.
- Line inversion mode with stripe type.
- 24bit RGB Interface + Serial Peripheral Interface(SPI)
- Gate Driver IC embeded on Panel(Dual ASG)
- Low Power consumption.

### \* Applications

- Display terminals for P-CNS(Portable Car Navigation System), DSC(Digital Still Camera), PMP(Portable Multimedia Player), Voip(Voice Over Internet Protocol) Phone application products.

### \* General information

Items	Specification	Unit	Note
Display area	70.08(H) x 52.56(V)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	16.7M	colors	-
Number of pixels	320RGB(H) x 240(V)	dot	-
Pixel arrangement	stripe type	-	-
Pixel pitch	0.219(H) x 0.219(V)	mm	-
Display mode	Normally White	-	-
Viewing direction	6	o'clock	-

### \* Mechanical information

Item	Min.	Typ.	Max.	Unit	Note	
Module size	Horizontal(H)	76.3	76.5	76.7	mm	-
	Vertical(V)	63.3	63.5	63.7	mm	(1)
	Depth(D)	2.98	3.13	3.28	mm	(1)
Weight	-	43	48	g	-	

Note (1) Not include FPC.

Refer to the Outline Dimension in the "9.Outline Dimension" for further information.

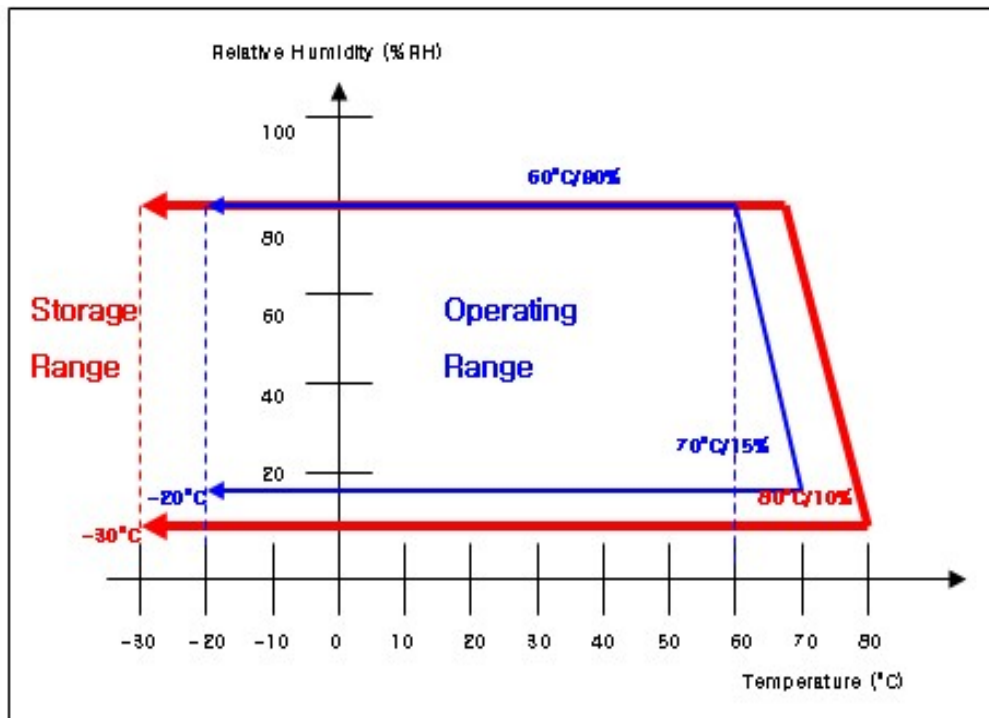
# 1. Absolute Maximum Ratings

## 1.1 Environment

ITEM	MIN	MAX	REMARK
Storage Temperature	-30°C	80°C	Note(1)
Operating Temperature	-20°C	70°C	Note(2)(3)

Note(1) 90%RH maximum humidity, 60°C maximum wet-bulb temperature

- (2) When operated at a temperature lower than 0°C, the LCD worked slowly and the screen appeared low-contrast images due to the characteristics of LC(Liquid Crystal).
- (3) If any fixed pattern is displayed on LCD for minutes, image-sticking phenomenon may occur.



Temperature & Humidity Graph at Absolute Environment

## 1.2 Electrical Absolute Ratings

### (1) TFT-LCD Module

Characteristics	Symbol	Min.	Max.	Unit	Note
Power supply voltage	$V_{CC}$	-0.5	3.6	V	-
I/O Power supply voltage	$V_{ci}$	-0.5	3.6	V	-
Input voltage	$V_i$	-0.5	$V_{ci} + 0.5$	V	-
Input current	$I_i$	$\pm 10$		mA	-

### (2) Back-Light Unit

( $T_a = 25 \pm 2^\circ\text{C}$ )

Item	Symbol	Min.	Max.	Unit.	Note
Current	$I_B$		25	mA	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.

Functional operation should be restricted to the conditions described under normal operating conditions.

## 2. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment: LCD-5000, BM-5A, BM-7, PR-650, EZ-Contrast

(Temp = 25 ± 2°C, VDD = 2.8V, I<sub>B</sub> = 18mA)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast ratio (Center point)		C/R	NOTE (1)	150	250	-	-	(2) BM-5A
Luminance of white (Center point)		YL		210	250	-	cd/m <sup>2</sup>	(3) BM-5A
Uniformity		-		80	-	-	%	(4) BM-7
Response time	Rising:Tr	Tr+Tf		$\phi = 0$	-	50	70	msec
	Falling:Tf		$\theta = 0$					
Color chromaticity (CIE 1931)	White	Wx	Viewing Angle  B/L On	TBD	TBD	TBD	-	(6) PR-650
		Wy		TBD	TBD	TBD		
	Red	Rx		TBD	TBD	TBD		
		Ry		TBD	TBD	TBD		
	Green	Gx		TBD	TBD	TBD		
		Gy		TBD	TBD	TBD		
	Blue	Bx		TBD	TBD	TBD		
		By		TBD	TBD	TBD		
Viewing angle	Hor.	$\theta_L$	$C/R \geq 10$	-	60	-	Degrees	(7) EZ-Contrast
		$\theta_R$		-	60	-		
	Ver.	$\phi_H$	B/L On	-	50	-		
		$\phi_L$	B/L On	-	55	-		

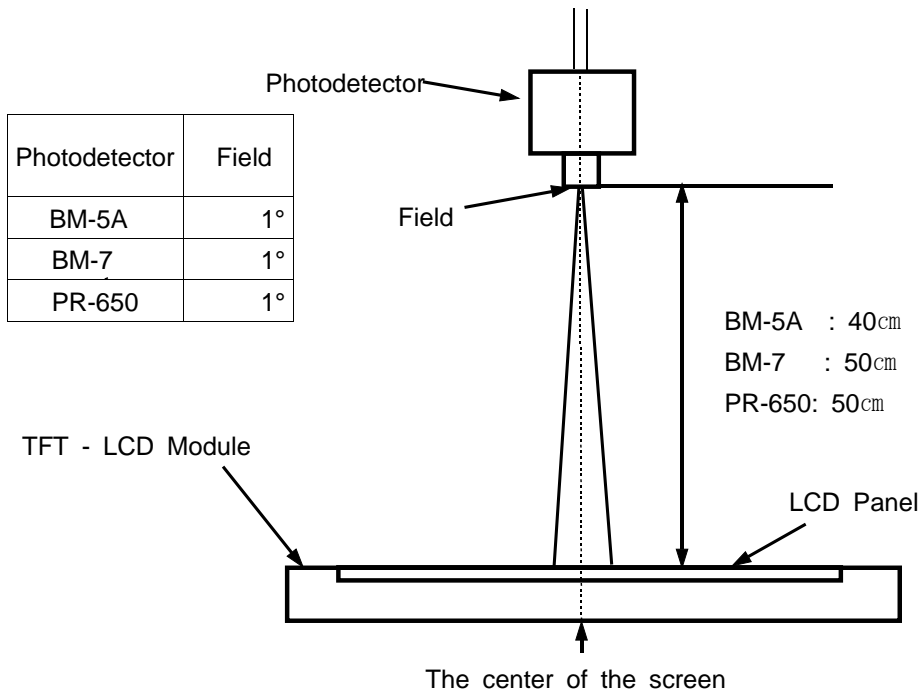


Note (1) Test Equipment Setup

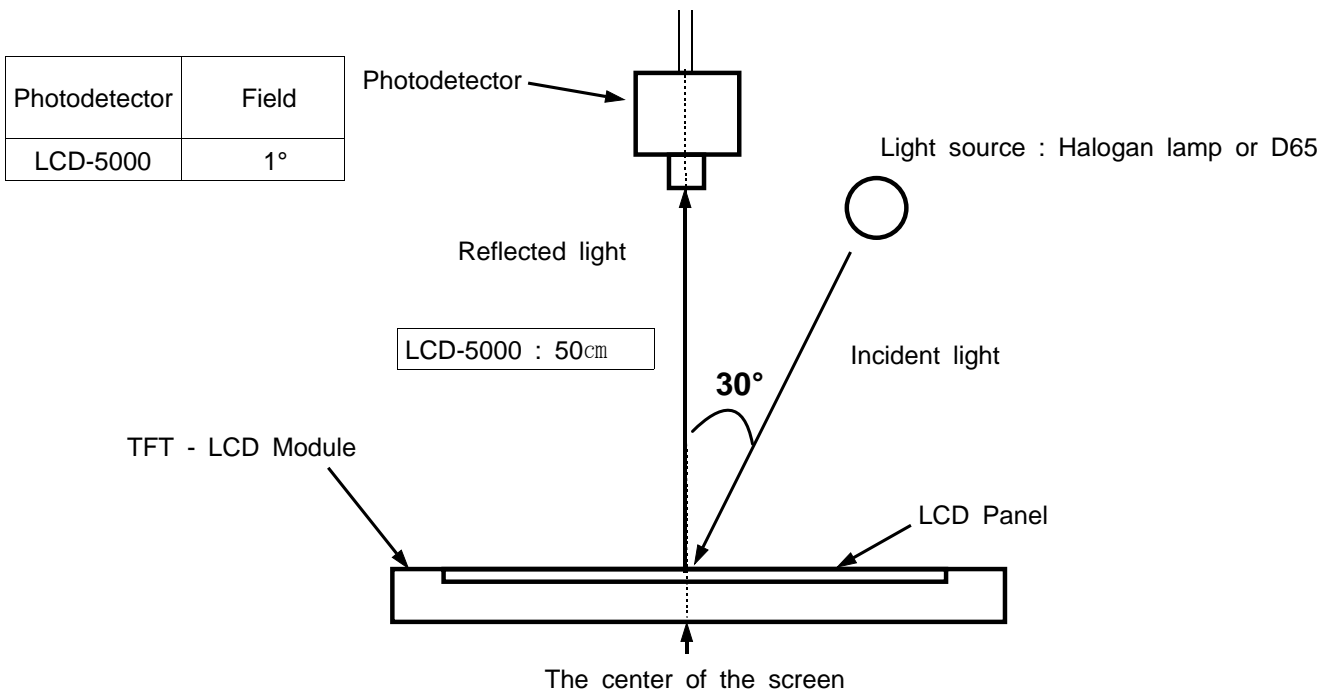
After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

Environment condition : Temp =  $25 \pm 2$  °C

Back-Light On condition



Back-Light Off condition



Optical Measuring Equipment Setup

Note (2) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point

$$CR = \frac{G \text{ max}}{G \text{ min}}$$

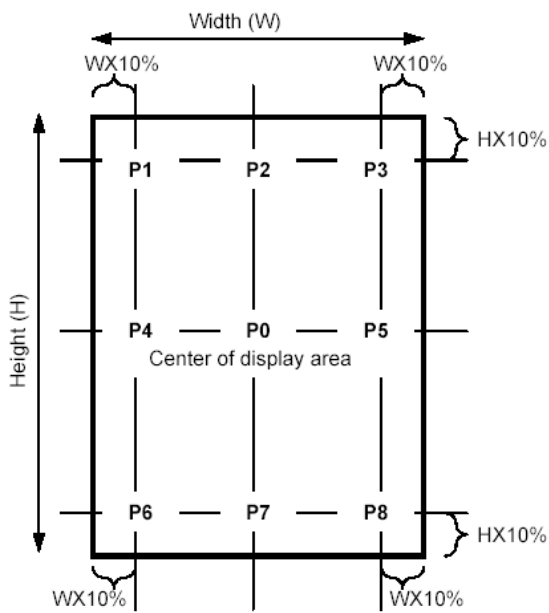
\* Gmax : Luminance with all pixels white

\* Gmin : Luminance with all pixels black

Note (3) Definition of Luminance of White : Luminance of white at the center point

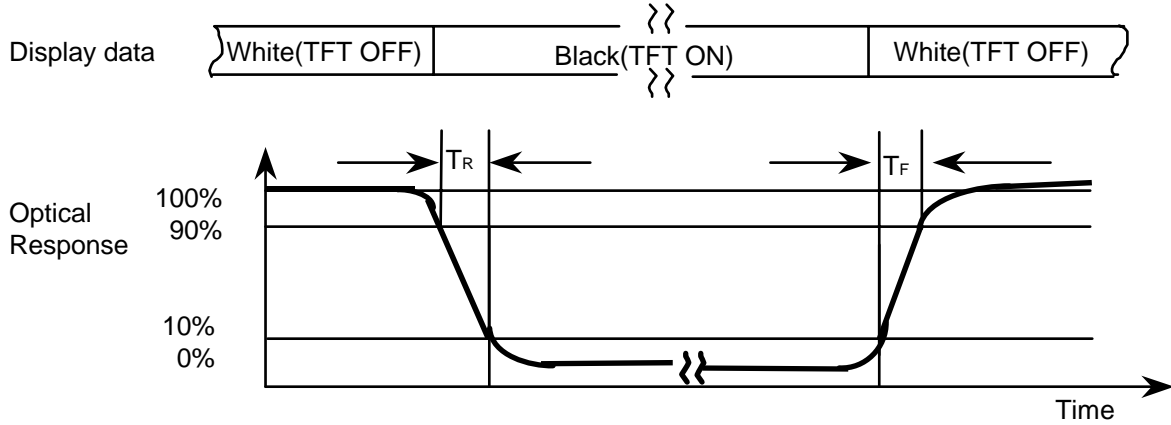
Note (4) Definition of brightness uniformity

Measure 9 point ( P0~P8 ) and define the brightness uniformity using



$$\text{Brightness Uniformity} = \frac{\text{Minimum Brightness Among P0~P8}}{\text{Maximum Brightness Among P0~P8}} \times 100$$

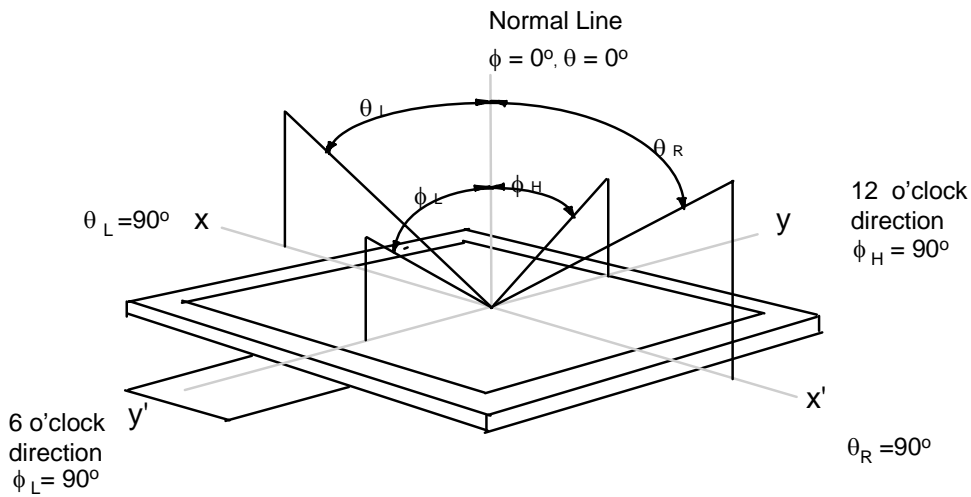
Note (5) Definition of Response time : Sum of  $T_r$ ,  $T_f$



Note (6) Definition of Color Chromaticity (CIE 1931)

Color coordinate of white & red, green, blue at center point.

Note (7) Definition of Viewing Angle : Viewing angle range ( $CR \geq 10$ )



### 3. Electrical Characteristics

#### 3.1 TFT-LCD Module

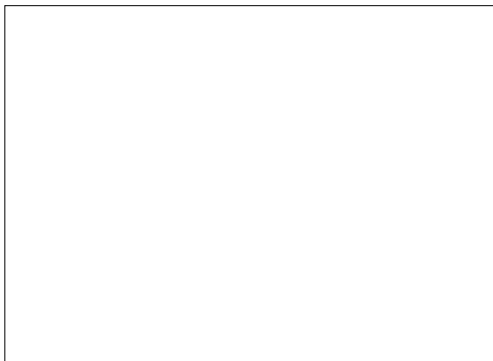
 $T_a = 25 \pm 2^\circ\text{C}$ 

Characteristics		Symbol	Min.	Typ.	Max.	Unit	Note
Power supply voltage		$V_{CC}$	3.0	3.3	3.6	V	-
IO Power supply voltage		$V_{ci}$	3.0	3.3	3.6	V	-
Power Dissipation	Black	$P$	TBD	TBD	TBD	mW	(1),(2)
	White	$P_{FULL}$	TBD	TBD	TBD		
Current Dissipation	Black	$I$	TBD	TBD	TBD	mA	
	White	$I_{FULL}$	TBD	TBD	TBD		
Frame frequency		$f_{Frame}$	TBD	TBD	TBD	Hz	-
Dot Clock		DOTCLK	TBD	TBD	TBD	MHz	-
Serial Clock		SCL	TBD	TBD	TBD	MHz	-

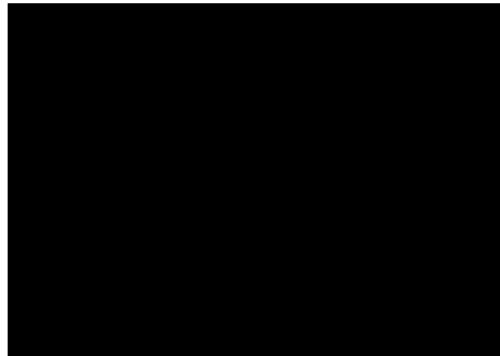
Note (1)  $V_{CC} = 3.3\text{V}$ ,  $f_{Frame} = \text{TBD}$  Hz, DOTCLK = TBD MHz

(2) Dissipation current check pattern

▶ 255 Gray white pattern



▶ 0 Gray Black pattern



### 3.2 Back-Light unit

The back-light system is an edge-lighting type with three white LED(Light Emitting Diode)s.

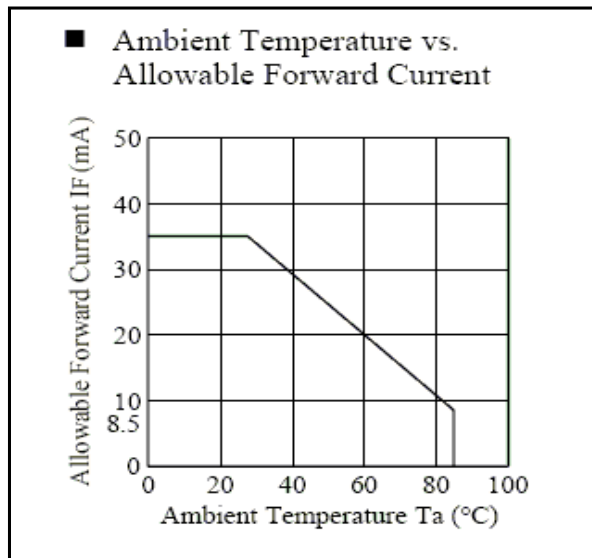
(Ta=25 ± 2°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Current	I <sub>B</sub>	-	20		mA	(1),(3)
Power Consumption	P <sub>BL</sub>	-	400		mW	(2)

Note (1) Six LEDs serial type.

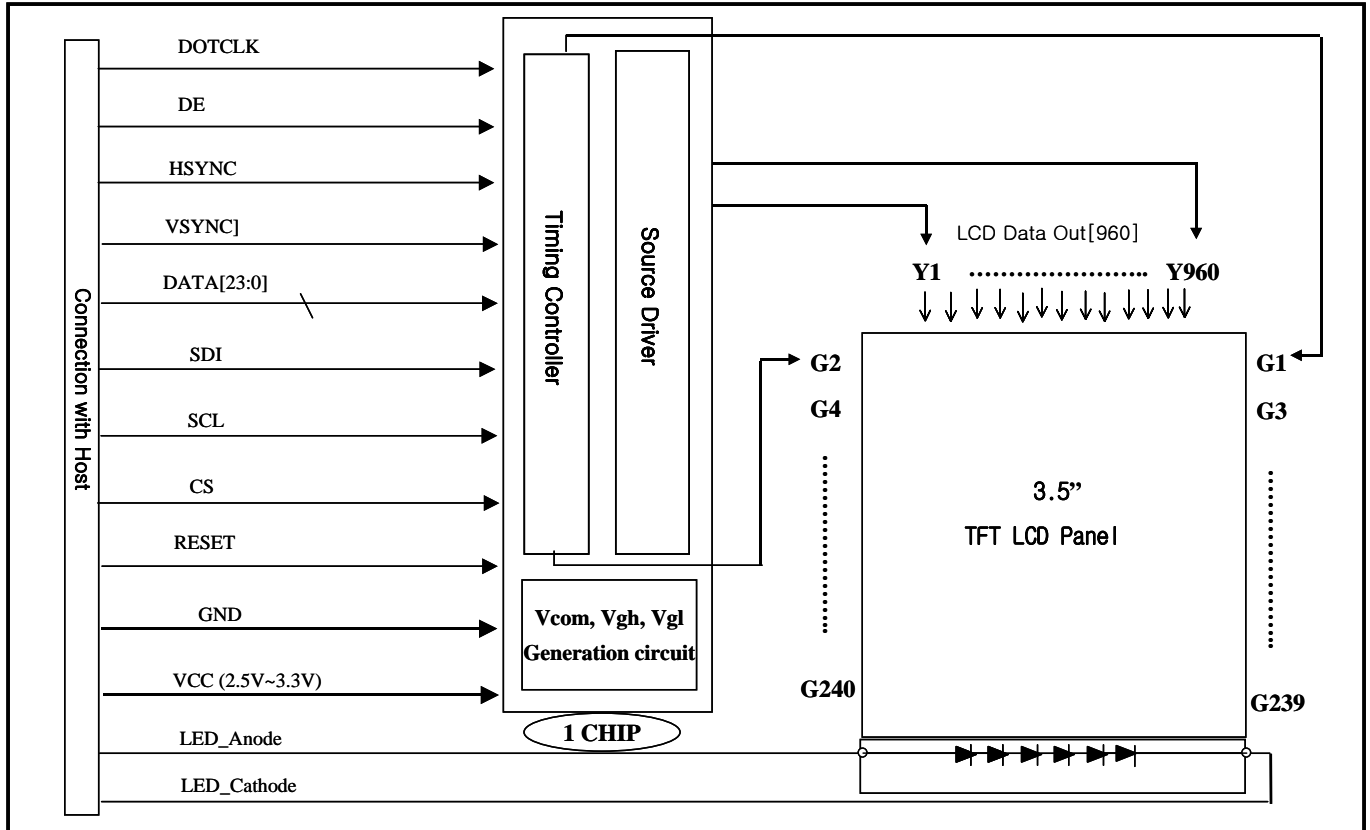
(2) Where I<sub>B</sub> = 20mA, V<sub>B</sub> = P<sub>BL</sub> / I<sub>B</sub>

(3) Ambient Temperature vs. Allowable Forward current.



## 4. Block Diagram

### 4.1 TFT-LCD Module (Interface System Structure) with Back Light Unit.



## 5. Input Terminal Pin Assignment

### 5.1 Input Signal & Power (Connector : FH28-54S-0.5SH)

Pin NO	Pin Name	Discription	Pin NO	Pin Name	Discription
1	LED_Cathode	Led Cathod pin	30	DATA18	bi-directional data Port
2	LED_Cathode	Led Cathod pin	31	DATA19	
3	LED_Anode	Led Anode pin	32	DATA20	
4	LED_Anode	Led Anode pin	33	DATA21	
5	C6	NO Connection	34	DATA22	
6	C5	NO Connection	35	DATA23	
7	M	NO Connection	36	HSYNC	Horizontal sync signal
8	RESET	System RESET	37	VSYNC	Vertical sync signal
9	CS	Chip selet	38	DOTCLK	RGB Interface dot clock
10	SCL	Serial clock signal	39	VCI	Analog System Input signal
11	SDI	Serial data signal	40	VCI	Analog System Input signal
12	DATA0(R0_LSB)	bi-directional data Port	41	VDD	System Input signal
13	DATA1		42	VDD	System Input signal
14	DATA2		43	C4	NO Connection
15	DATA3		44	VGL	NO Connection
16	DATA4		45	VGL	NO Connection
17	DATA5		46	C3	NO Connection
18	DATA6		47	VGH	NO Connection
19	DATA7		48	C2	NO Connection
20	DATA8(G0_LSB)		49	C1	NO Connection
21	DATA9		50	VCOM	NO Connection
22	DATA10		51	VCOM	NO Connection
23	DATA11		52	ENABLE	Data enable signal
24	DATA12		53	GND	Ground
25	DATA13		54	GND	Ground
26	DATA14				
27	DATA15				
28	DATA16(B0_LSB)				
29	DATA17				

### 5.2 Input Signal, Basic Display Colors and Gray Scale of Each Colors

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

Note) Definition of Gray :

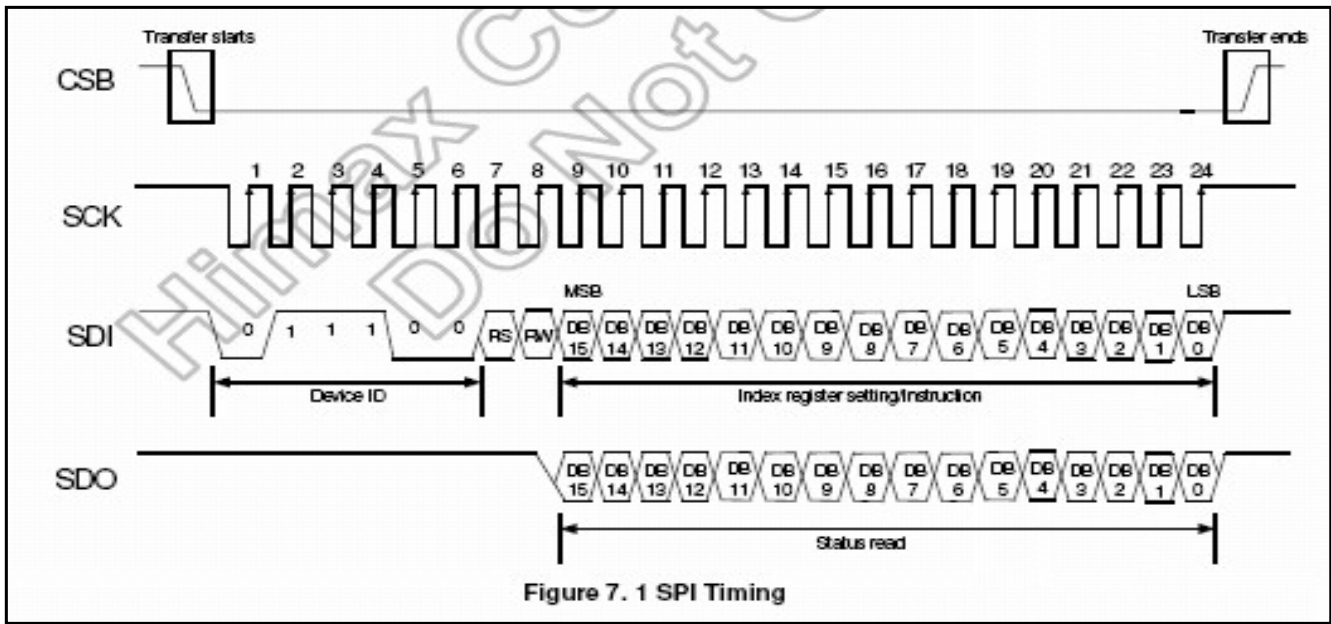
Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

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

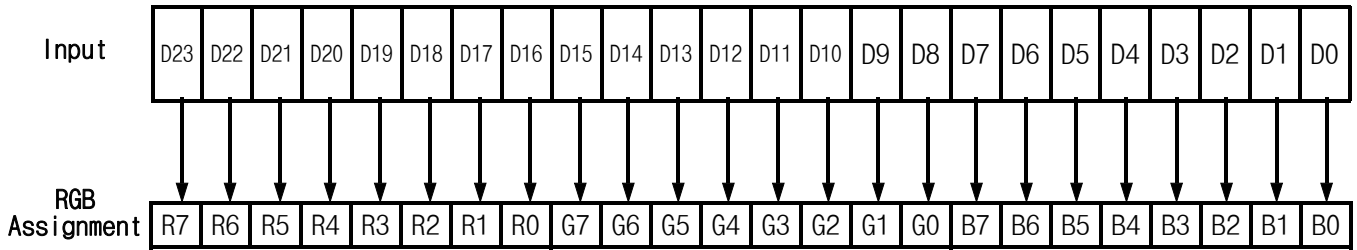
### 6. Operation Specifications



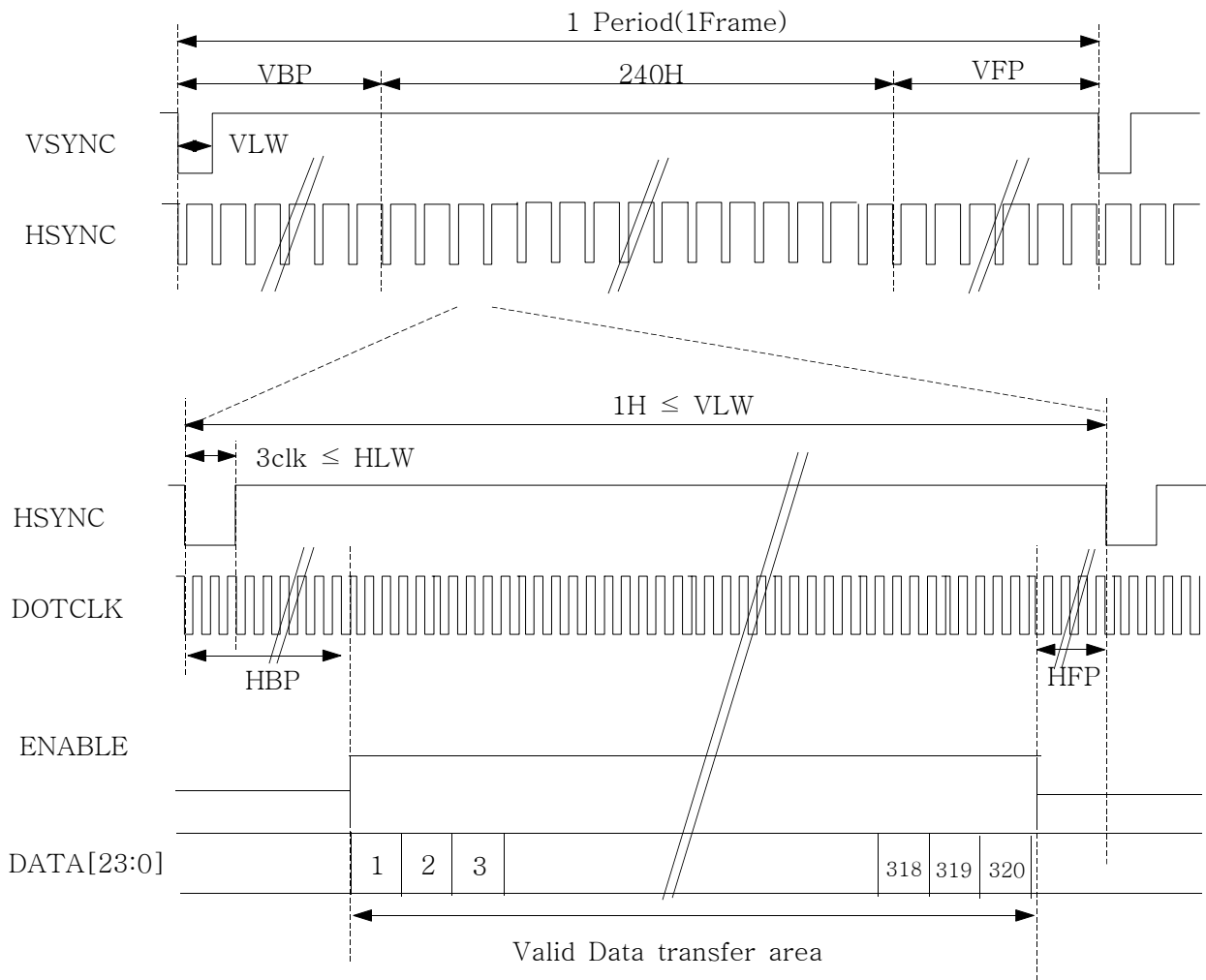
### 6.1 Serial Peripheral Interface



### 6.2 Data Format for 24bit RGB Interface



### 6.3 24bit RGB Interface Timing



$$\begin{aligned}
 \text{DOTCLK} &= f_{\text{frame}} \times (240 + \text{VBP} + \text{VFP}) \times (320 + \text{HBP} + \text{HFP}) \\
 &= 60\text{Hz} \times (240 + \text{VBP} + \text{VFP}) \times (320 + \text{HBP} + \text{HFP})
 \end{aligned}$$

\* HBP : 8 ~ 511 clk, VBP : 1~255H

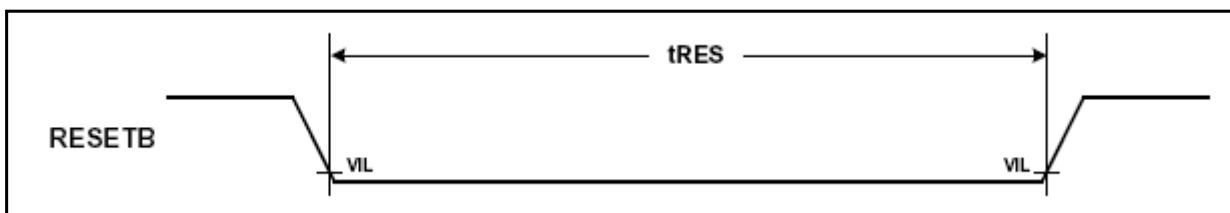
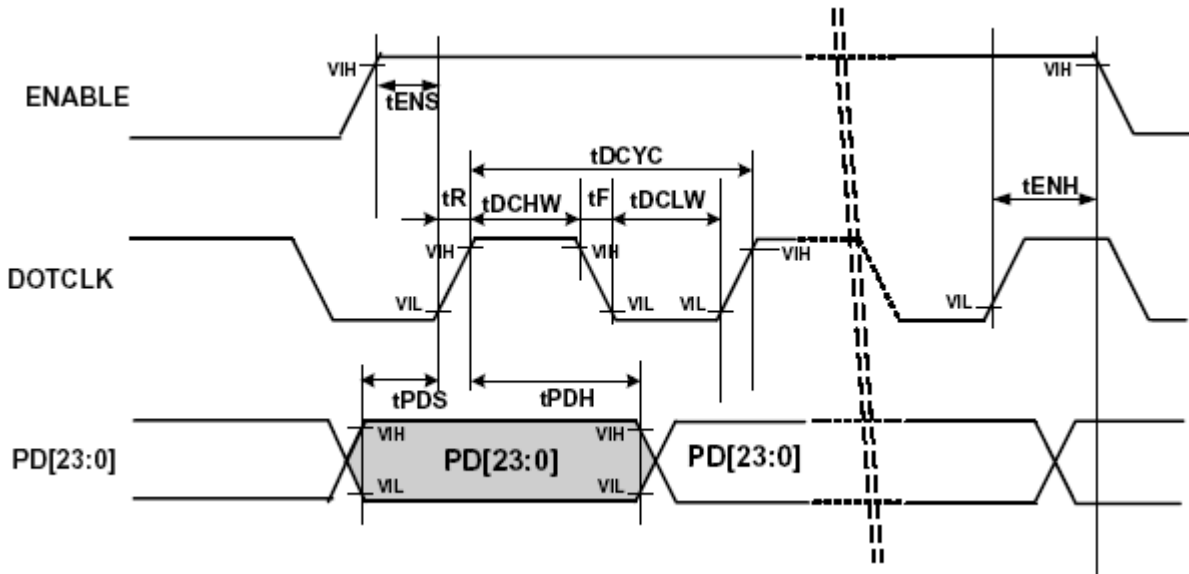
\* HLW  $\geq$  3clk, VLW  $\geq$  1H

### 6.4 Electrical Specifications (when Vccio: 2.5 ~ 3.3V )

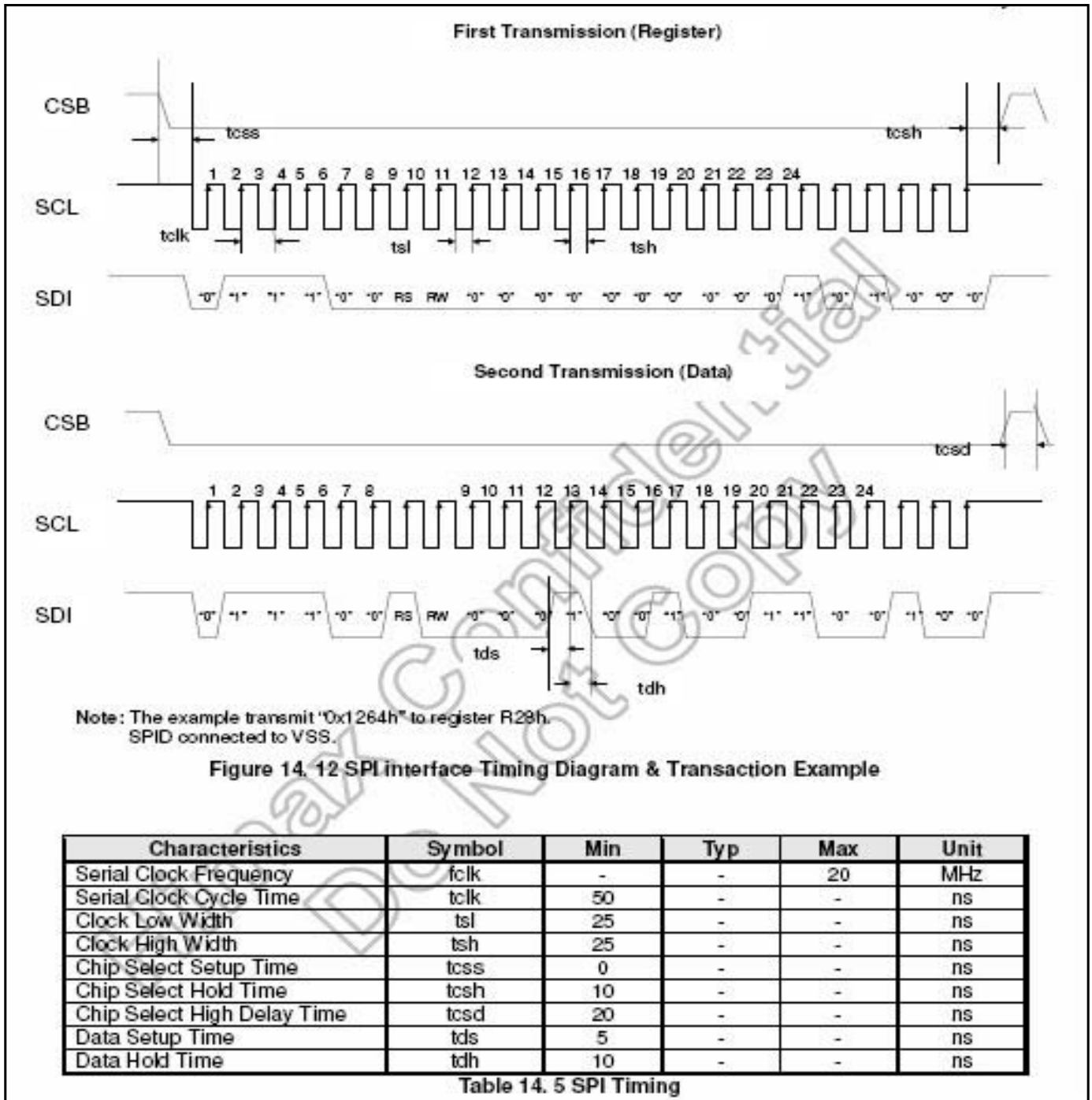
#### a. RGB Data Interface Characteristics

(T<sub>A</sub> = -40 to +85 °C)

Characteristic	Symbol	24bit RGB Interface		Unit
		Min	Max	
DOTCLK cycle time	tDCYC	50	-	ns
DOTCLK rise/fall time	tR,tF	-	2	
DOTCLK Pulse width high	tDCHW	20	-	
DOTCLK Pulse width low	tDCLW	20	-	
ENABLE setup time	tENS	15	-	
ENABLE hold time	tENH	15	-	
PD data setup time	tPDS	15	-	
PD data hold time	tPDH	10	-	



**b. AC Characteristics**



**c. Reset Timing Characteristics**

(T<sub>A</sub> = -40 to +85 °C)

Characteristic	Symbol	Min	Max	Unit
Reset low pulse width	tRES	10	-	us

**NOTE.** Reset low pulse width shorter than 1us do not make reset. It means undesired short pulse such as glitch, bouncing noise or electrostatic discharge do not cause irregular system reset. Please refer to the table below.

## C. DC Characteristics

Symbol	Parameter	Test condition	Min	Typ	Max	Unit
V <sub>DD</sub>	System power supply pins of the logic block	Recommend Operating Voltage Possible Operating Voltage	1.8	-	2.50	V
V <sub>DDIO</sub>	Power supply pin of IO pins	Recommend Operating Voltage Possible Operating Voltage	1.4	-	3.6	V
V <sub>CI</sub>	Booster Reference Supply Voltage Range	Recommend Operating Voltage Possible Operating Voltage	2.5 or V <sub>DDIO</sub>	-	3.6	V
I <sub>sleep</sub>	Sleep mode current			50		μA
I <sub>sp</sub>	Operating mode current	100pF loading at Source output		4.0	6	mA
V <sub>CI1M</sub>	Negative V <sub>CI</sub> Output Voltage	No panel loading	-V <sub>CI</sub>	-	-	V
V <sub>COX2</sub>	V <sub>COX2</sub> primary booster efficiency <sup>(1)</sup>	No panel loading, ITO for V <sub>COX2</sub> , V <sub>CI</sub> and V <sub>CHS</sub> = 10 Ohm	83	90	-	%
V <sub>GH</sub>	Gate driver High Output Voltage Booster efficiency <sup>(2)</sup>	No panel loading; 4x booster; ITO for C <sub>YP</sub> , C <sub>YN</sub> , V <sub>COX2</sub> , V <sub>CI</sub> and V <sub>CHS</sub> = 10 Ohm	84	89.5	-	%
		No panel loading; 5x booster; ITO for C <sub>YP</sub> , C <sub>YN</sub> , V <sub>COX2</sub> , V <sub>CI</sub> and V <sub>CHS</sub> = 10 Ohm	80	88.5	-	%
		No panel loading; 6x booster; ITO for C <sub>YP</sub> , C <sub>YN</sub> , V <sub>COX2</sub> , V <sub>CI</sub> and V <sub>CHS</sub> = 10 Ohm	72	80	-	%
V <sub>GL</sub>	Gate driver Low Output Voltage		-V <sub>GH</sub>		-5.1	V
V <sub>COMH</sub>	VCOM High Output Voltage		-		5.54	V
V <sub>COML</sub>	VCOM Low Output Voltage		V <sub>COM</sub> +0.5		-	V
V <sub>COMA</sub>	VCOM Amplitude		-		6	V
V <sub>LCD63</sub>	V <sub>LCD63</sub> Output Voltage		-		5.57	V
ΔV <sub>LCD63</sub>	Max. Source Voltage Variation		-2		2	%
V <sub>OH1</sub>	Logic High Output Voltage	I <sub>out</sub> = -100μA	0.9*V <sub>DDIO</sub>		V <sub>DD</sub>	V
V <sub>VD</sub>	Source Output Voltage Deviation			±20		mV
V <sub>OS</sub>	Source Output Voltage Offset				±30	mV
V <sub>OL1</sub>	Logic Low Output Voltage	I <sub>out</sub> = 100μA	0		0.1*V <sub>DDIO</sub>	V
V <sub>IH1</sub>	Logic High Input voltage		0.8*V <sub>DDIO</sub>		V <sub>DDIO</sub>	V
V <sub>IL1</sub>	Logic Low Input voltage		0		0.2*V <sub>DDIO</sub>	V
I <sub>OH</sub>	Logic High Output Current Source	V <sub>out</sub> = V <sub>DD</sub> - 0.4V	50			μA
I <sub>OL</sub>	Logic Low Output Current Drain	V <sub>out</sub> = 0.4V			-50	μA
I <sub>OZ</sub>	Logic Output Tri-state Current Drain Source		-1		1	μA
I <sub>IH1H</sub>	Logic Input Current		-1		1	μA
C <sub>IN</sub>	Logic Pins Input Capacitance			5	7.5	pF
R <sub>SON</sub>	Source drivers output resistance			1		kΩ
R <sub>SON</sub>	Gate drivers output resistance			500		Ω
R <sub>CON</sub>	VCOM output resistance			200		Ω

Note : (1) V<sub>CI</sub>X2 efficiency = V<sub>CI</sub>X2 / (2 x V<sub>CI</sub>) x 100%

(2) V<sub>GH</sub> efficiency = V<sub>GH</sub> / (V<sub>CI</sub> x n) x 100% (where n = booster factor)

Table 13. 1 DC Characteristics

## 7. Command List & Instruction Descriptions

### 7.1 Command List

Refer to the Appendix 1: Driver IC Specification

### 7.2 Instruction Descriptions

Refer to the Appendix 1: Driver IC Specification

## 8. Power On/Off Sequence

### 8.1 Power On Sequence

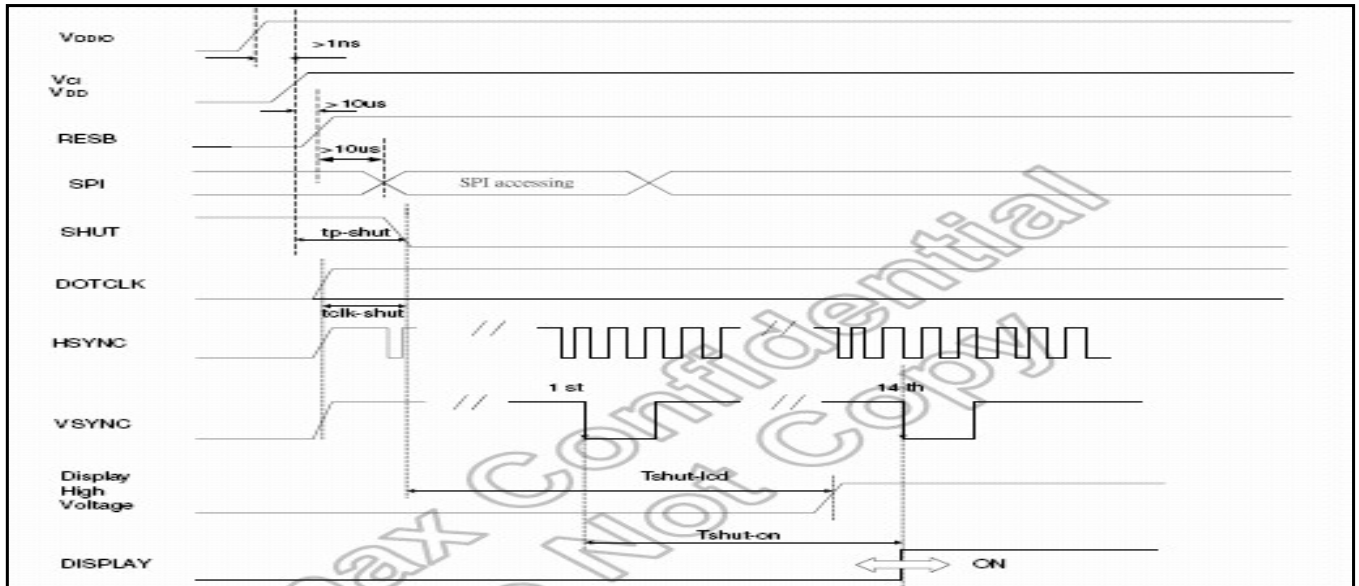


Figure 14. 10 Power Up Sequence

Characteristics	Symbol	Min	Typ	Max	Units
VDD / VDDIO on to falling edge of SHUT	$t_{p-shut}$	1	-	-	µs
DOTCLK	$t_{clk-shut}$	1	-	-	clk
Falling edge of SHUT to LCD power on	$t_{shut-lcd}$	-	-	128	ms
Falling edge of SHUT to display start	$t_{shut-on}$	-	-	14	frame
- 1 line: 408 clk - 1 frame: 262 line - DOTCLK = 6.5MHz		-	166	232.4	ms

Note: It is necessary to input DOTCLK before the falling edge of SHUT.  
Display starts at 10th falling edge of VSTNC after the falling edge of SHUT.

Reg#	Hex Code	Register Bit Value
R01h	XX00	RL = X REV = X PINV = X BGR = X SM = "0" TB = X CPE = X
R02h	0200	B/C = "1" NW = "00000000"
R03h	6364	DCT = "0110" BT = "011" BTF = "0" DC = "0110" AP = "010"
R04h	04XX	PALM = "1" BLT = "00" OEA = note 2 SEL = X SWD = X
R05h		GHN = "1" XDK = "0" GDIS = "1" LPF = "1" DEP = "0" CKP = "1" VSP = note 2 HSP = "0" DEO = "1" DIT = "1" PWM = "0" FB = "100"
R0Ah	4008	BR = "1000000" CON = "01000"
R0Bh	D400	NO = "11" SDT = "01" EQ = "100"
R0Dh	3229	VRC = "011" VDS = "10" VRH = "101001"
R0Eh	3200	VDV = "1001000"
R0Fh	0000	SCN = "00000000"
R16h	9F80	XLIM = "100111111"
R17h		STH = "00" HBP = note 2 VBP = note 2
R1Eh	0052	nOTP = "0" VCM = "1010010"
R30h	0000	PKP1 = "000" PKP0 = "000"
R31h	0407	PKP3 = "100" PKP2 = "111"
R32h	0202	PKP5 = "010" PKP4 = "010"
R33h	0000	PRP1 = "000" PRP0 = "000"
R34h	0505	PKN1 = "101" PKN0 = "101"
R35h	0003	PKN3 = "000" PKN2 = "011"
R36h	0707	PKN5 = "111" PKN4 = "111"
R37h	0000	PRN1 = "000" PRN0 = "000"
R3Ah	0904	VRP1 = "01001" VRP0 = "0100"
R3Bh	0904	VRN1 = "01001" VRN0 = "0100"

## 8.2 Power Off Sequence

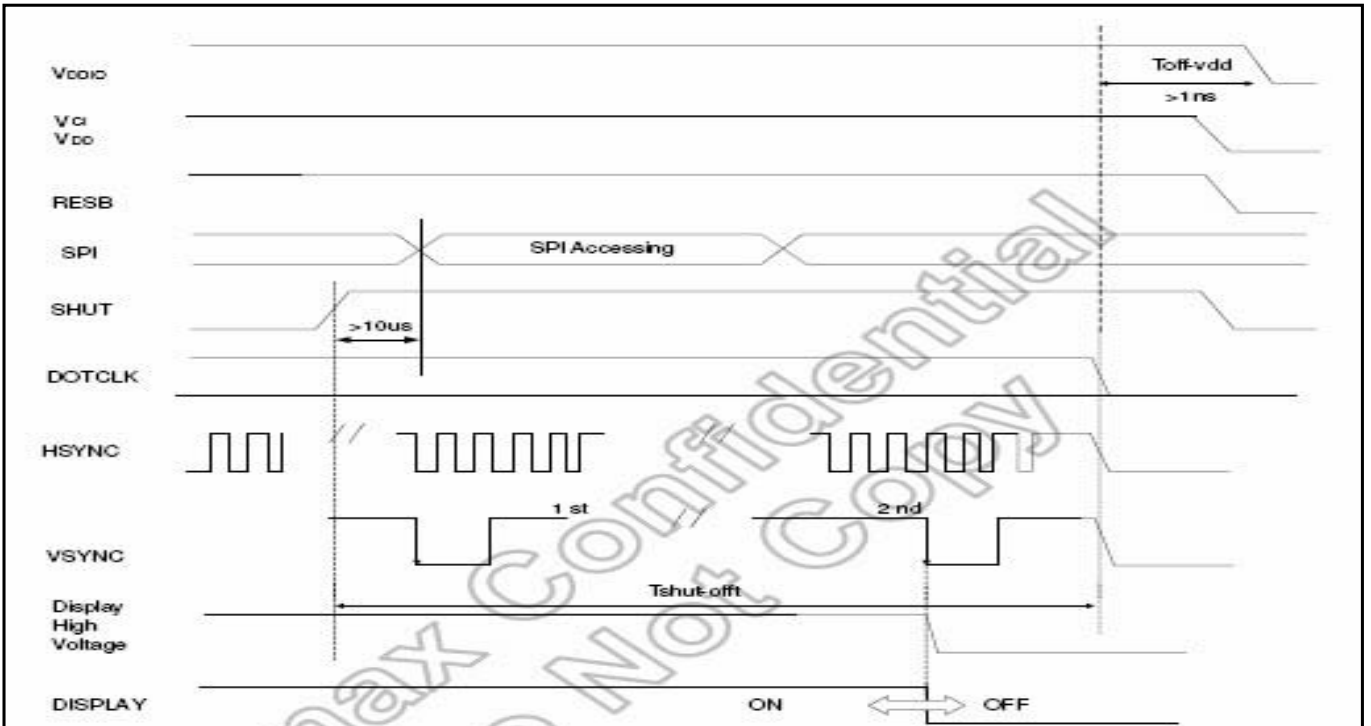


Figure 14. 11 Power Down Sequence

Characteristics	Symbol	Min	Typ	Max	Uni
Rising edge of SHUT to display off	tshut-off	2	-	-	frame
- 1 line: 408 clk		33.4	-	-	ms
- 1 frame: 262 line - DOTCLK = 6.5MHz		1	-	-	us
Input-signal-off to VDDD / VDDIO off	toff-vdd	1	-	-	us

Note: DOTCLK must be maintained at least 2 frames after the rising edge of SHUT.  
 Display become off at the 2nd falling edge of VSTNC after the falling edge of SHUT.  
 If RESET signal is necessary for power down, provide it after the 2-frames-cycle of the SHUT period.

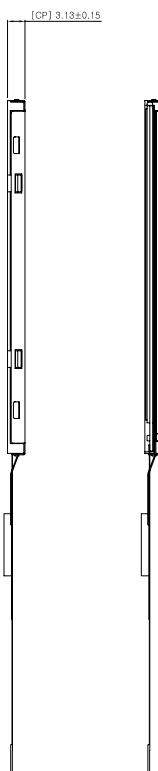
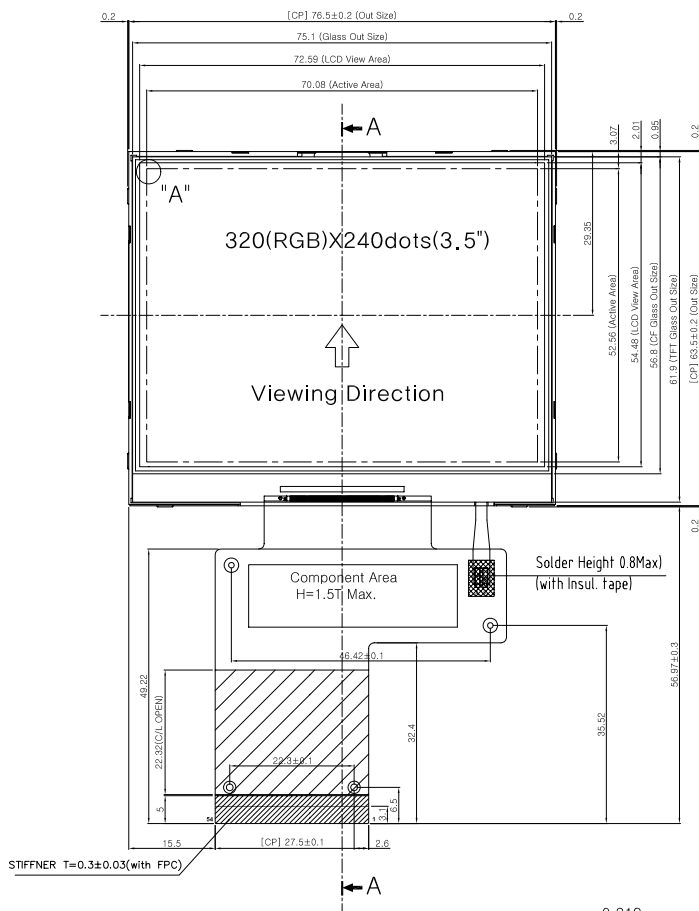
## 9. Outline Dimension

- Next Page Shown

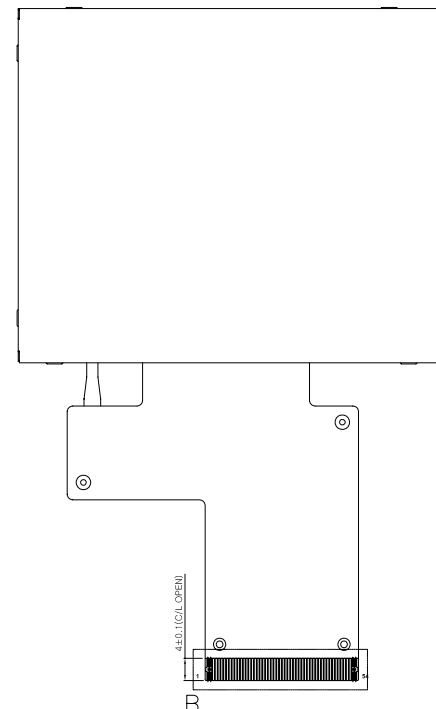


### 54-PIN TABLE

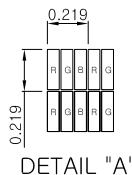
N0.	SYMBOL	N0.	SYMBOL
01	LED_Cathode	36	HSYNC
02	LED_Cathode	37	VSYNC
03	LED_Anode	38	DOTCLK
04	LED_Anode	39	AVDD
05	C6	40	AVDD
06	C5	41	VDD
07	M	42	VDD
08	RESET	43	C4
09	CS	44	VGL
10	SCL	45	VGL
11	SDI	46	C3
12	DATA0	47	VGH
13	DATA1	48	C2
14	DATA2	49	C1
15	DATA3	50	VCOM
16	DATA4	51	VCOM
17	DATA5	52	ENABLE
18	DATA6	53	GND
19	DATA7	54	GND
20	DATA8		
21	DATA9		
22	DATA10		
23	DATA11		
24	DATA12		
25	DATA13		
26	DATA14		
27	DATA15		
28	DATA16		
29	DATA17		
30	DATA18		
31	DATA19		
32	DATA20		
33	DATA21		
33	DATA22		
34	DATA22		
35	DATA23		



SECTION A-A'



DETAIL "B" SCALE=2/1



DETAIL "A"

NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	SPEC NO	REMARK

#### NOTES

1. Display type : 3.5", a-Si TFT
2. Driver LSI : HX8238-A
3. Viewing Direction : 6 O'clock
4. Operating Temperature : -20°C TO 60°C
5. Storage Temperature : -30°C TO 70°C
6. Backlight : white LED (6 Chip 1-way)

#### GENERAL TOLERANCE

STEP	LEVEL	LEVEL2	LEVEL3
0 < X < 4	±0.05	±0.1	±0.2
4 < X < 16	±0.1	±0.15	±0.3
16 < X < 64	±0.15	±0.20	±0.4
64 < X < 256	±0.20	±0.25	±0.5

00	07.06.15	Initial Release						
REV	DATE	DISCRIPTION OF REVISION				REASON		CHK'D BY
UNIT	mm	DRA'N BY	DES'D BY	CHK'D BY	APP'D BY	MODEL NAME	VMS-350GF01	
SCALE	N/S	Y.J.Song				PART/SHEET NAME	LCM-ASSY	SHEET 1 / 1
TOLERANCE		07.06.15				CODE NO.		VER. 00
<b>VODA TECH</b> Vision On Display Application						SPEC. NO		

**10. Packing**  
**TBD**

## 11. Marking & Others

Refer to additional drawing

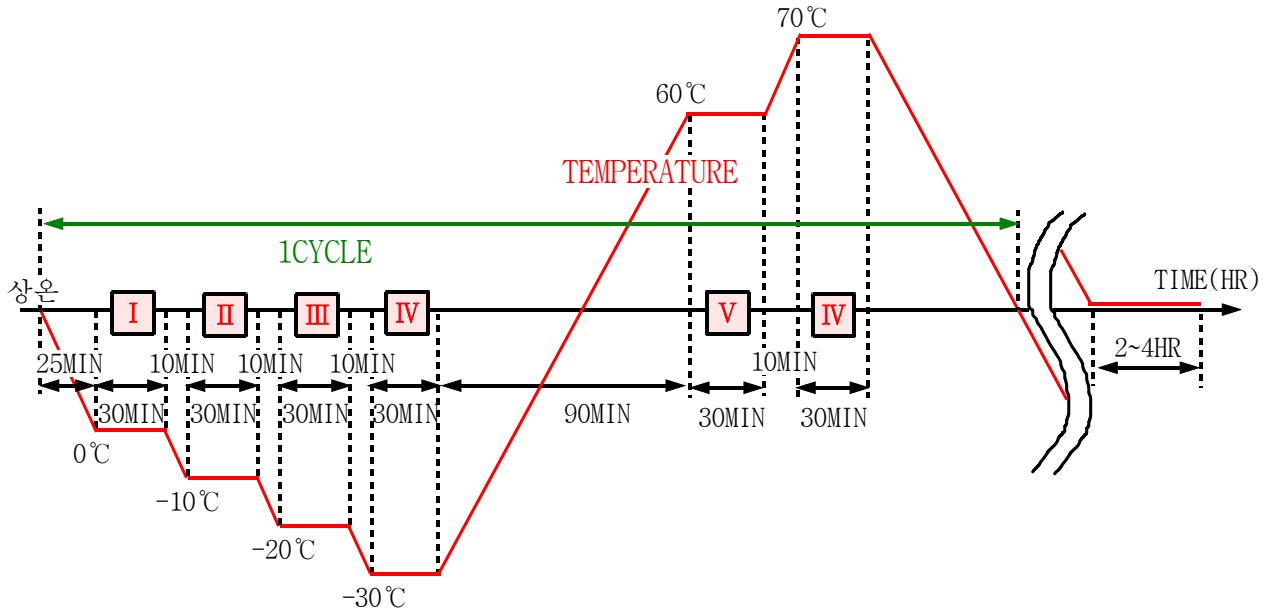
NO FIXED (Decision After Negotiation )

## 12. Reliability Test Result

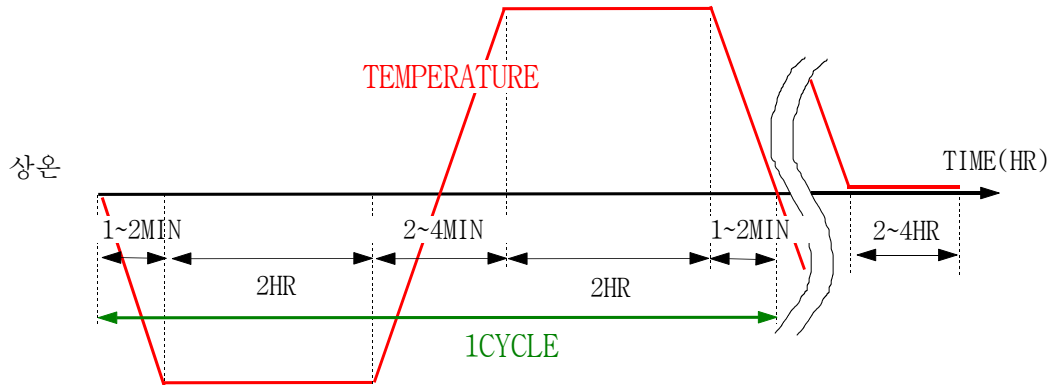
### 12.1 Condition

Item	Condition	Sample Size	Test Result	Note	
High Temperature Operating Life test	60°C , 240HR	10ea	PASS		
Low Temperature Operating Life test	-20°C , 240HR	5ea	PASS		
Thermal Humidity Bias test	50°C , 90%RH, 240HR	10ea	PASS		
Temperature Cycle ON/OFF test	-30°C ⇔ 70°C ON/OFF, 12CY	5ea	PASS	(1)	
High Temperature Storage test	70°C , 240HR	5ea	PASS		
Low Temperature Storage test	- 30°C , 240HR	5ea	PASS		
Wet High Temperature Storage test	60°C , 90%RH, 240HR	10ea	PASS		
Thermal Shock test (Storage)	-30°C ⇔ 70°C , 100CY	10ea	PASS	(2)	
Low Air Pressure Storage test	188mbar , 72HR	5ea	PASS		
ESD	Contact	SHIELD ±4kV NUDE ± 8kV, 150pF/330Ω	5ea	PASS	(3)
	Air	SHIELD ±8kV NUDE ±15kV, 150pF/330Ω	5ea	PASS	(3)
	Pad	±2kV, 100pF/1500Ω	5ea	PASS	(3)
Case Vibration Test	RANDOM VIBRATION MIL-STD 810E, Y axis	1box	PASS	(4)	
Box Drop Test	1 Color 3 Edges 6 Faces, 9.2~18.2kg 66cm	1box	PASS		

Note (1) ON Time over 10 seconds, OFF Time under 10 seconds



Note (2) Storage



Note (3) Main LCD, 5 times to every 4 corners of active area

Note (4) Basic transportation by common carrier environmental,  
514.4 MIN-STD-810E

### 12.2 Judgement

- Main LCD should work under the normal condition
- During the temperature and humidity test, the luminance and C/R(Contrast Ratio) should not be changed over 50% compared with those before the test.

## 13. Quality Specifications

### 13-1. Acceptable Quality Level(AQL)

Defect type	Sampling procedures	AQL
Major	MIL-STD-105E Inspection level II normal inspection single sample inspection	1%
Minor	MIL-STD-105E Inspection level II normal inspection single sample inspection	1.5%

- Major defect :

A major defect refers to a defect which is not considered to substantially degrade usability for product applications.

- Minor defect :

A minor defect refers to a defect which is not considered to substantially degraded product application, or a defect which deviates from existing standards almost unrelated to the effective use of the product or it's operation.

### 13-2. Inspection conditions

- The environmental conditions for inspection shall be as follows.

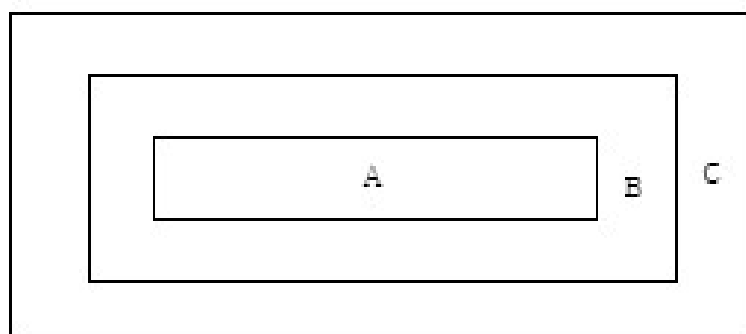
Room temperature :  $25 \pm 5^{\circ}\text{C}$

Humidity :  $65 \pm 10\%RH$

- The external visual inspection

The inspection shall be performed by using a single 20W fluorescent lamp for illumination and the distance from LCD to eyes of the inspector should be 50cm or more.

### 13-3. Definition of inspection zone in LCD



Zone A: Character/Digit area

Zone B: Viewing area  
(Except zone A)

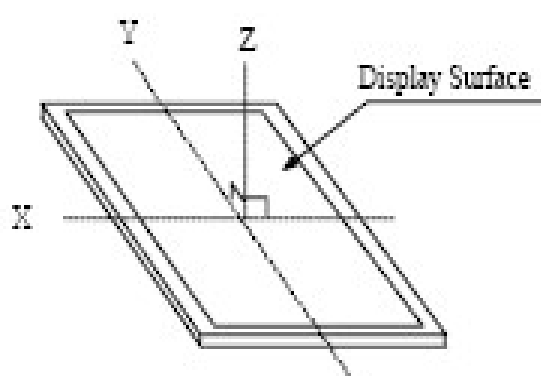
Zone C: Outside viewing area  
(Invisible area after assembly in customer's products)

## 13-4. Inspection method

### 13-4-1 Definition of Dark/Bright Spot or Line

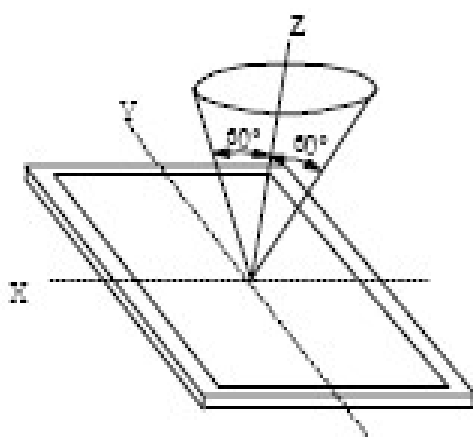
ITEM	Criterion for defects
Dark/Bright Spot (Stain,Dust)	Points on the display which appear dark/bright and remain unchanged in size
Dark/Bright Line (lint)	Lines on the display which appear dark/bright and remain unchanged in size

#### (1) Light method



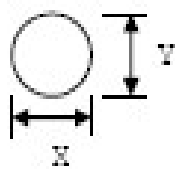
Fluorescent lamp set the perpendicular to the Display surface

#### (2) Inspection distance and angle



Inspection should be performed within  $\phi$  ( $\phi$  is usually  $30^\circ$ ) from Z axis to each X and Y axis. Inspection distance of any direction within  $\phi$  must be kept  $50 \pm 5$ cm to the display surface.

## 13-5. Incoming Inspection standards

ITEM	Criterion for defects	Defect type																			
1) Display on Inspection (Main & Sub)	(1) Non display is not allowed (2) Irregular (abnormal) operations are not allowed (3) Shorts pattern is not allowed (4) Pattern open is not allowed (5) All kinds of line defect such as Vertical, Horizontal, Cross are not allowed (6) Over current is not acceptable (7) Maximum rating (8) No Back lighting is reject Backlight flickering and abnormal lighting are reject	Major																			
2) Dark/Bright Spot Pinhole, Foreign Particle Scratch (Main & Sub) $(\phi = (X+Y)/2)$ 	<table border="1" data-bbox="526 952 1204 1142"> <thead> <tr> <th rowspan="2">Zone Size(mm)</th> <th colspan="3">Acceptable Q'ty</th> </tr> <tr> <th>A,</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\phi &lt; 0.2</math></td> <td colspan="2">Acceptable</td> <td rowspan="2">Acceptable</td> </tr> <tr> <td><math>0.2 \leq \phi \leq 0.5</math></td> <td colspan="2">3</td> </tr> </tbody> </table> <p data-bbox="526 1198 1125 1243">Note: NG if three or more spot crowd together</p>	Zone Size(mm)	Acceptable Q'ty			A,	B	C	$\phi < 0.2$	Acceptable		Acceptable	$0.2 \leq \phi \leq 0.5$	3		Minor					
Zone Size(mm)	Acceptable Q'ty																				
	A,	B	C																		
$\phi < 0.2$	Acceptable		Acceptable																		
$0.2 \leq \phi \leq 0.5$	3																				
3) Dark/Bright Line Polarizer Scratch (Main & Sub)	<table border="1" data-bbox="502 1344 1228 1556"> <thead> <tr> <th colspan="2">Size(mm)</th> <th colspan="3">Acceptable Q'ty</th> </tr> <tr> <th>Length(mm)</th> <th>Width(mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>-</td> <td><math>W &lt; 0.02</math></td> <td colspan="2">Acceptable</td> <td rowspan="2">Acceptable</td> </tr> <tr> <td><math>L \leq 2</math></td> <td><math>0.02 &lt; W \leq 0.05</math></td> <td colspan="2">3</td> </tr> </tbody> </table>	Size(mm)		Acceptable Q'ty			Length(mm)	Width(mm)	A	B	C	-	$W < 0.02$	Acceptable		Acceptable	$L \leq 2$	$0.02 < W \leq 0.05$	3		Minor
Size(mm)		Acceptable Q'ty																			
Length(mm)	Width(mm)	A	B	C																	
-	$W < 0.02$	Acceptable		Acceptable																	
$L \leq 2$	$0.02 < W \leq 0.05$	3																			
4) Bubble in polarizer (Main & Sub)	<table border="1" data-bbox="478 1657 1252 1971"> <thead> <tr> <th rowspan="3">Size(mm)</th> <th colspan="3">Acceptable</th> </tr> <tr> <th colspan="3">Zone</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\phi &lt; 0.3</math></td> <td colspan="2">Acceptable</td> <td rowspan="2">Acceptable</td> </tr> <tr> <td><math>0.3 \leq \phi \leq 0.50</math></td> <td colspan="2">3</td> </tr> </tbody> </table>	Size(mm)	Acceptable			Zone			A	B	C	$\phi < 0.3$	Acceptable		Acceptable	$0.3 \leq \phi \leq 0.50$	3		Minor		
Size(mm)	Acceptable																				
	Zone																				
	A	B	C																		
$\phi < 0.3$	Acceptable		Acceptable																		
$0.3 \leq \phi \leq 0.50$	3																				



5) Dot	Size(mm)	Acceptable			Major
		Zone			
		A	B	C	
Bright Dot		0		Acceptable	
Dark Dot(Random)		3			
Dark Dot(2 adjacent dot)		1			
6) Stains on LCD panel surface (Main & Sub)	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning tool are reject			Minor	
7) Back-light (Main & Sub)	1) The brightness and color of Backlight should correspond to specification. 2) Dust and black dot on Back light $\phi \leq 0.20$			Minor	
8) Defect of land surface contact (Poor soldering) (Main & Sub)	Evident crevices which is visible are reject			Minor	
9) Parts mounting (Main & Sub)	1) Failure to mount parts. 2) Parts not in the specifications are mounted. 3) Polarity is reversed.			Minor	
10) Parts alignment (Main & Sub)	1) LSI, IC lead width is more than 70% beyond pad outline. 2) Chip component is off center and more than 70% of the leads is off the pad outline.			Minor	
11) Solder Ball Solder chip (Main & Sub)	1) $0.45 \leq \phi, N \geq 1$ 2) $0.30 \leq \phi \leq 0.45, N \geq 1$ $\phi$ : Average diameter of solder ball(unit:mm) 3) $0.50 \leq L, N \geq 1$ $L$ : Average length of solder chip(unit:mm)			Minor Minor Minor	
12) Faulty PWB correction (Main & Sub)	1) Failure to stamp or label error, or not legible (all acceptable if legible). 2) The separation is more than 1/3 forbidden indication, Discoloration, In which the characters can be checked			Minor	

## 14. General Precautions

### 14-1. Handling

- Assembled, LCD module should be firmly attached to the set.  
Do not bent or twist.
- Refrain from strong mechanical shock and forces to the module.  
It may cause improper operating or damage to the module.
- Do not touch, press or rub the display panel with hard or stiff tools or subjects.  
The polarizer is easily damaged.
- Wipe off water or oil drop immediately  
If you leave drop for a long time, stain and discoloration may occur.
- When cleaning the surface of polarizer, use soft cloth with solvent like Isopropyl or Ethyl alcohol or Hexane.  
Do not use Water, Ketone, Acetone, Ethyl alcohol, Toluene, Ethyl acid, Methyl chloride.
- Be care full of applying HCFC, Chlorine(CL), Salfur(S), Spittle, Fingerprint to ITO pattern  
These may cause ITO corrosion.
- When handling the LCD module, put on a soft glover like finger-glover.
- Protection film on the polarizer shall be slowly peeled off just before use, so that the electrostatic charge can be minimized.
- Do not touch pads or pins of interface directly with bare hands.
- Protect the module from static electricity, it may cause damage to CMOS LSI.
- If the liquid crystal leaks from the panel it should be kept away from the eyes and mouths.  
In case of contact with skins, wash away thoroughly with soap and water.

### 14-2. Operation

- Do not input any signals before power is turned on.
- Do not connect or disconnect the module on the state of Power-ON.
- Power supply should be turned on or off according to Power ON/OFF sequence.
- Supply voltage within the specified voltage limit, the maximum rating, higher voltage cause the shorter LCD life or damaged.
- Avoid condensation of water, It may cause improper operation or disconnection of electrode.
- Do not leave LCD module in direct sunlight and strong ultraviolet ray for many hours. At that time the liquid crystal shall be deteriorated by ultraviolet.

### 14-3. Storage

- Do not leave the module in high temperature and humidity for a long time.  
It is recommended to store the module in the place with temperature from 0 to 35°C and relative humidity of less than 70%.
- Do not store the LCD module in the direct sunlight.
- Store the module in a dark place without sunlight and fluorescent.
- Avoid intensive shock and falls from a height.