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# APPROVAL SHEET

## 承認書

Customer 客戶名稱	
Part No. 產品型號	TVL-55739GD032J-LW-G-AAN
Product type 產品內容	Mode: Trans-missive Type, Positive mode 3.2" TFT LCD module 262K Colors
RoHS 綠色產品	<input type="checkbox"/> Non-compliance <input checked="" type="checkbox"/> Compliance
Remarks 備註欄	
<p><input checked="" type="checkbox"/> Preliminary Specification 暫行規格</p> <p><input type="checkbox"/> Final Specification 正式規格</p> <p>Signature by Customer: 客戶確認簽章:</p>	

Issued by QA	Checked by QA	Checked by PM	Approved By	
			QA	RD



KYOCERA Display Corporation

RoHS  
COMPLIANT

## Specification of LCD Module

Product No.: TVL-55739GD032J-LW-G-AAN

Issue date: 2013/02/21

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
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## 1. GENERAL DESCRIPTION

TVL-55739GD032J-LW-G-AAN is a Trans-missive type color active matrix liquid crystal display (LCD), which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, driver IC, FPC backlight and a bezel unit. The following table described the features of TVL-55739GD032J-LW-G-AAN.

## 2. FEATURES

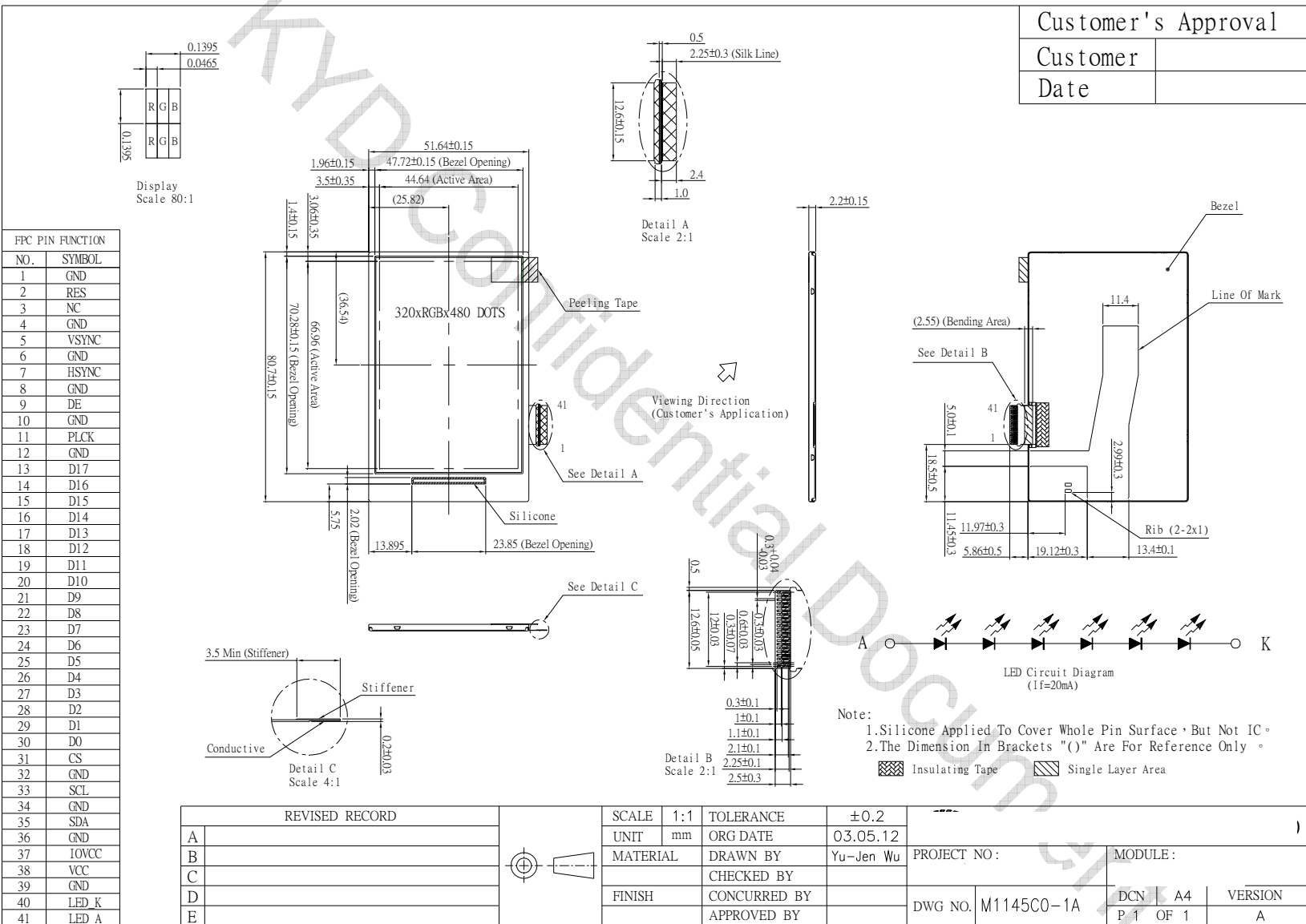
Display Mode	Transmissive Type
	TFT LCD, Positive
Display Format	RGB Strip type
Driver IC.	ILI9481B
Color	262K color
Interface	18 bits RGB interface
Viewing Direction	Higher Contrast ratio: 6 o'clock
	Less gray scale reversal: 12 O'clock 
Backlight type / color	LED / white *6

## 3. MECHANICAL SPECIFICATION

Item	Specifications	Unit
Dimensional outline	51.64(W)×80.7(H)×2.2(D)	mm
Resolution	320×3(R,G,B)×480	dot
Active area	44.64(W)×66.96(H)	mm
Pixel pitch	0.1395(W)×0.1395(H)	mm

# 4. MECHANICAL DIMENSION

Customer's Approval	
Customer	
Date	



## 5. MAXIMUM RATINGS

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

Item	Symbol	Values		Unit	Condition
		Min.	Max.		
Power Supply for Analog	VCC	-0.3	4.6	V	
Power Supply for Digital	IOVCC	-0.3	4.6	V	
Storage Temperature	T <sub>ST</sub>	-30	80	°C	
Operating Temperature (Ambient Temperature)	T <sub>OP</sub>	-20	70	°C	
Humidity	-	-	90	%RH	Note 1

Note1: T<sub>A</sub> ≤ 40°C Without dewing

Note2:

- a. All of voltage listed above are with respective to GND=0V.
- b. Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above.

## 6. ELECTRICAL CHARACTERISTICS

### 6.1. TFT LCD Characteristic

Typical operating conditions

(GND=AVSS=0V)

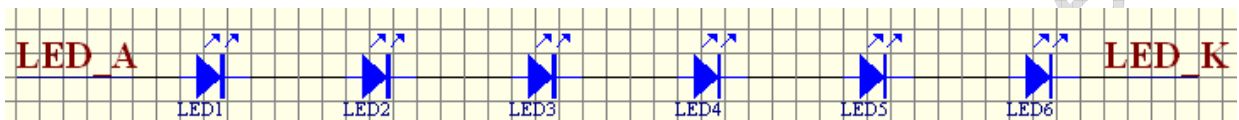
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Analog Power Supply Voltage	VCI	2.5	2.8	3.3	V	
I/O pin Power Supply Voltage	IOVCC	1.65	1.8	3.3	V	
Driver Input signal voltage	H	V <sub>IH</sub>	0.7*IOVCC	-	IOVCC	V
	L	V <sub>IL</sub>	0	-	0.3*IOVCC	V
Driver output signal voltage	H	V <sub>OH</sub>	0.8*IOVCC	-	IOVCC	V
	L	V <sub>OL</sub>	0	-	0.2*IOVCC	V
Supply Current for Logic	IDD	-	16	24	mA	
Sleep current	I <sub>slp</sub>	-	60	100	μA	
Frame Frequency	f <sub>Frame</sub>	-	60	-	Hz	



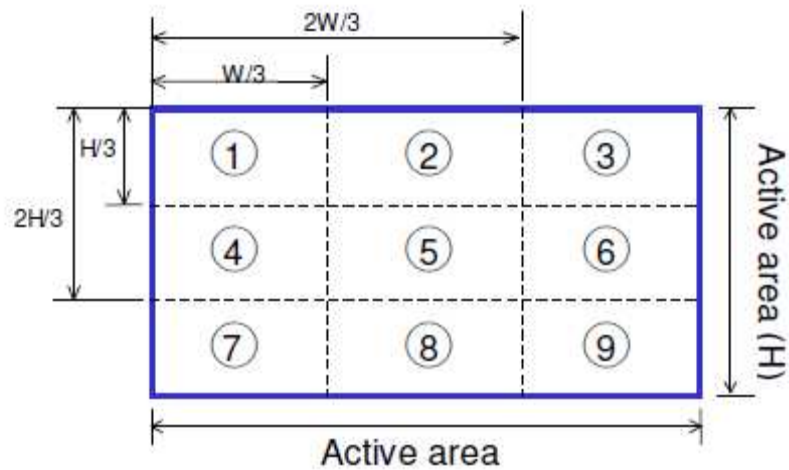
## 6.2. Backlight Characteristic

### 6.2.1. CHARACTERISTIC

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LED Current	$I_F$	-	20	-	mA	
LED Voltage	$V_F$	17.4	-	21.6	V	



### 6.2.2. LIGHTGUIDE SPECIFICATION



- Test Instrument : BM-7 (Distance =500mm ; Field = 1°)
- Light Source : LED \* 6 (White)
- Conditions :  $I_f = 20$  mA(typ)
- Measure Brightness : 1 ~ 9
- Uniformity = (Min. Brightness / Max. Brightness)\*100%
- Uniformity  $\geq 75\%$

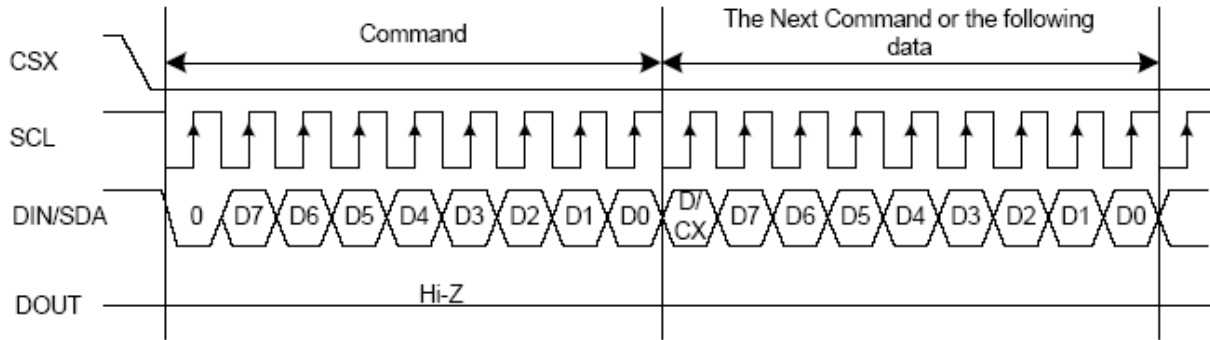
## 7. MODULE FUNCTION DESCRIPTION

### 7.1. PIN Description

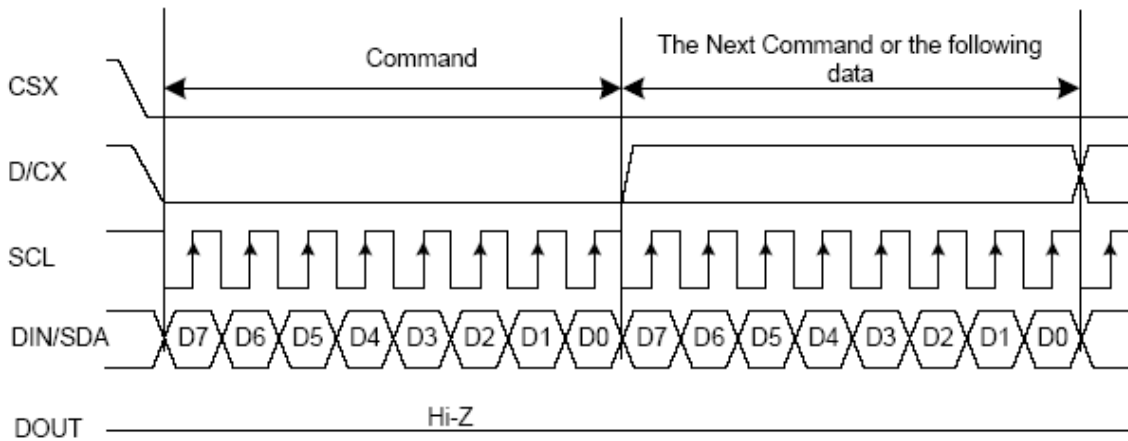
Pin	Symbol	Function
1	GND	Ground
2	RES	This signal low will reset the device and must be applied to properly initialize chip. Signal is low active.
3	NC	No Connect
4	GND	Ground
5	VSYNC	Vertical Sync Input
6	GND	Ground
7	HSYNC	Horizontal Sync Input
8	GND	Ground
9	DE	Data enable signal input
10	GND	Ground
11	PCLK	Pixel clock signal in DPI interface mode
12	GND	Ground
13~30	D17~D0	Data Bit 17~Data Bit 0
31	CS	Chip Select Pin
32	GND	Ground
33	SCL	Serial clock input pin.
34	GND	Ground
35	SDA	Serial data input pin.
36	GND	Ground
37	IOVCC	Power supply for digital circuit
38	VCC	Power supply for analog circuit
39	GND	Ground
40	LED_K	Backlight LED Power (-)
41	LED_A	Backlight LED Power (+)

## 7.2. Timing characteristics

### 7.2.1. Serial Interface(Type C)



DBI Type C Interface Write Sequence - Option 1



DBI Type C Interface Write Sequence - Option 3

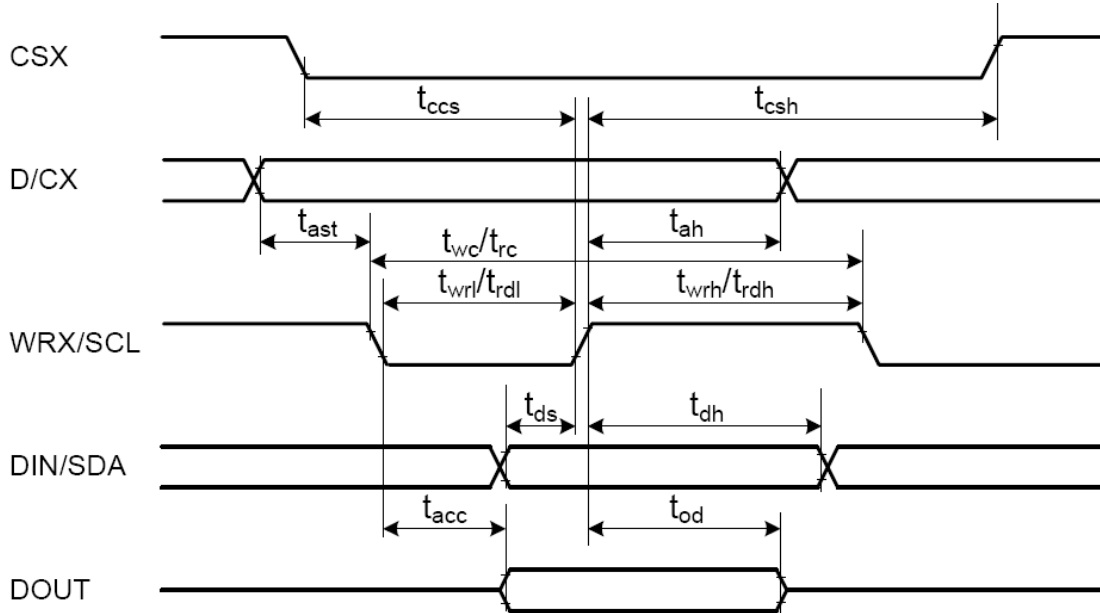
Note:

1. D7 is MSB and D0 is LSB of byte.
2. When the Interface control register (C6h) SDA\_EN is set as '1', the DIN/SDA pin is bi-direction and DOUT pin is not used.
3. When the Interface control register (C6h) SDA\_EN is set as '0', the DIN/SDA pin is uni-direction and DIN and DOUT pins are used for data write and read.



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### 7.2.2. DBI Type C Timing Characteristics

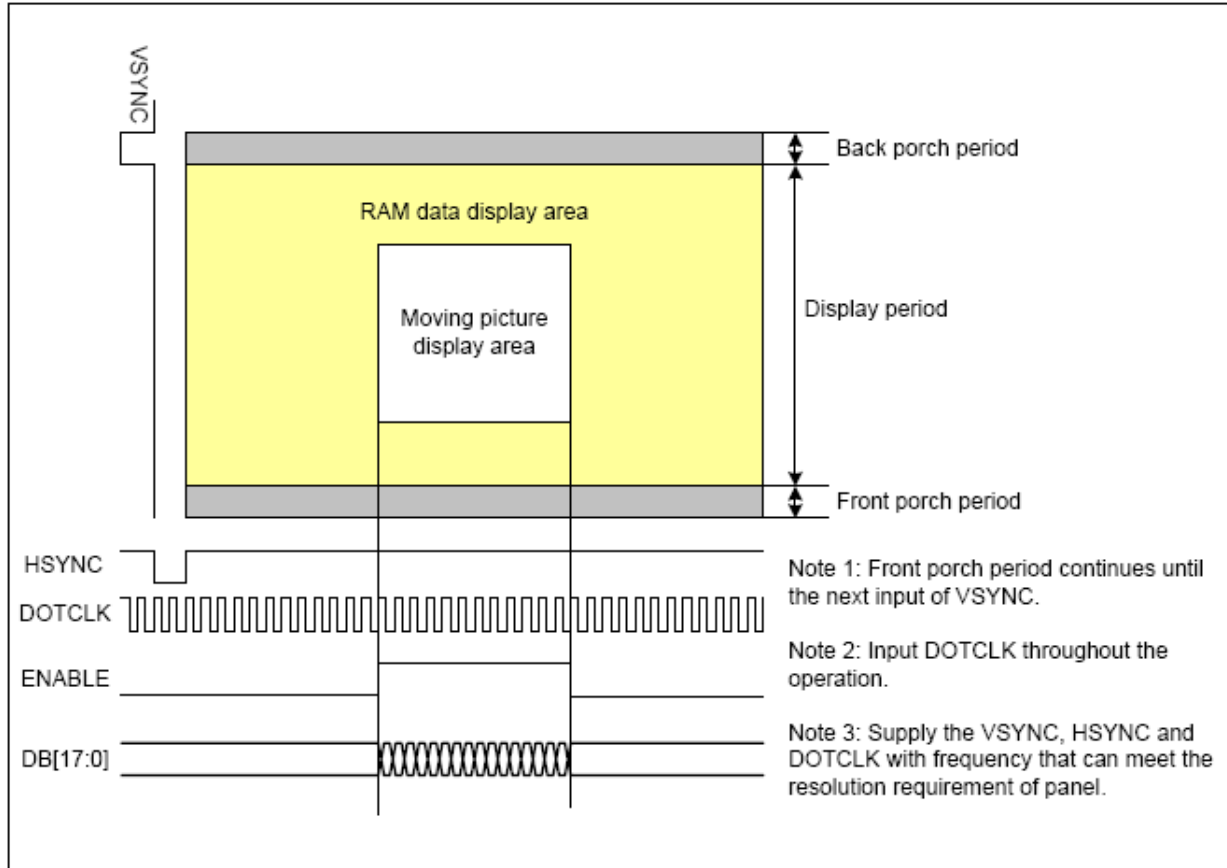


Signal	Symbol	Parameter	Min.	Max.	Unit	Description
CSX	$t_{ccs}$	Chip select setup time (Write)	40	-	ns	
	$t_{csh}$	Chip select hold time (Write)	40	-	ns	
D/CX	$t_{as}$	Address setup time	10		ns	
	$t_{ah}$	Address hold time (Write/Read)	10		ns	
WRX/SCL (Write)	$t_{wc}$	Write cycle	100		ns	
	$t_{wrh}$	SCL High duration (write)	50		ns	
	$t_{wrl}$	SCL Low duration (write)	50		ns	
WRX/SCL (Read)	$t_{rc}$	Read cycle	300		ns	
	$t_{rdh}$	SCL High duration (read)	120		ns	
	$t_{rdl}$	SCL Low duration (read)	120		ns	
DIN/SDA (Driver IC)	$t_{ds}$	Data setup time	30		ns	
	$t_{dh}$	Data hold time	30		ns	
DOUT (Driver IC)	$t_{acc}$	Access time	-	110	ns	
	$t_{od}$	Output disable time	10		ns	



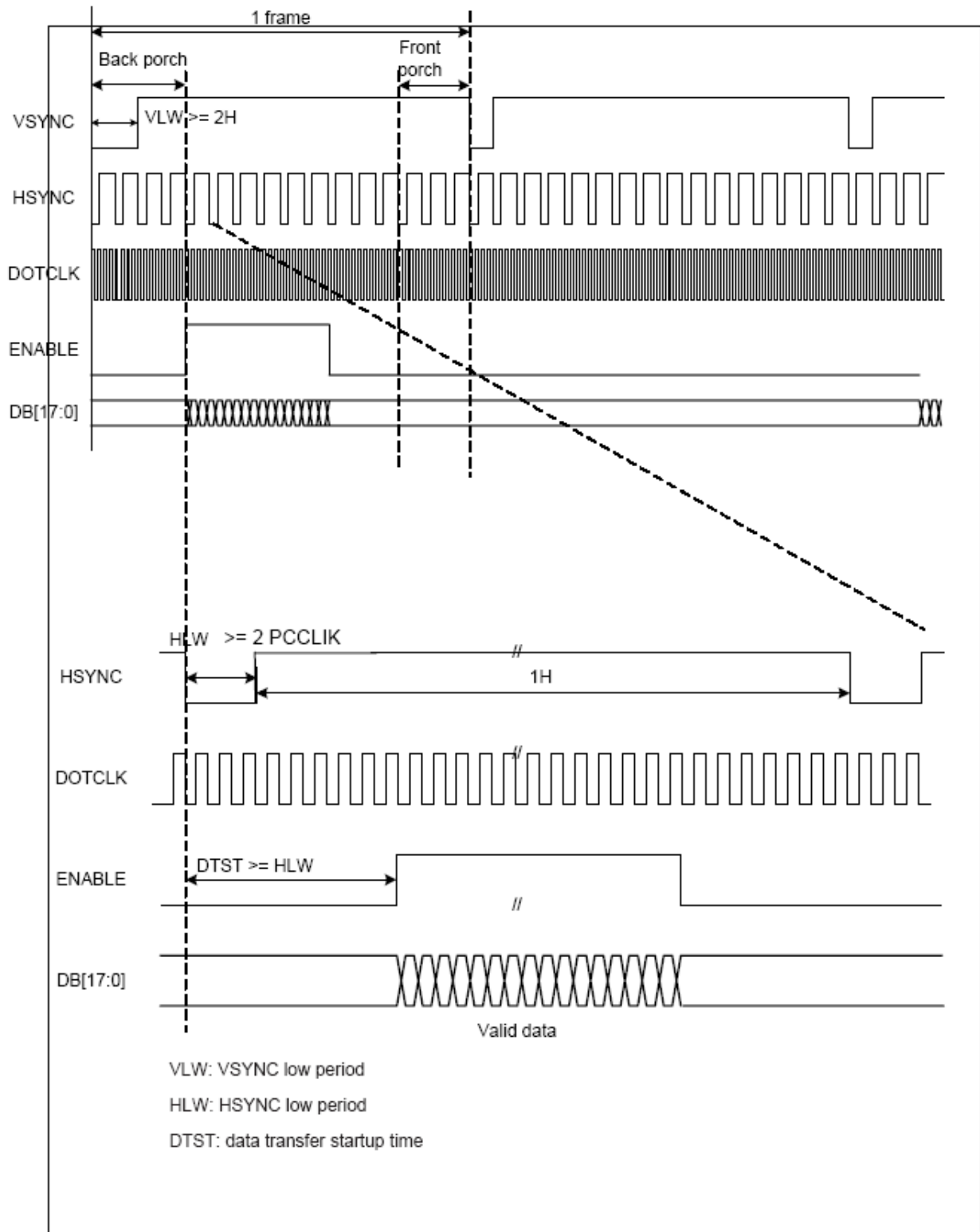
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### 7.2.3. Display Pixel Interface (DPI)



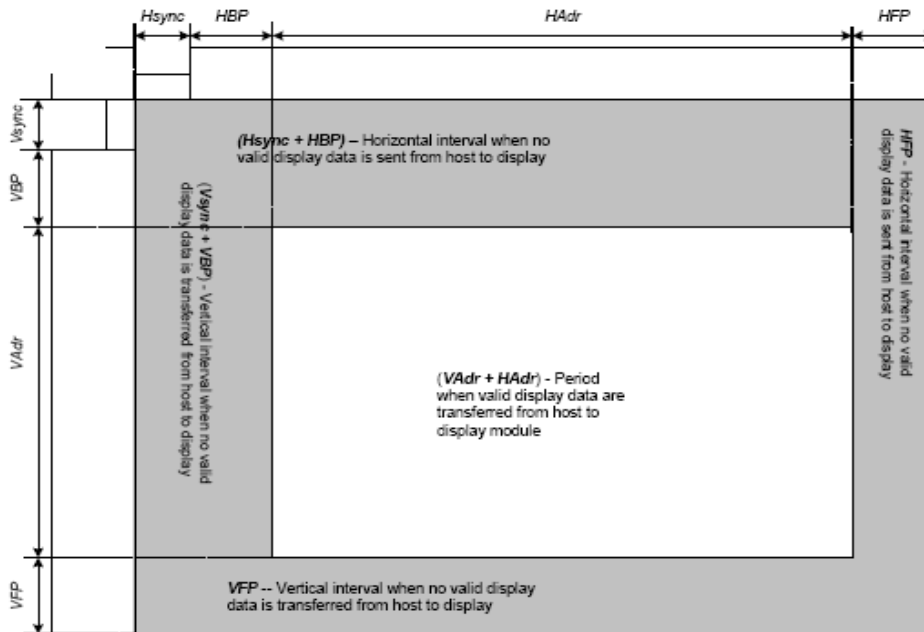


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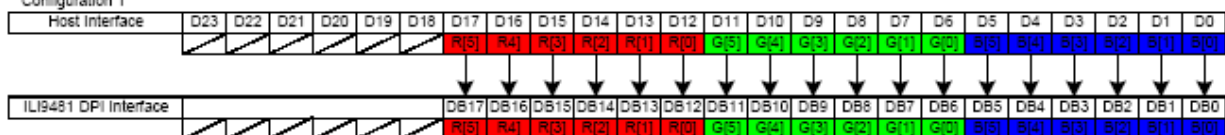
Parameters	Symbols	Condition	Min.	Typ.	Max.	Units
PCLK Cycle	PCLK <sub>CYC</sub>		-	125	104	ns
Horizontal Synchronization	Hsync		2	2	4	PCLK
Horizontal Back Porch	HBP		3	3	20	PCLK
Horizontal Address	HAdr		-	320	-	PCLK
Horizontal Front Porch	HFP		3	3	40	PCLK
Vertical Synchronization	Vsync		2	2	-	Line
Vertical Back Porch	VBP		2	2	30	Line
Vertical Address	VAdr		-	480	-	Line
Vertical Front Porch	VFP		2	4	30	Line
Vsync setup time	VSST					Hz
Vsync hold time	VSHT					Hz
Hsync setup time	HSST					Hz
Hsync hold time	HSHT					Hz
Data setup time	DST					Hz
Data hold time	DHT					Hz
Vertical Frequency(*)				50	60	Hz
Horizontal Frequency(*)			-	-	-	KHz
PCLK Frequency(*)			-	8	9.6	MHz

Notes:

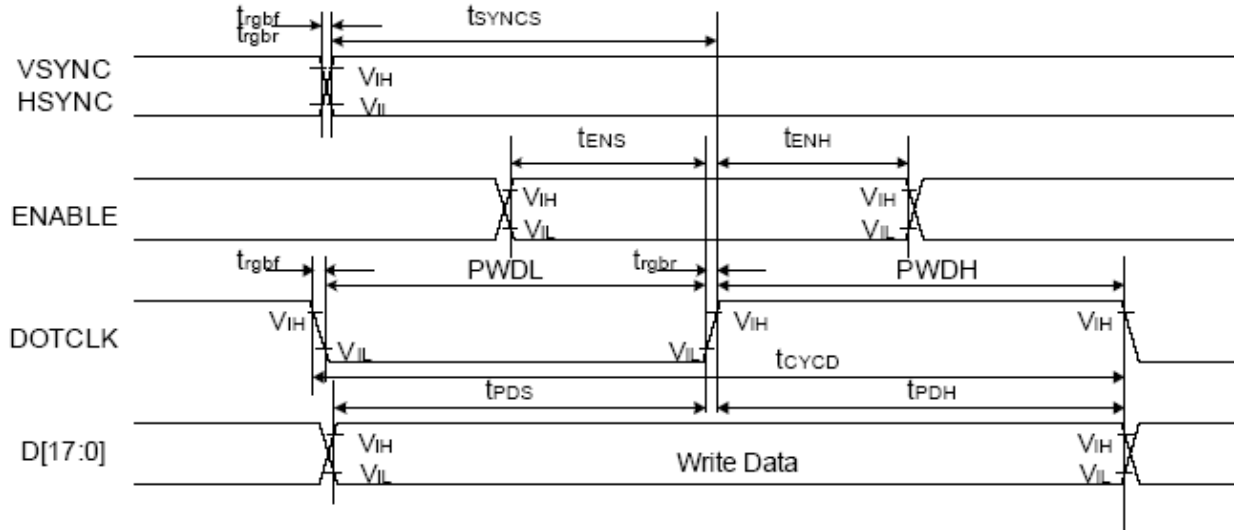
1. Vertical period (one frame) shall be equal to the sum of Vsync + VBP + VAdr + VFP.
2. Horizontal period (one line) shall be equal to the sum of Hsync + HBP + HAdr + HFP.
3. Control signals PCLK and Hsync shall be transmitted as specified at all times while valid pixels are transferred between the host processor and the display module.

### 18bit DPI Interface Connection: set\_pixel\_format D[6:4]=3'h6 : 18bpp

Configuration 1



### 7.2.4. DPI Interface Timing Characteristics



Signal	Symbol	Parameter	min	max	Unit
VSYNC / HSYNC	$t_{SYNCS}$	VSYNC/HSYNC setup time	15	-	ns
	$t_{SYNCH}$	VSYNC/HSYNC hold time	15	-	ns
ENABLE	$t_{ENS}$	ENABLE setup time	15	-	ns
	$t_{ENH}$	ENABLE hold time	15	-	ns
D[17:0]	$t_{POS}$	Data setup time	15	-	ns
	$t_{PDH}$	Data hold time	15	-	ns
DOTCLK	PWDH	DOTCLK high-level period	52	-	ns
	PWDL	DOTCLK low-level period	52	-	ns
	$t_{CYCD}$	DOTCLK cycle time	104	-	ns
	$t_{rgbr}$ , $t_{rgbf}$	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns





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### 7.3. Initialization Table

Initial Sequence					
Step	Instruction/Parameters	R/W	D/CX	Reg.	Description
1	Power on	Power Supply			
2	Delay	1ms			
3	Power on reset	Reset Pin = Low			
4	Delay	10ms			
5	Power on reset	Reset Pin = high			
6	Delay	50ms			
7	Soft_reset	W	0	01H	
8	Delay	20ms			
9	Exit_sleep_mode	W	0	11H	Sleep Out
10	Delay	80ms			
11	Set_address_mode	W	0	36H	
		W	1	88H	
12	Set_pixel_format	W	0	3AH	
		W	1	66H	
13	Power_Setting	W	0	D0H	
		W	1	07H	VCI1
		W	1	42H	DDVDH,VCL,VGH,VGL
		W	1	1BH	VREG1OUT
14	VCOM Control	W	0	D1H	
		W	1	00H	
		W	1	24H	VCOMH
		W	1	12H	VCOM AMPLITUDE
15	Power_Setting	W	0	D2H	For Normal Mode
		W	1	02H	
		W	1	00H	
16	Power_Setting	W	0	D3H	For Partial Mode
		W	1	01H	
		W	1	22H	
17	Power_Setting	W	0	D4H	For Idle Mode
		W	1	01H	
		W	1	22H	



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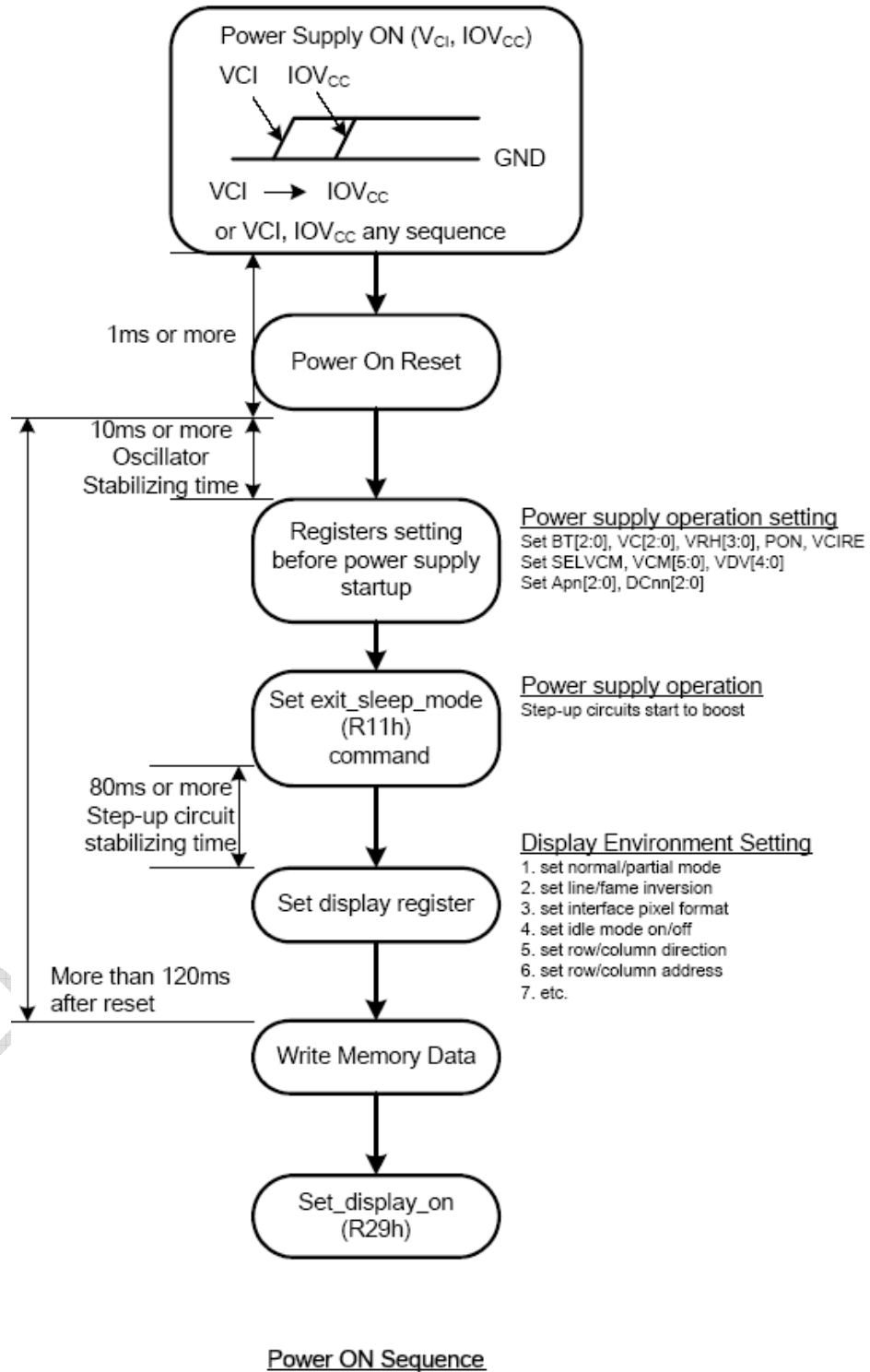
18	Panel Driving Setting	W	0	C0H	
		W	1	10H	
		W	1	3BH	
		W	1	00H	
		W	1	02H	
		W	1	00H	
19	Display_Timing_Setting	W	0	C1H	
		W	1	10H	
		W	1	10H	
		W	1	22H	
20	Frame Rate_Setting	W	0	C5H	
		W	1	04H	
21	Interface Control	W	0	C6H	
		W	1	02H	PCLK Setting
22	Gamma Setting	W	0	C8H	
		W	1	00H	
		W	1	37H	
		W	1	02H	
		W	1	26H	
		W	1	0BH	
		W	1	08H	
		W	1	46H	
		W	1	03H	
		W	1	77H	
		W	1	52H	
		W	1	00H	
		W	1	1EH	
23	NV Memory Write	W	0	E0H	
		W	1	00H	VM_D Setting
24	NV Memory Control	W	0	E1H	
		W	1	00H	VCM_PGM_EN Setting
25	NV Memory Status Read	W	0	E2H	
		W	1	00H	
		W	1	00H	
		W	1	00H	VCM data read value



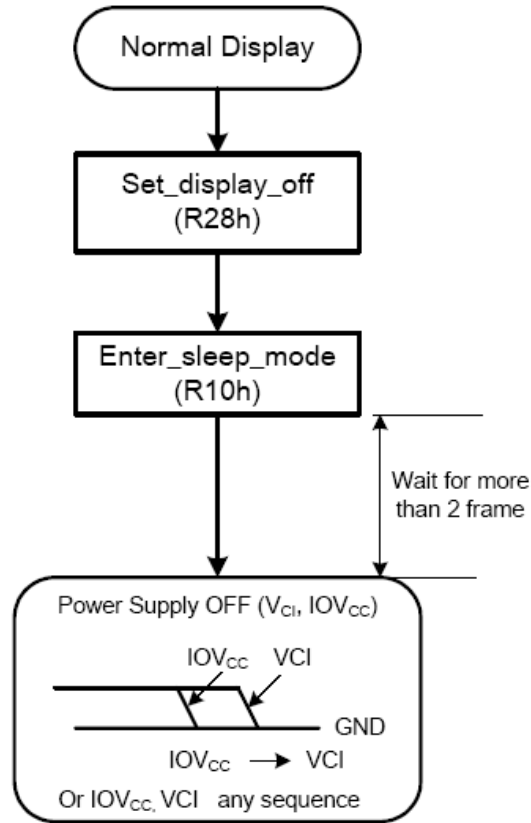
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26	NV Memory Protection	W	0	E3H	
		W	1	00H	
		W	1	00H	
27	Command Access Protect	W	0	B0H	
		W	1	00H	MCAP Setting
28	Frame Memory Access and Interface Setting	W	0	B3H	
		W	1	02H	Memory write control
		W	1	00H	
		W	1	00H	
		W	1	00H	
29	Display and Frame Memory Write Mode Setting	W	0	B4H	
		W	1	11H	DPI (RGB) interface
30	Power control	W	0	F3H	
		W	1	40H	
		W	1	0FH	
31	Power control	W	0	F6H	
		W	1	80H	
32	Power control	W	0	F7H	
		W	1	80H	
		W	1	01H	
33	Set_display_on	W	0	29H	Display On
34	Set_column_address	W	0	2AH	
		W	1	00H	
		W	1	00H	
		W	1	01H	
		W	1	3FH	
35	Set_column_address	W	0	2BH	
		W	1	00H	
		W	1	00H	
		W	1	01H	
		W	1	DFH	
36	Write memory start	W	0	2CH	

## 7.4. Power On Sequence



## 7.5. Power Off Sequence



Power OFF Sequence

## 8. ELECTRO-OPTICAL CHARACTERISTICS

LED backlight transmissive module: (EWV Polarizer)

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit	Conditions
Response time	Tr	25°C	--	20	30	ms	$\theta = 0^\circ$ , $\phi = 0^\circ$ (Note 2)
	Tf	25°C	--	10	15	ms	
Contrast ratio	CR	25°C	300	400	--	--	$\theta = 0^\circ$ , $\phi = 0^\circ$ LED:ON,LIGHT:OFF (Note 1)
Uniformity	--	--	75	--	--	%	--
Luminance of White	--	--	380	--	--	Cd/m <sup>2</sup>	--
Visual angle range front and rear	$\theta b$	25°C	60			Degree	$\phi = 0^\circ$ , CR $\geq$ 10 LED:ON, LIGHT:OFF (Note 3)
	$\theta f$	25°C	45				
Visual angle range left and right	$\theta l$	25°C	60			Degree	$\phi = 90^\circ$ , CR $\geq$ 10 LED:ON, LIGHT:OFF (Note 3)
	$\theta r$	25°C	60				
Visual angle direction priority	--	--	12 O'clock				Gray scale inversion (Note4)

### 8.1. CIE(x, y) chromaticity

Item	Symbol	Transmissive			Conditions
		Min.	Typ.	Max.	
Red	X	0.60	0.64	0.68	$\theta = 0^\circ$ , $\phi = 0^\circ$ BM-5A 1° angle
	y	0.30	0.34	0.38	
Green	X	0.35	0.39	0.43	
	y	0.52	0.56	0.60	
Blue	X	0.11	0.15	0.19	
	y	0.02	0.06	0.10	
White	X	0.28	0.32	0.36	
	y	0.28	0.32	0.36	
NTSC	%	56			

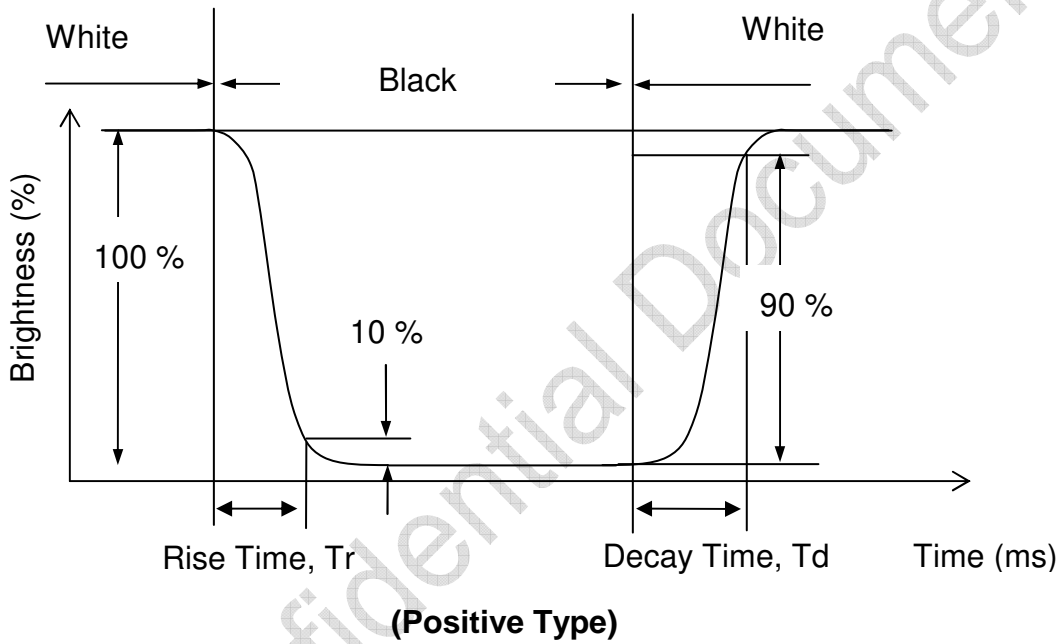
**FOR LCM**

**NOTE 1: Definition of Contrast Ratio (CR).**

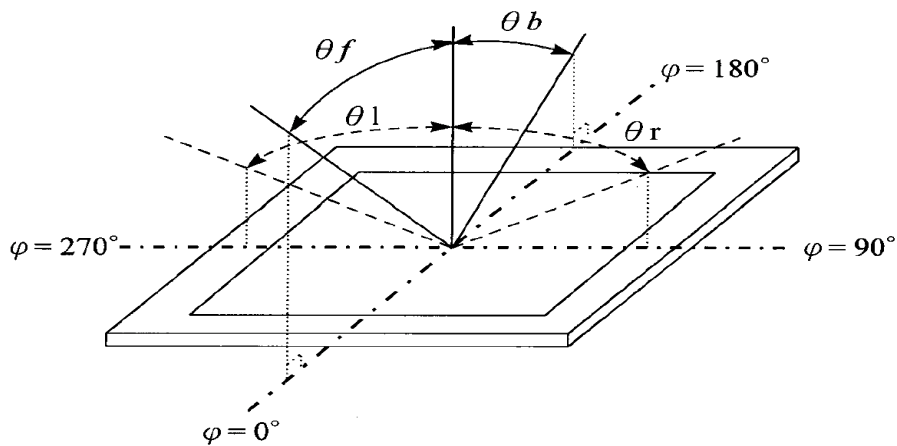
Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector output when LCD is at "Black" state}}$$

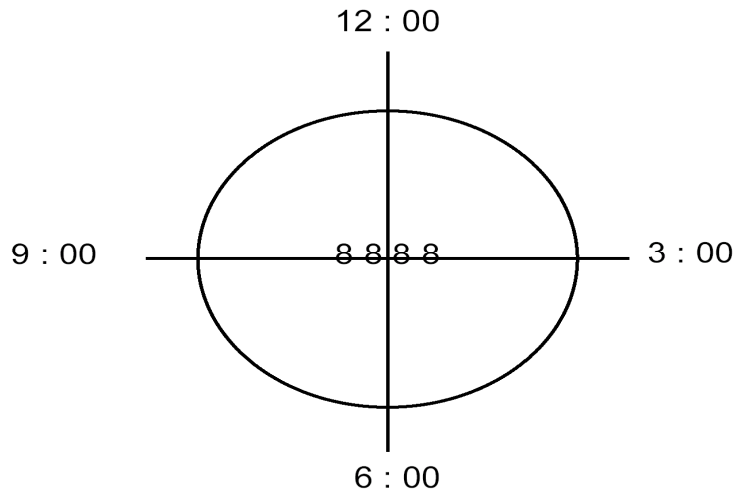
**NOTE 2: Response time definition**



**NOTE 3 :  $\phi$  、 $\theta$  definition**

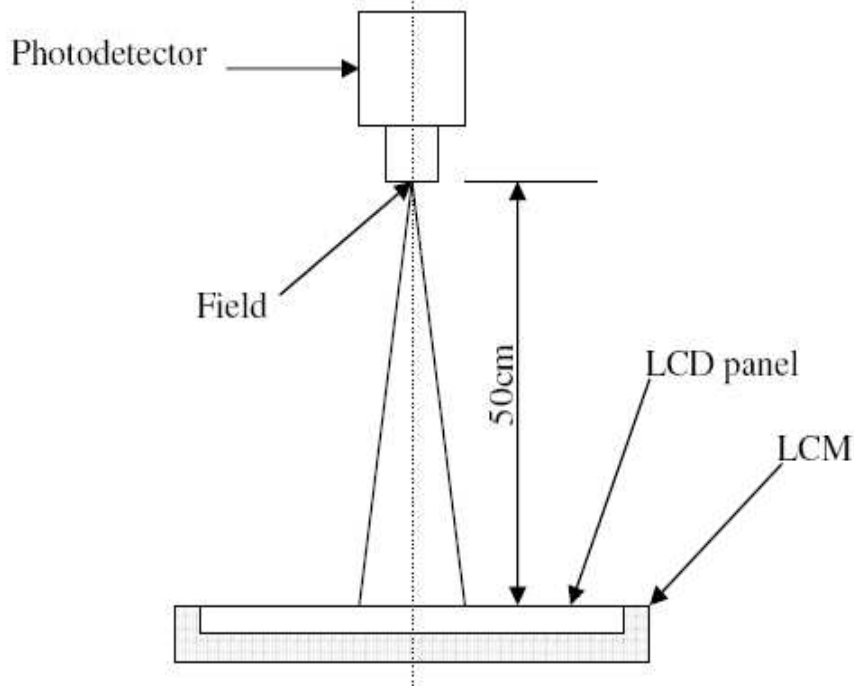


**NOTE 4: Visual angle direction priority**



**NOTE 5: Optical measurement equipment setup**

- Measurement should be executed in a stable, windless, and dark room(under 10 Lux). After lighting the backlight for 30mins.
- Humidity=60±15%
- Distance : 50cm
- Photodetector : BM-5 (Field 1°)





## 9. RELIABILITY

### 9.1. Tests

NO.	ITEM	CONDITION	CRITERION
1	High Temperature Operating	70°C 240 hrs	◦ No Defect Of Operational Function In Room Temperature Are Allowable(23±5°C). ◦ Leakage current should be below double of initial value.
2	Low Temperature Operating	-20°C 240 hrs	
3	High Temperature Non-Operating	80°C 240 hrs	
4	Low Temperature Non-Operating	-30°C 240 hrs	
5	High Temperature/ Humidity Non-Operating	40°C ,95%RH 240 hrs	
6	Temperature Shock Non-Operating	-30°C ← → 80°C ( 30min ) ( 30min ) 10 CYCLES	
7	Electrostatic Discharge	HBM:±2KV	

Note 1: Test after 24 hours in room temperature(23±5°C).

Note 2: The sampling above is individually for each reliability testing condition.

Note 3: The color fading of polarizing filter should not care.

Note 4: All of the reliability testing chamber above, is using D.I. water.(Min value: 1.0 MΩ -cm)

Note 5: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

### 9.2. Color performance

No.	ITEM	Criterion (initial)
1	Luminance	>50%
2	NTSC	>70%
3	Contrast Ratio	>50%

## 10. INSPECTION CRITERIA

### 10.1. Inspection Conditions

#### 10.1.1. Environmental conditions

The environmental conditions for inspection shall be as follows

Room temperature:  $23\pm 5^{\circ}\text{C}$

Humidity:  $50\pm 20\%\text{RH}$

#### 10.1.2. The external visual inspection

With a single  $1000\pm 200\text{lux}$  fluorescent lamp as the light source, the inspection was in the distance of 30cm or more from the LCD to the inspector's eyes.

### 10.2. Light Method

10.2.1. Environment lamp under  $1000\pm 200\text{ lux}$ , Viewing direction for inspection over 300mm

10.2.2. The distance from eye to defect around 300mm, the distance from ND Filter to defect around 25~30mm

