AZ DISPLAYS

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

CUSTOMER APPROVAL			
※ **PART NO. :** ATM0350B47B (AZ DISPLAYS) PRELIMINARY			
APPROVAL		**COMPANY CHOP**	
CUSTOMER COMMENTS			

ZETTLER DISPLAYS ENGINEERING APPROVAL		
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ZZK		

REVISION RECORD

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1. GENERAL SPECIFICATIONS

Item	Specification	Remark
1. LCD size	3.5 inch(Diagonal)	
2. Driver element	a-Si TFT active matrix	
3. Resolution	320x(RGB)x240	
4. Display mode	Normally white, TN,Transmissive	
5. Dot Pitch (W*H)	0.073mm(W) x 0.219mm(H)	
6. Pixel pitch(W*H)	0.219mm(W) x 0.219mm(H)	
7. Active Area(W*H)	70.08mm(W) x 52.56mm(H)	
8. Module size (W*H)	76.9mm(W) x 63.9mm(H) x 3.3mm(D)	Note 1
9. Surface treatment	Anti-glare	
10. Color arrangement	RGB-stripe	
11. Color	262K	
12. Viewing angle (L/R/T/B)	60/60/60/30	
13. Interface	MCU/RGB	
14. LCD controller	SSD2119AM1	
15. LCM brightness	400 cd/m2 Typ.	
16. Backlight driving condition	20mA @18.6V	
17. Touch panel	N.A.	
18. Touch controller	N.A.	
19. Operation temperature	-20~70 ºC	
20. Weight	T.B.D.	
21. RoHS	RoHS compliant	

Note 1: Please refer to mechanical drawing.

2. PIN ASSIGNMENT

TFT LCD Panel Driving Section

FPC Connector is used for the module electronics interface. The recommended model is FH12A-50S-0.5SH manufactured by Hirose.

Pin No.	Symbol	Function	Level	Note
1	VCI	Booster input voltage pin	P	
2	VCI	Booster input voltage pin	P	
3	VSS	Ground (0V)	P	
4	VDDIO	Voltage input pin for logic	P	
5	VSS	Ground (0V)	P	
6	RESET	Reset Signal pin (“Low” is enable)	I	
7	DC/SDC(RS)	Data or Command select PIN.	I	
8	E/RD	6800 system: E(enable signal) 8080 system: RD(read strobe signal) Serial mode: Not use and should be connected to V_{DDIO} or V_{SS}	I	
9	WR	6800 system: RW (indicates read cycle when high, write cycle when low) 8080 system: WR (write strobe signal)	I	
10	CS	Chip select	I	
11	SCL	Serial Clock.	I	
12	SD0	Data output pin in serial interface	O	
13	SDI	Data input pin in serial interface	I	
14	WSYNC(NC)	Ram write synchronization output. Leave it OPEN when not used.	O	
15~32	D17~D0	Data bus For parallel mode, 8/9/16/18 bit interface. Please refer to Section 15 Interface Mapping Section for definition. Unused pins should connect to V_{SS}.	I/O	
33	VSS	Ground	P	
34	DOTCLK	Dot-clock signal and oscillator source	I	
35	HSYNC	Line Synchronization input	I	
36	VSYNC	Frame/Ram Write Synchronization input	I	
37	DE	Display enable pin for controller	I	
38	VSS	Ground	P	
39	PS0	Interface select PIN	I	
40	PS1		I	
41	PS2		I	
42	PS3		I	
43	VSS	Ground	P	
44	NC (XR)	NC	--	
45	NC (YD)	NC		
46	NC (XL)	NC		

47	NC (YU)	NC		
48	VSS	Ground	P	
49	LEDK	Backlight LED Cathode	I	
50	LEDA	Backlight LED Anode.	I	

I: input, O: output, P: Power

PS3	PS2	PS1	PS0	Interface Mode
0	0	0	0	16-bit 6800 parallel interface
0	0	0	1	8-bit 6800 parallel interface
0	0	1	0	16-bit 8080 parallel interface
0	0	1	1	8-bit 8080 parallel interface
0	1	0	0	9-bit generic D[17:9] (262k colour) + 3-wire SPI If 65K color, D12 shorts to D17 internally
0	1	0	1	16-bit generic (262k colour) + 3-wire SPI
0	1	1	0	18-bit generic (262k colour) + 3-wire SPI
0	1	1	1	6-bit generic D[17:12] (262k colour) + 3-wire SPI
1	0	0	0	18-bits 6800 parallel interface
1	0	0	1	9-bits 6800 parallel interface
1	0	1	0	18-bit 8080 parallel interface
1	0	1	1	9-bit 8080 parallel interface
1	1	1	0	3-wire SPI
1	1	1	1	4-wire SPI

3. Operating Specification

3.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power Voltage	V_{DD}	-0.3	5.0	V	
Operation Temperature	T_{OP}	-20	70	ºC	
Storage Temperature	T_{ST}	-30	80	ºC	
LED Reverse Voltage	V_R	-	1.2	V	Each LED Note 2
LED Forward Current	I_F		25	mA	Each LED

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

Note 2: V_R Conditions: Zener Diode 20mA

3.2 Typical Operation Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power Voltage	V_{DD}	2.5	3.3	3.6	V	Note 1
Input Logic High Voltage	V_{IH}	0.8VCC	--	VCC	V	
Input Logic Low Voltage	V_{IL}	0	--	0.2VCC	V	

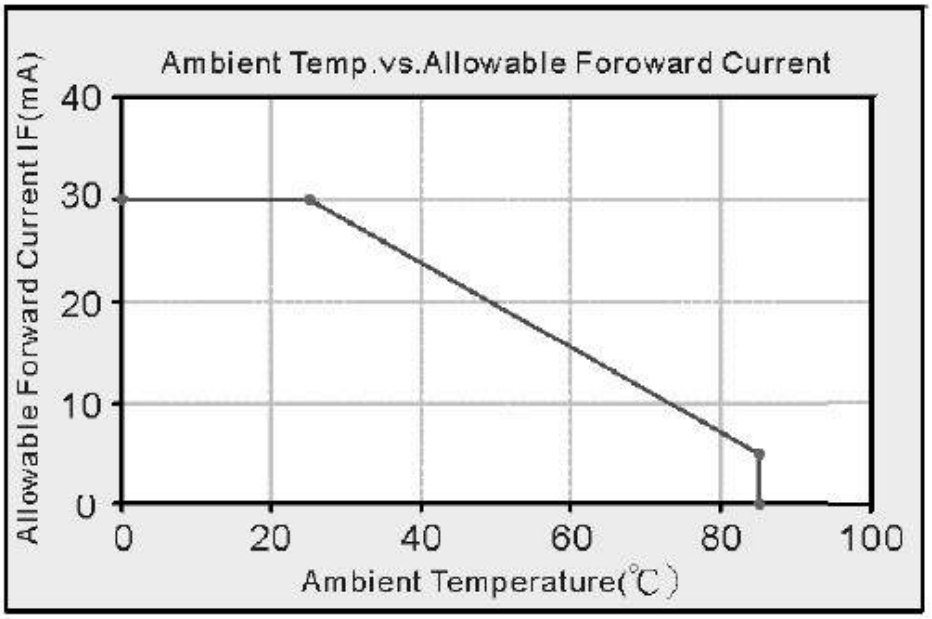
Note 1: V_{DD} setting should match the signals output voltage of customer's system board.

3.3 Backlight driving conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED Backlight	V_L	17.4	18.6	21.0	V	Note 1
Current for LED Backlight	I_L	--	20	--	mA	
LED life time	--	--	50000	--	H	Note 2

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and I_L =20mA.

Note 2: The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and I_L =20mA.



3.4 Timing Characteristics

Table 3-1: Parallel 6800 Timing Characteristics

(T_A = -40 to 85° C, V_{DDIO} = 1.4V to 2.4)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	75	-	-	ns
t_{cycle}	Clock Cycle Time (read cycle) (Based on VOL/VOH = 0.3*VDDIO/0.7*VDDIO)	1000	-	-	ns
t_{AS}	Address Setup Time (R/$\overline{W}$)	0	-	-	ns
t_{AH}	Address Hold Time (R/$\overline{W}$)	0	-	-	ns
t_{DSW}	Data Setup Time (D0~D7, WRITE)	5	-	-	ns
t_{DHW}	Data Hold Time (D0~D7, WRITE))	5	-	-	ns
t_{ACC}	Data Access Time (D0~D7, READ)	250	-	-	ns
t_{OH}	Output Hold time (D0~D7, READ)	100	-	-	ns
PW_{CSL}	Pulse width /CS low (write cycle)	40	-	-	ns
PW_{CSH}	Pulse width /CS high (write cycle)	25	-	-	ns
PW_{CSL}	Pulse width /CS low (read cycle)	500	-	-	ns
PW_{CSH}	Pulse width /CS high (read cycle)	500	-	-	ns
t_R	Rise time	-	-	15	ns
t_F	Fall time	-	-	15	ns

(T_A = -40 to 85° C, V_{DDIO} = 2.4V to 3.6V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	75	-	-	ns
t_{cycle}	Clock Cycle Time (read cycle) (Based on VOL/VOH = 0.3*VDDIO/0.7*VDDIO)	450	-	-	ns
t_{AS}	Address Setup Time (R/$\overline{W}$)	0	-	-	ns
t_{AH}	Address Hold Time (R/$\overline{W}$)	0	-	-	ns
t_{DSW}	Data Setup Time (D0~D7, WRITE)	5	-	-	ns
t_{DHW}	Data Hold Time (D0~D7, WRITE))	5	-	-	ns
t_{ACC}	Data Access Time (D0~D7, READ)	200	-	-	ns
t_{OH}	Output Hold time (D0~D7, READ)	100	-	-	ns
PW_{CSL}	Pulse width /CS low (write cycle)	40	-	-	ns
PW_{CSH}	Pulse width /CS high (write cycle)	25	-	-	ns
PW_{CSL}	Pulse width /CS low (read cycle)	225	-	-	ns
PW_{CSH}	Pulse width /CS high (read cycle)	225	-	-	ns
t_R	Rise time	-	-	15	ns
t_F	Fall time	-	-	15	ns

Note: CS can be pulled low during the write cycle, only /WR is needed to be toggled.

Figure 3-1: Parallel 6800-series Interface Timing Characteristics

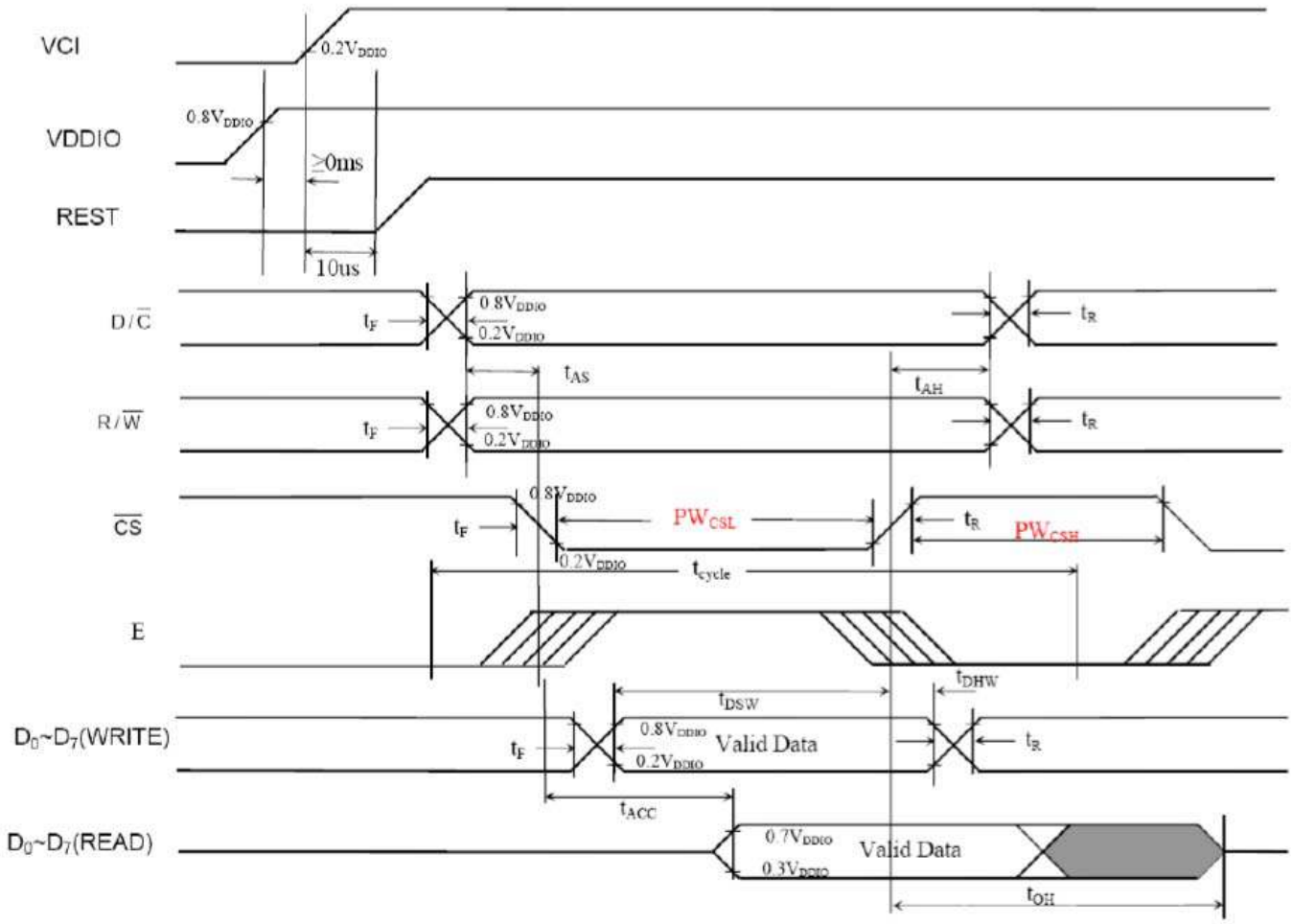


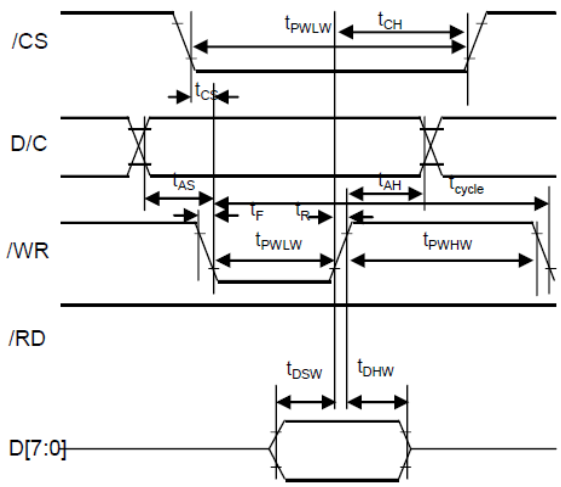
Table 3-2: Parallel 8080 Timing Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	100	-	-	ns
t_{AS}	Address Setup Time	10	-	-	ns
t_{AH}	Address Hold Time	0	-	-	ns
t_{CS}	Chip Select Time	0	-	-	ns
t_{CH}	Chip Select Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	10	-	-	ns
t_{DHW}	Write Data Hold Time	10	-	-	ns
t_{DHR}	Read Data Hold Time	100	-	-	ns
t_{ACC}	Access Time (RAM) Access Time (command)	250 250	- -	- -	ns ns
t_{PWLR} t_{PWLR} t_{PWLW}	Chip Select Low Pulse Width (read RAM) Chip Select Low Pulse Width (read Command) Chip Select Low Pulse Width (write)	500 500 50	- - -	- - -	ns ns ns
t_{PWHR} t_{PWHW}	Chip Select High Pulse Width (read) Chip Select High Pulse Width (write)	500 50	- -	- -	ns ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

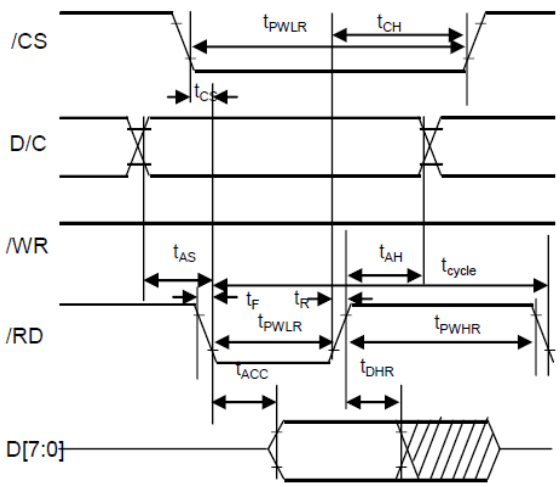
Note: All timings are based on 20% to 80% of V_{DDIO}-Vss

8080-series parallel interface characteristics (Form 1: /CS low pulse width > W/ R low pulse width)

Write cycle (Form 1)

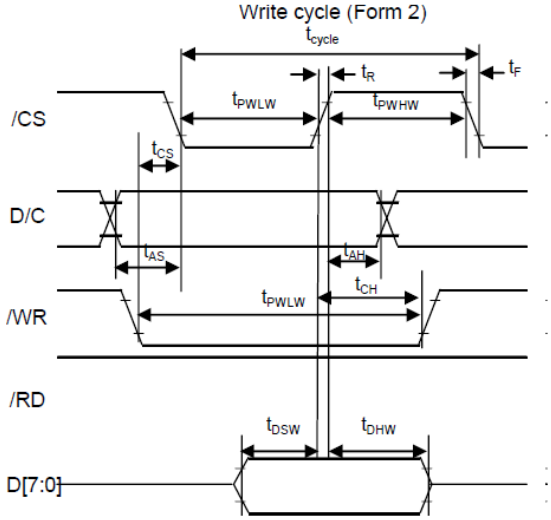


Read cycle (Form 1)



8080-series parallel interface characteristics (Form 2: /CS low pulse width < W/ R low pulse width)

Write cycle (Form 2)



Read cycle (Form 2)

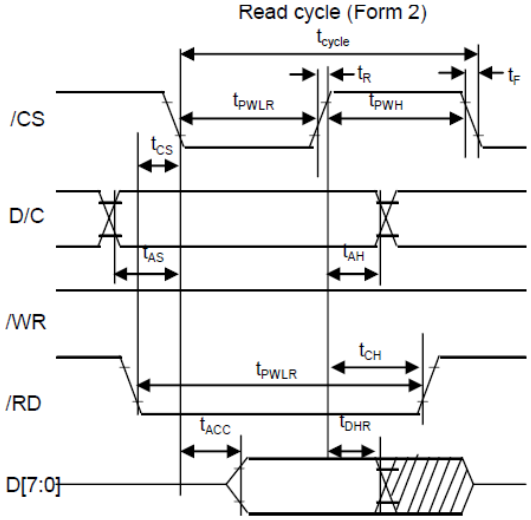


Table 3-3: Serial Timing Characteristics

(T_A = -40 to 85° C, V_{DDIO} = 1.4V to 3.6V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	77	-	-	ns
f_{CLK}	Serial Clock Cycle Time SPI Clock tolerance = +/- 2 ppm	-	-	15	MHz
t_{AS}	Register select Setup Time	4	-	-	ns
t_{AH}	Register select Hold Time	5	-	-	ns
t_{CSS}	Chip Select Setup Time	2	-	-	ns
t_{CSH}	Chip Select Hold Time	10	-	-	ns
t_{DSW}	Write Data Setup Time	5	-	-	ns
t_{OHW}	Write Data Hold Time	10	-	-	ns
t_{CLKL}	Clock Low Time	38	-	-	ns
t_{CLKH}	Clock High Time	38	-	-	ns
t_R	Rise time	-	-	15	ns
t_F	Fall time	-	-	15	ns

Figure 3-2: 4 wire Serial Timing Characteristics

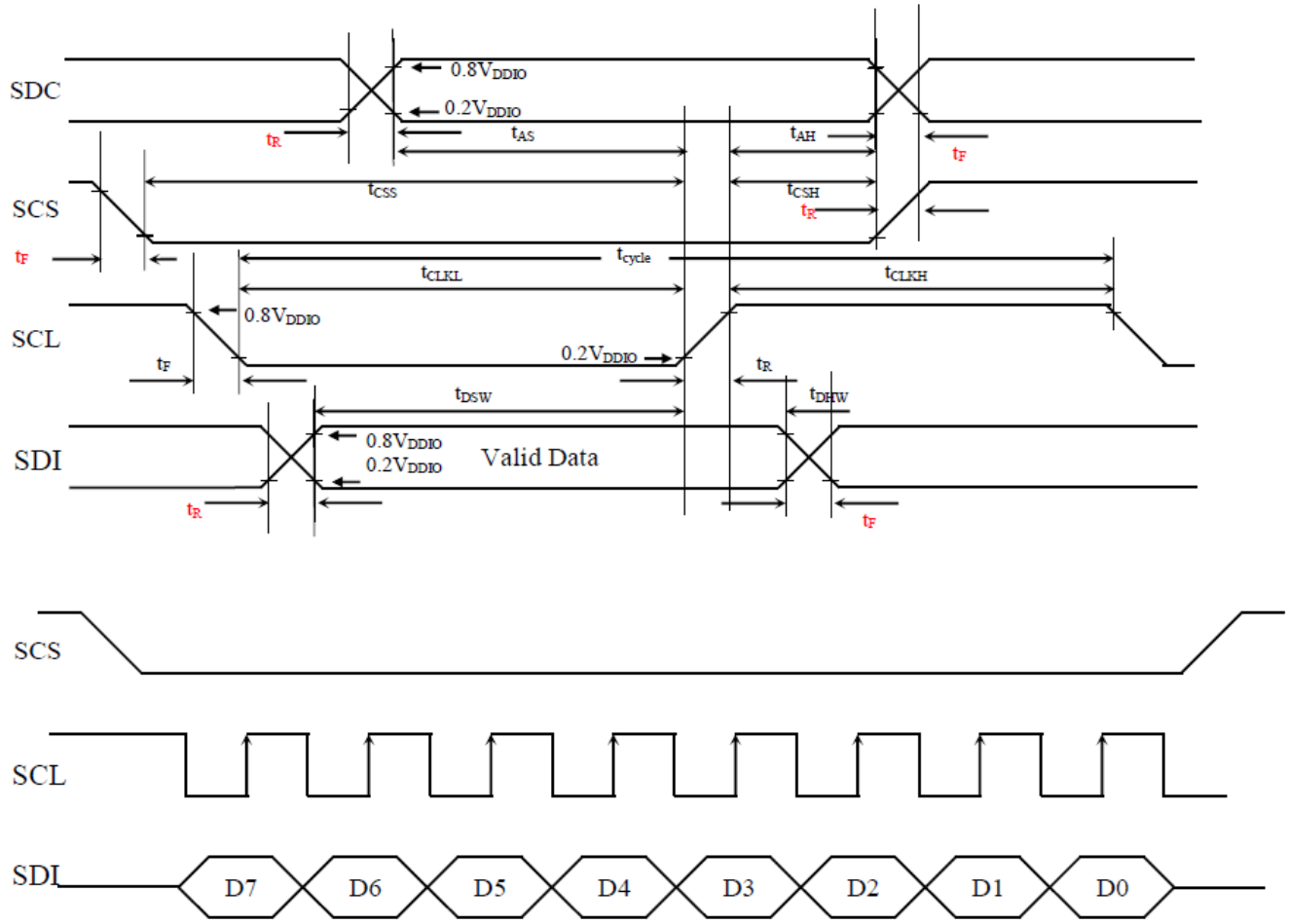


Table 3-4: RGB Timing Characteristics

(T_A = -40 to 85° C, V_{DDIO} = 1.4V to 3.6V)

Symbol	Parameter	Min	Typ	Max	Unit
f_{DOTCLK}	DOTCLK Frequency (70Hz frame rate)	1	5.5	8.2	MHz
t_{DOTCLK}	DOTCLK Period	122	182	1000	ns
t_{VSYS}	Vertical Sync Setup Time	20	-	-	ns
t_{VSYH}	Vertical Sync Hold Time	20	-	-	ns
t_{HSYS}	Horizontal Sync Setup Time	20	-	-	ns
t_{HSYH}	Horizontal Sync Hold Time	20	-	-	ns
t_{HV}	Phase difference of Sync Signal Falling Edge	0	-	HFP-1	t_{DOTCLK}
t_{CLK}	DOTCLK Low Period	61	-	-	ns
t_{CKH}	DOTCLK High Period	61	-	-	ns
t_{DS}	Data Setup Time	25	-	-	ns
t_{DH}	Data hold Time	25	-	-	ns

Note: External clock source must be provided to DOTCLK pin of SSD2119AM1. The driver will not operate in absence of the clocking signal.

*HFP: Horizontal Front Porch setting in customers' setup

Figure 3-3: RGB Timing Characteristics

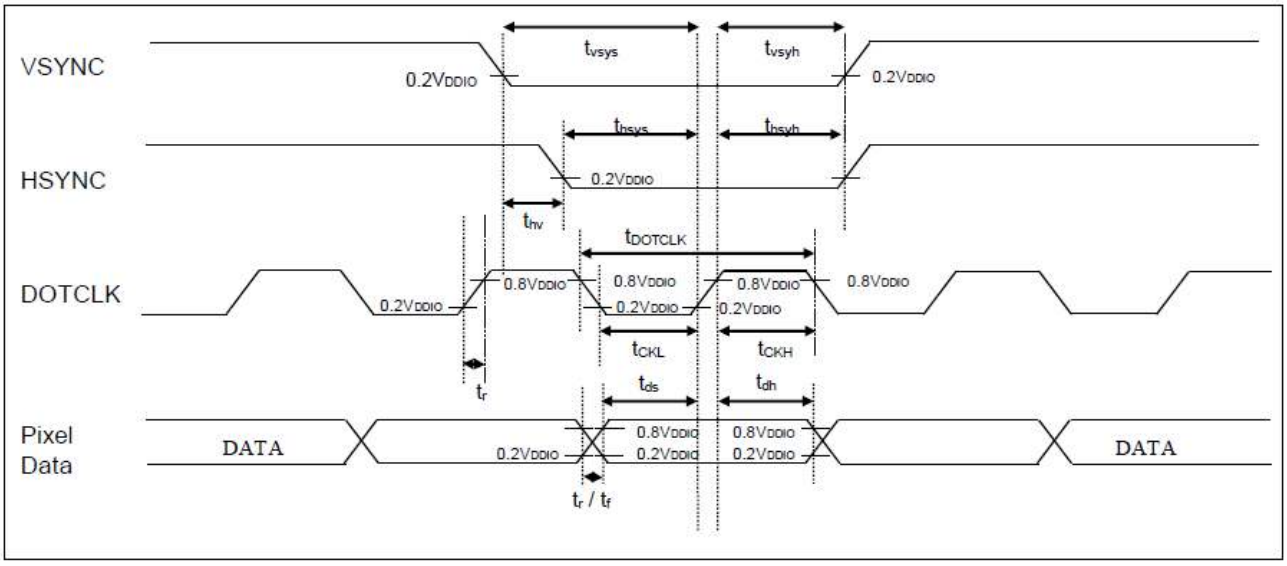


Figure 3-4: Power Up Sequence for RGB mode

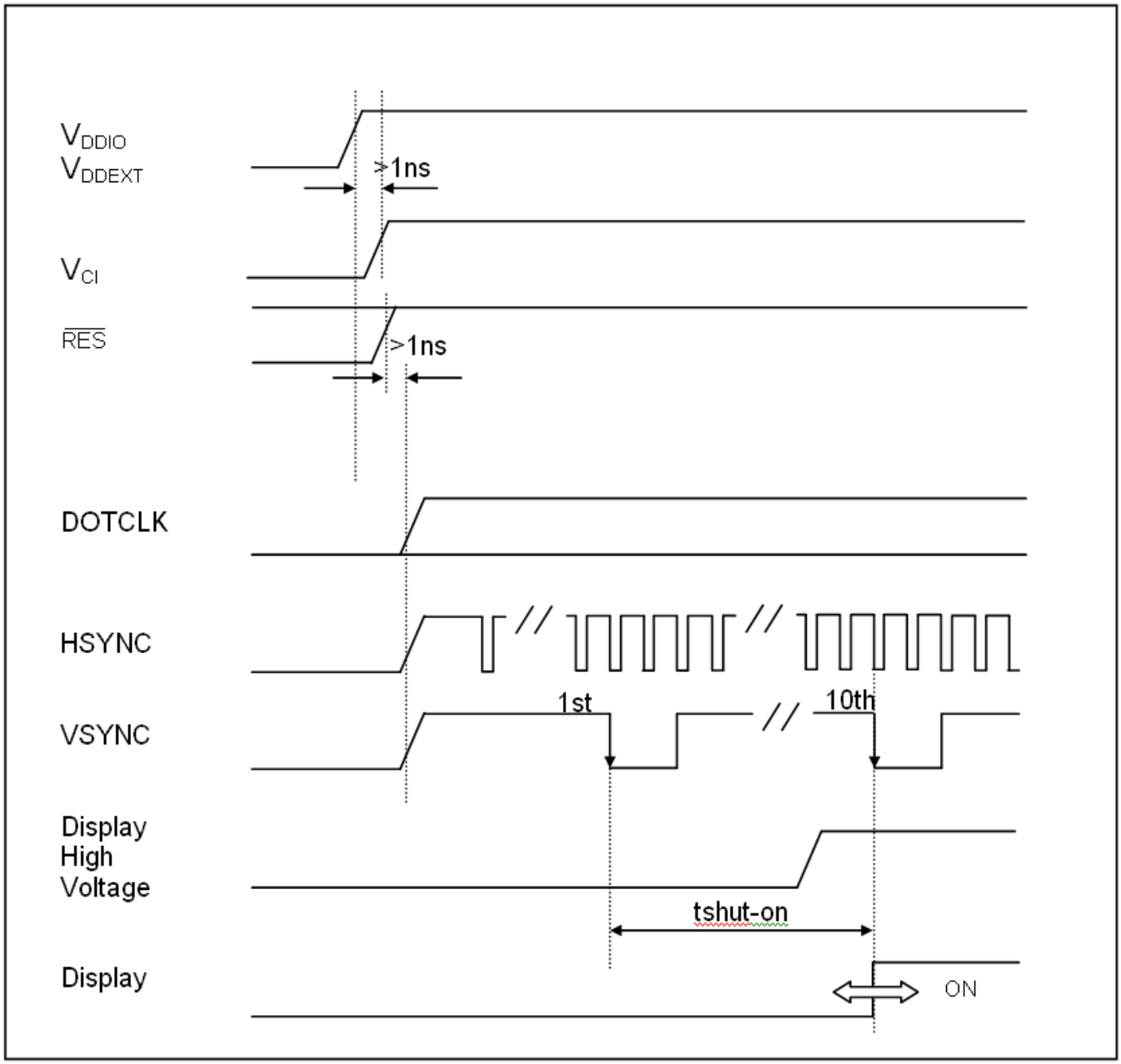
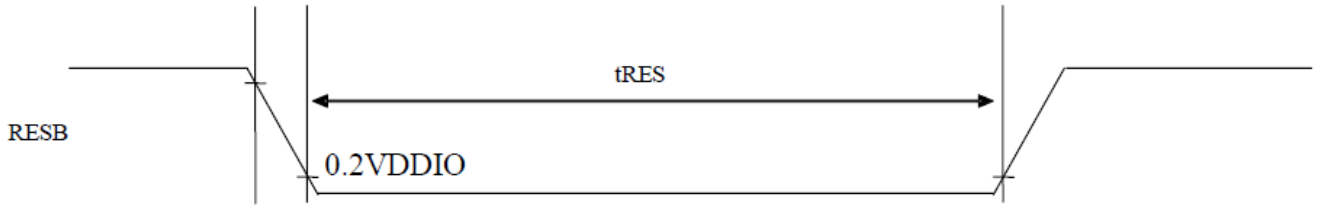


Table 3-5: Reset Timing

(T_A = -40 to 85° C, V_{DDIO} = 1.4V to 3.3V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{RES}	Reset pulse duration	15	--	--	us

Figure 3-5: Reset Timing Characteristics



4.0 OPTICAL SPECIFICATIONS

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing Angle (CR≥10)	θ_L	Φ=180°(9 O'CLOCK)	50	60	--	degree	Note 1
	θ_R	Φ=0°(3 O'CLOCK)	50	60	--		
	θ_T	Φ=90°(12 O'CLOCK)	50	60	--		
	θ_B	Φ=270°(6 O'CLOCK)	20	30	--		
Response Time	$T_{ON}+T_{OFF}$	Normal Θ=Φ=0°	--	30	50	msec	Note 3
Contrast Ratio	CR		150	300	--	--	Note 4
Color Chromaticity	W_X		0.26	0.31	0.36	--	Note 2
	W_Y		0.26	0.31	0.36	--	Note 5 Note 6
Luminance	L		350	400	--	cd/m^2	Note 6
Luminance Uniformity	YU		70	80	--	%	Note 7

Test Conditions:
1. VCC=3.3V, IL=20mA (Backlight current), the ambient temperature is 25℃.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

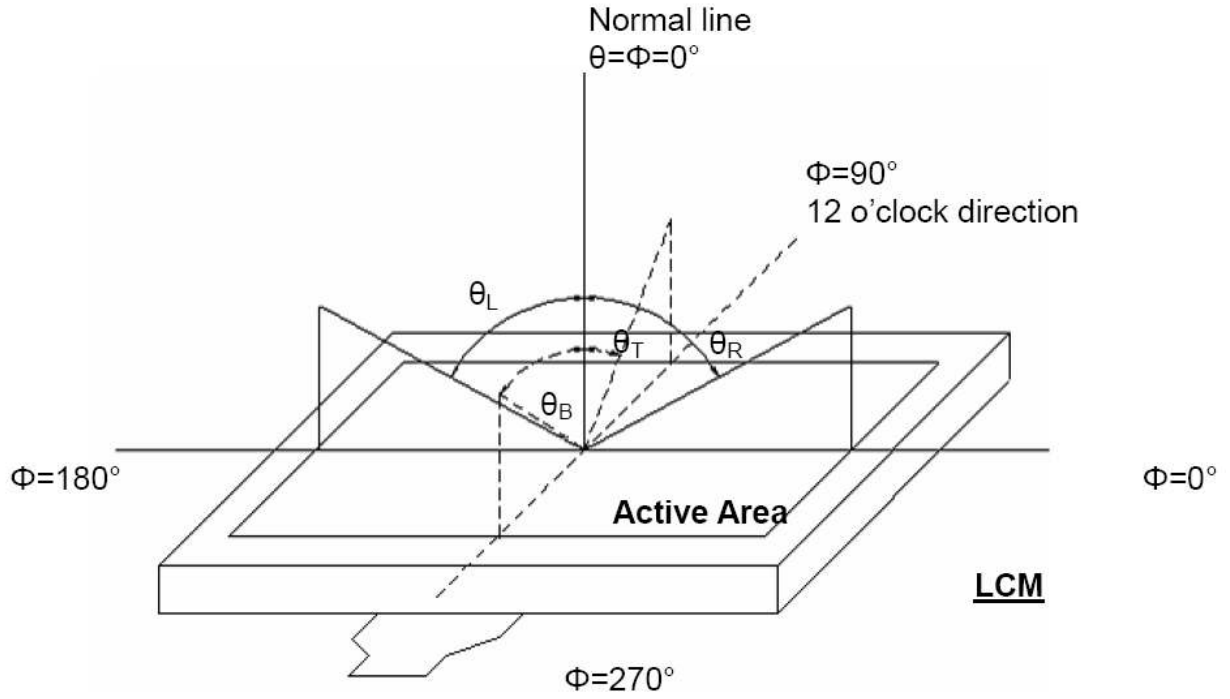


Figure 4.1 Definition of viewing angle.

Note 2: Definition of optical measurement system.
The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON

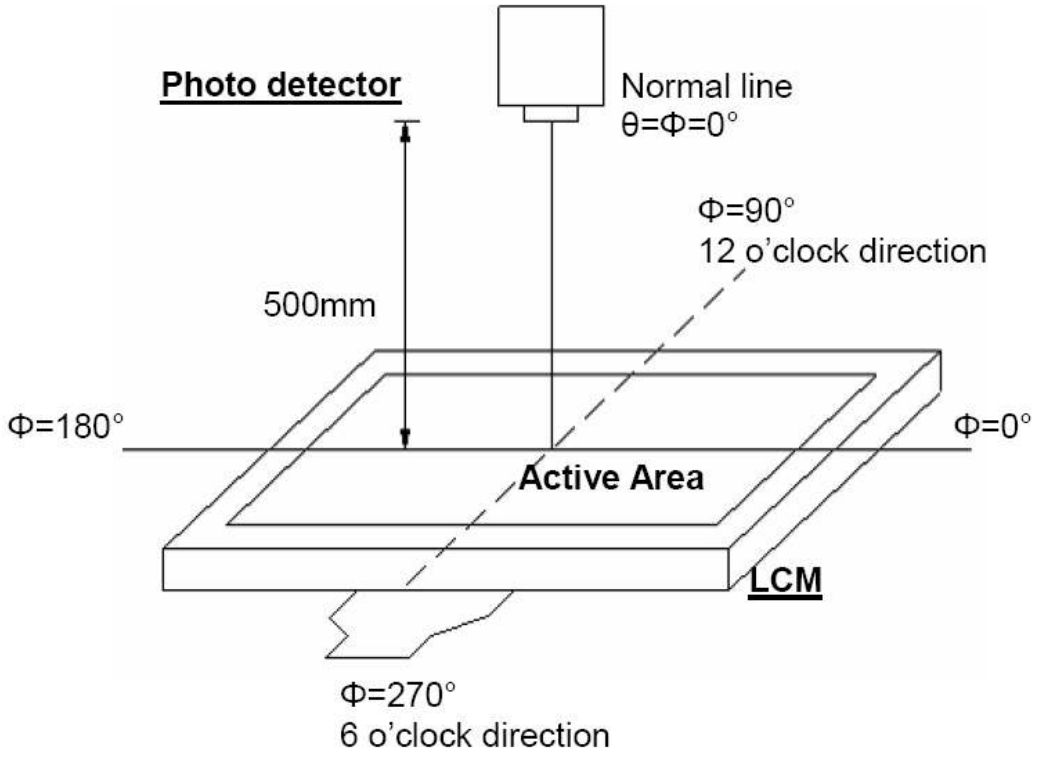


Figure 4.2 Optical measurement system setup

Note 3: Definition of Response time
The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.

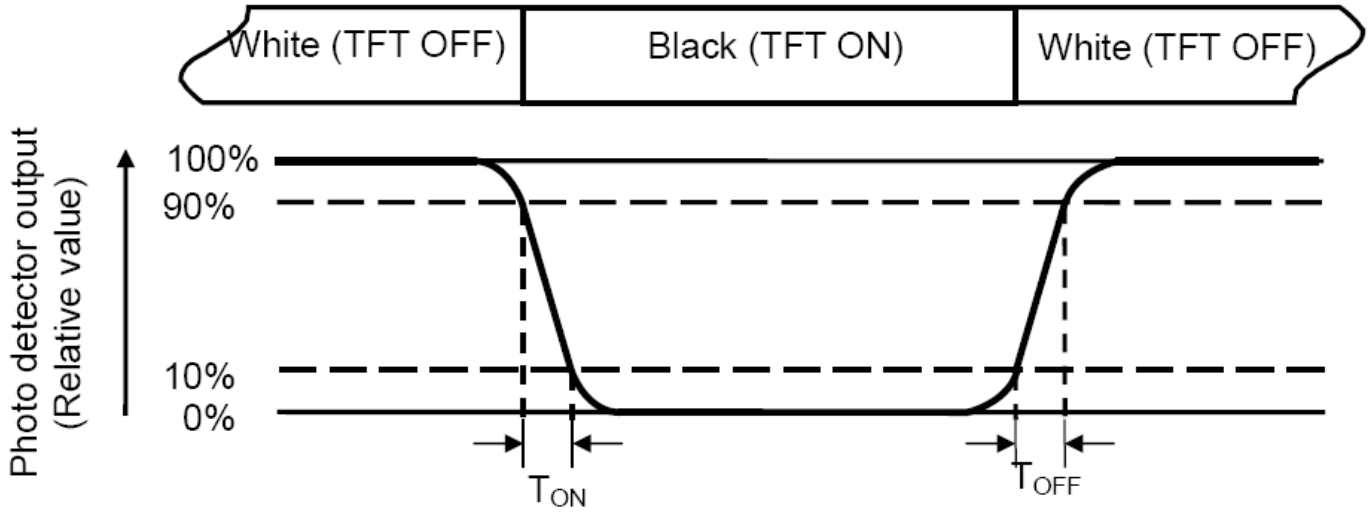


Figure 4.3 Definition of response.

Note 4: Definition of contrast ratio

$$\text{Contrast ratio(CR)} = \frac{\text{Luminance measured when LCD on the "white" state}}{\text{Luminance measured when LCD on the "black" state}}$$

Note 5: Definition of color chromaticity (CIE1931)
Color coordinates measured at center point of LCD.

Note 6: All input terminals LCD panel must be ground while measuring the center area of the panel. The LED driving condition is I_L=20mA .

Note 7: Definition of Luminance Uniformity
Active area is divided into 9 measuring areas (Refer to Fig. 4-4).Every measuring point is placed at the center of each measuring area.

$$Luminance\ \ Uniformity\ (Yu) = \frac{B_{min}}{B_{max}}$$

L-------Active area length W----- Active area width

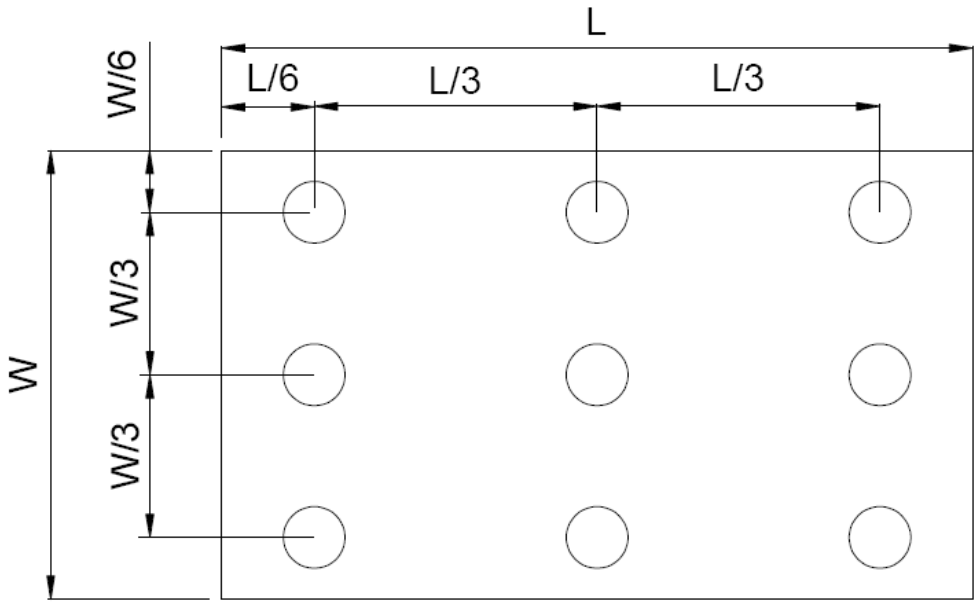


Figure 4.3 Definition of measuring points.

Bmax: The measured maximum luminance of all measurement position.
Bmin: The measured minimum luminance of all measurement position.

5. RELIABILITY TEST

Item	Test Condition Item	Remark
High temperature storage	Ta= 80 ºC 120hrs	Note 1 Note 4
Low temperature storage	Ta=-30 ºC 120hrs	Note 1 Note 4
High temperature operation	Ts= 70 ºC 96hrs	Note 2 Note 4
Low temperature operation	Ts=-20 ºC 96hrs	Note 1 Note 4
High temperature/High humidity operation	90% RH 60ºC 120hrs	Note 4
Thermal Shock (Non-operation)	-20℃/30 min ~ +60℃/30 min for a total 30 cycles, Start with cold temperature and end with high temperature.	Note 4
Vibration test	Freq:10~55~10Hz Amplitude:1.5mm 2 hours for each direction of X,Y,Z (6 hours for total)	
Mechanical shock	60G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package vibration test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package drop test	Height:60 cm 1 corner, 3 edges, 6 surfaces	
Electro static discharge	± 2KV, Human Body Mode, 150pF/330Ω	

Note 1: Ta is the ambient temperature of samples.
Note 2: Ts is the temperature of panel's surface.
Note 3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.
Note 4: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

6. PRECAUTION FOR USING LCM

1. When design the product with this LCD Module, make sure the viewing angle matches to its purpose of usage.
2. As LCD panel is made of glass substrate, Dropping the LCD module or banging it against hard objects may cause cracking or fragmentation. Especially at corners and edges.
3. Although the polarizer of this LCD Module has the anti-glare coating, always be careful not to scratch its surface. Use of a plastic cover is recommended to protect the surface of polarizer.
4. If the LCD module is stored at below specified temperature, the LC material may freeze and be deteriorated. If it is stored at above specified temperature, the molecular orientation of the LC material may change to Liquid state and it may not revert to its original state. Excessive temperature and humidity could cause polarizer peel off or bubble. Therefore, the LCD module should always be stored within specified temperature range.
5. Saliva or water droplets must be wiped off immediately as those may leave stains or cause color changes if remained for a long time. Water vapor will cause corrosion of ITO electrodes.
6. If the surface of LCD panel needs to be cleaned, wipe it swiftly with cotton or other soft cloth. If it is not still clean enough, blow a breath on the surface and wipe again.
7. The module should be driven according to the specified ratings to avoid malfunction and permanent damage. Applying DC voltage cause a rapid deterioration of LC material. Make sure to apply alternating waveform by continuous application of the M signal. Especially the power ON/OFF sequence should be kept to avoid latch-up of driver LSIs and DC charge up to LCD panel.
8. Mechanical Considerations
   a) LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.
   b) Do not tamper in any way with the tabs on the metal frame.
   c) Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
   d) Do not touch the elastomer connector; especially insert a backlight panel (for example, EL).
   e) When mounting a LCM makes sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
   f) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.
9. Static Electricity
   a) Operator

Wear the electrostatics shielded clothes because human body may be statically charged if not ware shielded clothes.
Never touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.

   b) Equipment

There is a possibility that the static electricity is charged to the equipment, which has a function of peeling or friction action (ex: conveyer, soldering iron, working table). Earth the equipment through proper resistance (electrostatic earth: $1x10^8$ ohm).
Only properly grounded soldering irons should be used.
If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.
The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.

   c) Floor

Floor is the important part to drain static electricity, which is generated by operators or equipment.
There is a possibility that charged static electricity is not properly drained in case of insulating floor. Set the electrostatic earth (electrostatic earth: $1x10^8$ ohm).

   d) Humidity

Proper humidity helps in reducing the chance of generating electrostatic charges. Humidity should be kept over 50%RH.

   e) Transportation/storage

The storage materials also need to be anti-static treated because there is a possibility that the human body or storage materials such as containers may be statically charged by friction or peeling.
The modules should be kept in antistatic bags or other containers resistant to static for storage.

   f) Soldering

Solder only to the I/O terminals. Use only soldering irons with proper grounding and no leakage.
Soldering temperature : 280° C ± 10° C
Soldering time: 3 to 4 sec.
Use eutectic solder with resin flux fill.
If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

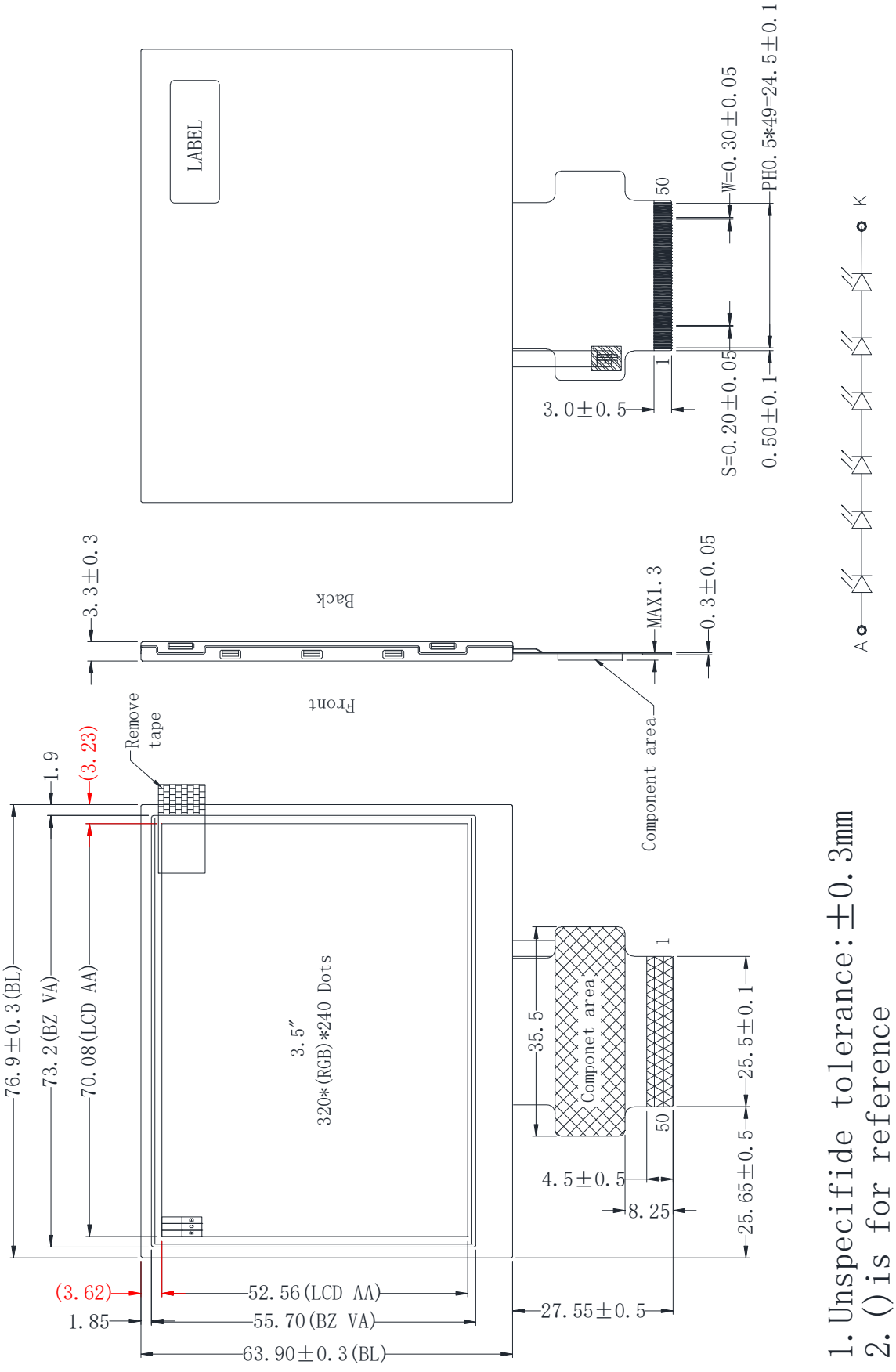
   g) Others

The laminator (protective film) is attached on the surface of LCD panel to prevent it from scratches or stains. It should be peeled off slowly using static eliminator.
Static eliminator should also be installed to the workbench to prevent LCD module from static charge.

10. Operation
    a) Driving voltage should be kept within specified range; excess voltage shortens display life.
    b) Response time increases with decrease in temperature.
    c) Display may turn black or dark blue at temperatures above its operational range; this is (however not pressing on the viewing area) may cause the segments to appear “fractured”.
    d) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear “fractured”.
11. If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. The toxicity is extremely low but caution should be exercised at all the time.
12. Disassembling the LCD module can cause permanent damage and it should be strictly avoided.
13. LCD retains the display pattern when it is applied for long time (Image retention). To prevent image retention, do not apply the fixed pattern for a long time. Image retention is not a deterioration of LCD. It will be removed after display pattern is changed.
14. Do not use any materials, which emit gas from epoxy resin (hardener for amine) and silicone adhesive agent (dealcohol or deoxym) to prevent discoloration of polarizer due to gas.
15. Avoid the exposure of the module to the direct sunlight or strong ultraviolet light for a long time.

The brightness of LCD module may be affected by the routing of CCFL cables due to leakage to the chassis through coupling effect. The inverter circuit needs to be designed taking the level of leakage current into consideration. Thorough evaluation is needed for LCD module and inverter built into its host equipment to ensure specified brightness.

7. MECHANICAL DRAWING



8. PACKAGE DRAWING

T.B.D.

9. INSPECTION SPECIFICATION

1. SCOPE SPECIFICATIONS CONTAIN

1.1 DISPLAY QUALITY EVALUATION

1.2 MECHANICS SPECIFICATION

2. SAMPLING PLAN

UNLESS THERE IS OTHER AGREEMENT, THE SAMPLING PLAN FOR INCOMING INSPECTION SHALL FOLLOW MIL-STD-105E.

2.1 LOT SIZE: QUANTITY PER SHIPMENT AS ONE LOT (DIFFERENT MODEL AS DIFFERENT LOT).

2.2 SAMPLING TYPE: NORMAL INSPECTION, SINGLE SAMPLING.

2.3 SAMPLING LEVEL: LEVEL II.

2.4 AQL: ACCEPTABLE QUALITY LEVEL

MAJOR DEFECT: AQL=0.65

MINOR DEFECT: AQL=1.0

3. PANEL INSPECTION CONDITION

3.1 ENVIRONMENT:

ROOM TEMPERATURE: 25±5°C.

HUMIDITY: 65±5% RH.

ILLUMINATION: 300 ~ 700 LUX.

3.2 INSPECTION DISTANCE:

35±5 CM

3.3 INSPECTION ANGLE:

THE VISION OF INSPECTOR SHOULD BE PERPENDICULAR TO THE SURFACE OF THE MODULE.

3.4 INSPECTION TIME：

PERCEPTIBILITY TEST TIME: 20 SECONDS MAX.

4. DISPLAY QUALITY

4.1 FUNCTION RELATED:

THE FUNCTION DEFECTS OF LINE DEFECT, ABNORMAL DISPLAY, AND NO DISPLAY ARE CONSIDERED MAJOR DEFECTS.

4.2 BRIGHT/DARK DOTS:

Defect Type	Specification	Major	Minor
Bright Dots	N≤ 2		●
Dark Dots	N≤ 3		●
Total Bright and Dark Dots	N≤ 4		●

Note: 1:

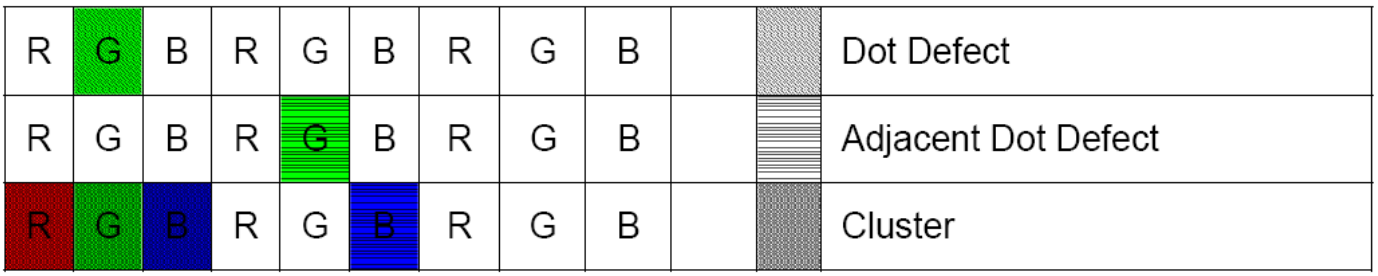
The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

The bright dot defect must be visible through 2% ND filter

Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.

4.3 Pixel Definition:



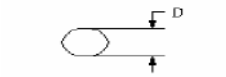
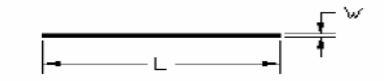
Note 1:

If pixel or partial sub-pixel defects exceed 50% of the affected pixel or sub-pixel area, it shall be considered as1 defect.

Note 2:

There should be no distinct non-uniformity visible through 2% ND Filter within 2 sec inspection times.

4.4Visual Inspection specifications:

Defect Type		Specification Size	Count(N)	Major	Minor
Dot Shape (Particle、Scratch and Bubbles in display area) 		D ≤0.25 mm	Ignored		
		0.25mm < D ≤ 0.5mm	N ≤ 3		•
		D > 0.5mm	N=0		
Newton Ring (Only for Touch panel)		D≤70mm	N≤4		
		D>70mm	N=0		•
TSP Fish Eyes (Only for Touch panel) (Bubble/Dent)		0.1mm<D≤0.2mm	N≤4		
		0.2mm<D≤0.3mm	N≤3		•
		0.3<D≤0.4	N≤2		
Line Shape (Particles、Scratch、Lint and Bubbles in display area) 		W ≤ 0.01 mm	Ignored		
		0.01mm< W ≤ 0.05mm and L ≤ 3mm	N ≤ 3		•
		W > 0.05mm or L > 3 mm	N=0		
Bubble in cell (active area)		It should be found by eyes			•
Bezel	Scratch	No harm			•
	Dirt				•
	Wrap	No harm			•
	Sunken	No harm			•
Label	No label	No			•
	Inverted label				•
	Broken				•
	Dirt	Word can be read.			•
	Not clear	No			•
	Word out of shape				•
	Mistake	No			•
	Position	Be attached on right position			•
Screw	Not enough	No			•
	Limp	No			•

Connector	Connection status	No bend on pins and damage		•
FPC/FFC	Broken	No		•

Note: Extraneous substance and scratch not affecting the display of image, for instance, extraneous substance under polarizer film but outside the display area, or scratch on metal bezel and backlight module or polarizer film outside the display area, shall not be considered as defective or non-conforming.