

BOLYMIN

**SPECIFICATIONS FOR
LCD MODULE**

**MODEL NO.
BO12864D1FPHB\$**

FOR MESSRS:

ON DATE OF:

APPROVED BY:

BOLYMIN, INC.
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1. Numbering System

<u>B</u>	<u>O</u>	<u>12864</u>	<u>D1</u>	<u>F</u>	<u>P</u>	<u>H</u>	<u>:</u>	<u>B</u>	<u>\$</u>
0	1	2	3	4	5	6	7	8	9

0	Brand	Bolymin	
1	Module Type	C= character type G= graphic type P= TAB/TCP type	O= COG type F= COF type L=PLED/OLED
2	Format	2002=20 characters, 2 lines 12232= 122 x 32 dots	
3	Version No.	A type	
4	LCD Color	G=STN/gray Y=STN/yellow-green PLED/yellow-green C=color STN,OLED/RGB	B=STN/blue,OLED/blue F=FSTN T=TN D=OLED/blue+yellow A=OLED/blue+yellow+green
5	LCD Type	R=positive/reflective P=positive/transflective	M=positive/transmissive N=negative/transmissive
6	Backlight type/color	L=LED array/ yellow-green H=LED edge/white R=LED array/red G=LED edge/yellow-green F=RGB array I=RGB edge Q=LED edge/red N=No backlight	D=LED edge/blue E=EL/white B=EL/blue C=CCFL/white Y=LED Bottom/yellow O=LED array/orange K=LED edge/green A=LED edge/amber
7	CGRAM Font (applied only on character type)	J=English/Japanese Font E=English/European Font G=Chinese(simple) F=Chinese(traditional)	C=English/Cyrillic Font H=English/Hebrew Font A=English/Arabic Font
8	View Angle/ Operating Temperature	B=Bottom/Normal Temperature H=Bottom/Wide Temperature U=Bottom/Ultra wide Temperature	T=Top/Normal Temperature W=Top/Wide Temperature C=9H/Normal Temperature E=Top/ultra wide temperature
9	Special Code	3=3 volt logic power supply n=negative voltage for LCD c=cable/connector xxx=to be assigned on datasheet	t=temperature compensation for LCD p=touch panel \$=RoHS

2. General Specification

(1) Mechanical Dimension

Item	Dimension	Unit
Number of Dots	128 x 64	dots
Module dimension (L x W x H)	52.0 x 42.0 x 4.65 –LED B/L	mm
View area	48.0 x 31.0	mm
Active area	44.77x 27.49	mm
Dot size	0.32x 0.4	mm
Dot pitch	0.35 x 0.43	mm

(2) Controller IC: ST7541 controller (4 gray scale)

(3) Temperature Range

	Normal
Operating	0 ~+50
Storage	-10 ~+60

3. Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T _{OP}	0	-	+50	
Storage Temperature	T _{ST}	-10	-	+60	
Supply Voltage For Logic	V _{dd} -V _{ss}	1.8	-	3.3	V
Supply Voltage For LCD	V _o -V _{ss}	3.5	-	15	V

4. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	Vdd-Vss	-	1.8	3.0	3.3	V
Supply Voltage For LCD	Vo-Vss	* Ta=-20 Ta=25 * Ta=+70	- - -	— 9 —	- - -	V
Input High Volt.	V _{IH}	-	0.7*Vdd	-	Vdd	V
Input Low Volt.	V _{IL}	-	Vss	-	0.3*Vdd	V
Output High Volt.	V _{OH}	-	0.7*Vdd	-	Vdd	V
Output Low Volt.	V _{OL}	-	Vss	-	0.3*Vdd	V
Supply Current	I _{dd}	Vdd=3.0V	-	550	-	uA

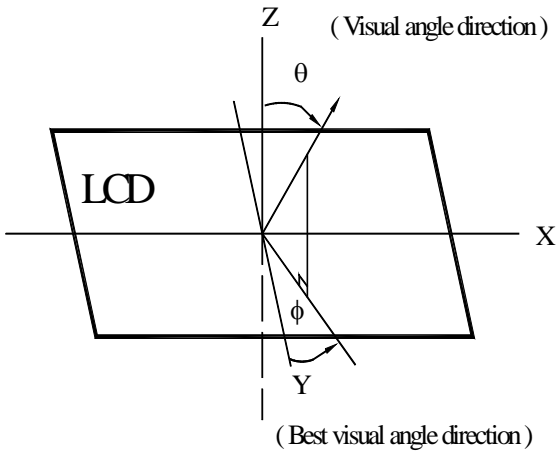
5. Optical Characteristics

a. FSTN

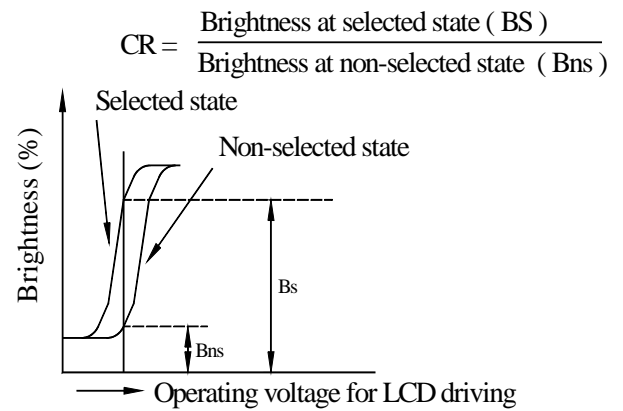
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
View Angle	(V)	CR 3	10	-	60	deg
	(H)	CR 3	-45	-	45	deg
Contrast Ratio	CR	-	-	5	-	-
Response Time 25	T rise	-	-	17	400	ms
	T fall	-	-	258	400	ms

5.1 Definitions

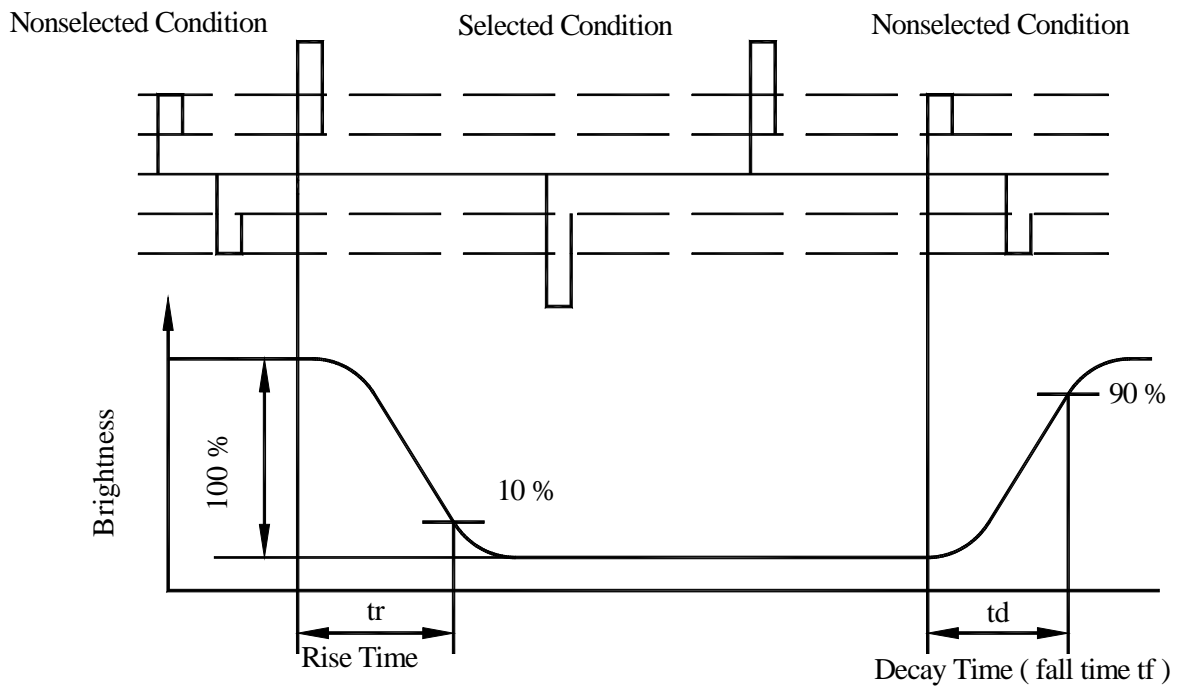
View Angles



Contrast Ratio



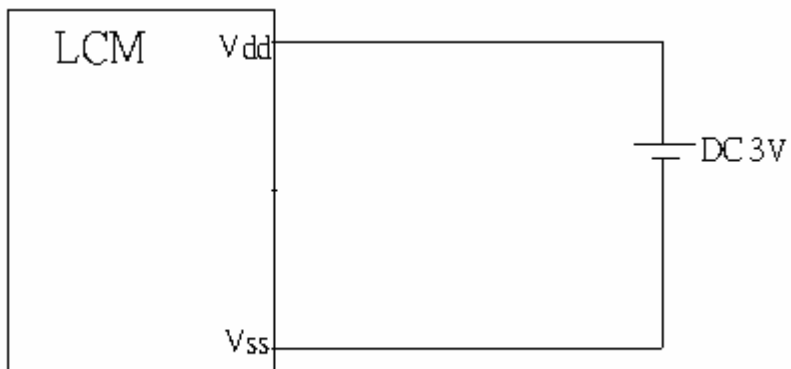
Response Time



6. Interface Description

Pin No.	Symbol	Level	Description
1	GND	-	Ground
2	VDD	-	Power supply(3V)
3	DB7	-	Data bus
4	DB6	-	Data bus
5	DB5	-	Data bus
6	DB4	-	Data bus
7	DB3	-	Data bus
8	DB2	-	Data bus
9	DB1	-	Data bus
10	DB0	-	Data bus
11	E	-	Enable signal
12	R/W	-	H : read L : write
13	A0	-	H: data , L: Instruction
14	/RES	-	Reset H: Disable L: Enable
15	/CS	-	H: chip selected L: chip unselected
16	GND	-	Ground

7. Power Supply for LCD Module

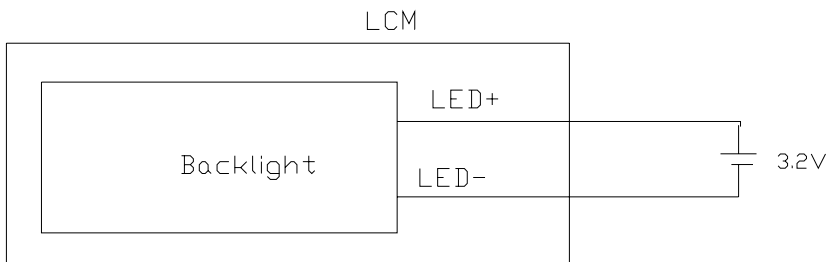


8. Backlight Information

(1) LED edge / White

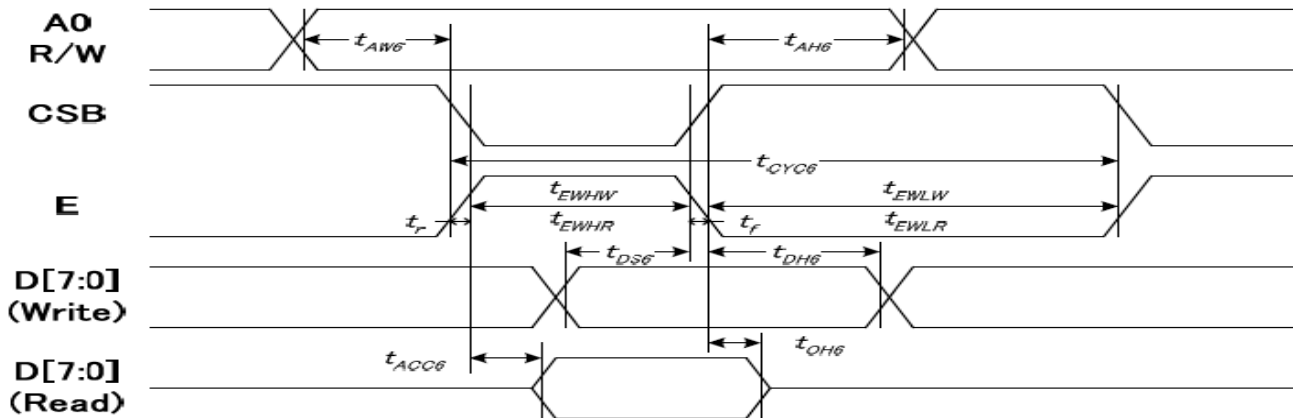
Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	I _{LED}		60		mA	V=3.1V
Supply Voltage	V	2.9	3.1	3.3	V	
Reverse Voltage	V _R	-	-	5	V	
Luminous Intensity	I _V	80	-	-	cd/m ²	I _{LED} =30mA
Wave Length			X=0.30 Y=0.30			I _{LED} =30mA
Life Time		-	20000	-	Hr.	V 3.2V
Color	White					

Drive Method



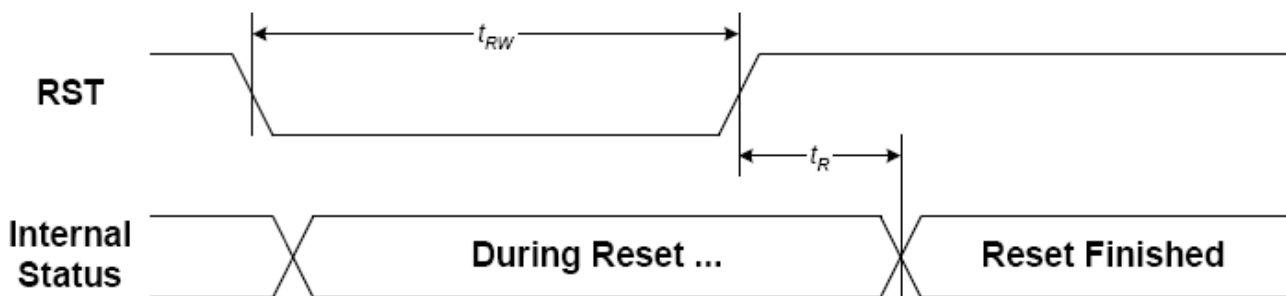
9. Timing Characteristics

9.1.6800 series



Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0, R/W	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tCYC6		400	—	
Enable L pulse width (WRITE)	E	tEHLW		220	—	
Enable H pulse width (WRITE)		tEHWLW		180	—	
Enable L pulse width (READ)		tEHLR		220	—	
Enable H pulse width (READ)		tEHWHR		180	—	
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Data hold time		tDH6		15	—	
READ access time		tACC6	CL = 100 pF	—	140	
READ Output disable time		tOH6	CL = 100 pF	10	100	

9.2. Reset Timing



Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	1.5	us
Reset "L" pulse width	RST	tRW		1.5	—	—	us

10. Instruction Description

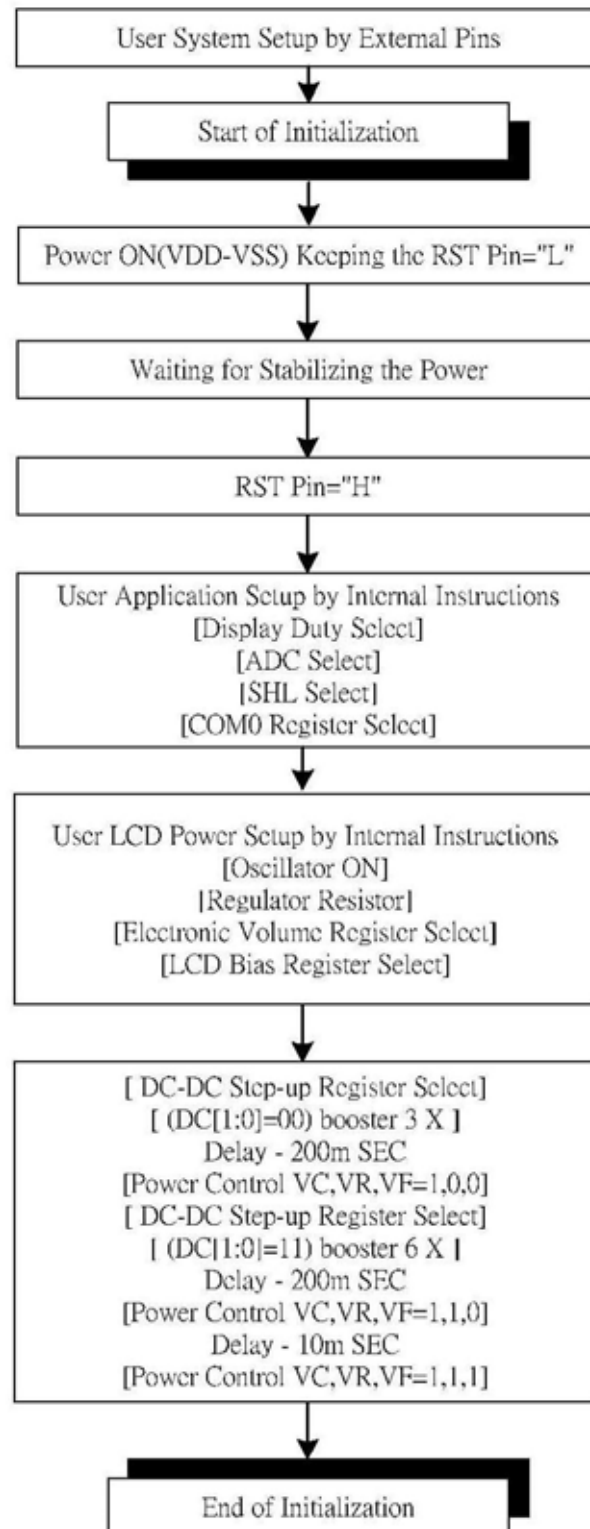
Instruction	A0	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Mode Set	0	0	0	0	1	1	1	0	0	0	2-byte command
	0	0	FR3	FR2	FR1	FR0	0	BE	x'	0	Set FR (Frame Rate) and BE (Booster Efficiency)
Read display data	1	1	Read data								Read data into DDRAM
Write display data	1	0	Write data								Write data into DDRAM
Read status	0	1	BUSY	ON	RES	MF2	MF1	MF0	DS1	DS0	Read the internal status
ICON control ON/OFF	0	0	1	0	1	0	0	0	1	ICON	ICON=0: ICON disable ICON=1: ICON enable & set page address to 16
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	0	Y7	Y6	Y5	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y4	Y3	Y2	Y1	Set column address LSB
Set Read-modify-Write	0	0	1	1	1	0	0	0	0	0	DDRAM address control: Read: No change Write: column address +1
Reset Read-modify-Write	0	0	1	1	1	0	1	1	1	0	Release read-modify-write
Display ON/OFF	0	0	1	0	1	0	1	1	1	D	D=0: Display OFF D=1: Display ON
Set Initial Display Line	0	0	0	1	0	0	0	0	x'	x'	2-byte command
	0	0	x'	S6	S5	S4	S3	S2	S1	S0	Specify the initial display line to realize vertical scrolling
Set Initial COM0	0	0	0	1	0	0	0	1	x'	x'	2-byte command
	0	0	x'	C6	C5	C4	C3	C2	C1	C0	Specify the first COM0 to move display window
Set Partial Display Duty	0	0	0	1	0	0	1	0	x'	x'	2-byte command
	0	0	L7	L6	L5	L4	L3	L2	L1	L0	Set partial display line number
Set N-line Inversion	0	0	0	1	0	0	1	1	x'	x'	2-byte command
	0	0	x'	x'	x'	N4	N3	N2	N1	N0	Set N-line inversion register
Release N-line Inversion	0	0	1	1	1	0	0	1	0	0	Exit N-line inversion mode
Reverse Display ON/OFF	0	0	1	0	1	0	0	1	1	REV	REV=0: normal display REV=1: reverse display
Entire Display ON/OFF	0	0	1	0	1	0	0	1	0	EON	EON=0: normal display EON=1: entire display ON

Instruction	A0	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Power Control	0	0	0	0	1	0	1	VC	VR	VF	Set power circuits ON/OFF
Select DC-DC step-up	0	0	0	1	1	0	0	1	DC1	DC0	Select built-in booster step
Select Regulator Register	0	0	0	0	1	0	0	R2	R1	R0	Select the internal resistance ratio of the regulator resistor
Select Electronic Volume	0	0	1	0	0	0	0	0	0	1	2-byte command
	0	0	x'	x'	EV5	EV4	EV3	EV2	EV1	EV0	Adjust contrast level
Select LCD bias	0	0	0	1	0	1	0	B2	B1	B0	Select LCD bias
High Power Mode	0	0	1	1	1	1	0	1	1	1	2-byte command
	0	0	0	0	0	1	1	0	1	0	Enable High Power Mode
High Power Mode Control	0	0	1	1	1	1	0	0	1	1	2-byte command
	0	0	0	0	0	0	1	1	0	1	Controls high driving mode
SHL select	0	0	1	1	0	0	SHL	x'	x'	x'	COM bi-directional selection SHL=0: normal direction SHL=1: reverse direction
ADC select	0	0	1	0	1	0	0	0	0	ADC	SEG bi-direction selection ADC=0: normal direction ADC=1: reverse direction
Oscillator ON	0	0	1	0	1	0	1	0	1	1	Start the built-in oscillator
Set power save mode	0	0	1	0	1	0	1	0	0	P	P=0: normal mode P=1: sleep mode
Release power save mode	0	0	1	1	1	0	0	0	0	1	Release power save mode
RESET	0	0	1	1	1	0	0	0	1	0	Software reset Refer to RESET CIRCUIT
Set display data length (DDL)	x'	x'	1	1	1	0	1	0	0	0	2-byte command
	x'	x'	D7	D6	D5	D4	D3	D2	D1	D0	Specify the number of data bytes. (3-Line SPI only)
Set FRC/PWM mode	0	0	1	0	0	1	0	FRC	PWM1	PWM0	FRC: 1=3FRC, 0=4FRC PWM[1:0]: (0,0)=(0,1)=9PWM (1,0)=12PWM (1,1)=15PWM
NOP	0	0	1	1	1	0	0	0	1	1	No operation
Test Instruction	0	0	1	1	1	1	x'	x'	x'	x'	Don't use this instruction

Instruction	A0	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
White palette (1 st /2 nd frame)	0	0	1	0	0	0	1	0	0	0	Set white mode palette
set PWM pulse width	0	0	WB3	WB2	WB1	WB0	WA3	WA2	WA1	WA0	1 st /2 nd frame
White palette (3 rd /4 th frame)	0	0	1	0	0	0	1	0	0	1	Set white mode palette
set PWM pulse width	0	0	WD3	WD2	WD1	WD0	WC3	WC2	WC1	WC0	3 rd /4 th frame
Light palette (1 st /2 nd frame)	0	0	1	0	0	0	1	0	1	0	Set light gray mode palette
set PWM pulse width	0	0	LB3	LB2	LB1	LB0	LA3	LA2	LA1	LA0	1 st /2 nd frame
Light palette (3 rd /4 th frame)	0	0	1	0	0	0	1	0	1	1	Set light gray mode palette
set PWM pulse width	0	0	LD3	LD2	LD1	LD0	LC3	LC2	LC1	LC0	3 rd /4 th frame
Dark palette (1 st /2 nd frame)	0	0	1	0	0	0	1	1	0	0	Set dark gray mode palette
set PWM pulse width	0	0	DB3	DB2	DB1	DB0	DA3	DA2	DA1	DA0	1 st /2 nd frame
Dark palette (3 rd /4 th frame)	0	0	1	0	0	0	1	1	0	1	Set dark gray mode palette
set PWM pulse width	0	0	DD3	DD2	DD1	DD0	DC3	DC2	DC1	DC0	3 rd /4 th frame
Black palette (1 st /2 nd frame)	0	0	1	0	0	0	1	1	1	0	Set black mode palette
set PWM pulse width	0	0	BB3	BB2	BB1	BB0	BA3	BA2	BA1	BA0	1 st /2 nd frame
Black palette (3 rd /4 th frame)	0	0	1	0	0	0	1	1	1	1	Set black mode palette
set PWM pulse width	0	0	BD3	BD2	BD1	BD0	BC3	BC2	BC1	BC0	3 rd /4 th frame

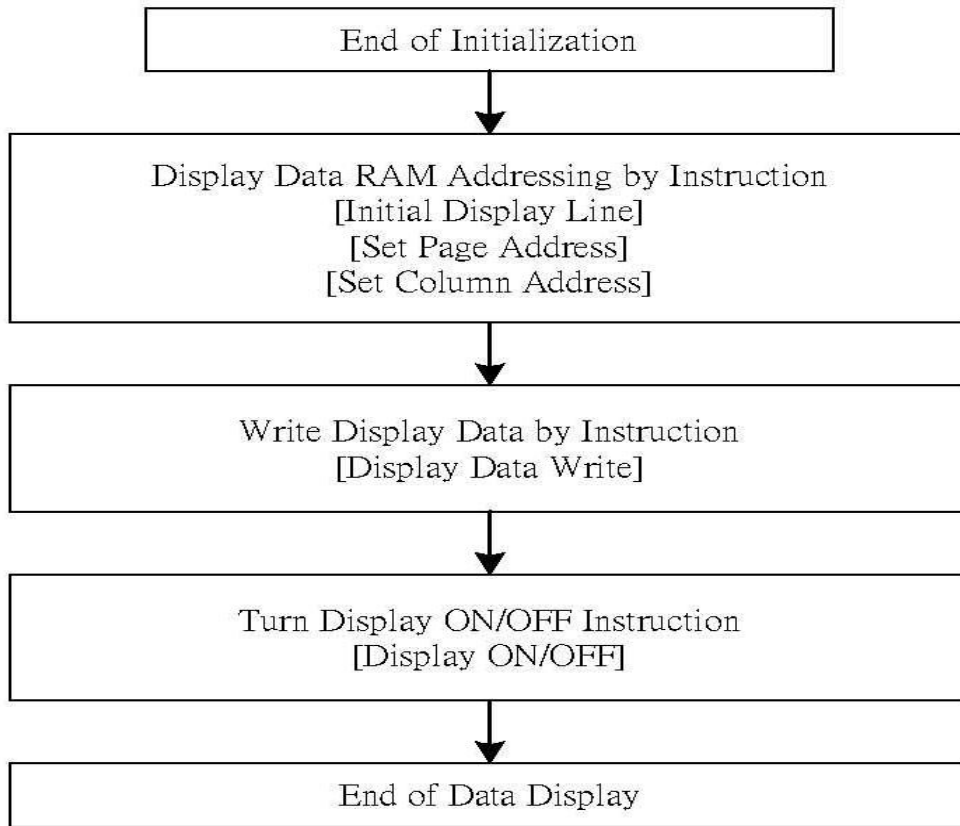
11. Initializing by Instruction

Referential Instruction Setup Flow: Initializing with the built-in Power Supply Circuits



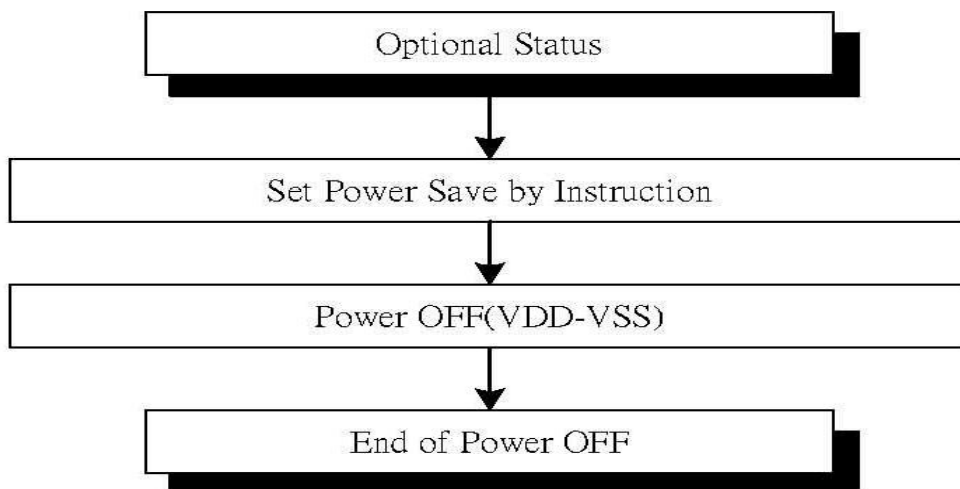
Initializing with the Built-in Power Supply Circuits

Referential Instruction Setup Flow: Data Displaying



Data Displaying

Referential Instruction Setup Flow: Power OFF

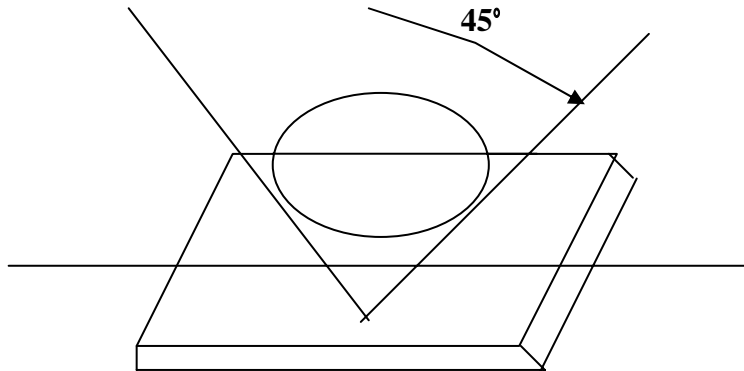


Power OFF

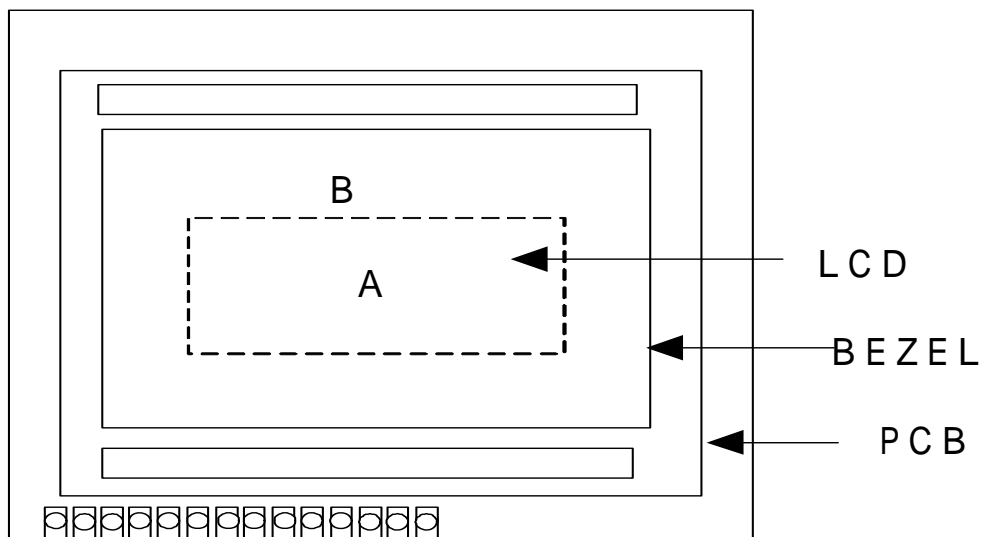
12. Quality Assurance

12.1 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.



Definition of applicable Zones

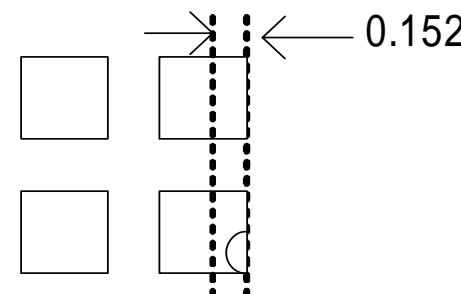
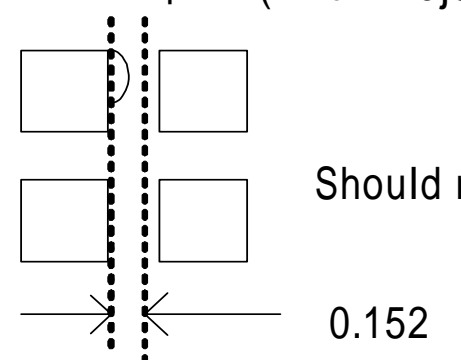
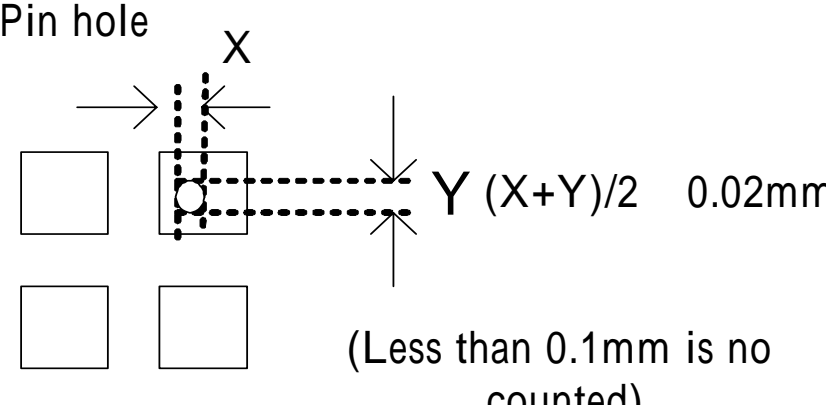
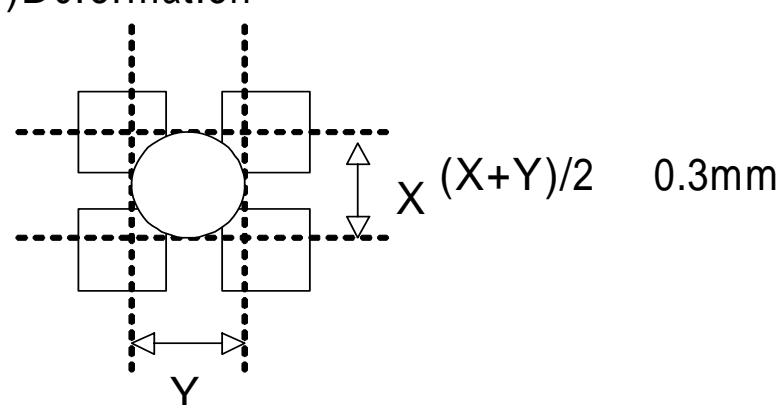


A : Display Area

B : Non-Display Area

12.2 Inspection Parameters

NO.	Parameter	Criteria																					
1	Black or White spots	<table border="1"> <thead> <tr> <th rowspan="2">Zone Dimension</th> <th colspan="2">Acceptable Number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">Acceptable Level</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>D < 0.15</td> <td>*</td> <td>*</td> <td rowspan="4">Minor</td> <td rowspan="4">2.5</td> </tr> <tr> <td>0.15 D 0.2</td> <td>4</td> <td>4</td> </tr> <tr> <td>0.2 D 0.25</td> <td>2</td> <td>2</td> </tr> <tr> <td>D 0.3</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p>D=(Long + Short)/2 *: Disregard</p>	Zone Dimension	Acceptable Number		Class Of Defects	Acceptable Level	A	B	D < 0.15	*	*	Minor	2.5	0.15 D 0.2	4	4	0.2 D 0.25	2	2	D 0.3	0	1
Zone Dimension	Acceptable Number			Class Of Defects	Acceptable Level																		
	A	B																					
D < 0.15	*	*	Minor	2.5																			
0.15 D 0.2	4	4																					
0.2 D 0.25	2	2																					
D 0.3	0	1																					
2	Scratch, Substances	<table border="1"> <thead> <tr> <th rowspan="2">Zone X(mm) Y(mm)</th> <th colspan="2">Acceptable Number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">Acceptable Level</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>* 0.04 W</td> <td>*</td> <td>*</td> <td rowspan="4">Minor</td> <td rowspan="4">2.5</td> </tr> <tr> <td>3.0 L 0.06 W</td> <td>4</td> <td>4</td> </tr> <tr> <td>2.0 L 0.08 W</td> <td>2</td> <td>3</td> </tr> <tr> <td>- 0.1 < W</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p>X: Length Y: Width *: Disregard Total defects should not exceed 4/module</p>	Zone X(mm) Y(mm)	Acceptable Number		Class Of Defects	Acceptable Level	A	B	* 0.04 W	*	*	Minor	2.5	3.0 L 0.06 W	4	4	2.0 L 0.08 W	2	3	- 0.1 < W	0	1
Zone X(mm) Y(mm)	Acceptable Number			Class Of Defects	Acceptable Level																		
	A	B																					
* 0.04 W	*	*	Minor	2.5																			
3.0 L 0.06 W	4	4																					
2.0 L 0.08 W	2	3																					
- 0.1 < W	0	1																					
3	Air Bubbles (between glass & polarizer)	<table border="1"> <thead> <tr> <th rowspan="2">Zone Dimension</th> <th colspan="2">Acceptable Number</th> <th rowspan="2">Class Of Defects</th> <th rowspan="2">Acceptable Level</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>D 0.15</td> <td>*</td> <td>*</td> <td rowspan="3">Minor</td> <td rowspan="3">2.5</td> </tr> <tr> <td>0.15 < D 0.25</td> <td>2</td> <td>*</td> </tr> <tr> <td>0.25 < D</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p>*: Disregard Total defects shall not excess 3/module.</p>	Zone Dimension	Acceptable Number		Class Of Defects	Acceptable Level	A	B	D 0.15	*	*	Minor	2.5	0.15 < D 0.25	2	*	0.25 < D	0	1			
Zone Dimension	Acceptable Number			Class Of Defects	Acceptable Level																		
	A	B																					
D 0.15	*	*	Minor	2.5																			
0.15 < D 0.25	2	*																					
0.25 < D	0	1																					

<p>4</p>	<p>Uniformity</p>	<p>(1) Pixel shape (with Dent)</p>  <p>(2) Pixel shape (With Projection)</p>  <p>Should not be connected to next pixel</p> <p>(3) Pin hole</p>  <p>$(X+Y)/2 \quad 0.02\text{mm}$</p> <p>(Less than 0.1mm is no counted)</p> <p>(4) Deformation</p>  <p>$(X+Y)/2 \quad 0.3\text{mm}$</p> <p>Total acceptable number : 1/pixel,5/cell</p>
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13. Reliability

Content of Reliability Test

Environmental Test										
No.	Test Item	Content of Test	Test Condition	Applicable Standard						
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	60 96hrs	—						
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10 96hrs	—						
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50 96hrs	—						
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-0 96hrs	—						
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40 ,90%RH 96hrs	—						
6	Thermal Shock Test	Endurance test applying the low and high temperature cycle. <div style="text-align: center;"> \leftarrow <table style="display: inline-table; border: none;"> <tr> <td style="padding: 0 10px;">-10</td> <td style="padding: 0 10px;">25</td> <td style="padding: 0 10px;">60</td> </tr> <tr> <td style="padding: 0 10px;">30min</td> <td style="padding: 0 10px;">5min</td> <td style="padding: 0 10px;">30min</td> </tr> </table> \rightarrow </div> 1 cycle	-10	25	60	30min	5min	30min	-10 / 60 5 cycles	—
-10	25	60								
30min	5min	30min								
7	Vibration test	Endurance test applying the vibration during transportation and using.	Total Fixed Amplitude:1.5mm Vibration Frequency :10~55Hz One cycle 60 seconds to 3 direction of X,Y,Z for each 15minutes	—						

14. Appendix (Drawing)

