

BOLYMIN

**SPECIFICATIONS FOR
LCD MODULE**

MODEL NO.
BO128128C series
VER.02

FOR MESSRS:

ON DATE OF:

APPROVED BY:

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1. Numbering System

<u>B</u>	<u>O</u>	<u>128128</u>	<u>C</u>	<u>F</u>	<u>P</u>	<u>H</u>	<u>:</u>	<u>H</u>	<u>xxx</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 128	dots
Module dimension (L x W x H)	36.3 x 44.7 x 2.1 (MAX) no b/l 36.3 x 44.7 x 4 (MAX) LED B/L	mm
View area	30.5 x 32.0	mm
Active area	27.25 x 29.81	mm
Dot size	0.199x 0.199	mm
Dot pitch	0.213 x 0.213	mm

(2) Controller IC: ST7528 controller

(3) Temperature Range

	Normal	Wide
Operating	0 ~+50	-20 ~+70
Storage	-10 ~+60	-30 ~+80

3. Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T _{OP}	0	-	+50	
Storage Temperature	T _{ST}	-20	-	+70	
Input Voltage	V _I	V _{SS}	-	V _{DD}	V
Supply Voltage For Logic	V _{DD} -V _{SS}	-0.5	-	+3.6	V
Supply Voltage For LCD output	V _{out_IN} -V _{SS}	-	-	15	V

4. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	Vdd-Vss	-	2.4	3.3	3.6	V
Supply Voltage For LCD	Vo-Vss	* Ta=-20 Ta=25 * Ta=+70	- - -	13.5 13.7 13.9	- - -	V
Input High Volt.	V _{IH}	-	1.8	-	Vdd	V
Input Low Volt.	V _{IL}	-	0	-	0.8	V
Output High Volt.	V _{OH}	-	0.7*Vdd	-	Vdd	V
Output Low Volt.	V _{OL}	-	Vss	-	0.3*Vss	V
Supply Current	I _{dd}	Vdd=3.3V	-	0.5	-	mA

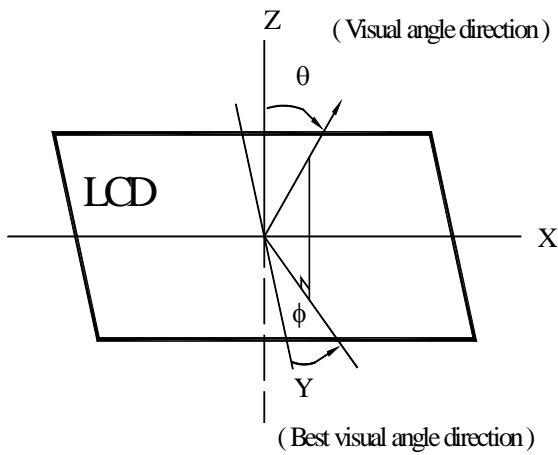
5. Optical Characteristics

a. FSTN

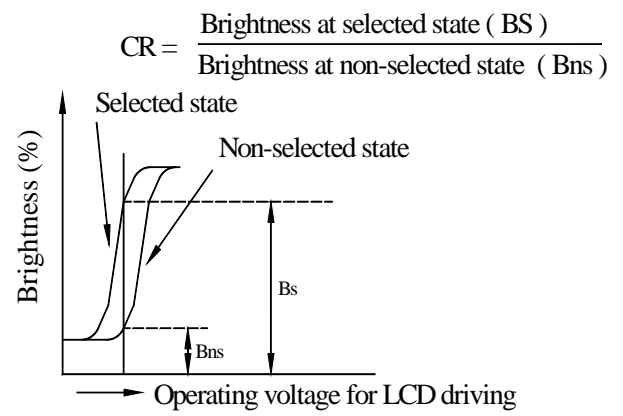
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
View Angle	(V)	CR 3	10	-	60	deg
	(H)	CR 3	-45	-	45	deg
Contrast Ratio	CR	-	-	24	-	-
Response Time 25	T rise	-	-	30	400	ms
	T fall	-	-	310	400	ms

5.1 Definitions

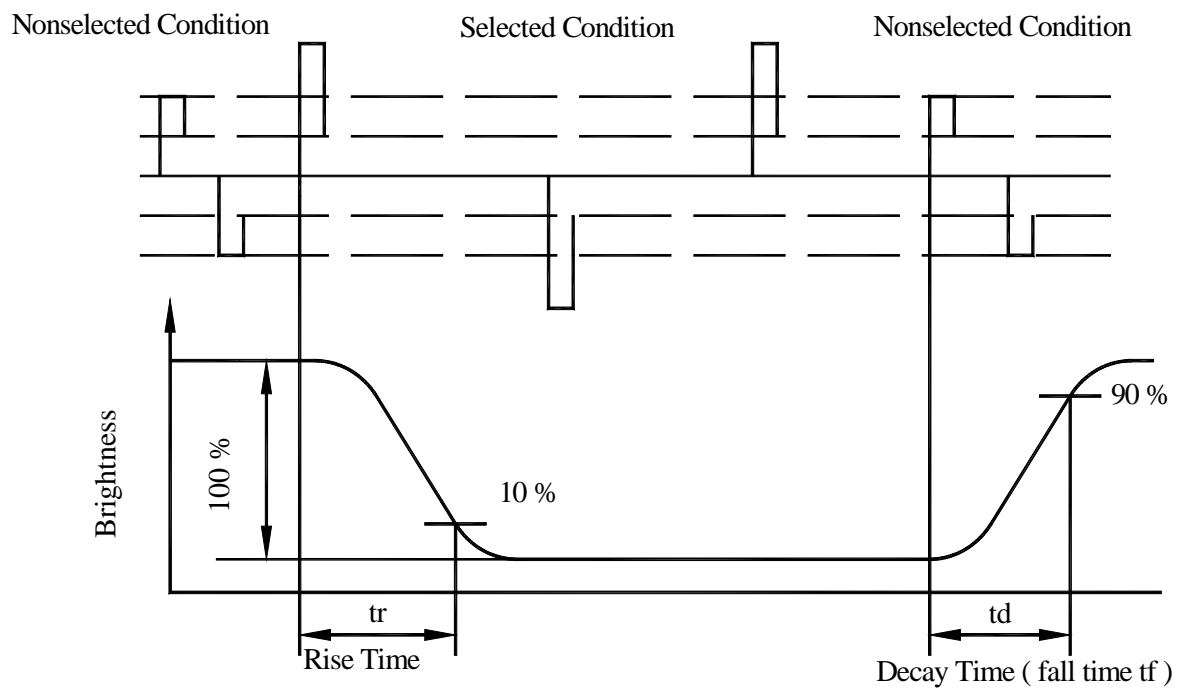
View Angles



Contrast Ratio



Response Time



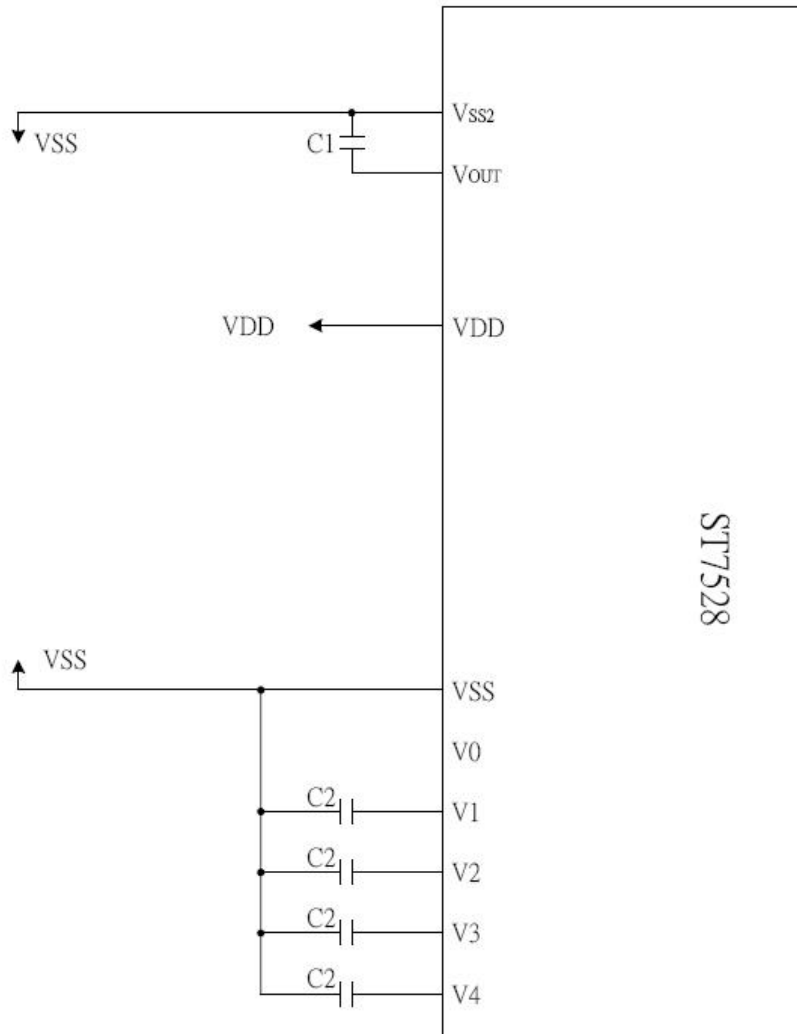
6. Interface Description

Pin No.	Symbol	Level	Description
1	NC	-	No connection
2	V0	-	LCD driver voltage V0 V1 V2 V3 V4 VSS
3	V1	-	
4	V2	-	
5	V3	-	
6	V4	-	
7	VOUT	-	DC-DC voltage converter
8	VSS	-	Ground
9	VDD	3.0V	Power supply (+3.3V)
10	SID	H/L	Serial Data Input
11	SCLK	H/L	Serial Clock Input
12	A0	H/L	H=Data L=Instruction
13	/RESET	L	Reset : L=Enable H=Disable
14	/CSB	L	L=chip selected H=chip unselected

7. Power Supply for LCD Module

* Bias Power Save circuit

When we set the Instruction of Bias Power Save, the bias also could be working, and the IC current consumption will be lower about 100uA to 200uA



$C1 = 1\mu\text{F} \sim 4.7\mu\text{F}$

$C2 = 0.1\mu\text{F} \sim 1\mu\text{F}$

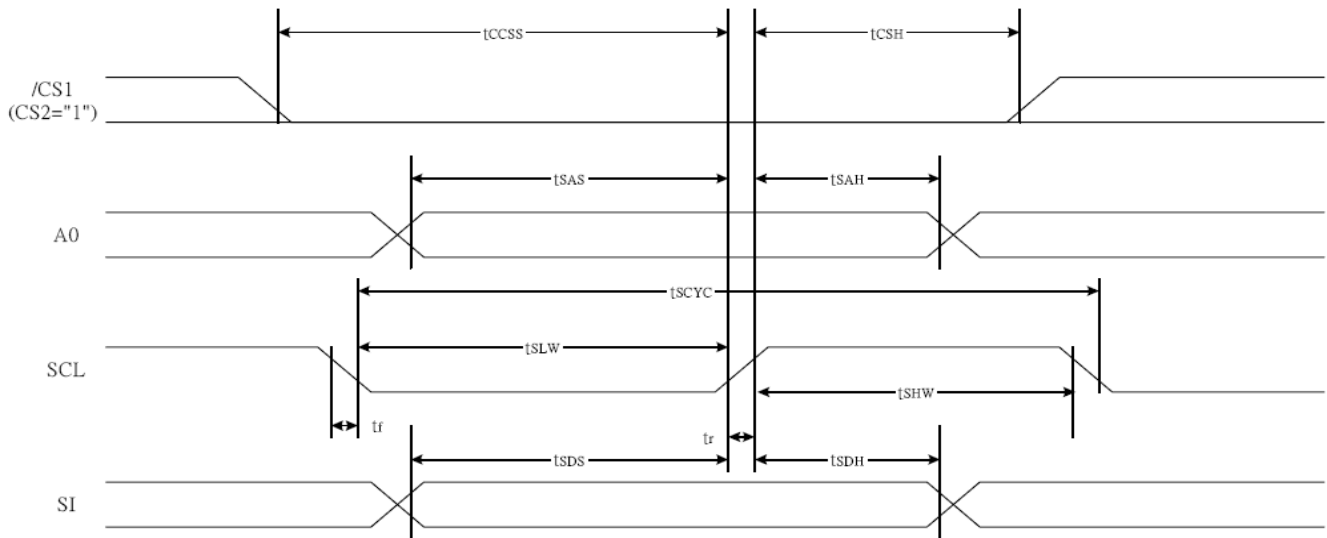
8. Backlight Information

(1) LED edge/white

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	I _{LED}		30	-	mA	V=3.1V
Supply Voltage	V	-	3.1	3.3	V	-
Reverse Voltage	V _R	-	-	8	V	-
Luminous Intensity	I _V	-	20	-	cd/m ²	I _{LED} =30mA
Life Time	-	-	20000	-	Hr.	V 3.1V
Color	White					

9. Timing Characteristics

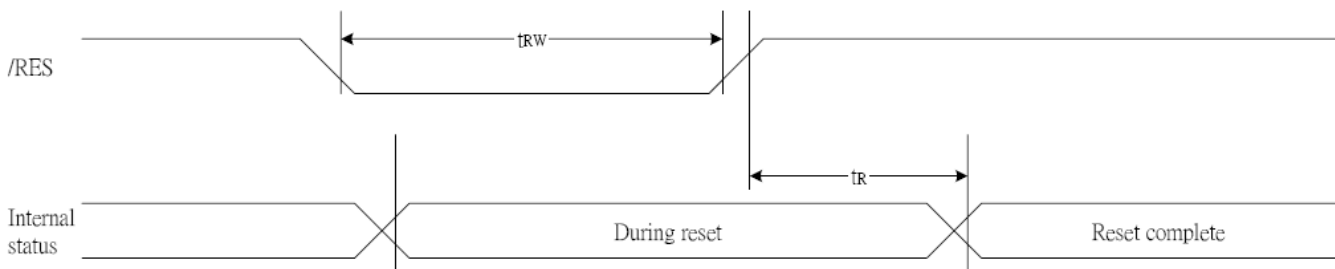
Serial Interface (4-line interface)



($V_{DD}=3.3V, T_a=-30\sim 85^{\circ}C$)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Serial Clock Period	SCL	tSCYC		50	—	ns
SCL "H" pulse width		tSHW		25	—	
SCL "L" pulse width		tSLW		25	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		10	—	
Data setup time	SI	tSDS		20	—	
Data hold time		tSDH		10	—	
CS-SCL time	CSB	tCSS		20	—	
CS-SCL time		tCSH		40	—	

Reset Timing



($V_{DD} = 3.3V, T_a = -30 \text{ to } 85^{\circ}C$)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	1	us
Reset "L" pulse width	RESB	tRW		1	—	—	us

10. Instruction Description

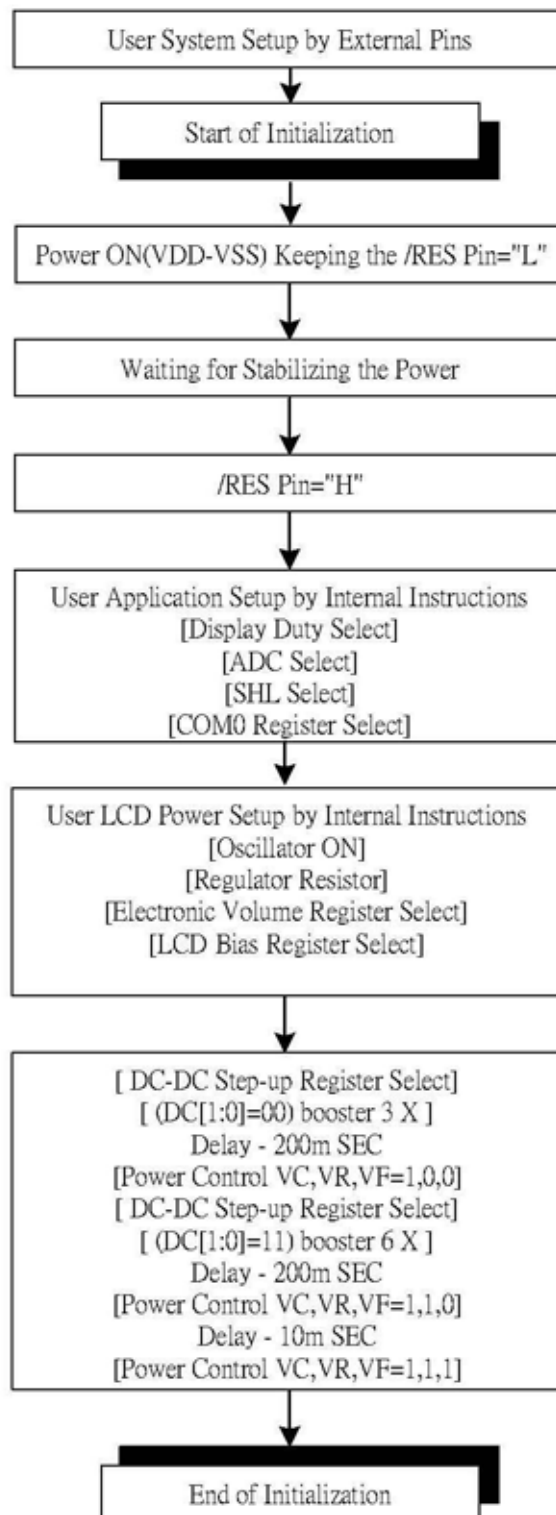
Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
EXT=0 or 1											
Mode Set	0	0	0	0	1	1	1	0	0	0	2-byte instruction to set Mode and FR(Frame frequency control) BE(Booster efficiency control)
	0	0	FR3	FR2	FR1	FR0	0	BE	x'	EXT	
EXT=0											
Read display data	1	1	Read data								Read 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 register ON/OFF	0	0	1	0	1	0	0	0	1	ICON	ICON=0: ICON disable(default) ICON=1: ICON enable & set the 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	Y9	Y8	Y7	Y6	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y5	Y4	Y3	Y2	Set column address LSB
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	release modify-read mode
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 register	0	0	0	1	0	0	0	0	x'	x'	2-byte instruction to specify the initial display line to realize vertical scrolling
	0	0	x'	S6	S5	S4	S3	S2	S1	S0	
Set initial COM0 register	0	0	0	1	0	0	0	1	x'	x'	2-byte instruction to specify the initial COM0 to realize window scrolling
	0	0	x'	C6	C5	C4	C3	C2	C1	C0	
Select partial display line	0	0	0	1	0	0	1	0	x'	x'	2-byte instruction to set partial display duty ratio
	0	0	D7	D6	D5	D4	D3	D2	D1	D0	
Set N-line inversion	0	0	0	1	0	0	1	1	x'	x'	2-byte instruction to set N-line inversion register
	0	0	x'	x'	x'	N4	N3	N2	N1	N0	
Release N-line inversion	0	0	1	1	1	0	0	1	0	0	Release 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	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Ext=0											
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Select DC-DC step-up	0	0	0	1	1	0	0	1	DC1	DC0	Select the step-up of internal voltage converter
Select regulator register	0	0	0	0	1	0	0	R2	R1	R0	Select the internal resistance ratio of the regulator resistor
Select electronic volumn register	0	0	1	0	0	0	0	0	0	1	2-byte instruction to specify the reference voltage
	0	0	x'	x'	EV5	EV4	EV3	EV2	EV1	EV0	
Select LCD bias	0	0	0	1	0	1	0	B2	B1	B0	Select LCD bias
Set Bias Power Save Mode	0	0	1	1	1	1	0	0	1	1	Bias Power save Save the Bias current consumption
	0	0	0	0	0	0	0	0	0	0	
Release Bias Power Save Mode	0	0	1	1	1	1	0	0	1	1	Bias Power save release set the Bias power to normal
	0	0	0	0	0	0	0	1	0	0	
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 start	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	initial the internal function
Set data direction & display data length(DDL)	x'	x'	1	1	1	0	1	0	0	0	2-byte instruction to specify the number of data bytes. (SPI mode)
	x'	x'	D7	D6	D5	D4	D3	D2	D1	D0	
Select FRC and PWM mode	0	0	1	0	0	1	0	FRC	PWM1	PWM0	FRC(1:3FRC, 0:4FRC) PWM1 PWM0 0 0 45PWM 0 1 45 PWM 1 0 60PWM 1 1 ---
NOP	0	0	1	1	1	0	0	0	1	1	<i>No operation</i>
Test Instruction	0	0	1	1	1	1	x'	x'	x'	x'	<i>Don't use this instruction</i>

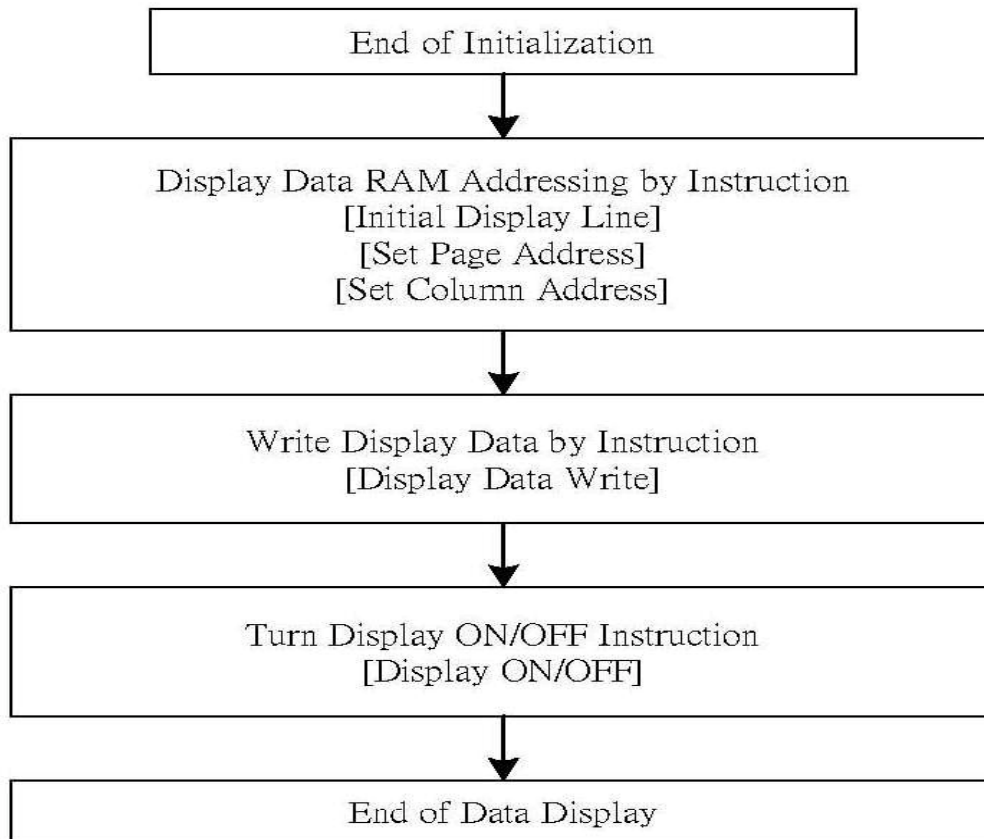
Instruction	A0	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
EXT=1											
Set white mode and 1 st frame, set pulse width	0	0	1	0	0	0	0	0	0	0	Set white mode and 1st frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set white mode and 2 nd frame, set pulse width	0	0	1	0	0	0	0	0	0	1	Set white mode and 2nd frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set white mode and 3 rd frame, set pulse width	0	0	1	0	0	0	0	0	1	0	Set white mode and 3rd frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set white mode and 4 th frame, set pulse width	0	0	1	0	0	0	0	0	1	1	Set white mode and 4th frame
	0	0	X'	X'	GA05	GA04	GA03	GA02	GA01	GA00	
Set gray level 1 mode	0	0	84H~87H (4 bytes)								Set gray level1
Set gray level 2 mode	0	0	88H~8BH (4 bytes)								Set gray level2
Set gray level 3 mode	0	0	8CH~8FH (4bytes)								Set gray level3
Set gray level 4 mode	0	0	90H~93H (4bytes)								Set gray level4
Set gray level 5 mode	0	0	94H~97H (4bytes)								Set gray level5
Set gray level 6 mode	0	0	98H~9BH (4 bytes)								Set gray level6
Set gray level 7 mode	0	0	9CH~9FH (4 bytes)								Set gray level7
Set gray level 8 mode	0	0	A0H~A3H (4 bytes)								Set gray level8
Set gray level 9 mode	0	0	A4H~A7H (4 bytes)								Set gray level9
Set gray level 10 mode	0	0	A8H~ABH (4 bytes)								Set gray level10
Set gray level 11mode	0	0	ACH~AFH (4 bytes)								Set gray level11
Set gray level 12 mode	0	0	B0H~B3H (4 bytes)								Set gray level12
Set gray level 13 mode	0	0	B4H~B7H (4 bytes)								Set gray level13
Set gray level 14 mode	0	0	B8H~BBH (4 bytes)								Set gray level14
Set Dark mode and 1st frame, set pulse width	0	0	1	0	1	1	1	1	0	0	Set Dark mode and 1st frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	
Set Dark mode and 2nd frame, set pulse width	0	0	1	0	1	1	1	1	0	1	Set Dark mode and 2nd frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	
Set Dark mode and 3rd frame, set pulse width	0	0	1	0	1	1	1	1	1	0	Set Dark mode and 3rd frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	
Set Dark mode and 4th frame, set pulse width	0	0	1	0	1	1	1	1	1	1	Set Dark mode and 4th frame, set pulse width
	0	0	X'	X'	GAF5	GAF4	GAF3	GAF2	GAF1	GAF0	

11. Command Description

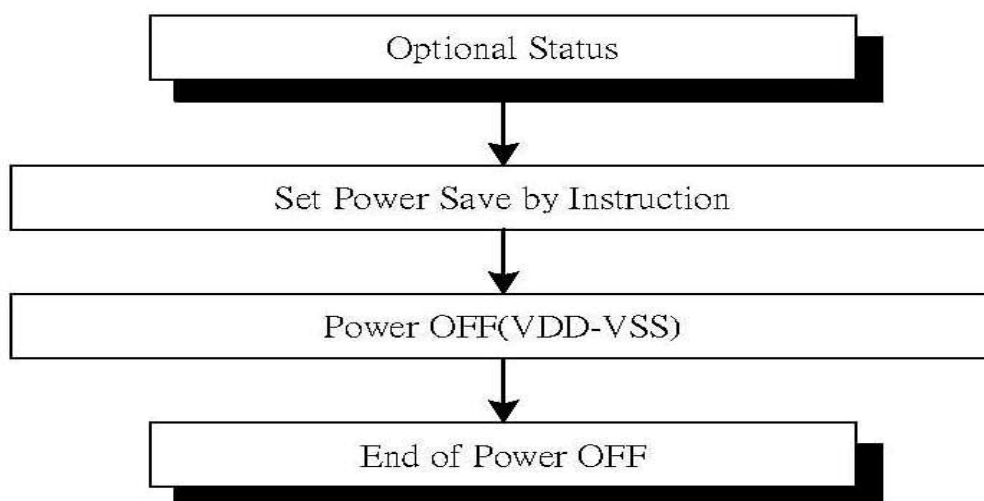
Referential Instruction Setup Flow: Initializing with the built-in Power Supply Circuits



Referential Instruction Setup Flow: Data Displaying



Referential Instruction Setup Flow: Power OFF



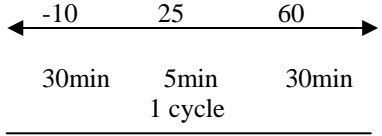
12. Quality Assurance

Screen Cosmetic Criteria

No.	Defect	Judgement Criterion	Partition																				
1	Spots	<p>A)Clear</p> <table border="1"> <thead> <tr> <th>Size:d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d 0.1</td> <td>Disregard</td> </tr> <tr> <td>0.1<d 0.2</td> <td>6</td> </tr> <tr> <td>0.2<d 0.3</td> <td>2</td> </tr> <tr> <td>0.3<d</td> <td>0</td> </tr> </tbody> </table> <p>Note:Including pin holes and defective dots which must be within one pixel size.</p> <p>B)Unclear</p> <table border="1"> <thead> <tr> <th>Size:d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d 0.2</td> <td>Disregard</td> </tr> <tr> <td>0.2<d 0.5</td> <td>6</td> </tr> <tr> <td>0.5<d 0.7</td> <td>2</td> </tr> <tr> <td>0.7<d</td> <td>0</td> </tr> </tbody> </table>	Size:d mm	Acceptable Qty in active area	d 0.1	Disregard	0.1<d 0.2	6	0.2<d 0.3	2	0.3<d	0	Size:d mm	Acceptable Qty in active area	d 0.2	Disregard	0.2<d 0.5	6	0.5<d 0.7	2	0.7<d	0	Minor
Size:d mm	Acceptable Qty in active area																						
d 0.1	Disregard																						
0.1<d 0.2	6																						
0.2<d 0.3	2																						
0.3<d	0																						
Size:d mm	Acceptable Qty in active area																						
d 0.2	Disregard																						
0.2<d 0.5	6																						
0.5<d 0.7	2																						
0.7<d	0																						
2	Bubbles in Polarizer	<table border="1"> <thead> <tr> <th>Size:d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d 0.3</td> <td>Disregard</td> </tr> <tr> <td>0.3<d 1.0</td> <td>3</td> </tr> <tr> <td>1.0<d 1.5</td> <td>1</td> </tr> <tr> <td>1.5<d</td> <td>0</td> </tr> </tbody> </table>	Size:d mm	Acceptable Qty in active area	d 0.3	Disregard	0.3<d 1.0	3	1.0<d 1.5	1	1.5<d	0	Minor										
Size:d mm	Acceptable Qty in active area																						
d 0.3	Disregard																						
0.3<d 1.0	3																						
1.0<d 1.5	1																						
1.5<d	0																						
3	Scratch	In accordance with spots cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor																				
4	Allowable Density	Above defects should be separated more than 30mm each other.	Minor																				
5	Coloration	<p>Not to be noticeable coloration in the viewing area of the LCD panels.</p> <p>Back-light type should be judged with back-light on state only.</p>	Minor																				

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 200hrs	-
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10 200hrs	-
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50 200hrs	-
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0 200hrs	-
5	High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	70 ,90%RH 96hrs	-
6	High Temperature/ Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40 ,90%RH 96hrs	-
7	Temperature Cycle	Endurance test applying the low and high temperature cycle. 	-10 /60 10 cycles	-
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz 1.5mmp-p 22~500Hz 1.5G Total 0.5hrs	-
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msdc 3 times of each direction	-
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115mbar 40hrs	-
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V,RS=1.5k CS=100pF 1 time	-

***Supply voltage for logic system=5V. Supply voltage for LCD system = Operating voltage at 25

14. Appendix (Drawing)

