SPECIFICATIONS FOR
LCD MODULE

MODEL NO.
BO128128B series
VER.01

RoHS COMPLIANT

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

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History of Version

Version	Contents	Date	Note
01	NEW VERSION	2009/04/01	SPEC.

CONTENTS

1. Numbering System

	B	O	128128	B	-	-	-	-	-	xxx
	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)	56.0x 64.0 x 1.9-No B/L 56.0x 64.0 x 5.0-LED B/L	mm
View area	50 x 50	mm
Active area	47 x 47	mm
Dot size	0.32x 0.32	mm
Dot pitch	0.35 x 0.35	mm

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

(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}	-20	-	+70	℃
Storage Temperature	T_{ST}	-30	-	+80	℃
Supply Voltage For Logic	Vdd-Vss	1.8	-	3.3	V
Supply Voltage For LCD	Vo-Vss	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℃	— — —	— 14.0 —	— — —	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(with positive voltage)	Idd	Vdd=3.0V	—	5	—	mA

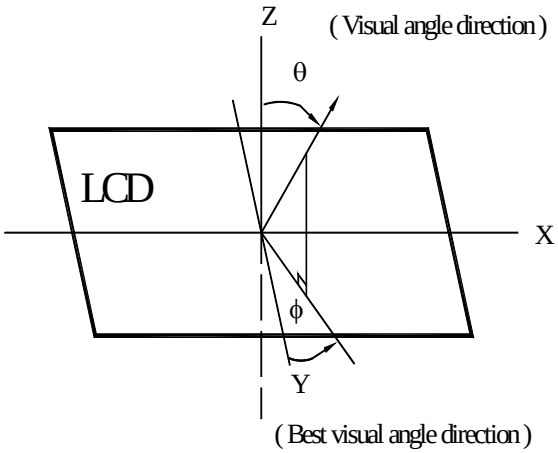
5. Optical Characteristics

a. FSTN

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
View Angle	(V) θ	CR≧2	10	-	60	deg
	(H) ϕ	CR≧2	-45	-	45	deg
Contrast Ratio	CR	-	-	5	-	-
Response Time 25℃	T rise	-	-	52	400	ms
	T fall	-	-	118	400	ms

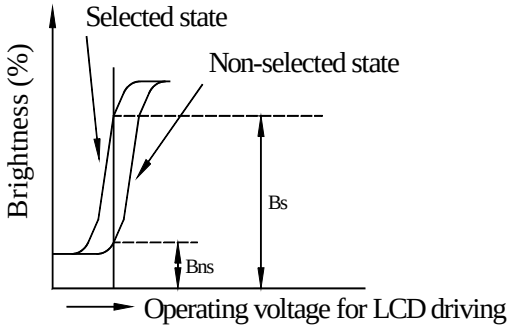
5.1 Definitions

■View Angles

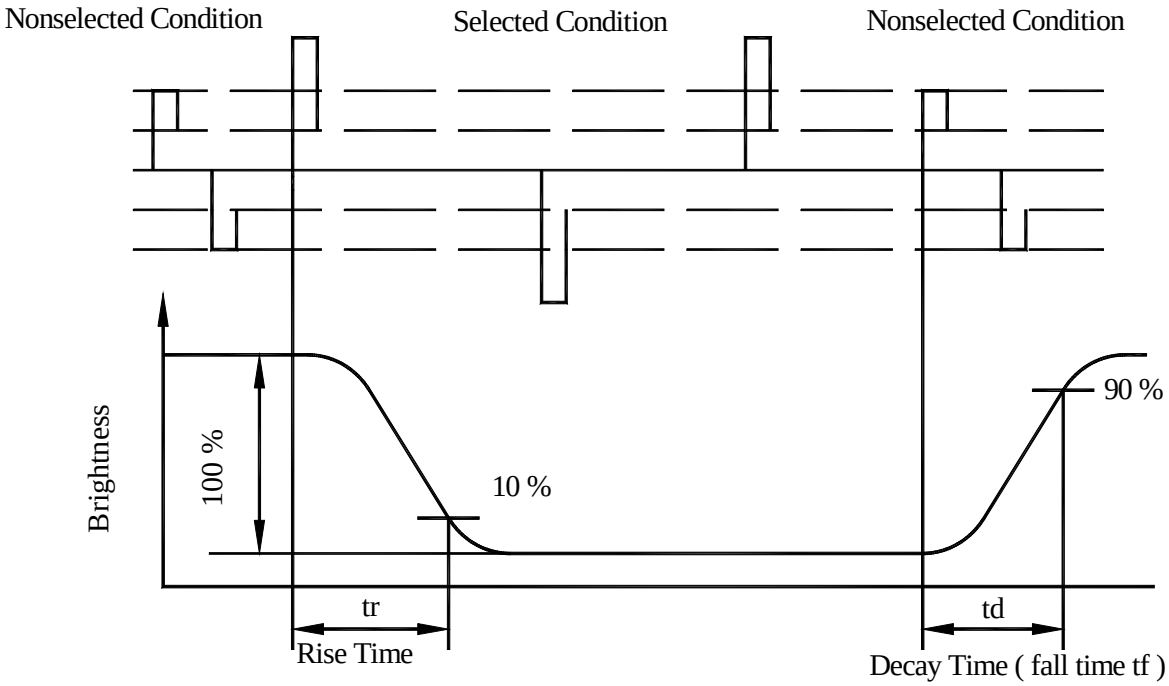


■Contrast Ratio

$$CR = \frac{\text{Brightness at selected state (BS)}}{\text{Brightness at non-selected state (Bns)}}$$



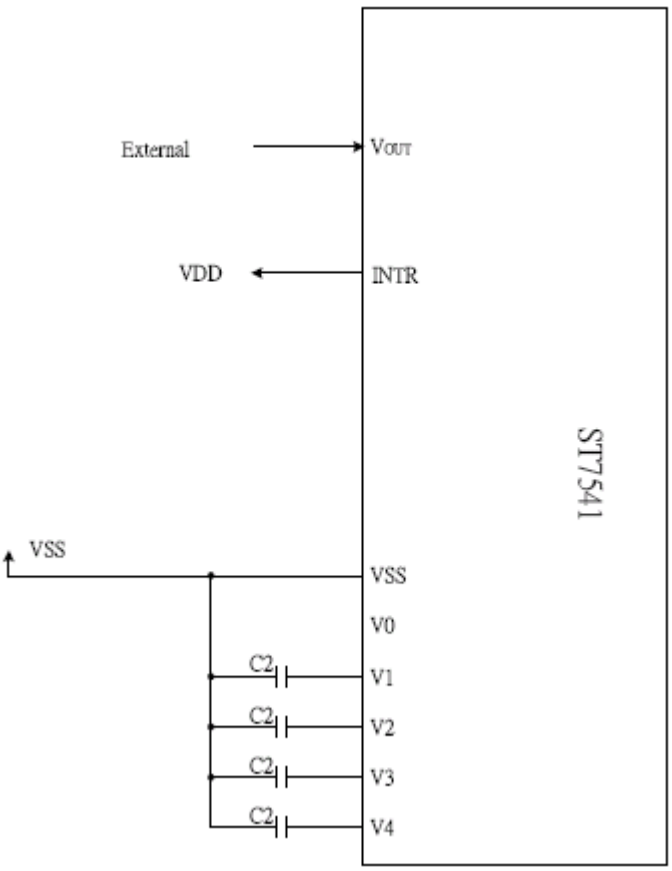
■Response Time



6. Interface Description

Pin No.	Symbol	Level	Description
1	VO	-	LCD driver voltage
2	V1	-	
3	V2	-	
4	V3	-	
5	V4	-	
6	NC	-	No connector
7	VSS	-	Ground
8	VDD	-	Power supply
9	SCL	H/L	I2C serial clock input
10	SDA	H/L	I2C serial clock input
11	/RES	H/L	Reset H: Disable L: Enable
12	NC	-	No connector

7. Power Supply for LCD Module



C2 = 0.1u F ~ 1u F (suggestion value: C2=0.1uF)

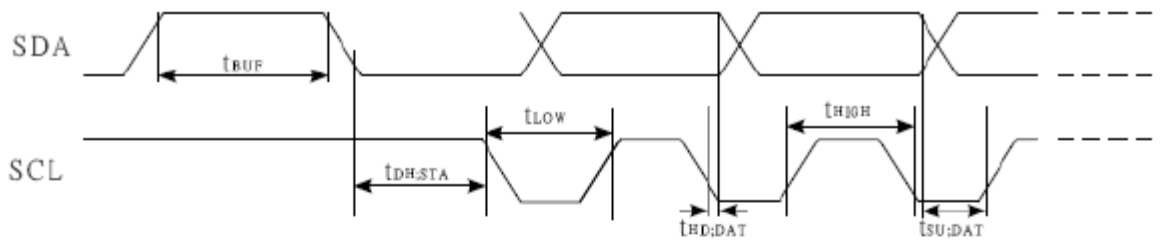
8. Backlight Information

(1) LED edge / white

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	ILED	—	60	80	mA	V=3.2V
Supply Voltage	V	—	3.2	—	V	
Reverse Voltage	VR	—	—	5	V	
Luminous Intensity	IV	—	80	—	cd/m^2	ILED=60mA
Life Time		—	20000	—	Hr.	V≦3.2V
Color	White					

9. Timing Characteristics

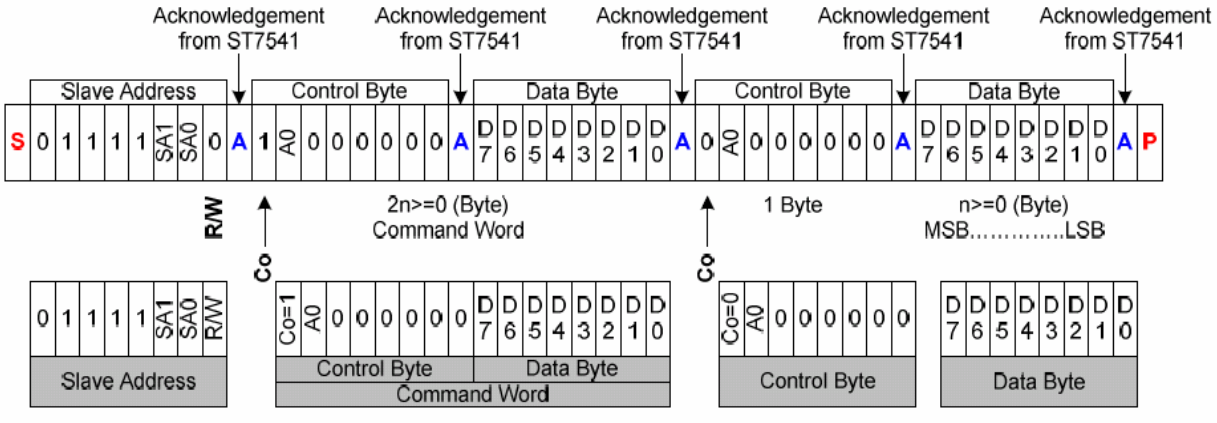
9.1.I2C series



(V_{DD}=3.3V,Ta=-30~85℃)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
SCL clock frequency	SCL	FSCLK		-	400	kHZ
SCL clock low period	SCL	TLOW		1.3	-	us
SCL clock high period	SCL	THIGH		0.6	-	us
Data set-up time	SI	TSU;Data		100	-	ns
Data hold time	SI	THD;Data		0	0.9	us
SCL,SDA rise time	SCL	TR		20+0.1Cb	300	ns
SCL,SDA fall time	SCL	TF		20+0.1Cb	300	ns
Capacitive load represented by each bus line		Cb		-	400	pF
Setup time for a repeated START condition	SI	TSU;SUA		0.6	-	us
Start condition hold time	SI	THD;STA		0.6	-	us
Setup time for STOP ondition		TSU;STO		0.6	-	us
Tolerable spike width on bus		TSW		-	50	ns
BUS free time between a STOP and StART condition	SCL	TBUF		1.3		us

Write Mode (R/W="0")

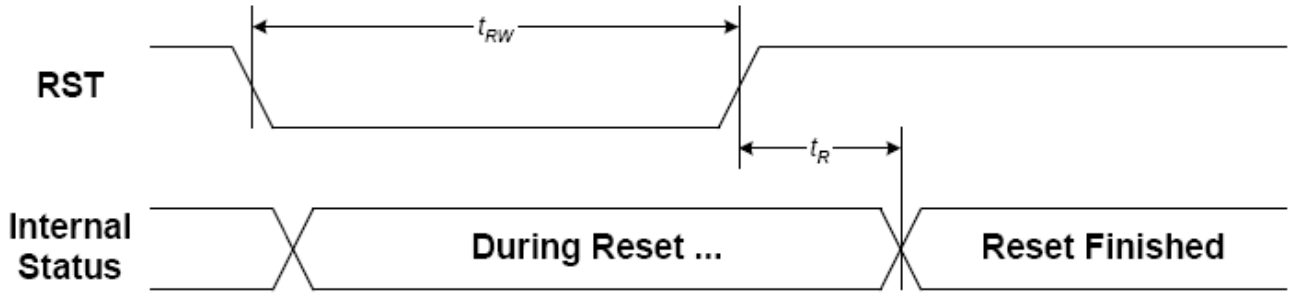


2-line Interface protocol

Co	0	Last control byte. Only a stream of data bytes is allowed to follow. This stream may only be terminated by a STOP or RE-START condition.
	1	Another control byte will follow the data byte unless a STOP or RE-START condition is received.

Default SA0=0 SA1=0

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

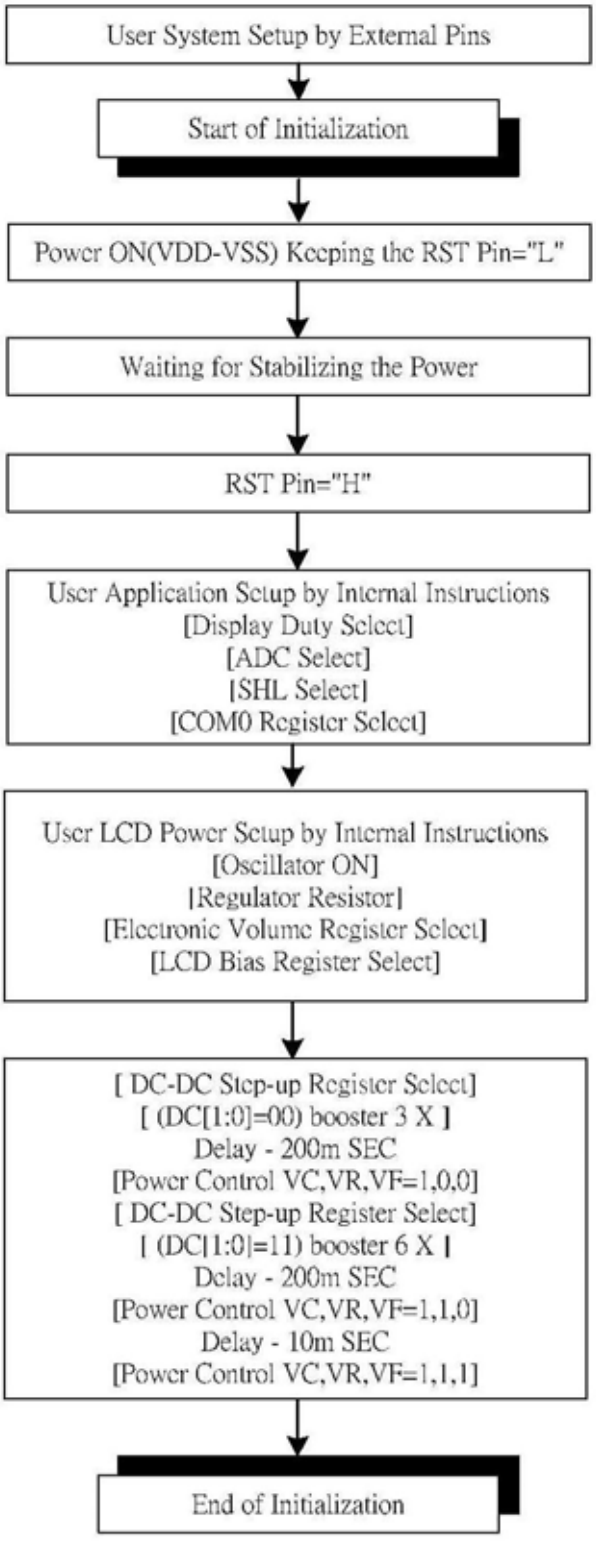
Instruction	A0	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Mode Set	0	0	0	0	1	1	1	0	0	0	2-byte command Set FR (Frame Rate) and BE (Booster Efficiency)
	0	0	FR3	FR2	FR1	FR0	0	BE	x'	0	
Read display data	1	1	Read data								Read data into DDRAM
Write display data	1	0	Write data								Write data into DDRAM
Read status	0	1	BUSY	ON	RES	MF2	MF1	MF0	DS1	DS0	Read the internal status
ICON control 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 Specify the initial display line to realize vertical scrolling
	0	0	x'	S6	S5	S4	S3	S2	S1	S0	
Set Initial COM0	0	0	0	1	0	0	0	1	x'	x'	2-byte command Specify the first COM0 to move display window
	0	0	x'	C6	C5	C4	C3	C2	C1	C0	
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

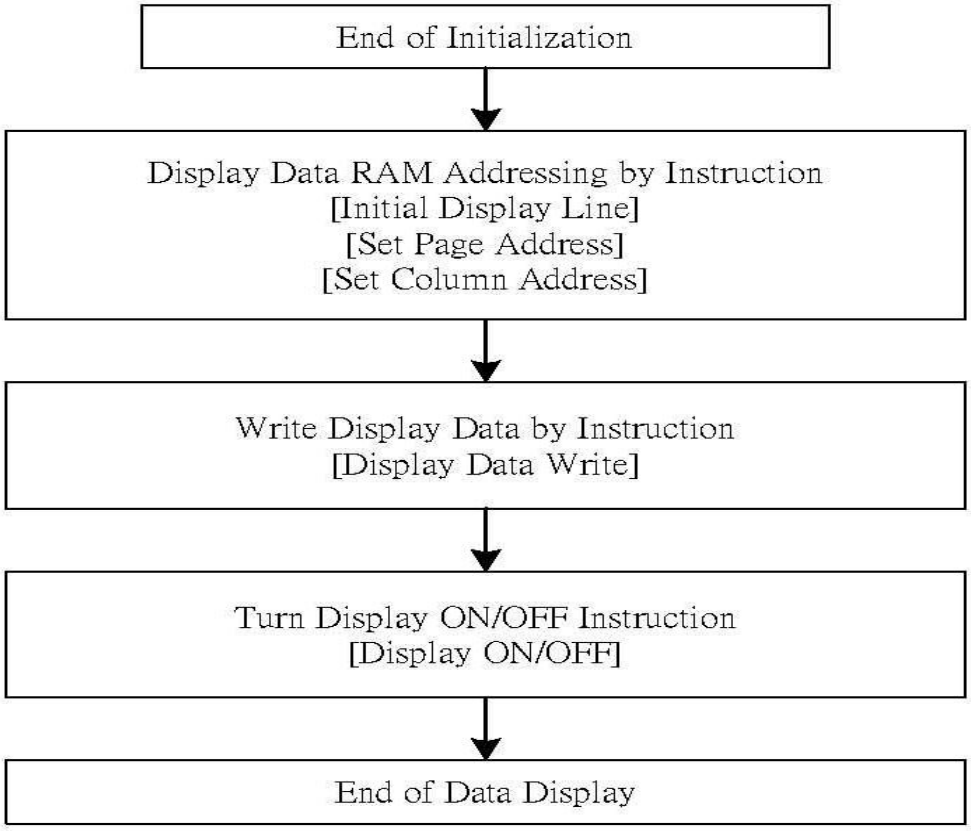
11. Initializing by Instruction

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



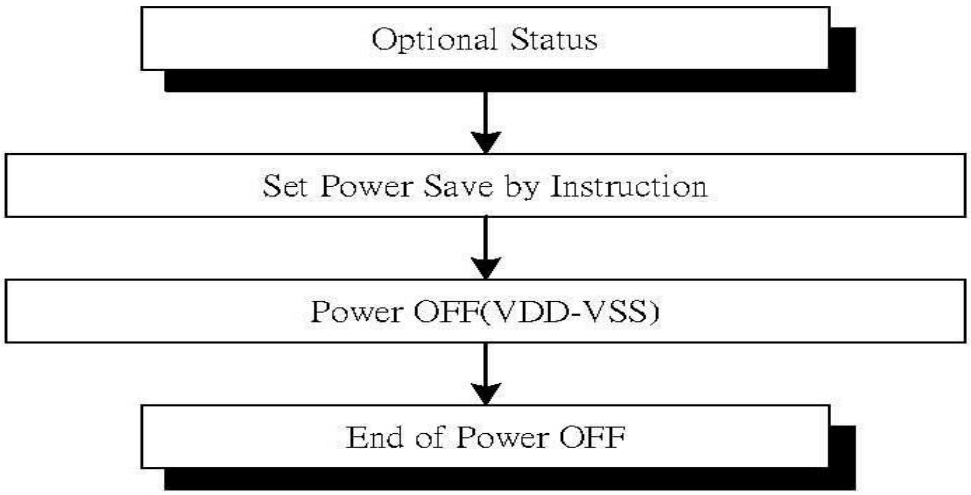
Initializing with the Built-in Power Supply Circuits

Referential Instruction Setup Flow: Data Displaying



Data Displaying

Referential Instruction Setup Flow: Power OFF



Power OFF

12. Quality Assurance

Screen Cosmetic Criteria

No.	Defect	Judgement Criterion	Partition
1	Spots	A)Clear 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 Note:Including pin holes and defective dots which must be within one pixel size. B)Unclear 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
2	Bubbles in Polarizer	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
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	Not to be noticeable coloration in the viewing area of the LCD panels. Back-light type should be judged with back-light on state only.	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.	80°C 96hrs	——
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30°C 96hrs	——
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70°C 96hrs	——
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20°C 96hrs	——
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40°C,90%RH 96hrs	——
6	Thermal Shock Test	Endurance test applying the low and high temperature cycle. -30°C 25°C 80°C ←——→ 30min 5min 30min 1 cycle	-30°C/ 80°C 5 cycles	——
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)