LM9033A

LCD Module User Manual

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Rev.	Descriptions	Release Date
0.1	Prelimiay release	2005-07-13
0.2	Typing Correction in 1.3 Block Diagram	2005-11-21

Table of Content

1. Basic Specifications

1.1 Display Specifications

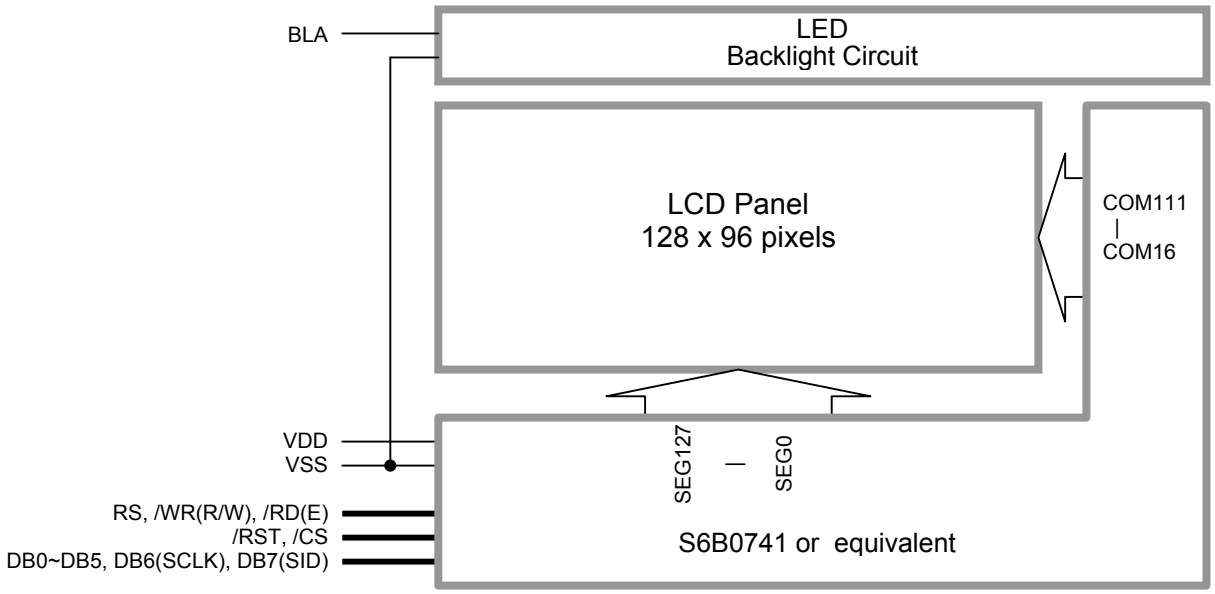
1) LCD Display Mode : FSTN, Positive, Transflective
2) Display Color : Display Data = “1” : Dark Gray (*1)
: Display Data = “0” : Light Gray (*2)
3) Viewing Angle : 6 H
4) Driving Method : 1/96 duty, 1/10bias
5) Back Light : White LED backlight

Note:
*1. Color tone may slightly change by Temperature and Driving Condition.
*2. The Color is defined as the inactive / background color

1.2 Mechanical Specifications

1) Outline Dimension : 63.8 x 47.4 x 7.3MAX
(see attached Outline Drawing for details)

1.3 Block Diagram

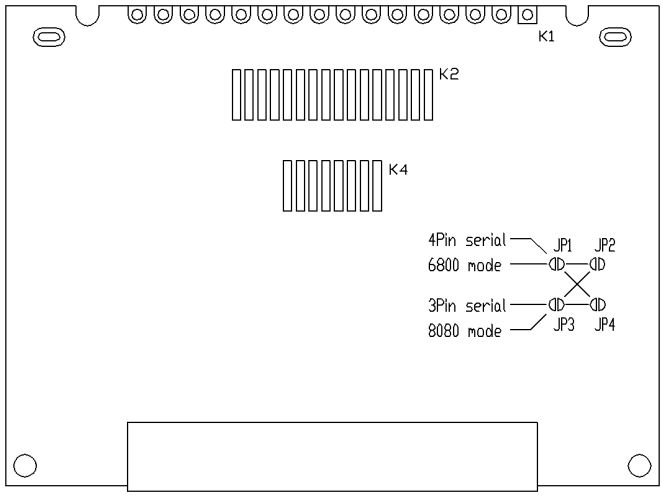


1.4 Terminal Functions

Pin No.		Pin Name	I/O	Descriptions			
K1,K2	K3			8-bit parallel 8080 mode	8-bit parallel 6800 mode	4-pin SPI mode	3-pin SPI mode
1	1	/CS	Input	Chip Select /CS=L, enable access to the LCD module /CS=H, disable access to the LCD module			
2	2	/RST	Input	Reset signal /RST = L, Initialization is executed /RST = H, Normal running.			
3	3	RS	Input	Register Select RS = H, Transferring the Display RAM data RS = L, Transferring the Instruction data			Not use, leave open or pull Hi
4	-	/WR (R/W)	Input	/WR=L→H, /RD=H; Data or Instruction latch into the LCD module	R/W = H, E=L; Data or Status read form the LCD module	Not used, leave open or pull Hi	
5	-	/RD (E)	Input	/WR=H, /RD=L; Data or Status read form the LCD module	R/W=L, E= H→L; Data or Instruction latch into the LCD module	Not used, leave open or pull Hi	
6	-	DB0	I/O	8-bit Data bus; Three state I/O terminal for display data or instruction data When /CS=H, DB0~DB7= High Impedance		Not used, leave open	
:	-	:	:				
11	-	DB5	I/O				
12	4	DB6 (SCLK)	I/O (Input)			Serial Clock Input	
13	5	DB7 (SID)	I/O (Input)			Serial Data Input	
14	6	VDD	Power	Positive Power Supply			
15	7	VSS	Power	Negative Power Supply, Ground (0V)			
16	8	BLA	Power	Positive Power for LED backlight			

1.5 Jumper Functions

Jumper Setting				Function	Descriptions
JP1	JP2	JP3	JP4		
OPEN	CLOSE	CLOSE	OPEN	8080 mode	Set to 8080 mode (8-bit parallel)
CLOSE	CLOSE	OPEN	OPEN	6800 mode	Set to 6800 interface mode (8-bit parallel)
CLOSE	OPEN	OPEN	CLOSE	4pin SPI	Set to 4-pin SPI mode (serial) <default setting>
OPEN	OPEN	CLOSE	CLOSE	3pin SPI	Set to 3-pin SPI mode (serial)



Back side of the LCD module

2. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	0	3.4	V	V_{SS} = 0V
Operating Temperature	T_{OP}	-20	70	°C	No Condensation
Storage Temperature	T_{ST}	-30	80	°C	No Condensation

Cautions:
Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

3. Electrical Characteristics

3.1 DC Characteristics

V_{SS}=0V, V_{DD} =3.3V, T_{OP} =25°C

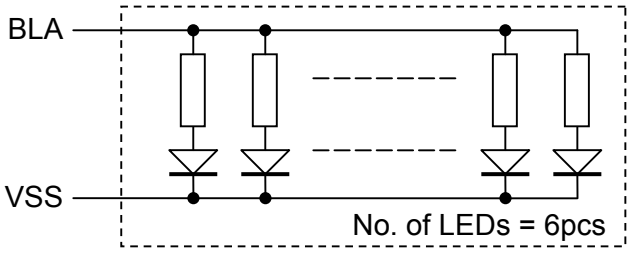
Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage	V_{DD}	3.0	-	3.4	V	VDD
Input High Voltage	V_{IH}	$0.8V_{DD}$	-	V_{DD}	V	/CS, /RST, RS, /WR(R/W), /RD(E), DB0-DB5, DB6(SCLK), DB7(SID)
Input Low Voltage	V_{IL}	V_{SS}	-	$0.2V_{DD}$	V	
Output High Voltage (I_{OH}=-0.4mA)	V_{OH}	$0.8V_{DD}$	-	V_{DD}	V	DB0-DB7
Output Low Voltage (I_{OL}=+0.4mA)	V_{OL}	V_{SS}	-	$0.2V_{DD}$	V	
Operating Current	I_{DD}	-	1.3	7.5	mA	VDD

3.2 LED Backlight Circuit Characteristics

V_{SS}=0V, If_{BLA}=40mA, T_{OP}=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Forward Voltage	Vf_{BLA}	-	3.3	-	V	BLA
Forward Current	If_{BLA}	-	-	80	mA	BLA

Cautions:
Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.



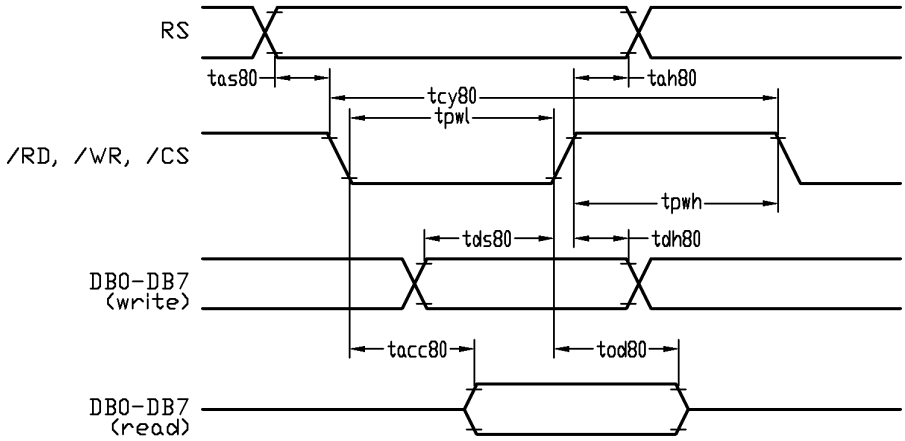
3.3 AC Characteristics

3.3.1 8080 Interface

V_{SS}=0V, V_{DD} =3.3V, T_{OP} =25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Address Setup Time	tas80	5	-	-	ns
Address Hold Time	tah80	5	-	-	ns
System Cycle Time (write)	tcy80	125	-	-	ns
System Cycle Time (read)	tcy80	210	-	-	ns
Pulse Width High	tpwh	50	-	-	ns
Pulse Width Low	tpwl	50	-	-	ns
Data Setup Time	tds80	40	-	-	ns
Data Hold Time	tdh80	7	-	-	ns
Read Access Time	tacc80	19	-	-	ns
Output Disable Time	tod80	-	-	63	ns

note: signal rise time and fall time should less than 12ns



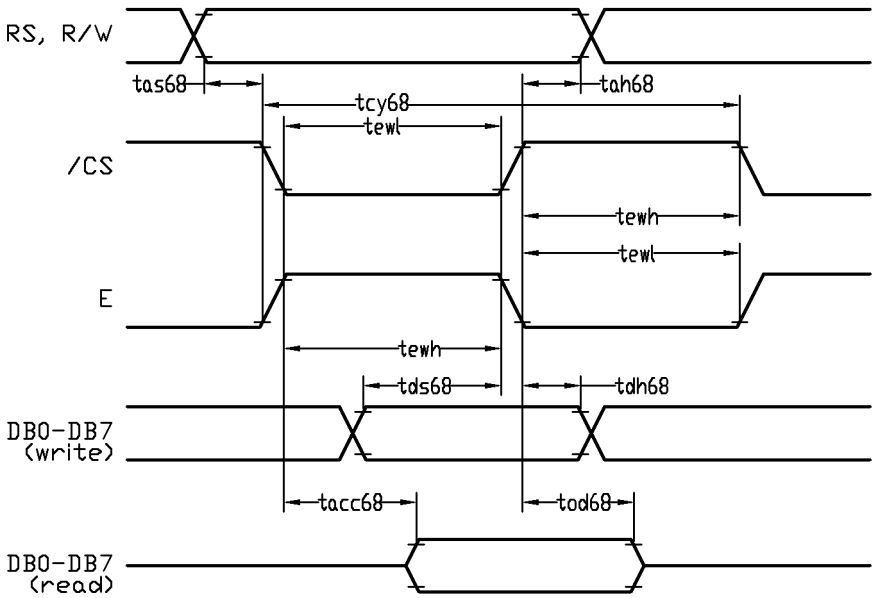
8080 Interface Timing Diagram

3.3.2 6800 Interface

V_{SS}=0V, V_{DD} =3.3V, T_{OP} =25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Address Setup Time	tas68	5	-	-	ns
Address Hold Time	tah68	5	-	-	ns
System Cycle Time (write)	tcy68	125	-	-	ns
System Cycle Time (read)	tcy68	210	-	-	ns
Enable Width High	tewh	50	-	-	ns
Enable Width Low	tewl	50	-	-	ns
Data Setup Time	tds68	40	-	-	ns
Data Hold Time	tdh68	7	-	-	ns
Read Access Time	tacc68	19	-	-	ns
Output Disable Time	tod68	-	-	63	ns

note: signal rise time and fall time should less than 12ns



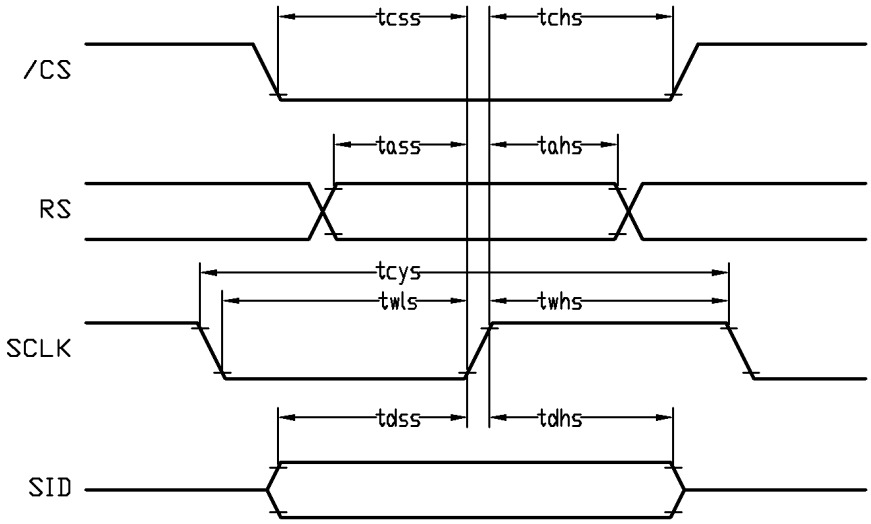
6800 Interface Timing Diagram

3.3.3 Serial Interface

V_{SS}=0V, V_{DD} =3.3V, T_{OP} =25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Serial Clock Cycle	tcys	80	-	-	ns
SCLK Pulse Width High	twhs	38	-	-	ns
SCLK Pulse Width Low	twls	38	-	-	ns
Address Setup Time	tass	40	-	-	ns
Address Hold Time	tahs	40	-	-	ns
Data Setup Time	tdss	40	-	-	ns
Data Hold Time	tdhs	40	-	-	ns
/CS Setup Time	tcss	40	-	-	ns
/CS Hold Time	tchs	0.6tcys	-	-	ns

note: signal rise time and fall time should less than 12ns

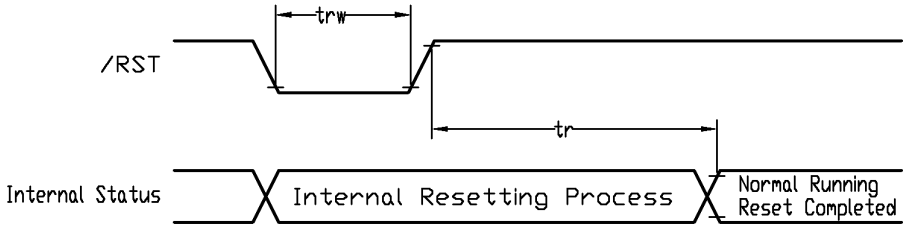


Serial Interface Timing Diagram

3.3.4 Reset Input

V_{SS}=0V, V_{DD} =3.3V, T_{OP} =25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset Low Pulse Width	trw	1200	-	-	ns
Reset Time	tr	-	-	1200	ns



Reset Timing Diagram

4. Function Specifications

4.1 Resetting the LCD module

The LCD module should be initialized by setting /RST terminal at low level after the power supply stable.

4.2 Serial Interface

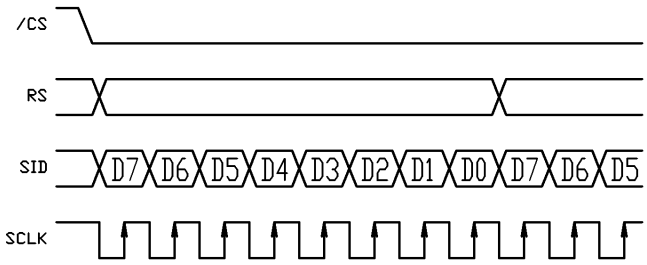
In serial mode, only write operation is available.
There are two type of serial interface

- 4-pin SPI mode
- 3-pin SPI mode

4.2.1 4-pin SPI Mode

In this mode, host transferring the command and display data by 4 wires only.

/CS, Enable the data transaction and init/reset the serial shift register and counter
RS, Address the transferred data as command or display data
SID, Serial data stream, D7 first, D0 last
SCLK, Serial clock, rising edge trigger



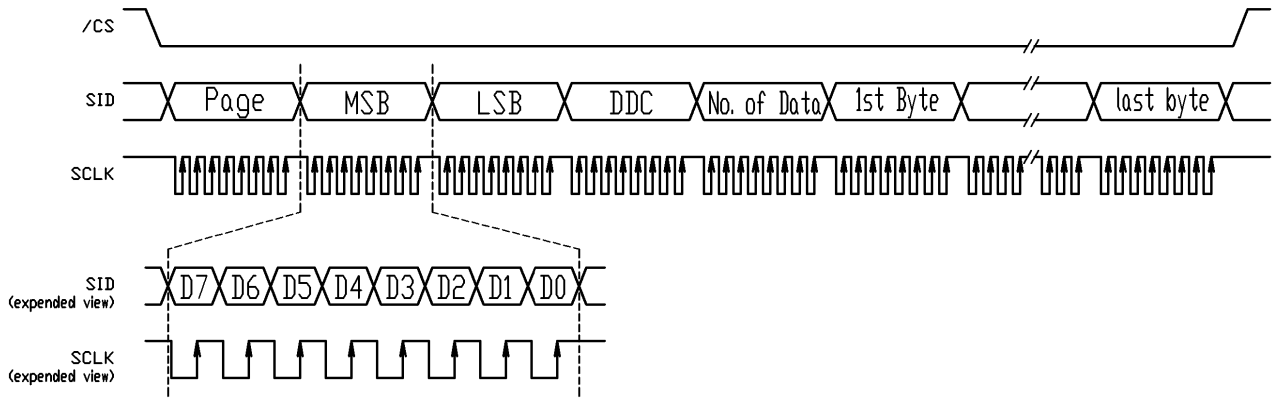
4-pin Serial Mode Timing Diagram

4.2.2 3-pin SPI Mode

In this mode, host transferring the command and display data by 3 wires only.

/CS, Enable the data transaction and init/reset the serial shift register and counter
SID, Serial data stream, D7 first, D0 last
SCLK, Serial clock, rising edge trigger

Basically, the 3pin SPI serial stream is transferring command only.
For the display data, it is necessary to use the “Data Direction + Display Data Length” command (two byte command) to address the display data.



3-pin SPI Timing Diagram

4.3 Display Memory Map

Page Address	Data	LCD Module Top View												
0	D0 : D7													
1	D0 : D7													
2	D0 : D7													
: :						128x96 pixels								
9	D0 : D7													
10	D0 : D7													
11	D0 : D7													
Column Address	Y7 : Y1	00h		01h		02h		. . .		7Dh		7Eh		7Fh	
	Y0	0	1	0	1	0	1	. . .		0	1	0	1	0	1
	Internal Display RAM Address													

Note: Display start line = 0, COM0 Register=16, Duty Ratio = 1/96, ADC=1, SHL=1

Only the upper 7bit (Y7:Y1) could be accessed by Column Address instruction, and the instruction will set the Y0 to “0”.

The 4-Gray Level are controlled by the combination of two bits in two adjacent byte of Internal Display RAM Address (same Column Address). Please see the following diagram for example.

Internal Display RAM Address								
hex	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
00	0	0	0	0	0	0	0	0
:	:	:	:	:	:	:	:	:
2n	:	:	:	:	:	:	:	0
2n + 1	:	:	:	:	:	:	:	1
:	:	:	:	:	:	:	:	:
FF	1	1	1	1	1	1	1	1

Data bit Value			
0	0	1	1
0	1	0	1

00	0	0	0	0	0	0	0
:	:	:	:	:	:	:	:
n	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:
7F	1	1	1	1	1	1	1
hex	Y7	Y6	Y5	Y4	Y3	Y2	Y1
Column Address							

0%	30%	60%	100%
Column Dot Gray Level			

Since the internal display RAM address counter is increased by 1, at each read or write data instruction. The microprocessor could access the display data continuously.
Note, the Column address counter is independent of page address register.

4.4 Instructions

Instructions	Code										Descriptions
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
read Display Data	1	1	Display RAM Data								Read data form DDRAM
write Display Data	1	0	Display RAM Data								write data into DDRAM
read Status	0	1	BUSY	ON/OFF	RES	MF2	MF1	MF0	DS1	DS0	read the internal status BUSY=1, chip busy; BUSY=0, ready; ON/OFF=1, display on; ON/OFF=0, display off RES=1, resetting; RES=0, reset finished MF[2…0]=manufacture ID DS[1…0]=display size
ICON Control Register	0	0	1	0	1	0	0	0	1	ICON	ICON=0, ICON disabled (default) ICON=1, ICON enabled
set Page Address	0	0	1	0	1	1	P3	P2	P1	P0	set Page Address Register
set Column Address MSB	0	0	0	0	0	1	0	Y7	Y6	Y5	set Column Address high 3bit
set Column Address LSB	0	0	0	0	0	0	Y4	Y3	Y2	Y1	set Column Address low 4bit
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	DON	DON=0, display OFF DON=1, display ON
set Initial display line register	0	0	0	1	0	0	0	0	x	x	specify the initial display line (2byte instruction)
	0	0	x	S6	S5	S4	S3	S2	S1	S0	
set initial COM0 register	0	0	0	1	0	0	0	1	x	x	specify the initial COM0 (2byte instruction)
	0	0	x	C6	C5	C4	C3	C2	C1	C0	
set partial display duty ratio	0	0	0	1	0	0	1	0	x	x	set partial display duty ratio (2byte instruction)
	0	0	D7	D6	D5	D4	D3	D2	D1	D0	
set N-line Inversion	0	0	0	1	0	0	1	1	x	x	set N-line inversion register (2byte instruction)
	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
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

Note:

*1. For the details of the Display Control Instructions, please refer to Samsung S6B0741 handbook.

Instruction (cont')

Instructions	Code										Function Discription
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Power Control	0	0	0	0	1	0	1	VC	VR	VF	Power circuit control VC=1, Booster on VC=0, Booster off VR=1, regulator circuit on VR=0, reulartor circuit off VF=1, voltage follower cuircit on VF=0, voltage follower cuircit off
select DC-DC step-up	0	0	0	1	1	0	0	1	DC1	DC0	Select the step-up of the internal voltage converter DC1 DC0 0 0 3 times boosting 0 0 4 times boosting 1 0 5 times boosting 1 1 6 times boosting
select regulator resistor	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor R2 R1 R0 1+(Rb/Ra) 0 0 0 2.3 0 0 1 3.0 0 1 0 3.7 0 1 1 4.4 1 0 0 5.1 1 0 1 5.8 1 1 0 6.5 1 1 1 7.2
set Electronic Volume Register	0	0	1	0	0	0	0	0	0	1	Specify the Reference Voltage (2-byte instruction)
	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 B2 B1 B0 LCD bias 0 0 0 1/5 0 0 1 1/6 0 1 0 1/7 0 1 1 1/8 1 0 0 1/9 1 0 1 1/10 1 1 0 1/11 1 1 1 1/12
SHL select	0	0	1	1	0	0	SHL	x	x	x	SHL=0, normal direction (COM0 → COM127) SHL=1, reverse direction (COM127 → COM0)
ADC select	0	0	1	0	1	0	0	0	0	ADC	ADC=0, normal direction (SEG0 → SEG127) ADC=1, reverse direction (SEG127 → SEG0)
Oscillator on start	0	0	1	0	1	0	1	0	1	1	Start the internal oscillator
set Power Save Mode	0	0	1	0	1	0	1	0	0	P	P=0, normal running 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 function
set Data Direction & Display Data Length (DDL)	x	x	1	1	1	0	1	0	0	0	specify the number of data bytes (3-pin SPI only) (2-byte instruction)
	x	x	D7	D6	D5	D4	D3	D2	D1	D0	
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	test mode, never use

Note:
*1. For the details of the Display Control Instructions, please refer to Samsung S6B0741 handbook.

Instruction (cont')

Instructions	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function Descriptions
set FRC and PWM mode	0	0	1	0	0	1	0	FRC	PWM1	PWM0	FRC=1, 3FRC FRC=0, 4FRC PWM1 PWM0 0 0 9PWM 0 1 9PWM 1 0 12PWM 1 1 15PWM
set white mode 1st/2nd frame pulse width	0	0	1	0	0	0	1	0	0	0	set white mode and 1st/2nd frame (2-byte instruction)
	0	0	WB3	WB2	WB1	WB0	WA3	WA2	WA1	WA0	
set white mode 3rd/4th frame pulse width	0	0	1	0	0	0	1	0	0	1	set white mode and 3rd/4th frame (2-byte instruction)
	0	0	WD3	WD2	WD1	WD0	WC3	WC2	WC1	WC0	
set light gray mode 1st/2nd frame pulse width	0	0	1	0	0	0	1	0	1	0	set light gray mode and 1st/2nd frame (2-byte instruction)
	0	0	LB3	LB2	LB1	LB0	LA3	LA2	LA1	LA0	
set light gray mode 3rd/4th frame pulse width	0	0	1	0	0	0	1	0	1	1	set light gray mode and 3rd/4th frame (2-byte instruction)
	0	0	LD3	LD2	LD1	LD0	LC3	LC2	LC1	LC0	
set dark gray mode 1st/2nd frame pulse width	0	0	1	0	0	0	1	1	0	0	set dark gray mode and 1st/2nd frame (2-byte instruction)
	0	0	DB3	DB2	DB1	DB0	DA3	DA2	DA1	DA0	
set dark gray mode 3rd/4th frame pulse width	0	0	1	0	0	0	1	1	0	1	set dark gray mode and 3rd/4th frame (2-byte instruction)
	0	0	DD3	DD2	DD1	DD0	DC3	DC2	DC1	DC0	
set black mode 1st/2nd frame pulse width	0	0	1	0	0	0	1	1	1	0	set black mode and 1st/2nd frame (2-byte instruction)
	0	0	BB3	BB2	BB1	BB0	BA3	BA2	BA1	BA0	
set black mode 3rd/4th frame pulse width	0	0	1	0	0	0	1	1	1	1	set black mode and 3rd/4th frame (2-byte instruction)
	0	0	BD3	BD2	BD1	BD0	BC3	BC2	BC1	BC0	

Note:
*1. For the details of the Display Control Instructions, please refer to Samsung S6B0741 handbook.

4.5 Initialization Sequence Example

	Code Function										Note
	RS	D7	D6	D5	D4	D3	D2	D1	D0	hex	
Turn on Power Supply VDD & VSS While maintaining /RES at LOW	-	-	-	-	-	-	-	-	-	-	-
↓											
Wait until power supply is stabilized	-	-	-	-	-	-	-	-	-	-	-
↓											
Release the /RES Reset Signal (/RES = HIGH)	-	-	-	-	-	-	-	-	-	-	See AC Characteristics section for timing details
↓											
Short Delay	-	-	-	-	-	-	-	-	-	-	Wait until internal Reset finished
↓											
Display Duty = 1/96	0	0	1	0	0	1	0	0	0	48h	meet LCD panel characteristic
	0	1	1	0	0	0	0	0	0	60h	(2-byte inst.)
↓											
ADC = 1	0	1	0	1	0	0	0	0	1	A1h	Flip x-direction (SEG)
↓											
SHL = 1	0	1	1	0	0	1	0	0	0	C8h	Flip y-direction (COM)
↓											
COM0 Register = 16	0	0	1	0	0	0	1	0	0	44h	meet LCD panel characteristic
	0	0	0	0	1	0	0	0	0	10h	(2-byte inst.)
↓											
Initial display line = 0	0	0	1	0	0	0	0	0	0	40h	meet LCD panel characteristic
	0	0	0	0	0	0	0	0	0	00h	(2-byte inst.)
↓											
Oscillator on Start	0	1	0	1	0	1	0	1	1	ABh	start the internal oscillator
↓											
DC-DC step-up register = 5	0	0	1	1	0	0	1	1	0	66h	5 time boosting
↓											
Regulator Resistor = 7	0	0	0	1	0	0	1	1	1	27h	set to max.
↓											
Electronic Volume Register = 32	0	1	0	0	0	0	0	0	1	81h	set to middle
	0	0	0	1	0	0	0	0	0	20h	(2-byte inst.)
↓											
LCD Bias = 1/9	0	0	1	0	1	0	1	0	0	54h	LCD panel characteristic
↓											
FRC=4, PWM=15	0	1	0	0	1	0	0	1	1	93h	Gray scale driving method
↓											
1st & 2nd frame's PWM level of "White" level	0	1	0	0	0	1	0	0	0	88h	PWM=0 in 1st and 2nd frame
	0	0	0	0	0	0	0	0	0	00h	(2-byte inst.)
↓											
3rd & 4th frame's PWM level of "White"	0	1	0	0	0	1	0	0	1	89h	PWM=0 in 3rd and 4th frame
	0	0	0	0	0	0	0	0	0	00h	(2-byte inst.)
↓											
1st & 2nd frame's PWM level of "Light Gray"	0	1	0	0	0	1	0	1	0	8Ah	PWM=8 in 1st and 2nd frame
	0	1	0	0	0	1	0	0	0	88h	(2-byte inst.)
↓											
3rd & 4th frame's PWM level of "Light Gray"	0	1	0	0	0	1	0	1	1	8Bh	PWM=8 in 3rd and 4th frame
	0	1	0	0	0	1	0	0	0	88h	(2-byte inst.)
↓											

Initialization Sequence Example (cont')

1st & 2nd frame's PWM level of "Dark Gray"	0	1	0	0	0	1	1	0	0	8Ch
	0	1	0	1	1	1	0	1	1	BBh
3rd & 4th frame's PWM level of "Dark Gray"	0	1	0	0	0	1	1	0	1	8Dh
	0	1	0	1	1	1	0	1	1	BBh
1st & 2nd frame's PWM level of "Black"	0	1	0	0	0	1	1	1	0	8E
	0	1	1	1	0	1	1	1	0	EE
3rd & 4th frame's PWM level of "Black"	0	1	0	0	0	1	1	1	1	8F
	0	1	1	1	0	1	1	1	0	EE
Power Control: VC=1, VR=0, VF=0	0	0	0	1	0	1	1	0	0	2C
Wait for ~1ms										
Power Control: VC=1, VR=1, VF=0	0	0	0	1	0	1	1	1	0	2E
Wait for ~1ms										
Power Control: VC=1, VR=1, VF=1	0	0	0	1	0	1	1	1	1	2F
Wait for ~1ms										
Display ON, DON=1	0	1	0	1	0	1	1	1	1	AF
Send display data…										

PWM=B in 1st and 2nd frame (2-byte inst.)	
PWM=B in 3rd and 4th frame (2-byte inst.)	
PWM=E in 1st and 2nd frame (2-byte inst.)	
PWM=E in 3rd and 4th frame (2-byte inst.)	
Turn on VLCD booster	
wait for fully on	
Turn on voltage regulator	
wait for fully on	
turn on voltage follower	
wait for fully on	
turn on display	
set the address and send the display data	

4.5.1 Power off the LCD Module

It recommends that LCD module should enter sleep mode before power off.

4.5.2 Refreshing The LCD Module

It recommends that the operating modes and display contents should be refreshed periodically to prevent the effect of unexpected noise.

5. Design and Handling Precaution

1. The LCD panel is made by glass. Any mechanical shock (eg. dropping form high place) will damage the LCD module.
2. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
3. The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
4. Never attempt to disassemble or rework the LCD module.
5. Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.
6. When mounting the LCD module, make sure that it is free form twisting, warping and distortion.
7. Ensure to provide enough space (with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
8. Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
9. Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
10. LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
11. When peeling off the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
12. Take care and prevent get hurt by the LCD panel sharp edge.
13. Never operate the LCD module exceed the absolute maximum ratings.
14. Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
15. Never apply signal to the LCD module without power supply.
16. IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommend.
17. LCD module reliability may be reduced by temperature shock.
18. When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module