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LM6059ACA-1

LCD Module User Manual

Prepared by: Dong Date: 2013-08-31	Checked by: Date:	Approved by: Date:
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Rev.	Descriptions	Release Date
0.1	Preliminary release	2013-08-31

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1. Basic Specifications

1.1 Display Specifications

- 1) LCD Display Mode : FSTN, Positive, Transflective
- 2) Display Color : Display Data = "0" : Light Gray(*1)
: Display Data = "1" : Deep Blue (*2)
- 3) Viewing Angle : 6H
- 4) Driving Method : 1/65 duty, 1/9 bias

Note:

*1. Color tone may slightly change by Temperature and Driving Condition.

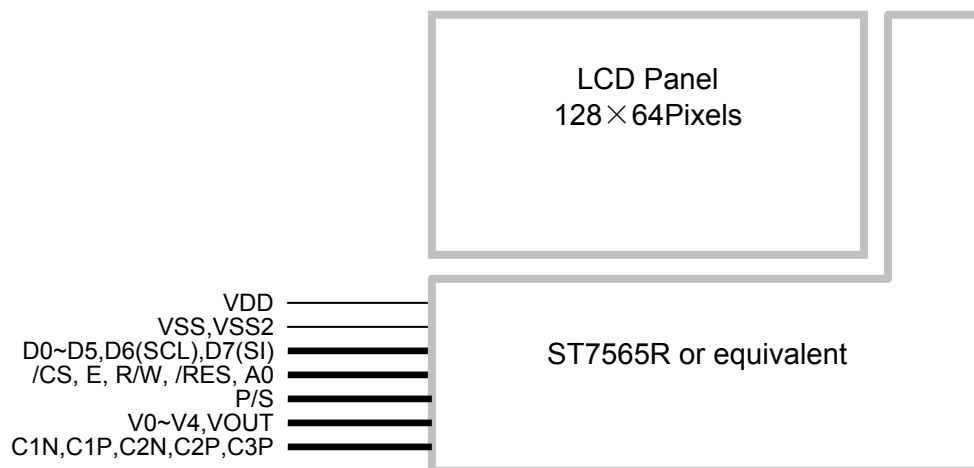
*2. The Color is defined as the inactive / background color

*3. Fine Contrast adjustment function is necessary in the application design for optimal display result

1.2 Mechanical Specifications

- 1) Outline Dimension : 44.9 x 38.9 x 7.9 (mm) (exclude FPC terminal)
(See attached Outline Drawing for details)

1.3 Block Diagram



1.4 Terminal Functions

PIN NO	PIN Name	I/O	Descriptions	
			8-bit parallel 6800mode(default)	Serial mode
1	VDD	Supply	Positive power supply	
2	P/S	Input	P/S=High	P/S=Low
3	VSS	Supply	Negative power supply,0V	
4	V0	--	LCD driving voltage supply terminals	
5	V1	--		
6	V2	--		
7	V3	--		
8	V4	--		
9	C2N	--	Power Booster Circuit Capacitance terminals	
10	C2P	--		
11	C1P	--		
12	C1N	--		
13	C3P	--		
14	VOUT	--	Power Booster Circuit Output	
15	VSS2	Supply	Negative power supply,0V	
16	D7(SI)	I/O	8-bit Data bus;	Serial data input
17	D6(SCL)	I/O	Three state I/O terminal for display data or	Serial clock input
18	D5	I/O	instruction data	Not used, Leave open
:	:	I/O	when /CS=H,	
23	D0	I/O	D0~D7=High Impedance	
24	E	Input	R/W=H,E=H; Data or Status read form the LCD module	Not used, Leave open or pull Hi
25	R/W	Input	R/W=L,E=H→L; Data or Status latch into the LCD module	
26	A0	Input	Register Select A0 = H, Transferring the Display Data A0 = L, Transferring the Control Data	
27	/RES	Input	Reset signal /RES = L, Initialization is executed /RES = H, Normal running.	
28	/CS	Input	Chip Select /CS=L, enable access to the LCD module /CS=H, disable access to the LCD module	

2. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	+3.3	V	$V_{SS} = 0V$
Input Voltage	V_{IN}	-0.3	$V_{DD}+0.3$	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

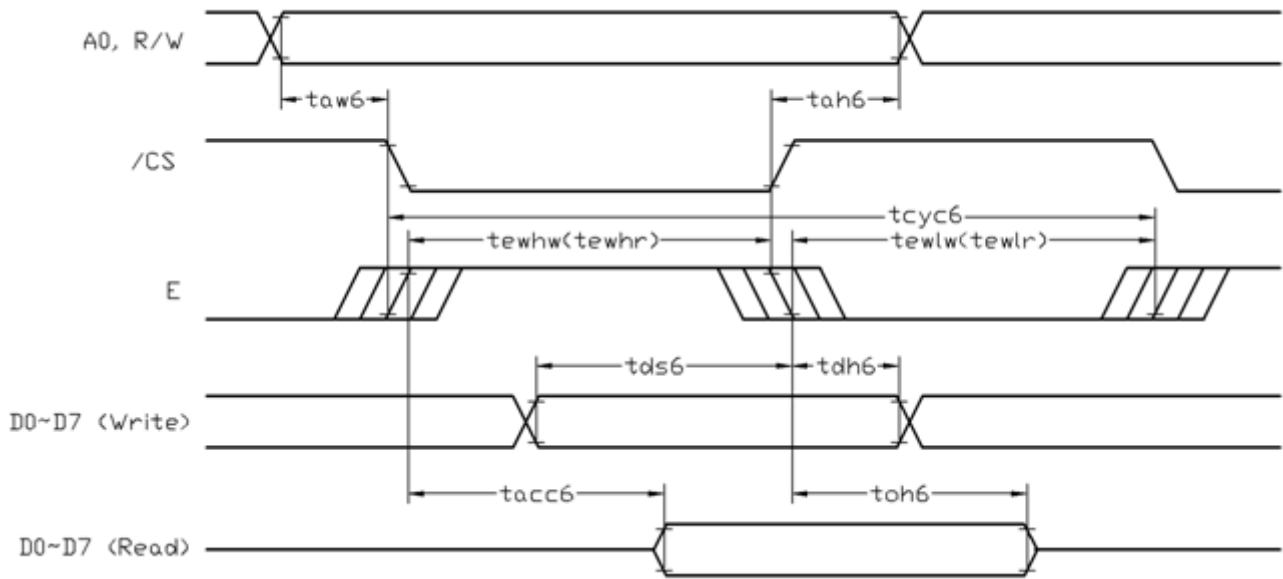
3.1 DC Characteristics

$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition / Application Pin
Operating Voltage	V_{DD}	2.8	-	3.3	V	VDD
Input High Voltage	V_{IH}	$0.8 \times V_{DD}$	-	V_{DD}	V	/RES, /CS, A0,
Input Low Voltage	V_{IL}	V_{SS}	-	$0.2 \times V_{DD}$	V	W/R, E, D0~D7
Output High Voltage	V_{OH}	$0.75 \times V_{DD}$	-	V_{DD}	V	D0~D7
Output Low Voltage	V_{OL}	V_{SS}	-	$0.25 \times V_{DD}$	V	D0~D7
Operating Current	I_{DD}	-	0.2	1.5	mA	VDD

3.2 AC Characteristics

3.2.1 6800 Mode System Bus Timing



$V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
System cycle time	tcyc6	500	-	-	ns
Address setup time (A0)	taw6	10	-	-	ns
Address hold time (A0)	tah6	10	-	-	ns
Control LOW pulse width (RD)	tewlr	275	-	-	ns
Control LOW pulse width (WR)	tewlw	275	-	-	ns
Control HIGH pulse width (RD)	tewhr	225	-	-	ns
Control HIGH pulse width (WR)	tewhw	225	-	-	ns
Data setup time	tds6	50	-	-	ns
Data hold time	tdh6	10	-	-	ns
/RD access time (*2)	tacc6	-	-	175	ns
Output disable time (*2)	tch6	13	-	125	ns

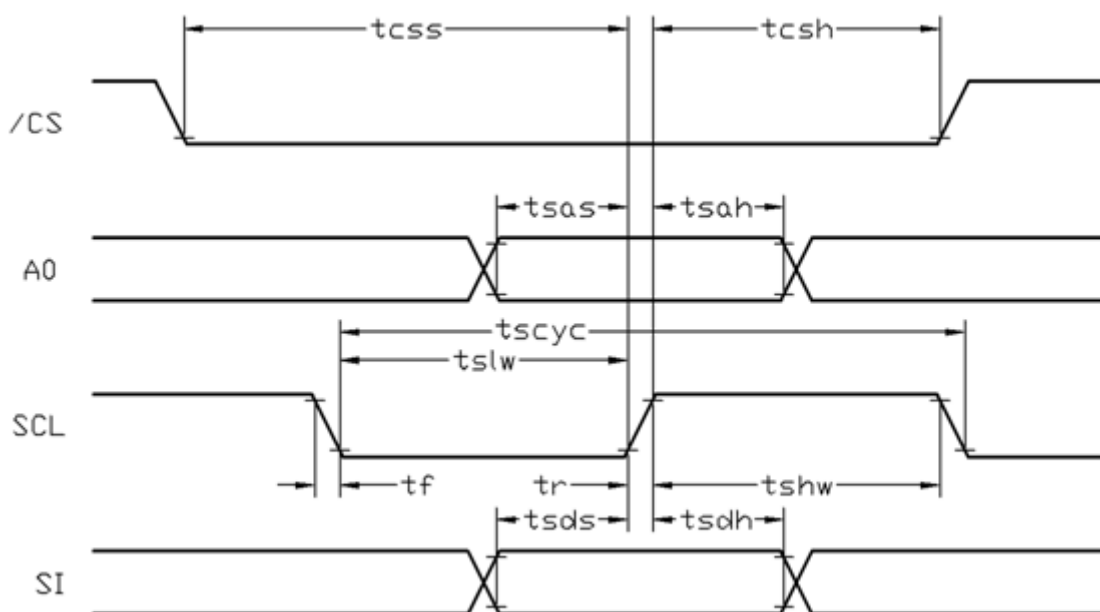
Note:

*1. Input signal rise/fall time should be less than 15ns .

*2. CL=100pF

*3.All timing is using 20% and 80% of VDD as the reference.

3.2.2 Serial Mode Interface



$V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
Serial Clock Period	tscyc	125	-	-	ns
Address setup time (A0)	tsas	38	-	-	ns
Address hold time (A0)	tsah	25	-	-	ns
SCL "H" pulse width	tshw	63	-	-	ns
SCL "L" pulse width	tslw	63	-	-	ns
Data setup time	tsds	38	-	-	ns
Data hold time	tsdh	25	-	-	ns
CS-SCL time	tcss	38	-	-	ns
CS-SCL time	tcsh	75	-	-	ns

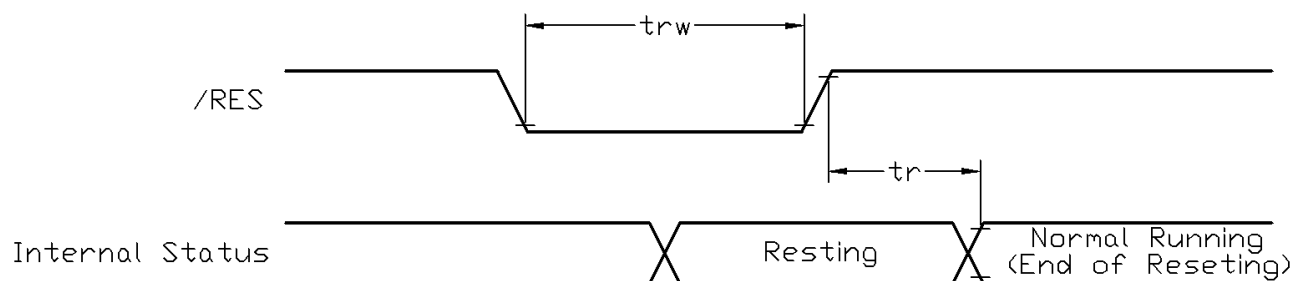
Note:

*1. Input signal rise/fall time should be less than 15ns .

*2. CL=100pF

*3.All timing is using 20% and 80% of VDD as the reference.

3.3 Reset Timing



$V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset time	tr	-	-	2.5	μs
Reset LOW pulse width	trw	2.5	-	-	μs

Note:

*1.All timing is using 20% and 80% of VDD as the reference.

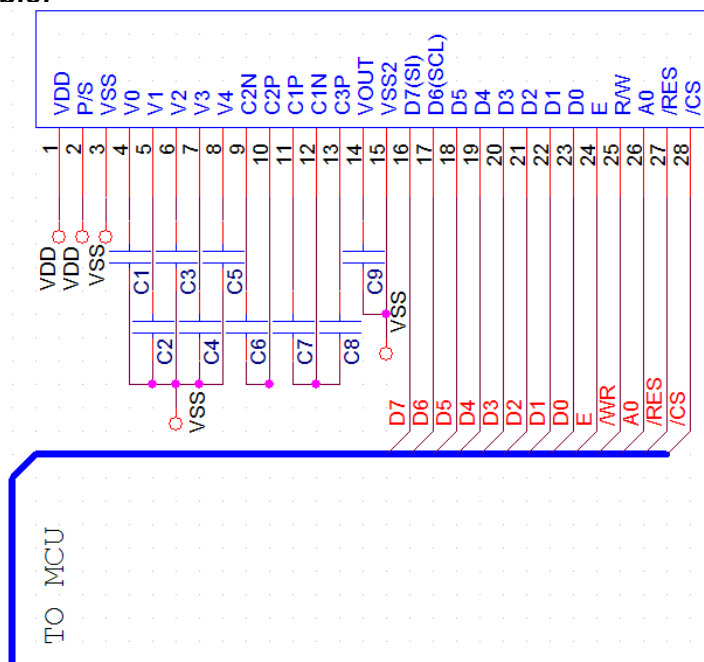
4. Function specifications

4.1 Adjusting the Display Contrast

- This LCD module equipped with latest digital contrast adjustment function.
- Its display contrast could be adjusted by MCU command. (please see the command tables for details)
- It is recommended to provide a contrast adjustment interface for end-user, where the best display result could meet the individual preference in mass production.

4.2 Application circuit(Example)

- 4x boosting
- Parallel 6800 mode
- Using internal ref resistor
- C1~C9=1.0uF(25V)



Note:

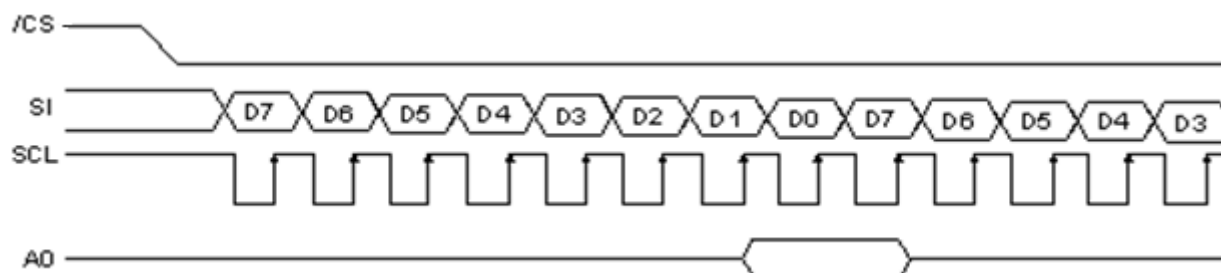
Please refer to the ST7565R data sheet for details

4.3 The Parallel Interface

Shared	6800 Mode		Function
A0	R/W	E	
H	H	H	Reads the display data
H	L	H→L	Writes the display data
L	H	H	Status read
L	L	H→L	Write control data(command)

4.4 The Serial Interface

When the serial interface has been selected then when the chip is in active state the serial data input(SI) and the serial clock(SCL) can be received. The serial data is read from the serial data input pin in the rising edge of the serial clock. When "A0"="H", the data is display data, and when "A0"="L", the data is command.



4.5 Basic Setting

To drive the LCD module correctly and provide normally display, please use the following setting

- ADC = 0 (normal)
- Common Output Mode Select = 1 (reverse)
- LCD Bias Select = 1/9
- Initial Display Line = 0
- Entire Display ON/OFF = OFF (normal)
- Reverse Display ON/OFF = OFF (normal)
- Set Power Control Set:
voltage follower = ON, voltage converter = ON, voltage regulator = ON
- Booster Set = 4x
- Display ON/OFF = ON

Note:

*1. These setting/commands should issue the LCD module while start up.

*2. See the Display Commands section for details.

4.6 Resetting the LCD module

The LCD module should be initialized by using /RES terminal.

While turning on the VDD and VSS power supply, maintain /RES terminal at LOW level. After the power supply stabilized, release the reset terminal (/RES=HIGH)

4.7 Display Memory Map

Page address	data	LCD Display (front view)	
0	D0 : D7		
1	D0 : D7		
2	D0 : D7		
3	D0 : D7		
4	D0 : D7		
5	D0 : D7		
6	D0 : D7		
7	D0 : D7		
Column Address		00h →	7F

Note:

*1. ADC = 0 (normal)

*2. Common Output Mode Select = 1 (reverse)

*3. Initial Display Line = 0

4.8 Display Commands

Command	Command Code										Function	
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address Least significant column address				Sets the most significant 4 bits of the display RAM column address.
Column address set lower bit	0	1	0	0	0	0	0					Sets the least significant 4 bits of the display RAM column address.
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data							Writes to the display RAM	
(7) Display data read	1	0	1	Read data							Reads from the display RAM	
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/reverse	0	1	0	1	0	1	0	0	1	1	0	Sets the LCD display normal/reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565P)
(12) Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
(17) Vo voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio(Rb/Ra) mode
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set the Vo output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value						
(19) Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0	0: OFF, 1: ON
Static indicator register set				0	0	0	0	0	0	0	0	
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
											step-up value	

Note: *1. Do not use any other command not listed, or the system malfunction may result.

*2. For the details of the Display Commands, please refer to ST7565P data sheet.

4.9 Display Commands (continue)

(21) Power saver											Display OFF and display all points ON compound command	
(22) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(23) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

Note: *1. Do not use any other command not listed, or the system malfunction may result.

*2. For the details of the Display Commands, please refer to ST7565P data sheet.

4.9.1 Power off the LCD Module

It recommends that enter Power Save mode before power off the LCD module.

4.9.2 Refreshing The LCD Module

It recommends that the operating modes and display contents 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 from 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 from 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