



深圳市拓普微科技开发有限公司

SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

LM6060CFW-3

LCD Module User Manual

Prepared by: liangquan Date: 2015-11-19	Checked by: Date:	Approved by: Date:
--	----------------------------------	-----------------------------------

Rev.	Descriptions	Release Date
0.1	Preliminary release	2015-11-19

Table of Content

1. Basic Specifications	3
1.1 Display Specifications	3
1.2 Mechanical Specifications	3
1.3 Block Diagram.....	3
1.4 Terminal Functions.....	4
Absolute Maximum Ratings	4
2. Electrical Characteristics	5
2.1 DC Characteristics	5
2.2 LED Backlight Circuit Characteristics	5
2.3 AC Characteristics	6
2.4 Reset Timing.....	7
3. Function specifications	7
3.1 Adjusting the Display Contrast	7
3.2 The Serial Interface.....	7
3.3 Basic Setting	8
3.4 Resetting the LCD module	8
3.5 Display Memory Map.....	8
3.6 Display Commands	9
3.7 Display Commands (continue).....	10
3.8 Basic Operating Sequence (example).....	11
4. Design and Handling Precaution	12

1. Basic Specifications

1.1 Display Specifications

- 1) LCD Display Mode : STN-Blue, Negative, Transmissive
- 2) Display Color : Display Data = "1" : Light Gray(*1)
: Display Data = "0" : Deep Blue (*2)
- 3) Viewing Angle : 6H
- 4) Driving Method : 1/65 duty, 1/9 bias
- 5) Backlight : White LED backlight

Note:

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

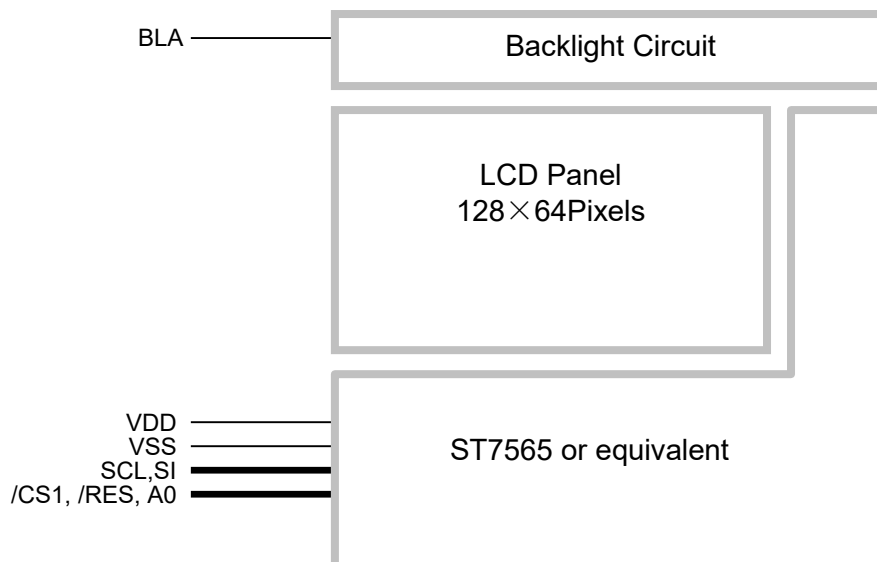
*2. The Color is defined as the inactive / background color

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

1.2 Mechanical Specifications

- 1) Outline Dimension : 73.0 x 42.0 x 10.9MAX (mm)(Exclude FFC)
(See attached Outline Drawing for details)

1.3 Block Diagram



1.4 Terminal Functions

PIN NO	PIN Name	I/O	Descriptions
1	BLA	Supply	Positive power for LED backlight
2	/CS1	Input	Chip Select /CS1=L, enable access to the LCD module /CS1=H, disable access to the LCD module
3	/RES	Input	Reset signal /RES = L, Initialization is executed /RES = H, Normal running.
4	A0	Input	Register Select A0 = H, Transferring the Display Data A0 = L, Transferring the Control Data
5	SCL	I/O	Serial clock input
6	SI	I/O	Serial data input
7	VSS	Supply	Negative power supply,0V
8	VDD	Supply	Positive power supply

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.

2. Electrical Characteristics

2.1 DC Characteristics

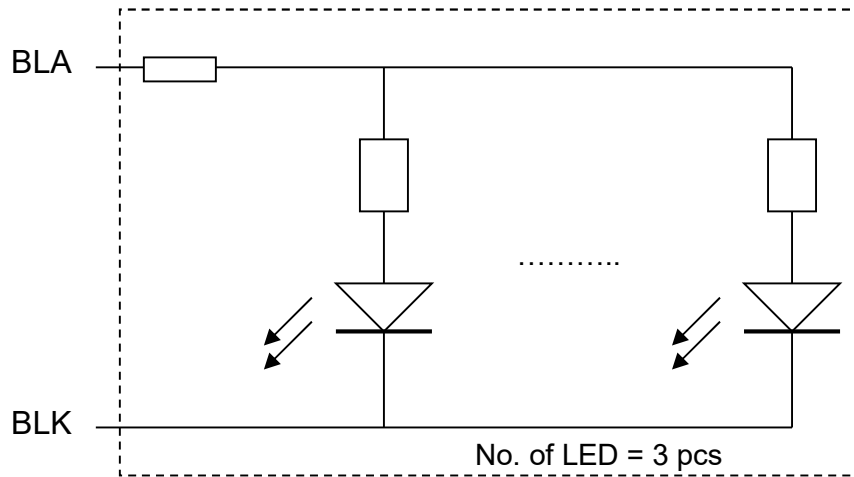
$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

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, /CS1, A0,
Input Low Voltage	V_{IL}	V_{SS}	-	$0.2 \times V_{DD}$	V	SCL, SI
Operating Current	I_{DD}	-	0.3	1.5	mA	VDD

2.2 LED Backlight Circuit Characteristics

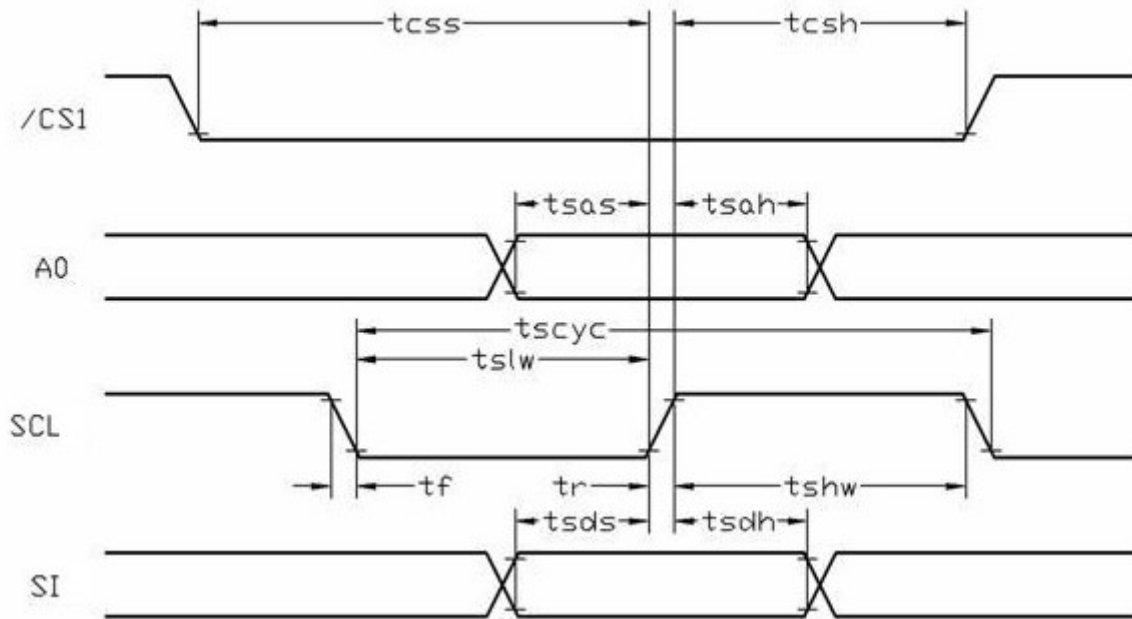
$BLK=0V, BLA=3.3V, T_{OP}=25^{\circ}C$

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Forward Voltage	BLA	-	3.3	-	V	BLA
Forward Current	I_{BLA}	-	48	50	mA	BLA



2.3 AC Characteristics

2.3.1 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
/CS1-SCL time	tcss	38	-	-	ns
/CS1-SCL time	tcsh	75	-	-	ns

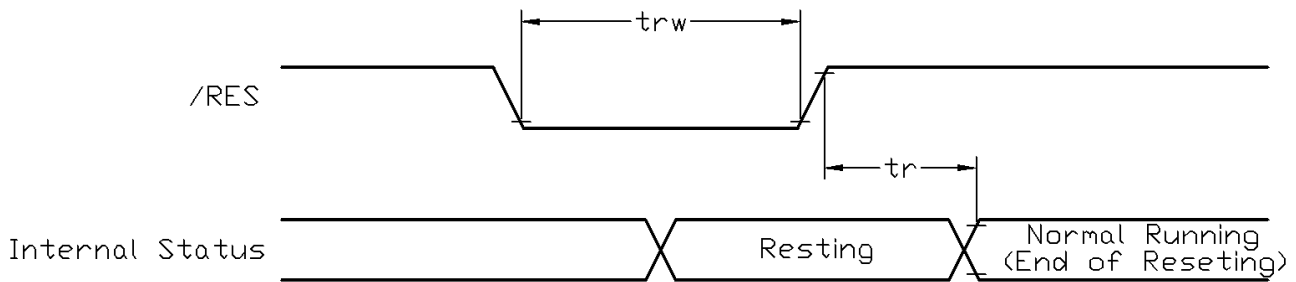
Note:

*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.

2.4 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.

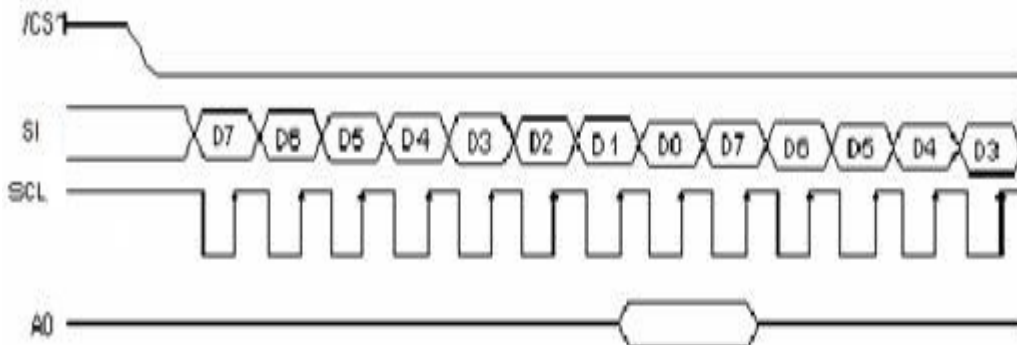
3. Function specifications

3.1 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.

3.2 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.



3.3 Basic Setting

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

- ADC = 0 (normal)
- SHL 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.

3.4 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)

3.5 Display Memory Map

Page address	data	LCD Display (front view)	
0	D0 : D7	128x64 pixels	
1	D0 : D7		
2	D0 : D7		
3	D0 : D7		
4	D0 : D7		
5	D0 : D7		
6	D0 : D7		
7	D0 : D7		
Column Address		00h	→ 7Fh

Note:

*1. ADC = 0 (normal)

*2. SHL Selection = 1 (reverse)

*3. Initial Display Line = 0

3.6 Display Commands

No.	Instructions	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	DON	DON=0, display off DON=1, display oin	
2	Display start line set	0	1	0	0	1	Display start address					0	Sets the display RAM display start line address	
3	Set Page Address	0	1	0	1	0	1	1	Page Address			0	Set the display RAM page address	
4	Set Column Address (Upper-4-bits)	0	1	0	0	0	0	1	Col. Add. Upper			0	Set the upper-4-bit of column address counter	
	Set Column Address (Lower-4-bits)	0	1	0	0	0	0	0	Col. Add. Lower			0	Set the lower-4-bit of column address counter	
5	Read Status	0	0	1	Status				0	0	0	0	Read the status data	
6	Write Display Data	1	1	0	Write Data									Write data into the display RAM
7	Read Display Data	1	0	1	Read Data									Read data form the display RAM
8	ADC Select	0	1	0	1	0	1	0	0	0	0	ADC	Sets the display RAM address SEG output correspondence ADC= 0,normal . ADC=1, reverse	
9	Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	REV	REV=0, Normal display REV=1, Reverse display	
10	Entire Display ON/OFF	0	1	0	1	0	1	0	0	1	0	EON	EON=0, Normal display EON=1, Entire display ON	
11	Set LCD Bias	0	1	0	1	0	1	0	0	0	1	BIAS	Set the LCD driving voltage bias BIAS=0, 1/9 BIAS BIAS=1, 1/7 BIAS	
12	Set Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	Enter the "Read-Modify-Write" mode column address counter will increase in each "Write Display Data", and will not increase in each "Read Display Data command"	
13	Reset Read-Modify-Write	0	1	0	1	1	1	0	1	1	1	0	Clear the "Read-Modify-Write" mode	
14	Reset	0	1	0	1	1	1	0	0	0	1	0	Resets the LCD module	
15	SHL Select	0	1	0	1	1	0	0	SHL	*	*	*	Set the COM scanning direction SHL=0, Normal display SHL=1, Flipped in y direction * = don't care terms	
16	Power Control Set	0	1	0	0	0	1	0	1	VC	VR	VF	Set the power circuit operation mode VF: LCD Supply Voltage Follower VR: LCD Supply Voltage Regulator VC: LCD Supply Voltage Converter (1=ON, 0=OFF)	
17	Regulator Resistor Select	0	1	0	0	0	1	0	0	Radio setting			Set the built-in resistor ratio (Rb/Ra)	

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 ST7565R data sheet.

3.7 Display Commands (continue)

No.	Instructions	Code											Function
		A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
18	Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set reference voltage mode
	Electronic volume register set	0	1	0	*	*	Electronic Control value					Set reference voltage register (Display contrast value)	
19	Booster Ratio Set	0	1	0	1	1	1	1	1	0	0	0	Select booster ratio
		0	1	0	0	0	0	0	0	0	ste p	00=2x,3x,4x; 01=5x. 11=6x	
20	Power Save	-	-	-	-	-	-	-	-	-	-	-	Compound Instruction: Display OFF + Entire Display ON
21	NOP	0	1	0	1	1	1	0	0	0	1	1	Non-operation 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 ST7565R data sheet.

3.7.1 Power off the LCD Module

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

3.7.2 Refreshing The LCD Module

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

3.8 Basic Operating Sequence (example)

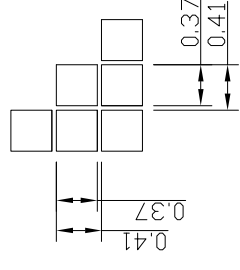
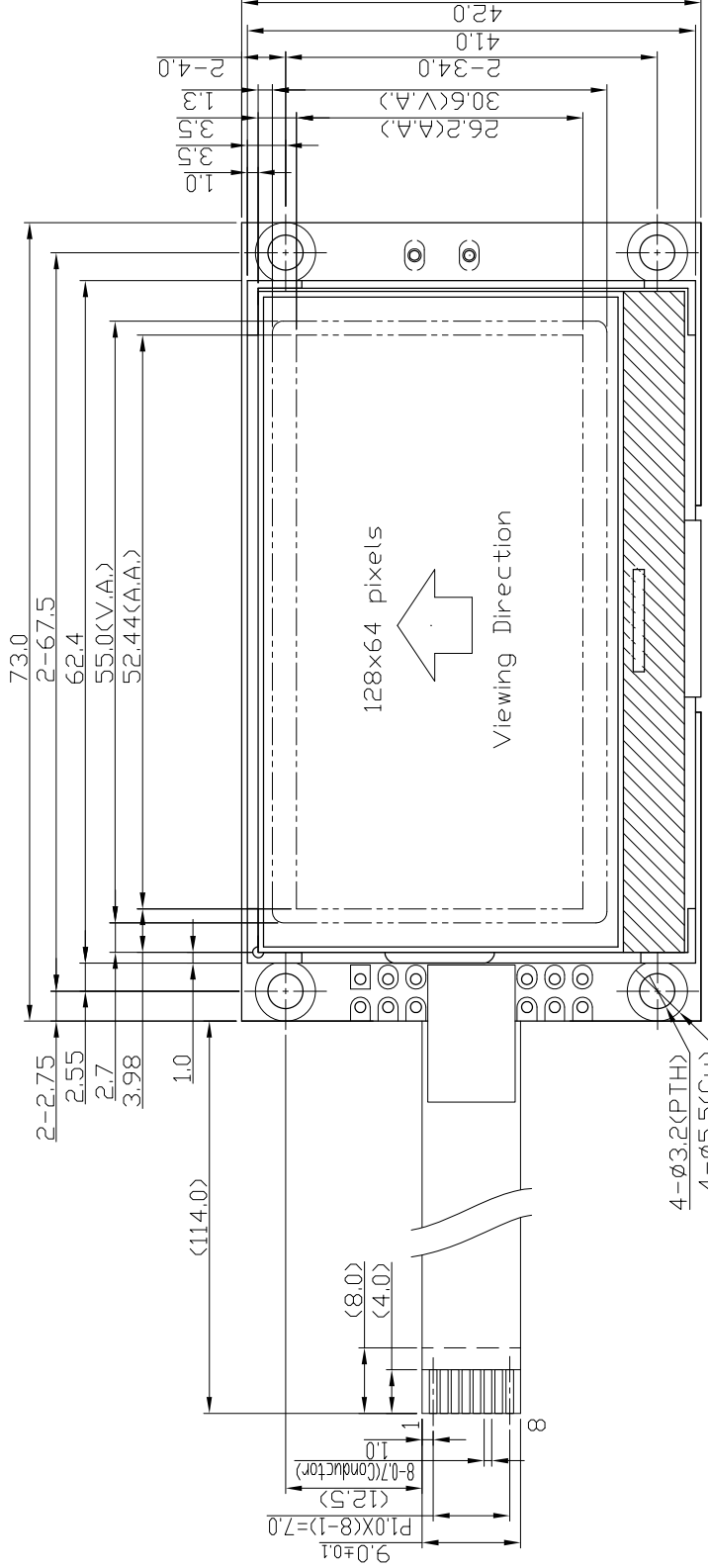
3.8.1 Initialization Sequence

		Code Function										Note	
A0	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
LCD bias = 1/9		0	1	0	1	0	0	0	1	0	A2h	LCD panel Characteristic	
ADC = normal		0	1	0	1	0	0	0	0	0	A0h	No flip on x-direction (SEG)	
SHL = reverse		0	1	1	0	0	1	0	0	0	C8h	Flip on y-direction (COM)	
Initial Display Line=0		0	0	1	0	0	0	0	0	0	40h	i.e. Display RAM "page 0 - D0" Matched to top line of the LCD	
Power Control Voltage Follower = OFF Voltage Regulator = OFF Voltage Converter = ON Delay 50ms		0	0	0	1	0	1	1	0	0	2Ch	Turn on the internal Voltage Converter and wait until VOUT stable.	
Power Control Voltage Follower = OFF Voltage Regulator = ON Voltage Converter = ON Delay 50ms		0	0	0	1	0	1	1	1	0	2Eh	Turn on the Internal Voltage Regulator and wait until VOUT stable.	
Power Control Voltage Follower = ON Voltage Regulator = ON Voltage Converter = ON Delay 50ms		0	0	0	1	0	1	1	1	1	2Fh	Turn on the internal Voltage Follower and wait until VOUT stable	
Booster Ratio Set		0	1	1	1	1	1	0	0	0	F8h	4x step up selected	
		0	0	0	0	0	0	0	0	0	00h		
Regulator Resistor Select		0	0	0	1	0	0	1	0	1	25h	Set the built-in resistor ratio to middle	
Set Reference Voltage Mode		0	1	0	0	0	0	0	0	1	81h	Set to the middle of the range It may be adjusted for achieving the best display contrast	
Set Reference Voltage Resistor		0	0	0	1	0	0	0	0	0	20h		
Display ON		0	1	0	1	0	1	1	1	1	AFh	Turn on the LCD display	
Set Page Address = 0		0	1	0	1	1	0	0	0	0	B0h	Specify the Display Data RAM page address to 00h	
Set Column Address (Upper-4bit=0)		0	0	0	0	1	0	0	0	0	10h	Specify the Display Data RAM column address to 00h	
Set Column Address (Lower-4bit=4)		0	0	0	0	0	0	1	0	0	04h		
Write Display Data		1	Display Data									Write data to Display Data RAM.	
Write Other Display Data ...													

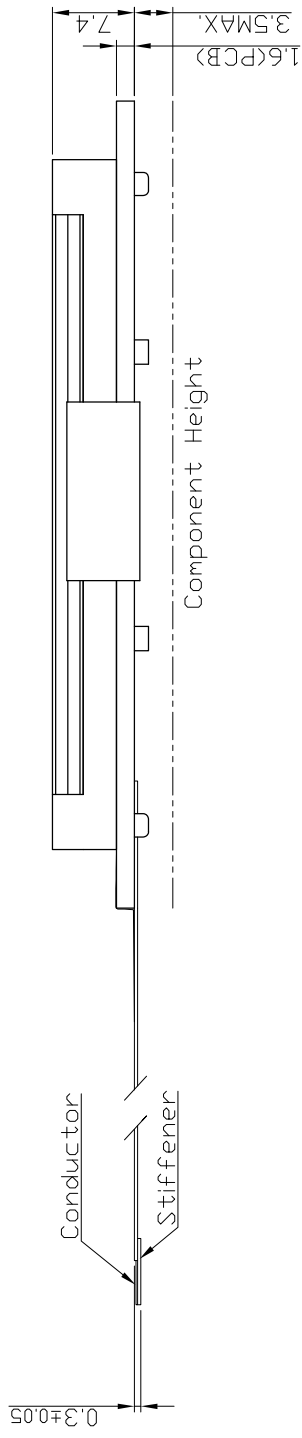
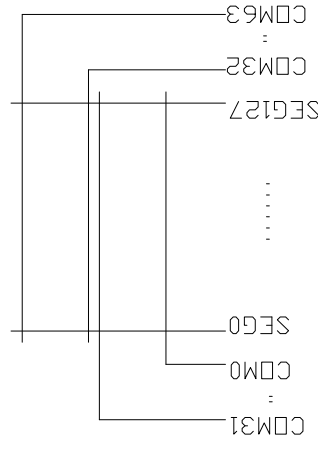
4. Design and Handling Precaution

Please refer to "LCD-Module-Design-Handling-Precaution.pdf".

Terminal	No.	Pin Name
	1	BLA
	2	/CS1
	3	/RES
	4	A0
	5	SCL
	6	SI
	7	VSS
	8	VDD



Panel Wiring Details
Scale=free



- Note:
- *1. LCD Display Type : STN-Blue, Negative, Transmissive
 - *2. Viewing Direction : 6H
 - *3. Duty : 1/65 , Bias : 1/9
 - *4. Operating Voltage : 3.3V
 - *5. Backlight Supply : 3.3V
 - *6. Backlight Color : White
 - *7. Operating Temperature : -20°C ~ 70°C
 - *8. Storage Temperature : -30°C ~ 80°C

C					
B					
A					
Rev/Note					Date
Dwg Title	LM6060CFW-3 Outline Dwg				Date
Dwg No.	MK-005390-1-1	Unit	mm	Paper Size	2015-11-19
Scale	2/1	Tol.	±0.5	A3	
Approved		Checked		Drawn	
					Luo Lih

TOPWAY