



深圳市拓普微科技开发有限公司
SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

LM6020FCW

LCD Module User Manual

Prepared by: Dong Date:2014-07-23	Checked by: Date:	Approved by: Date:
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Rev.	Descriptions	Release Date
0.1	Preliminary release	2014-07-23

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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 : 6H
- 4) Driving Method : 1/65 duty, 1/9 bias
- 5) Backlight : White LED backlight

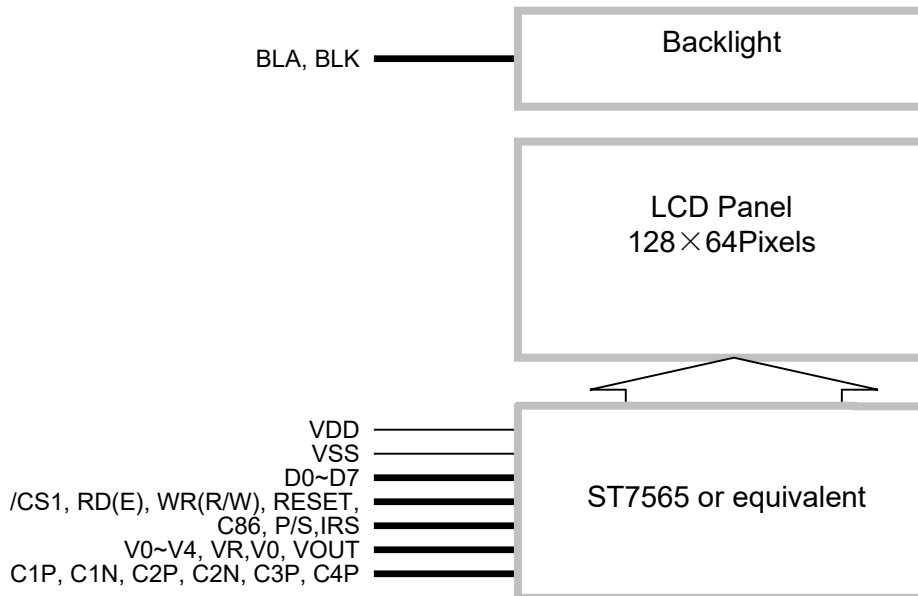
Note:

- *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 : 44.9 x 32.6 x 8.9MAX (mm) (exclude FPC terminal)
(See attached Outline Drawing for details)

1.3 Block Diagram



2. Terminal Functions

PIN NO.	PIN Name	I/O	Descriptions		
			8-bit parallel 8080 mode(Default)	8-bit parallel 6800 mode	Serial mode
1	/CS1	Input	Chip Select /CS1=L, enable access to the LCD module /CS1=H, disable access to the LCD module		
2	RESET	Input	Reset signal /RES = L, Initialization is executed /RES = H, Normal running.		
3	A0	Input	Register Select A0 = H, Transferring the Display Data A0 = L, Transferring the Control Data		
4	WR (R/W)	Input	/WR=L→H, /RD=H; Data or Instruction latch into the LCD module	R/W=H,E=H; Data or Status read from the LCD module R/W=L,E=H→L; Data or Status latch into the LCD module	Not used, Leave open or pull Hi
5	RD (E)	Input	/WR=H, /RD=L; Data or Status read from the LCD module		
6	D0	I/O	8-bit Data bus;		Not used, Leave open
:	:	I/O	Three state I/O terminal for display data or instruction data		
11	D5	I/O	when /CS=H,		Serial clock input
12	D6	I/O	D0~D7=High Impedance		Serial data input
13	D7	I/O			
14	VDD	Supply	Positive power supply		
15	VSS	Supply	Negative power supply,0V		
16	VOUT	--	Power Booster Circuit output		
17	C3P	--	Power Booster Circuit Capacitance terminals		
18	C1N	--			
19	C1P	--			
20	C2P	--			
21	C2N	--			
22	C4P	--			
23	VRS	--	Internal output VREG power supply (leave open)		
24	V4	--	LCD driving voltage supply terminals		
:	:	:			
28	V0	--			
29	VR	Input	Power Booster Resistor ratio reference input		
30	C86	Input	C86=Low	C86=High	C86=Low
31	P/S	Input	P/S=High	P/S=High	P/S=Low
32	IRS	Input	Select the resistors for the V0 voltage level adjustment IRS=H, Using the internal resistors IRS=L, Using external attached to the VR Terminal		
-	BLA	Power	Backlight Positive Supply		
-	BLK	Power	Backlight Negative Supply		

3. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V _{DD}	-0.3	+3.6	V	V _{SS} = 0V
Input Voltage	V _{IN}	-0.2	V _{DD} +0.2	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.

4. Electrical Characteristics

4.1 DC Characteristics

V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition / Application Pin
Operating Voltage	V _{DD}	2.7	-	3.3	V	VDD
Input High Voltage	V _{IH}	0.85xV _{DD}	-	V _{DD}	V	RESET, /CS1, A0, WR(R/W), RD(E), D0~D7
Input Low Voltage	V _{IL}	V _{SS}	-	0.15xV _{DD}	V	
Output High Voltage	V _{OH}	0.75xV _{DD}	-	V _{DD}	V	D0~D7
Output Low Voltage	V _{OL}	V _{SS}	-	0.25xV _{DD}	V	D0~D7
Operating Current	I _{DD}	-	0.3	1.5	mA	VDD

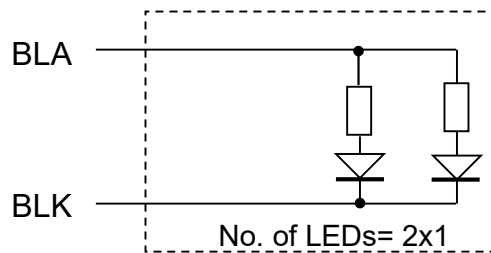
4.2 LED Backlight Circuit Characteristics

BLK=0V, BLA=3.3V, T_{OP}=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Forward Voltage	V _{BLA}	-	3.3	-	V	BLA
Forward Current	I _{BLA}	-	34	40	mA	BLA

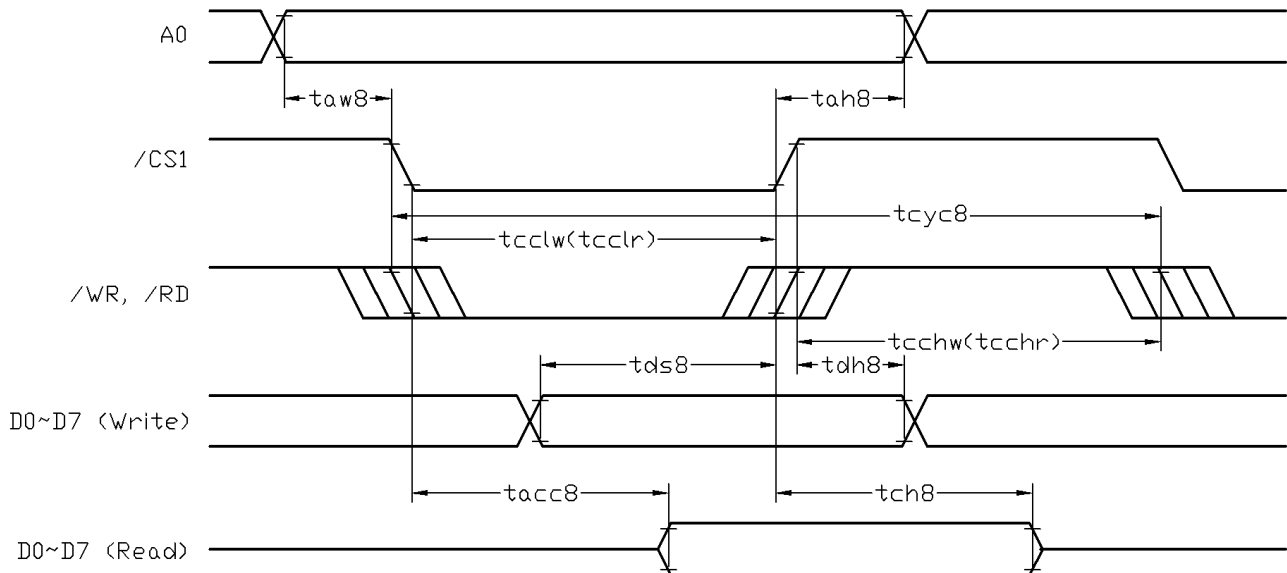
Cautions:

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



4.3 AC Characteristics

4.3.1 8080 Mode System Bus Timing



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

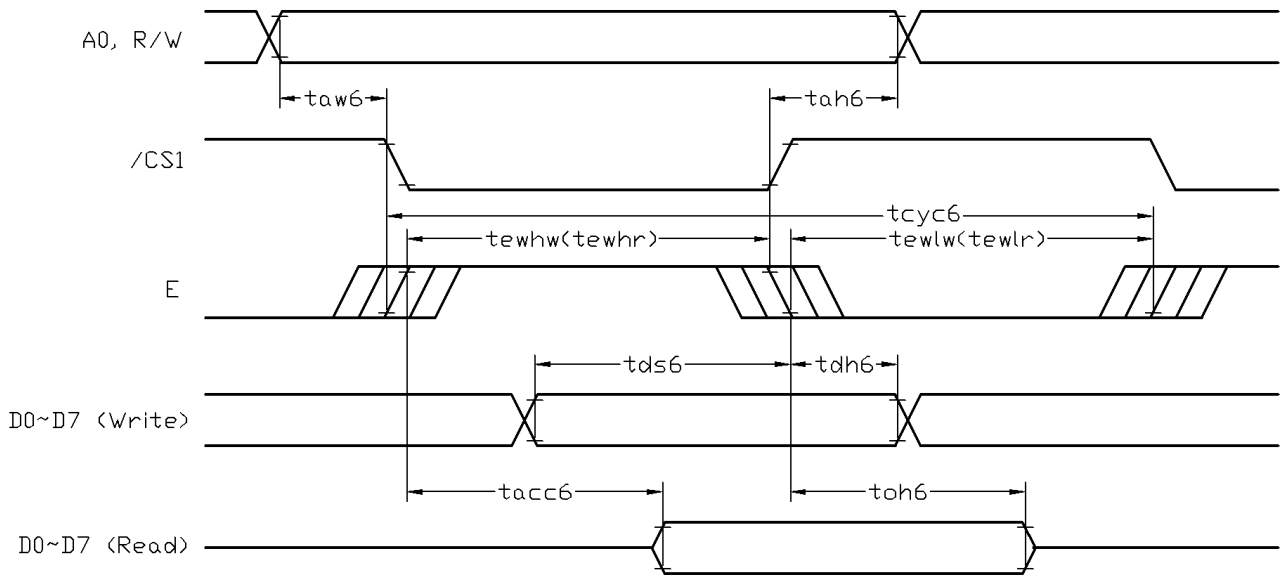
Item	Symbol	MIN.	TYP.	MAX.	Unit
System cycle time	tcyc8	312	-	-	ns
Address setup time (A0)	taw8	5	-	-	ns
Address hold time (A0)	tah8	5	-	-	ns
Control LOW pulse width (/RD)	tcclr	182	-	-	ns
Control LOW pulse width (/WR)	tcclw	104	-	-	ns
Control HIGH pulse width (/RD)	tcchr	104	-	-	ns
Control HIGH pulse width (/WR)	tcchw	104	-	-	ns
Data setup time	tds8	52	-	-	ns
Data hold time	tdh8	5	-	-	ns
/RD access time (*2)	tacc8	-	-	49	ns
Output disable time (*2)	toh8	7	-	35	ns

Note:

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

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

4.3.2 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	312	-	-	ns
Address setup time (A0)	taw6	5	-	-	ns
Address hold time (A0)	tah6	5	-	-	ns
Control LOW pulse width (R/W)	tewlr	104	-	-	ns
Control LOW pulse width (R/W)	tewlw	104	-	-	ns
Control HIGH pulse width (/RD)	tewhr	182	-	-	ns
Control HIGH pulse width (R/W)	tewhw	104	-	-	ns
Data setup time	tds6	52	-	-	ns
Data hold time	tdh6	5	-	-	ns
/RD access time (*2)	tacc6	-	-	49	ns
Output disable time (*2)	tch6	7	-	35	ns

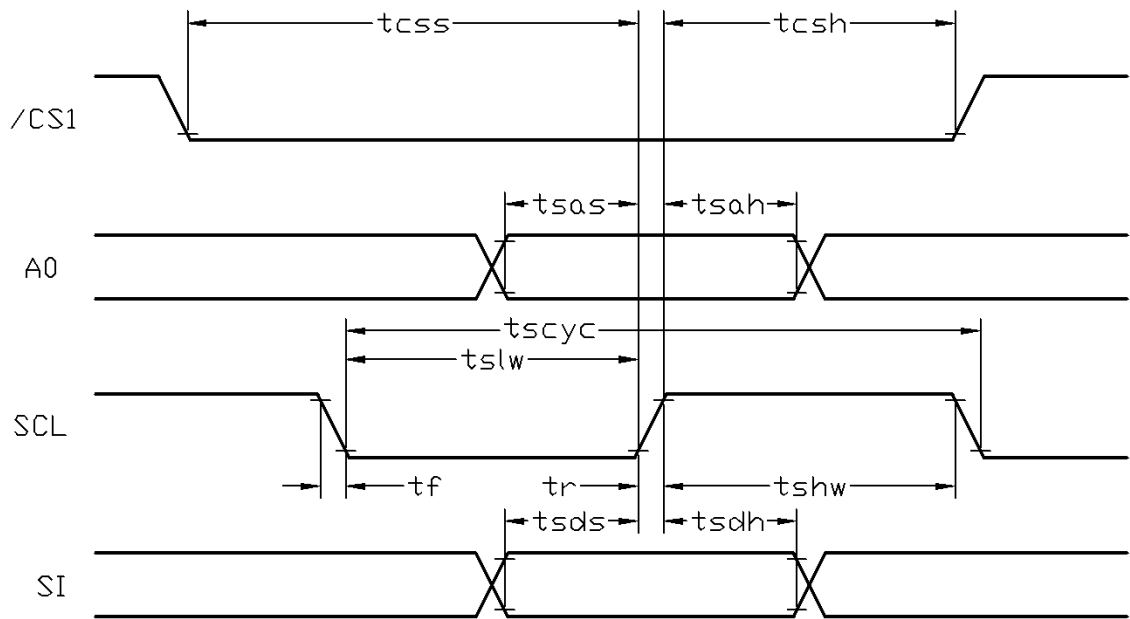
Note:

*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.

4.3.3 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	65	-	-	ns
Address setup time (A0)	tsas	26	-	-	ns
Address hold time (A0)	tsah	13	-	-	ns
SCL "H" pulse width	tshw	33	-	-	ns
SCL "L" pulse width	tslw	33	-	-	ns
Data setup time	tsds	26	-	-	ns
Data hold time	tsdh	13	-	-	ns
CS-SCL time	tcss	26	-	-	ns
CS-SCL time	tcsh	52	-	-	ns

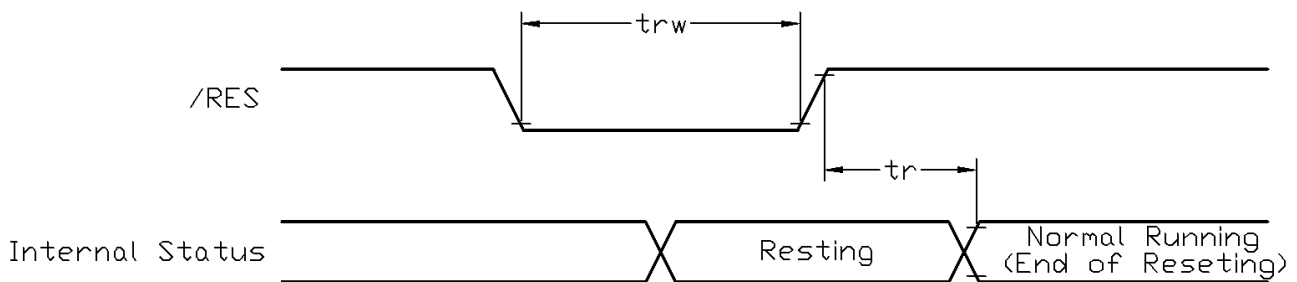
Note:

*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.

4.4 Reset Timing



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

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset time	tr	-	-	1.3	μs
Reset LOW pulse width	trw	1.3	-	-	μs

Note:

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

5. Function specifications

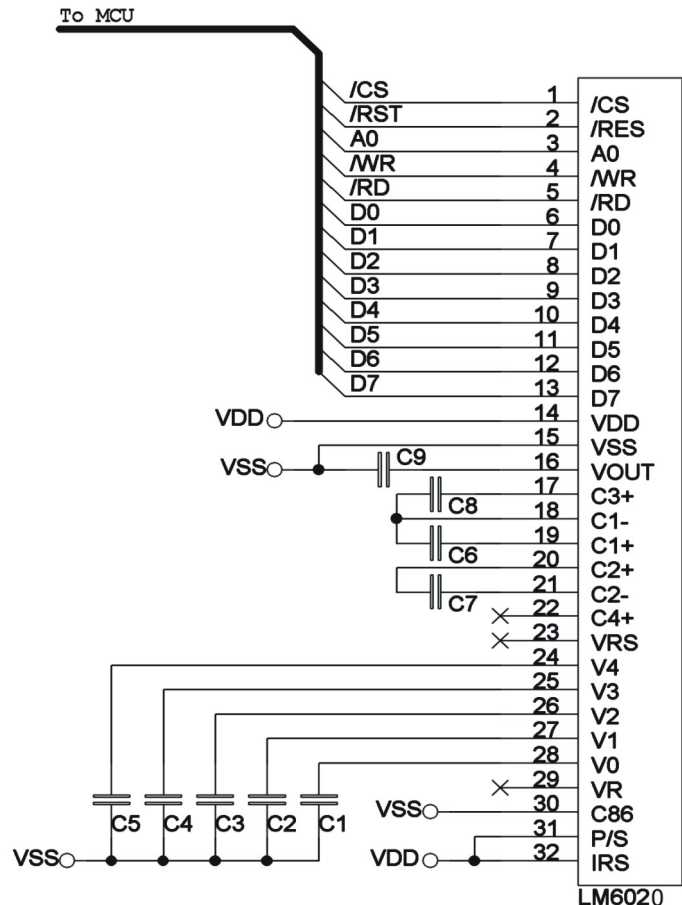
5.1 Adjusting the Display Contrast

- 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.

5.2 Application circuit (Example)

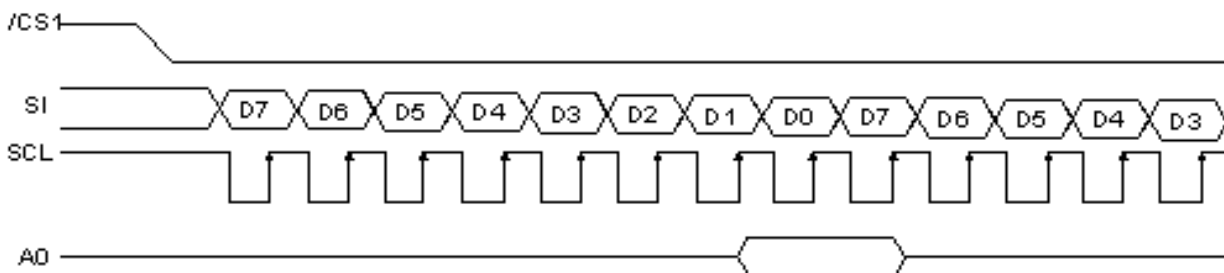
- 4x boosting
- 80 mode
- Using internal ref resistor
- C1~C5 = 1.0uF (25V)
- C6~C9 = 1.0uF (25V)

Note:
Please refer to the ST7565 data sheet for details



5.3 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.



5.4 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
- 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.

5.5 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)

5.6 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

5.7 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	1	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address					0	Sets the display RAM display start line address	
(3) Page address set	0	1	0	1	0	1	Page address				0	Sets the display RAM page address	
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address			0	Sets the most significant 4 bits of the display RAM column address.	
Column address set lower bit				0	0	0	0	Least significant column address			0	Sets the least significant 4 bits of the display RAM column address.	
(5) Status read	0	0	1	Status			0	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	1	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	1	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	1	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	1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565R)
(12) Read-modify-write	0	1	0	1	1	1	0	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	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	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) V ₀ 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	0	1	Set the V ₀ output voltage electronic volume register
Electronic volume register set				0	0	Electronic volume value							
(19) Sleep mode set	0	1	0	1	0	1	0	1	1	0	0	1	0: Sleep mode, 1: Normal mode
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	1	Command for non-operation
(22) 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 ST7565 data sheet.

5.7.1 Power off the LCD Module

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

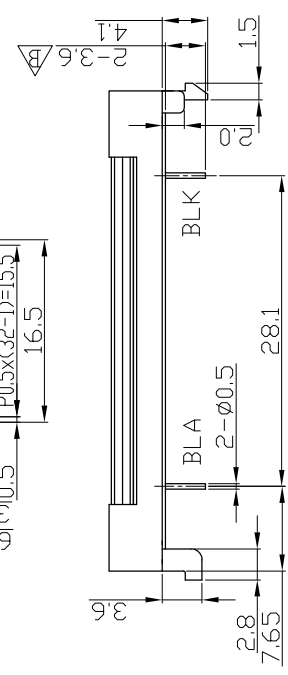
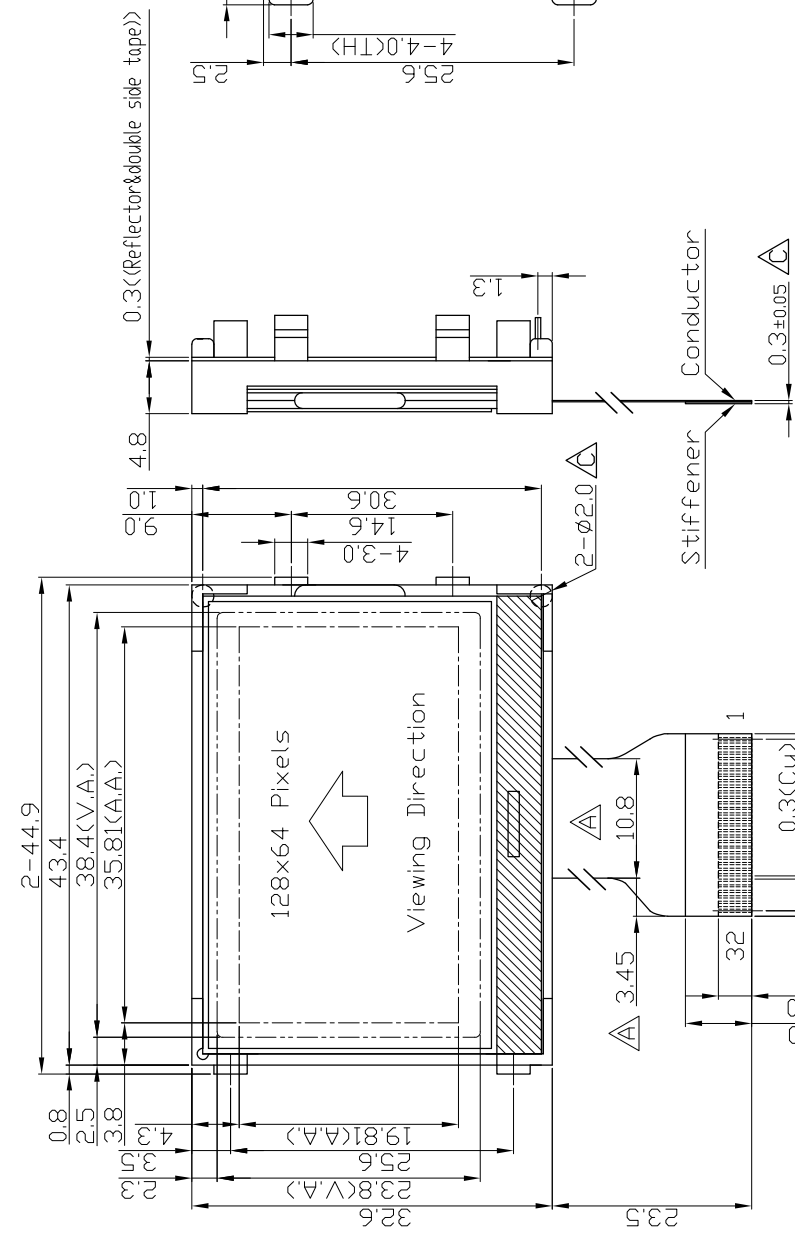
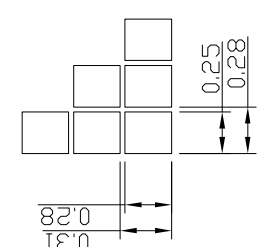
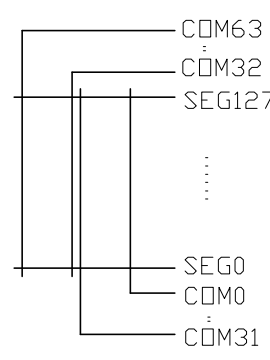
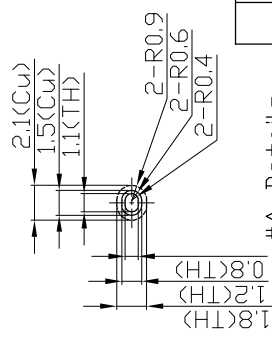
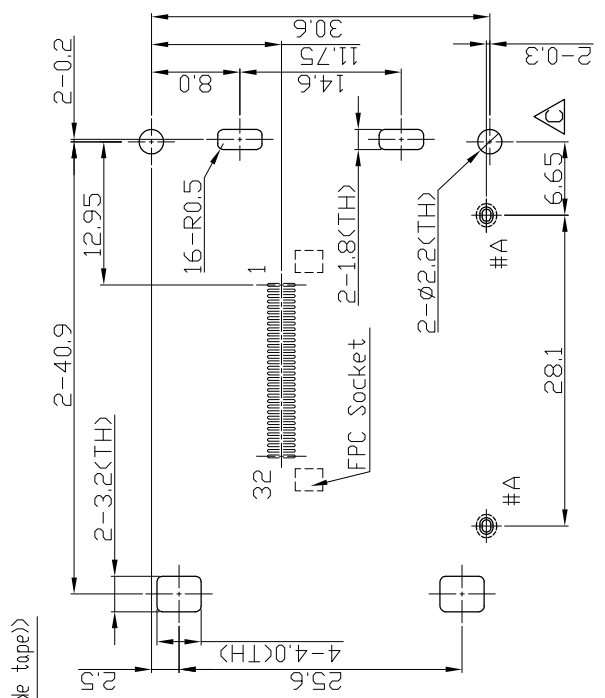
5.7.2 Refreshing The LCD Module

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

6. Design and Handling Precaution

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

Terminal	No.	Pin Name
	1	/CS1
	2	RESET
	3	A0
	4	WR(R/W)
	5	RD(E)
	6	D0
	7	D1
	8	D2
	9	D3
	10	D4
	11	D5
	12	D6
	13	D7
	14	VDD
	15	VSS
	16	VDUT
	17	C3P
	18	C1N
	19	C1P
	20	C2P
	21	C2N
	22	C4P
	23	VRS
	24	V4
	25	V3
	26	V2
	27	V1
	28	V0
	29	VR
	30	C86
	31	P/S
	32	IRS



- Note:
- *1. Display Type : FSTN, Positive, Transflective
 - *2. Viewing Direction : 6H
 - *3. Duty : 1/65, Bias : 1/9
 - *4. Operating Voltage : 3.0V
 - *5. Backlight Supply : 3.3V TYP.
 - *6. Backlight Color : White
 - *7. Operating Temperature : -20°C~70°C
 - *8. Storage Temperature : -30°C~80°C
 - *9. Application PCB thickness : 1.6mm

C	Typing Correction	Luo Lin	2019-09-20
B	Revise Pin's Length	Luo Lin	2015-05-29
A	Revise FPC Outline	Li Jiang	2014-05-14
Rev/Note	Dwg Title	LM6020FCW Outline Dwg	Date
Dwg No.	MK-004761C-1-1	Date	2014-03-31
Scale	2/1	Unit	mm
Approved	Checked	Drawn	Li Jiang
		Paper Size	A3

