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

TWM14002

LCD Module User Manual

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Dong		
Date: 2016-01-15	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary release	2014-07-02
0.2	Revise Outline Dimension	2016-01-15

Table of Content

1. Basic Specifications

1.1 Display Specifications

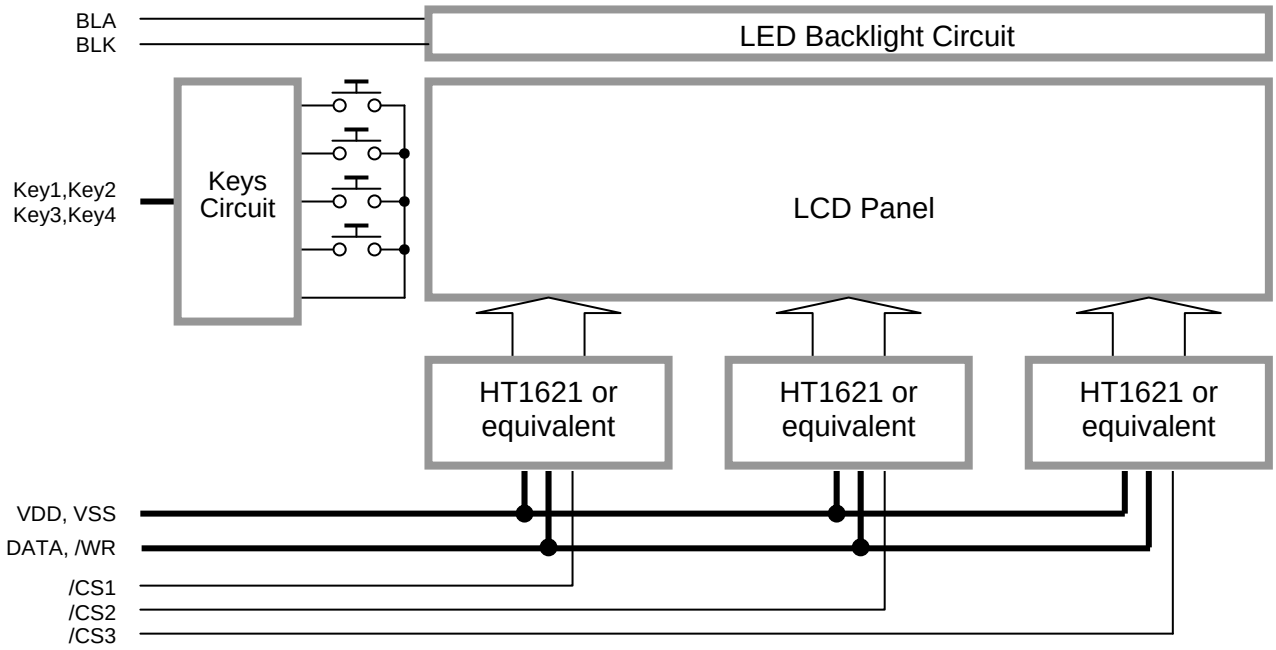
1) LCD Display Mode :STN-Gray, Positive, Transflective
2) Display Color : Display Data = “1” : Blue (*1)
: Display Data = “0” : White (*2)
3) Viewing Angle : 6 H
4) Driving Method : 1/4 duty, 1/3 bias
5) Backlight : White LED backlight

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

1.2 Mechanical Specifications

1) Outline Dimension : 82.9 x85.2 x 18.86
see attached Outline Drawing for details

1.3 Block Diagram



1.4 Terminal Functions

Pin No.	Pin Name	I/O	Descriptions
K1			
1	BLA	Power	Positive Power for LED backlight
2	BLK	Input	Negative Power for LED backlight
3	VDD	Power	Positive Power Supply
4	VSS	Power	Negative Power Supply, Ground
5	DATA	Input	Serial Data input/output with internal pull-up resistor
6	/RD	Input	Read Clock input with internal pull-up resistor /RD=L→H; Data read from the LCD module
7	/WR	Input	Write Clock input with internal pull-up resistor /WR=L→H; Data or Instruction latch into the LCD module
K2			
1	/CS1	Input	Chip selection input of left IC /CS1=High, disable data or command writing /CS1=Low, enable data or command writing
2	/CS2	Input	Chip selection input of middle IC /CS2=High, disable data or command writing /CS2=Low, enable data or command writing
3	/CS3	Input	Chip selection input of right IC /CS3=High, disable data or command writing /CS3=Low, enable data or command writing
K3			
1	KEY1	-	Keyboard Circuit
2	KEY2	-	Keyboard Circuit
3	KEY3	-	Keyboard Circuit
4	KEY4	-	Keyboard Circuit

2. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	5.5	V	V_{SS} = 0V
Input Voltage	V_{IN}	V_{SS}-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} =5.0V, T_{OP} =25°C

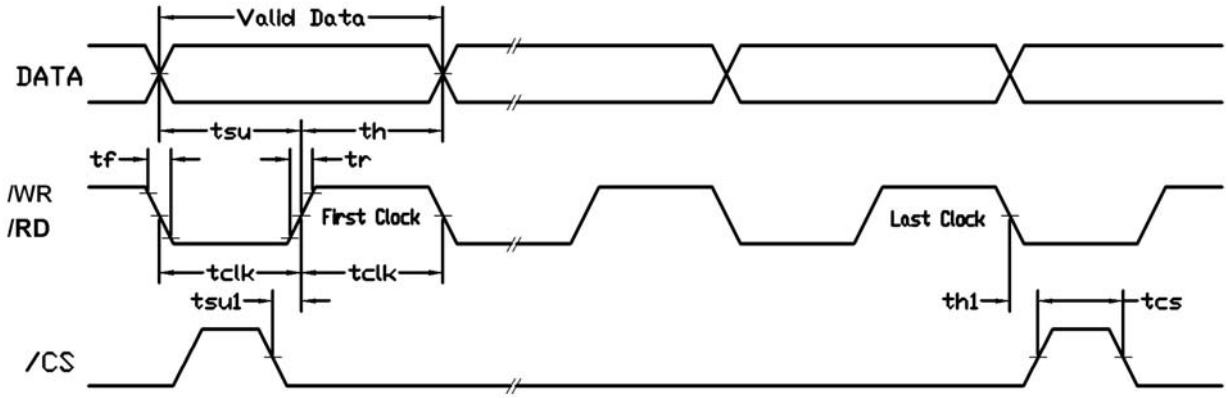
Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage (*1)	V_{DD}	4.8	5.0	5.2	V	VDD
Input High Voltage	V_{IN}	0.85xVDD	-	VDD	V	DATA, /WR, /CS1~/CS3
Input Low Voltage	V_{IN}	VSS	-	0.5	V	DATA, /WR, /CS1~/CS3
Operating Current	I_{DD}	-	0.9	2.3	mA	VDD

Note:
*1. The variation of Operating Voltage may affect the LCD display contrast.

3.2 AC Characteristics

V_{SS}=0V, V_{DD} =5.0V, T_{OP} =25°C

Symbol	MIN.	TYP.	MAX.	Unit	Descriptions
tcs	325	-	-	ns	Serial I/F Reset Pulse Width
tclk	4.5	-	-	µs	/WR, /RD Input Pulse Width
Tr, tf	-	-	112	ns	Rise / Fall Time Serial Data
tsu	78	-	-	ns	Setup Time for DATA to /WR
th	325	-	-	ns	Hold Time for DATA to /WR
tsu1	650	-	-	ns	Setup Time for /CS to /WR
th1	65	-	-	ns	Hold Time for /CS to /WR



4. Function Specifications

4.1 Basic Setting

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

BIAS = 1/3
No. of Commons = 4
LCD Display = on

Note:
These setting/commands should issue to both controllers while start up.
See the Command Listing section for details.

4.2 Command and Data format

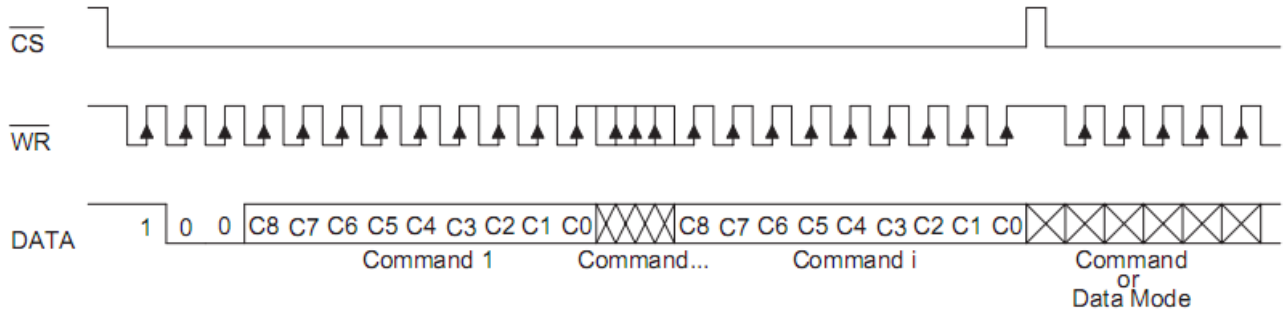
The LCD module could be controlled by software in two Operation modes. Modes are identified by "Mode ID".

Operation Mode	Mode ID
Write Command	**1 0 0**
Read Data	**1 1 0**
Write Data	**1 0 1**

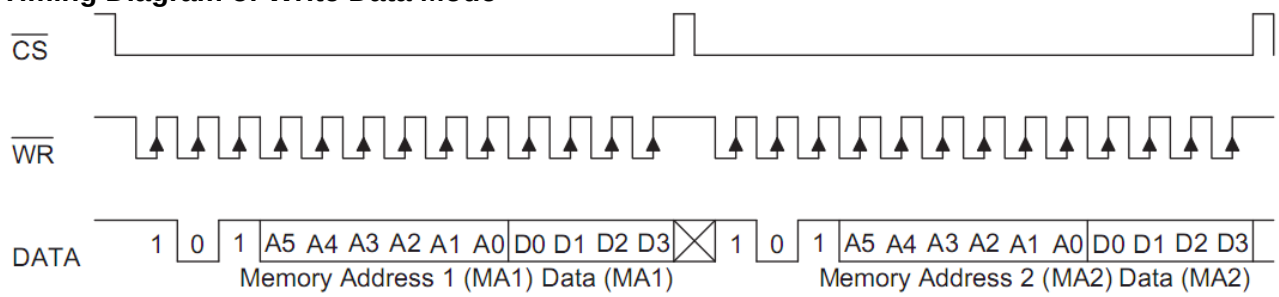
The mode ID should be issued before the data or command is transferred.
If successive commands is issuing, the command mode ID, namely **1 0 0**, can be omitted after the first command with mode ID. If successive data is issuing, the data mode ID, namely **1 0 1**, can be omitted after the first data with mode ID. In Write Data (Successive Address Writing) Mode the internal address pointer will be increased by 1 after each data received.

While the system is operating in the non-successive command or the non-successive address data mode, the /CS1 or /CS2 or /CS3 pin should be set to "1" and the previous operation mode will be reset also.
Once the /CS1 or /CS2 or /CS3 pin returns to "0" a new operation mode ID should be issued first.

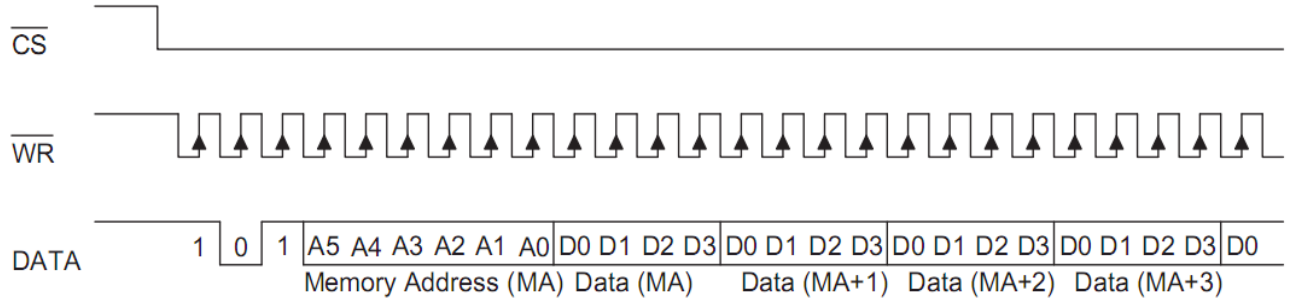
Timing Diagram of Write Command Mode



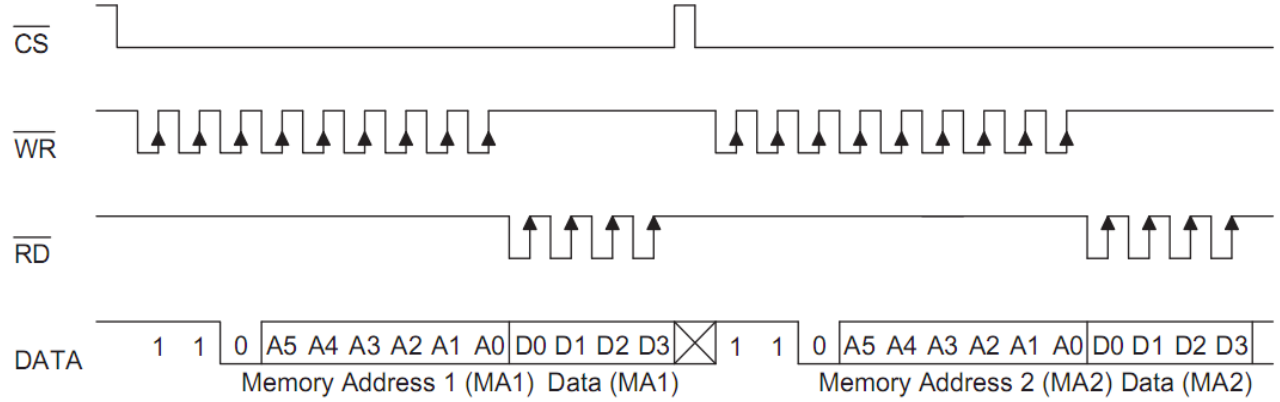
Timing Diagram of Write Data Mode



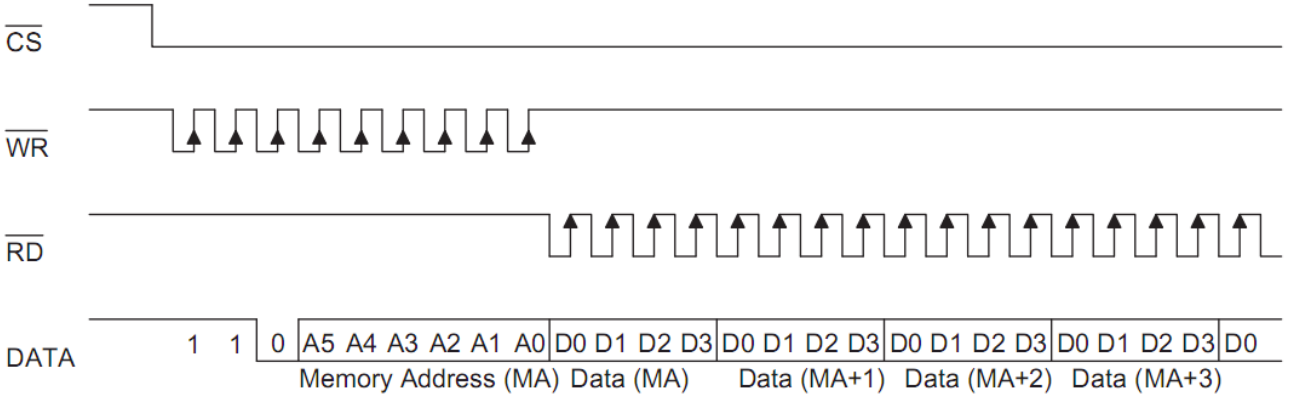
Timing Diagram of Write Data (Successive Address Writing) Mode



Timing Diagram of Read Data Mode



Timing Diagram of Read Data (Successive Address Writing) Mode



4.3 Interfacing

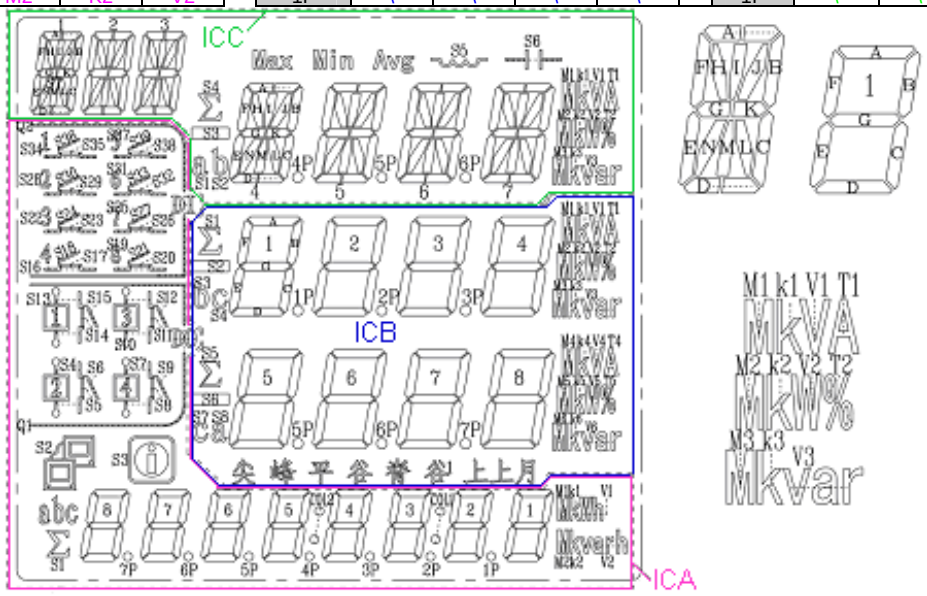
The /CS1, /CS2 and/CS3 line are used to initialize the serial interface circuit and to terminate the communication between the host and the LCD module. If the /CS1 or /CS2 or/CS3 pin is set to 1, the data or command issued between the host and the dedicated controller will be disabled. Before issuing a mode command or mode switching, a high level pulse is required on /CS1 or /CS2 or/CS3 to initialize the serial interface.

The DATA line is the serial data input line. Data or commands to be written have to be passed through the DATA line.

The /WR line is the WRITE clock input. The data, address, and command on the DATA line are all latched into the LCD module at the rising edge of the /WR signal.

4.4 Memory Map

	/CS1=0, /CS2=1,/CS3=1					/CS1=1, /CS2=0,/CS3=1					/CS1=1, /CS2=1,/CS3=0				
Add. (hex)	D3 COMA4	D2 COMA3	D1 COMA2	D0 COMA1		**Add. (hex)**	D3 COMB4	D2 COMB3	D1 COMB2	D0 COMB1		**Add. (hex)**	D3 COMC4	D2 COMC3	D1 COMC2	D0 COMC1
00	S37	S38	S39	Q2		00	脊	谷 1	上	上月		00	T1	V1	K1	M1
01	S34	S35	S36	\		01	尖	峰	平	谷		01	T2	V2	K2	M2
02	S31	S32	S33	\		02	\	M6	K6	V6		02	V3	K3	M3	S6
03	S28	S29	S30	\		03	M5	K5	V5	T5		03	7D	7C	7B	S5
04	S25	S26	S27	\		04	M4	K4	V4	T4		04	7L	7K	7J	7A
05	S22	S23	S24	\		05	8D	8C	8B	8A		05	7N	7M	7I	7H
06	S19	S20	S21	\		06	7P	8E	8G	8F		06	\	7E	7G	7F
07	S16	S17	S18	\		07	7D	7C	7B	7A		07	6D	6C	6B	Avg
08	S15	S14	S13	\		08	6P	7E	7G	7F		08	6L	6K	6J	6A
09	S12	S11	S10	\		09	6D	6C	6B	6A		09	6N	6M	6I	6H
0A	S7	S8	S9	\		0A	5P	6E	6G	6F		0A	6P	6E	6G	6F
0B	S4	S5	S6	\		0B	5D	5C	5B	5A		0B	5D	5C	5B	Min
0C	\	S2	S3	Q1		0C	\	5E	5G	5F		0C	5L	5K	5J	5A
0D	S1	a	b	c		0D	S7	S8	S6	S5		0D	5N	5M	5I	5H
0E	\	8E	8G	8F		0E	V3	K3	M3	\		0E	5P	5E	5G	5F
0F	8D	8C	8B	8A		0F	T2	V2	K2	M2		0F	4D	4C	4B	Max
10	7P	7E	7G	7F		10	T1	V1	K1	M1		10	4L	4K	4J	4A
11	7D	7C	7B	7A		11	4A	4B	4C	4D		11	4N	4M	4I	4H
12	6P	6E	6G	6F		12	4F	4G	4E	3P		12	4P	4E	4G	4F
13	6D	6C	6B	6A		13	3A	3B	3C	3D		13	\	3D	3C	3B
14	5P	5E	5G	5F		14	3F	3G	3E	2P		14	3L	3K	3J	3A
15	5D	5C	5B	5A		15	2A	2B	2C	2D		15	3N	3M	3I	3H
16	4P	4E	4G	4F		16	2F	2G	2E	1P		16	\	3E	3G	3F
17	4D	4C	4B	4A		17	1A	1B	1C	1D		17	S4	2D	2C	2B
18	3P	3E	3G	3F		18	1F	1G	1E	\		18	2L	2K	2J	2A
19	3D	3C	3B	3A		19	S1	S2	S4	S3		19	2N	2M	2I	2H
1A	2P	2E	2G	2F		1A	\	\	\	\		1A	S3	2E	2G	2F
1B	2D	2C	2B	2A		1B	\	\	\	\		1B	S2	1D	1C	1B
1C	1P	1E	1G	1F		1C	\	\	\	\		1C	1L	1K	1J	1A
1D	1D	1C	1B	1A		1D	\	\	\	\		1D	1N	1M	1I	1H
1E	COL1	M1	K1	K2		1E	\	\	\	\		1E	S1	1E	1G	1F
\	COL2	M2	K2	V2		1F	\	\	\	\		1F	\	\	\	\



Display Pattern

4.5 Command Listing

Command Mode

Command	Mode ID	Code									Function	Note
		C8	C7	C6	C5	C4	C3	C2	C1	C0		
SYS DIS	**1 0 0**	0	0	0	0	0	0	0	0	x	Turn off both system oscillator and LCD bias generator	*1
SYS EN	**1 0 0**	0	0	0	0	0	0	0	1	x	Turn on system oscillator	
LCD OFF	**1 0 0**	0	0	0	0	0	0	1	0	x	Turn off LCD by turn off LCD bias generator	*1
LCD ON	**1 0 0**	0	0	0	0	0	0	1	1	x	Turn on LCD by turn on LCD bias generator	
RC256K	**1 0 0**	0	0	0	1	1	0	x	x	x	Select System clock source to on-chip oscillator	*1
BIAS 1/3	**1 0 0**	0	0	1	0	a	b	x	1	x	1/3 bias driving option ab=00 : 2 commons option ab=01 : 3 commons option ab=10 : 4 commons option	
TEST	**1 0 0**	1	1	1	0	0	0	0	0	x	Test mode, not used	
NORMAL	**1 0 0**	1	1	1	0	0	0	1	1	x	Normal mode	*1

Data Mode

Command	Mode ID	Code										Function	Note
		A5	A4	A3	A2	A1	A0	D0	D1	D2	D3		
Write Display Data	**1 0 1**	Display Memory Address (00h - 3Fh)						Display Data				Write Data to Display Memory	*2

Note:
*1. Power on default setting.
*2. Refer to Timing Diagram for details.
*3. x = don't care bit.

4.6 Initialization

Issue the following commands for normal display.

Steps	Command	Mode ID	Code									Function
			C8	C7	C6	C5	C4	C3	C2	C1	C0	
1	SYS EN	**1 0 0**	0	0	0	0	0	0	0	1	x	Turn on system oscillator
2	RC256K	**1 0 0**	0	0	0	1	1	0	x	X	x	Using on-chip RC oscillator
3	BIAS 1/3	**1 0 0**	0	0	1	0	1	0	x	1	x	1/3 bias driving and 4 commons
4	NORMAL	**1 0 0**	1	1	1	0	0	0	1	1	x	Normal mode
5	LCD ON	**1 0 0**	0	0	0	0	0	0	1	1	x	Turn on LCD for normal display

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