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

TWM12007-1

LCD Module User Manual

Prepared by:	Checked by:	Approved by:
Dong		
Date: 2017-10-20	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary release	2013-04-03
0.2	**Update Pattern of 4.4 Memory Map Display**	2017-10-20

Table of Content

1. Basic Specifications

1.1 Display Specifications

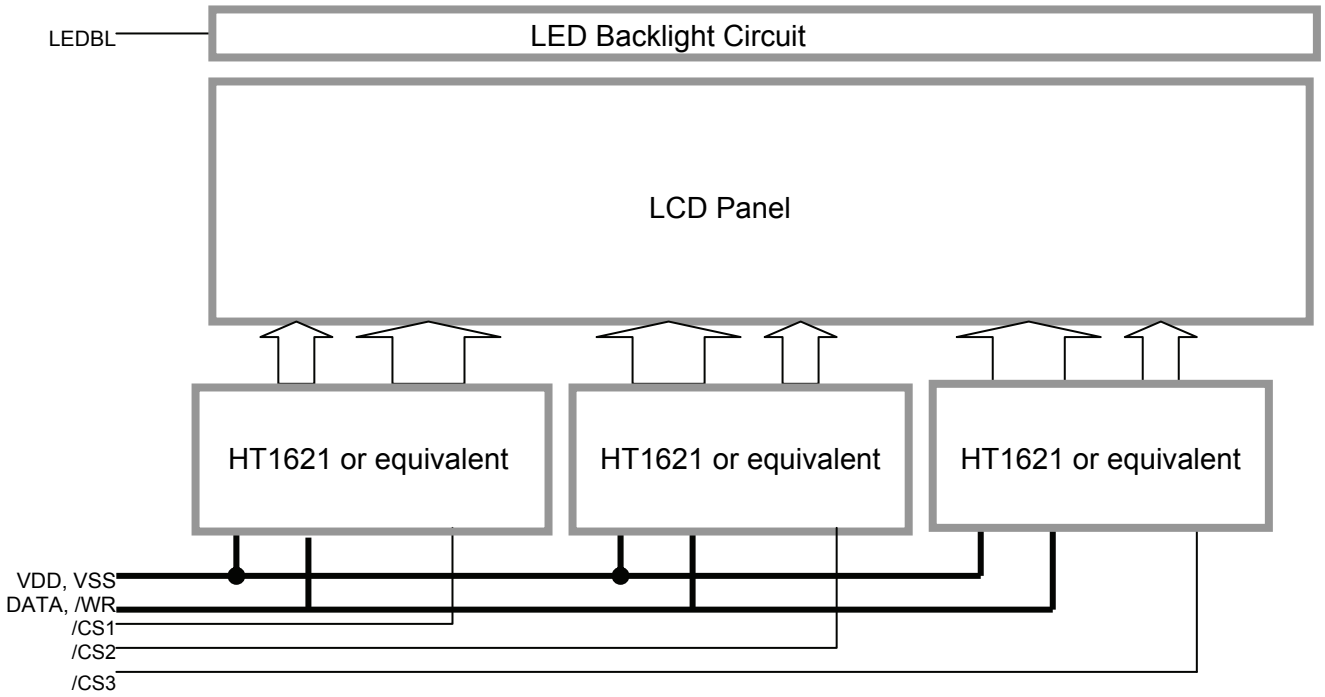
1) LCD Display Mode :STN-Gray, Positive, Transflective
2) Display Color : Display Data = “1” : Blue (*1)
: Display Data = “0” : White (*2)
3) Viewing Angle : 6 H
4) Driving Method : 1/4 duty, 1/3 bias
5) Backlight : White LED backlight

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 : 92.0 x92.0 x 12.1 MAX
see attached Outline Drawing for details

1.3 Block Diagram



1.4 Terminal Functions

Pin No.	Pin Name	I/O	Descriptions
1	VDD	Power	Positive Power Supply
2	/CS1	Input	Chip selection input of left IC /CS1=High, disable data or command writing /CS1=Low, enable data or command writing
3	/CS2	Input	Chip selection input of middle IC /CS2=High, disable data or command writing /CS2=Low, enable data or command writing
4	/CS3	Input	Chip selection input of right IC /CS3=High, disable data or command writing /CS3=Low, enable data or command writing
5	DATA	Input	Serial Data input with internal pull-up resistor
6	/WR	Input	Write Clock input with internal pull-up resistor Data on the Data line are latched on the rising edge of this signal
7	LEDBL	Input	Backlight control LEDBL = High, backlight on LEDBL = Low, backlight off
8	KEY1	-	Keyboard Circuit
9	KEY2	-	Keyboard Circuit
10	KEY3	-	Keyboard Circuit
11	KEY4	-	Keyboard Circuit
12	KEY5	-	Keyboard Circuit
13	VSS	Power	Negative Power Supply, Ground
14	NC	-	No Connection should leave open
15	NC	-	
16	NC	-	

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

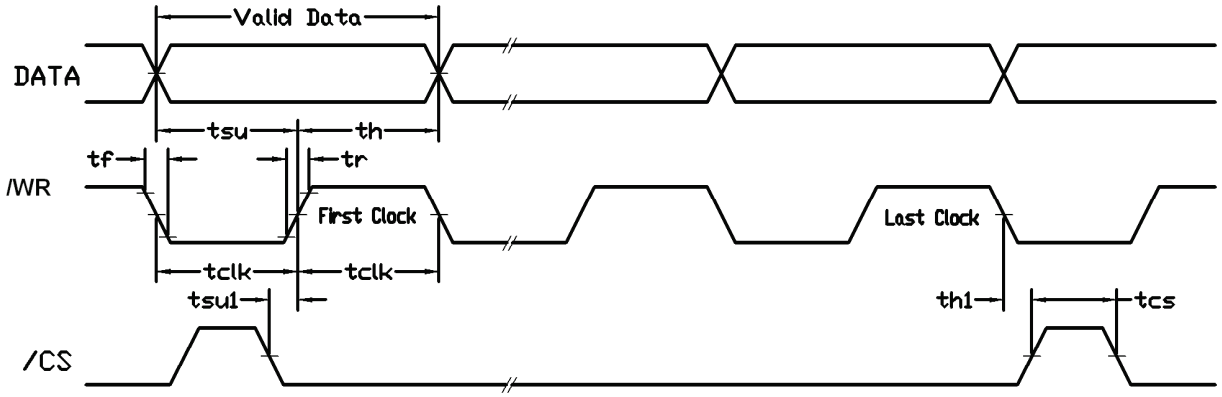
Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage (*1)	V_{DD}	4.8	5.0	5.2	V	VDD
Input High Voltage	V_{IN}	0.85xVDD	-	VDD	V	DATA, /WR, /CS1~/CS3
Input Low Voltage	V_{IN}	VSS	-	0.5	V	DATA, /WR, /CS1~/CS3
Operating Current (*2)	I_{DD}	-	0.5	1.3	mA	VDD
Operating Current (*3)	I_{DD}	-	39	-	mA	VDD

Note:
*1. The variation of Operating Voltage may affect the LCD display contrast.
*2. Backight off.
*3. Backight on.

3.2 AC Characteristics

V_{SS}=0V, V_{DD} =5.0V, T_{OP} =25°C

Symbol	MIN.	TYP.	MAX.	Unit	Descriptions
tcs	310	-	-	ns	Serial I/F Reset Pulse Width
tclk	8.5	-	-	µs	/WR, /RD Input Pulse Width
Tr, tf	-	-	100	ns	Rise / Fall Time Serial Data
tsu	150	-	-	ns	Setup Time for DATA to /WR
th	150	-	-	ns	Hold Time for DATA to /WR
tsu1	150	-	-	ns	Setup Time for /CS to /WR
th1	150	-	-	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

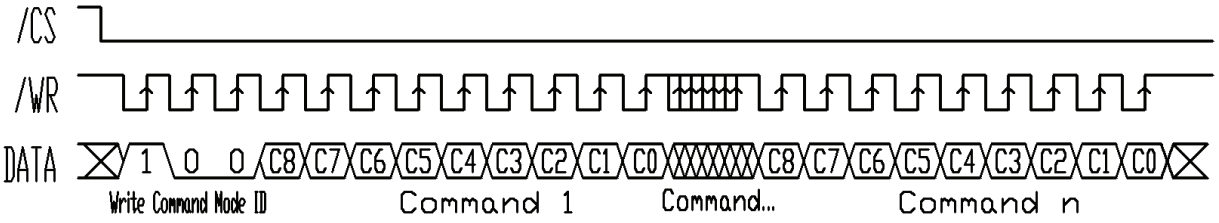
The LCD module could be controlled by software in two Operation modes. Modes are identified by "Mode ID".

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

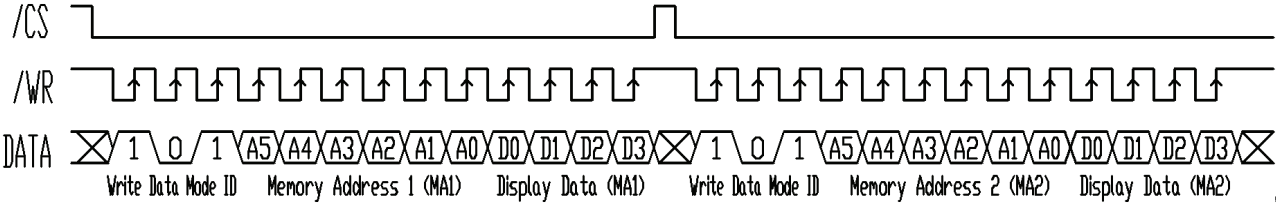
The mode ID should be issued before the data or command is transferred.
If successive commands is issuing, the command mode ID, namely **1 0 0**, can be omitted after the first command with mode ID. If successive data is issuing, the data mode ID, namely **1 0 1**, can be omitted after the first data 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.

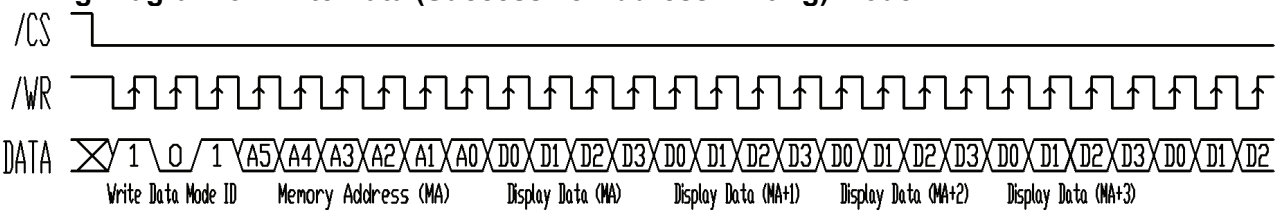
Timing Diagram of Write Command Mode



Timing Diagram of Write Data Mode



Timing Diagram of Write Data (Successive Address Writing) Mode



4.3 Interfacing

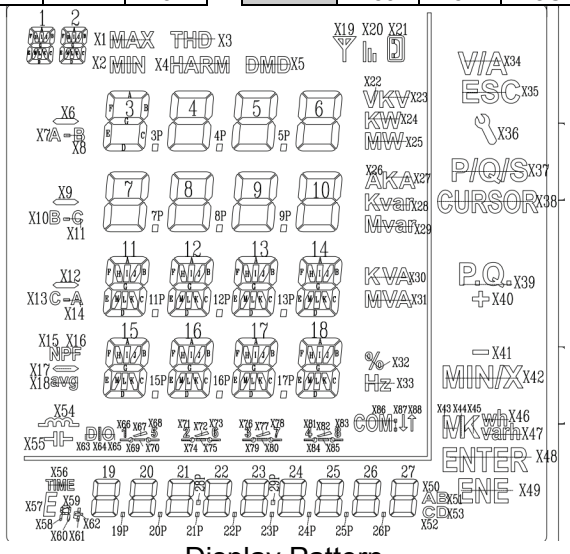
The /CS1, /CS2 and/CS3 line are used to initialize the serial interface circuit and to terminate the communication between the host and the LCD module. If the /CS1 or /CS2 or/CS3 pin is set to 1, the data or command issued between the host and the dedicated controller will be disabled. Before issuing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

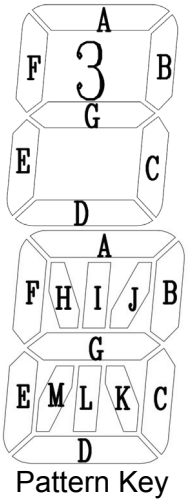
The /WR line is the WRITE clock input. The data, address, and command on the DATA line are all latched into the LCD module at the rising edge of the /WR signal.

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	1F	1E	1D	X11		00	11F	11E	11D	\		00	X54	X57	X58	X62
01	1H	1G	1M	1L		01	11H	11G	11M	11L		01	X56	X59	X60	X61
02	1A	1I	1K	X10		02	11A	11I	11K	X12		02	19A	19F	19E	19D
03	1J	1B	1C	X9		03	11J	11B	11C	11P		03	19B	19G	19C	19P
04	2F	2E	2D	X8		04	12F	12E	12D	X14		04	20A	20F	20E	20D
05	2H	2G	2M	2L		05	12H	12G	12M	12L		05	20B	20G	20C	20P
06	2A	2I	2K	X7		06	12A	12I	12K	X13		06	21A	21F	21E	21D
07	2J	2B	2C	X6		07	12J	12B	12C	12P		07	21B	21G	21C	21P
08	3A	3F	3E	3D		08	13F	13E	13D	X15		08	22A	22F	22E	22D
09	3B	3G	3C	3P		09	13H	13G	13M	13L		09	22B	22G	22C	22P
0A	4A	3F	4E	4D		0A	13A	13I	13K	X16		0A	23A	23F	23E	23D
0B	4B	4G	4C	4P		0B	13J	13B	13C	13P		0B	23B	23G	23C	23P
0C	5A	5F	5E	5D		0C	14F	14E	14D	X17		0C	\	\	\	28P
0D	5B	5G	5C	5P		0D	14H	14G	14M	14L		0D	\	\	X53	29P
0E	6A	6F	6E	6D		0E	14A	14I	14K	X18		0E	24A	24F	24E	24D
0F	6B	6G	6C	X25		0F	14J	14B	14C	\		0F	24B	24G	24C	24P
10	X5	X22	X23	X24		10	15F	15E	15D	\		10	25A	25F	25E	25D
11	X19	X20	X21	\		11	15H	15G	15M	15L		11	25B	25G	25C	25P
12	X4	X3	X1	X2		12	15A	15I	15K	\		12	26A	26F	26E	26D
13	X34	X35	X36	\		13	15J	15B	15C	15P		13	26B	26G	26C	26P
14	7A	7F	7E	7D		14	16F	16E	16D	\		14	27A	27F	27E	27D
15	7B	7G	7C	7P		15	16H	16G	16M	16L		15	27B	27G	27C	X52
16	8A	8F	8E	8D		16	16A	16I	16K	\		16	X48	X49	X51	X50
17	8B	8G	8C	8P		17	16J	16B	16C	16P		17	X87	X88	X47	X46
18	9A	9F	9E	9D		18	17F	17E	17D	\		18	X42	X43	X44	X45
19	9B	9G	9C	9P		19	17H	17G	17M	17L		19	X86	X33	X32	X41
1A	10A	10F	10E	10D		1A	17A	17I	17K	\		1A	X85	X84	X82	X83
1B	10B	10G	10C	X29		1B	17J	17B	17C	17P		1B	X80	X79	X78	X81
1C	X37	X27	X26	X28		1C	18F	18E	18D	\		1C	X74	X73	X77	X76
1D	X38	X39	X30	\		1D	18H	18G	18M	18L		1D	X75	X72	X71	X68
1E	\	\	\	X40		1E	18A	18I	18K	\		1E	X70	X69	X67	X66
1F	\	\	\	X31		1F	18J	18B	18C	\		1F	X55	X63	X64	X65



Display Pattern



Pattern Key

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