深圳市拓普微科技开发有限公司
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LM192160DCW-1

LCD Module User Manual

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Date: 2011-11-15	Date:	Date:

Rev.	Descriptions	Release Date
0.1	New release	2011-11-15

Table of Content

1. Basic Specifications

1.1 Display Specifications

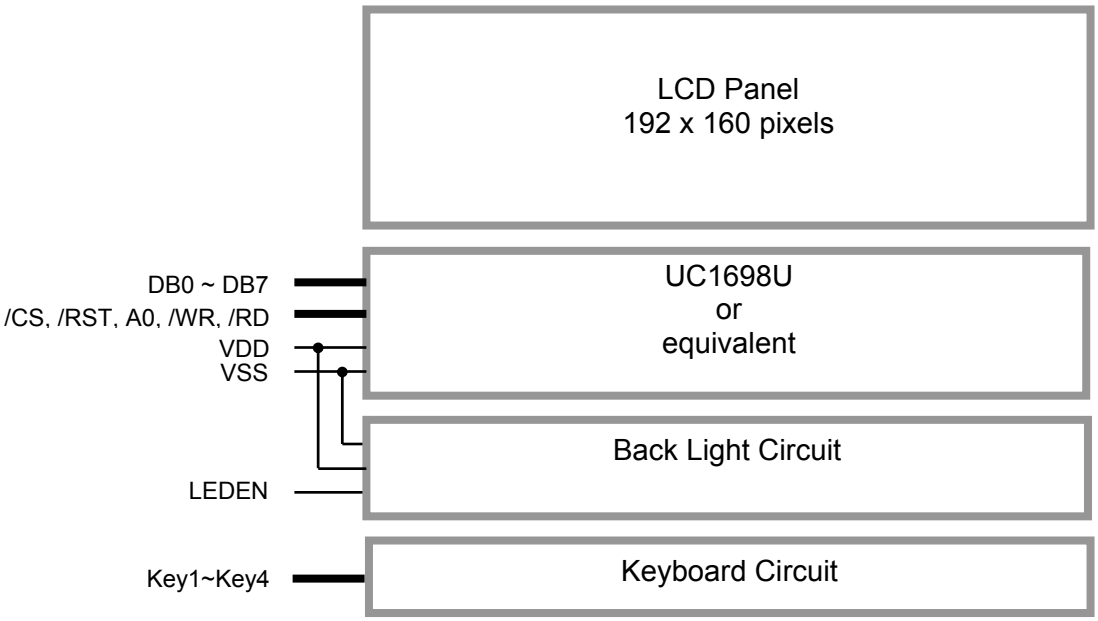
1) LCD Display Mode : FSTN, Positive, Transflective
2) Display Color : Display Data = “1” : Dark Gray (*1)
: Display Data = “0” : Light Gray (*2)
3) Viewing Angle : 6H
4) Driving Method : 1/160 duty, 1/12 bias
5) Backlight : White LED backlight

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 : 85.4 x 84.6 x 14.6 MAX
(see attached Outline Drawing for details)

1.3 Block Diagram



1.4 Terminal Functions

Pin No.	Pin Name	I/O	Descriptions		
			8-bit parallel 8080 mode	8-bit parallel 6800 mode	Serial mode
1	VSS	Power	0V Supply, Ground (0V)		
2	A0	Input	Register Select A0=H: data on DB0 to DB7 is display data A0=L: data on DB0 to DB7 is control data		
3	/WR	Input	/WR=L→H, /RD=H; Data or Instruction latch into the LCD module	/WR=L,/RD= H→L; Data or Instruction latch into the LCD module	Not use, connect to VSS
4	/RD	Input	/WR=H, /RD=L; Data or Status read form the LCD module	/WR=H, /RD=H; Data or Status read form the LCD module	
5	/CS	Input	Chip Select /CS=L : Data IO is enabled		
6	/RST	Input	Reset: /RST=L: Initialization is executed /RST=H: Normal		
7	VDD	Power	Positive Power Supply		
8	DB0	I/O	8-bit Data bus; Three state I/O terminal for display data or instruction data when /CS =H, DB0~DB7=High Impedance		Serial clock input(DB0)
:	:				Not use, connect to VDD or VSS
11	DB3				Serial data input(DB3)
:	:				Not use, connect to VDD or VSS
15	DB7				
16	NC	-	-		
17	LEDEN	Input	Backlight Control Input;		
18	NC	-	-		
19	VSS	Power	0V Supply, Ground (0V)		
20	VSS	Power	0V Supply, Ground (0V)		
21	Key4	-	Keyboard Circuit		
22	Key3	-			
23	Key2	-			
24	Key1	-			

Interface setting:

Setting	8080 mode(Default)	6800 mode	4-wire SPI mode
JP1	OPEN	OPEN	CLOSE
JP2	CLOSE	CLOSE	OPEN
JP3	OPEN	CLOSE	CLOSE
JP4	CLOSE	OPEN	OPEN
JP5	OPEN	OPEN	CLOSE
JP6	CLOSE	CLOSE	OPEN

2. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	+4.0	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}=3.0V, T_{OP}=25°C

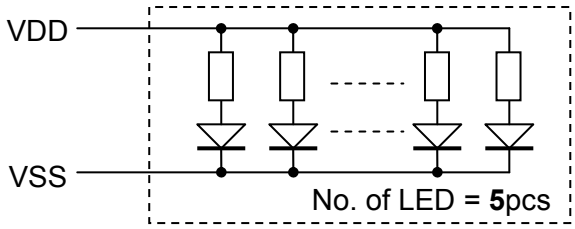
Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage	V_{DD}	2.7	3.0	3.3	V	VDD
Input High Voltage	V_{IN}	0.8xVDD	-	VDD	V	DB0~DB7, /WR,/RD, /CS, A0, /RST
Input Low Voltage	V_{IN}	VSS	-	0.2xVDD	V	DB0~DB7, /WR,/RD, /CS, A0, /RST
Operating Current	I_{DD}	-	2.1	5.5	mA	VDD

3.2 LED Backlight Circuit Characteristics

BLK=0V, If_{BLA}=85mA, T_{OP} =25°C

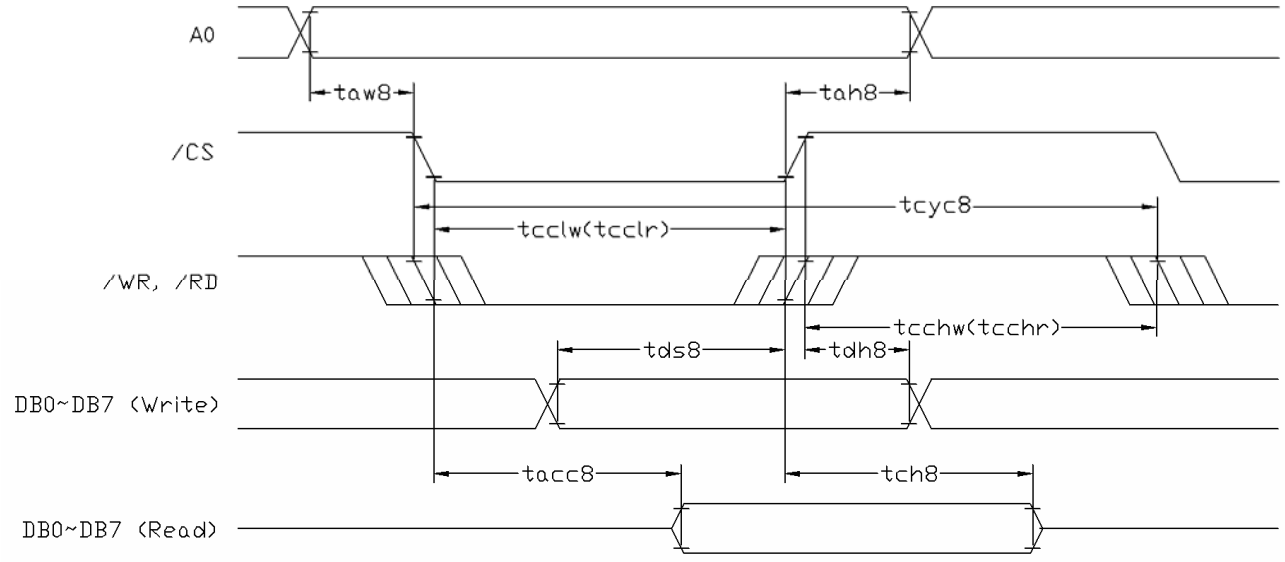
Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Forward Voltage	Vf_{BLA}	-	3.0	-	V	BLA
Forward Current	If_{BLA}	-	85	100	mA	BLA

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



3.3 AC Characteristics

3.3.1 8080 Mode System Bus Timing

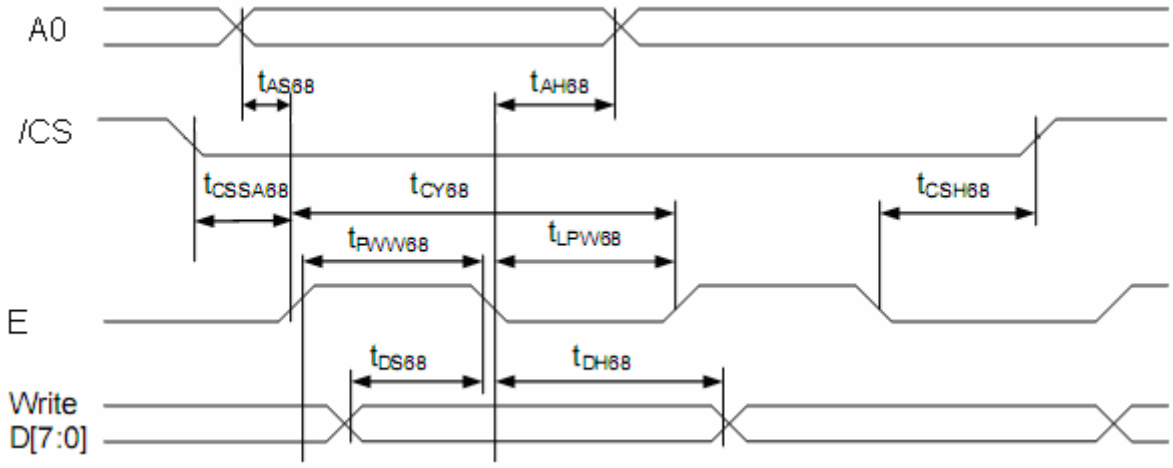


V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
System cycle time	tcyc8	128	-	-	ns
Address setup time (A0)	taw8	0	-	-	ns
Address hold time (A0)	tah8	0	-	-	ns
Control LOW pulse width (/WR)	tcclw	71	-	-	ns
Control LOW pulse width (/RD)	tcclr	71	-	-	ns
Control HIGH pulse width (/WR)	tcchw	64	-	-	ns
Control HIGH pulse width (/RD)	tcchr	64	-	-	ns
Data setup time	tds8	42	-	-	ns
Data hold time	tdh8	0	-	-	ns
/RD access time (*2)	tacc8	-	-	60	ns
Output disable time (*2)	tch8	-	-	38	ns

Note:
*1. Input signal rise/fall time should be less than 12ns
*2. CL=100pF

3.3.2 68 Mode

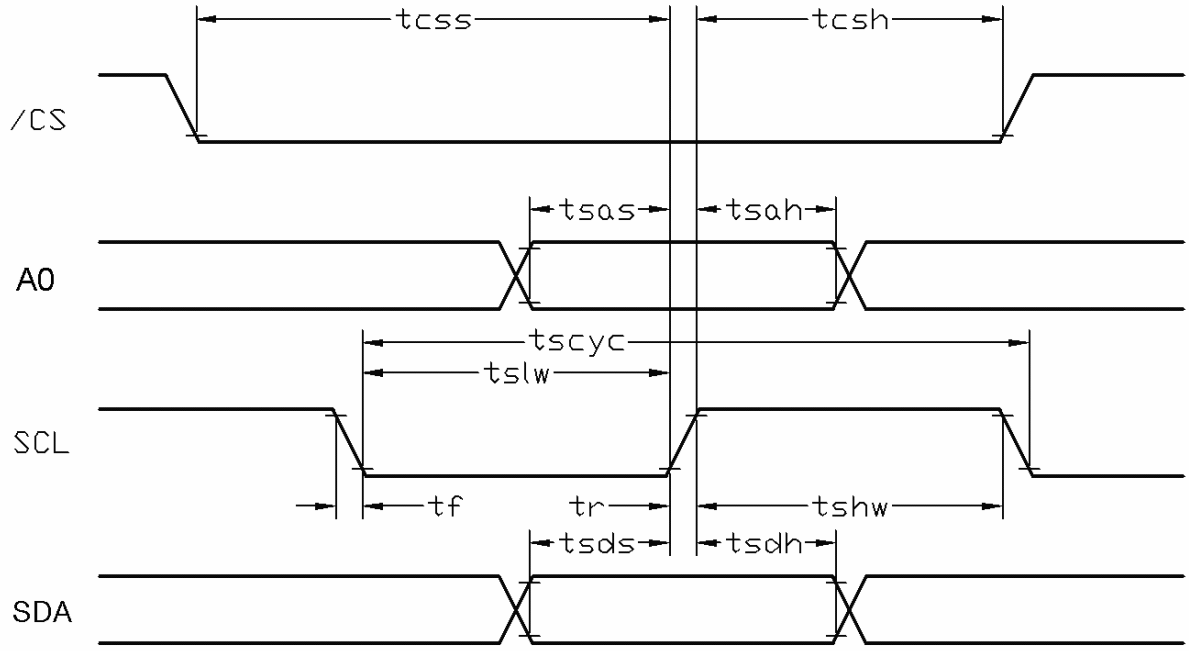


VSS=0V, VDD=3.0V, TOP=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Address setup time	tAS68	0	-	-	ns
Address hold time	tAH68	0	-	-	ns
System cycle time	tCY68	80	-	-	ns
Pulse width	tPWW68	50	-	-	ns
Low pulse width	tLPW68	40	-	-	ns
Data setup time	tDS68	30	-	-	ns
Data hold time	tDH68	0	-	-	ns
Chip select setup time	tCSSA68	5	-	-	ns
	tCSH68	5	-	-	ns

Note:
*1. Input signal rise/fall time should be less than 12ns
*2. CL=100pF

3.3.3 Serial Mode Interface



V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25°C

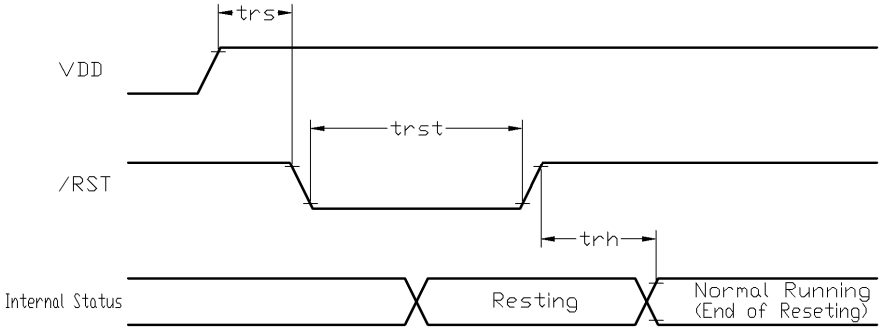
Item	Symbol	MIN.	TYP.	MAX.	Unit
Serial Clock Period	tscyc	57	-	-	ns
Address setup time (A0)	tsas	5	-	-	ns
Address hold time (A0)	tsah	5	-	-	ns
SCL “H” pulse width	tshw	37	-	-	ns
SCL “L” pulse width	tslw	37	-	-	ns
Data setup time	tsds	21	-	-	ns
Data hold time	tsdh	5	-	-	ns
CS-SCL time	tcss	7	-	-	ns
CS-SCL time	tcsh	7	-	-	ns

Note:
*1. Input signal rise/fall time should be less than 12ns

3.4 Reset Timing

V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset setup time	trs	1.0	-	-	ms
Reset hold time	trh	1.0	-	-	ms
Reset active time	trst	150	-	-	us



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 Resetting the LCD module

The LCD module should be initialized by hardware reset, using /RST terminal.
While turning on the VDD and VSS power supply, maintain /RST terminal at LOW level. After the power supply stabilized, release the reset terminal (/RST=HIGH)

4.3 Display Pixel Map(example)

ROW no.	IC COM Line	ROW add.	LCD Display (front view)
1st	C160	00h	
2nd	C159	01h	
3rd	C158	02h	
:	:	:	192 x 160 pixels
158th	C3	9Dh	
159th	C2	9Eh	
160th	C1	9Fh	Non-displaying Area

Column no.	1st	2nd	3rd	4th	5th	6th	→	187th	188th	189th	190th	191th	192th	193th
IC SEG Line	S97	S98	S99	S100	S101	S102	→	S283	S284	S285	S286	S287	S288	S289
Column Address	21h			22h			→	5Fh			60h			
Grouping	R3~R0	G3~G0	B3~G0	R3~R0	G3~G0	B3~B0	→	R3~R0	G3~G0	B3~G0	R3~R0	G3~G0	B3~G0	B3~G0

Note:

*1. This mono LCM is driven by a color LCD driver.
Every three dots are being driven by R G B segment driver.

*2. The above is based on:
4R4G4B setting, each dot will be driven by 4bit; LC[7:6]=0:1, DC[4]=1
Mirror Y direction; LC[2]=1
Normal X direction; LC[1]=0
Color Mapping as RGB; LC[5]=1

*3. For details please refer to UC1698 datasheet

4.4 Command Summary

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status & PM	0	1	GE	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A
				Ver	PMO[6:0]								
				Product Code (8h)				PID[1:0]		MID[1:0]			
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	0	#	#	#	Set CA[6:4]	0
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	0
6	Set Power Control	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b
7	Set Adv. Program Control	0	0	0	0	1	1	0	0	0	R	Set APC[R][7:0], R = 0 or 1	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
8	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0
	Set Scroll Line MSB	0	0	0	1	0	1	#	#	#	#	Set SL[7:4]	0
9	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	0
	Set Row Address MSB	0	0	0	1	1	1	#	#	#	#	Set RA[7:4]	0
10	Set V_{BIAS} Potentiometer	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	40H
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
11	Set Partial Display Control	0	0	1	0	0	0	0	1	0	#	Set LC[8]	0
12	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
13	Set Fixed Lines	0	0	1	0	0	1	0	0	0	0	Set {FLT, FLB}	0
		0	0	#	#	#	#	#	#	#	#		
14	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	10b
15	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
16	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
17	Set Display Enable	0	0	1	0	1	0	1	#	#	#	Set DC[4:2]	110b
18	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	0
19	Set N-Line Inversion	0	0	1	1	0	0	1	0	0	0	Set NIV[4:0]	1DH
				-	-	-	#	#	#	#	#		
20	Set Color Pattern	0	0	1	1	0	1	0	0	0	#	Set LC[5]	0 (BGR)
21	Set Color Mode	0	0	1	1	0	1	0	1	#	#	Set LC[7:6]	10b
22	Set COM Scan Function	0	0	1	1	0	1	1	#	#	#	Set CSF[2:0]	000b
23	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
24	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
25	Set Test Control	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
26	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 12
27	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[6:0]	159
		0	0	-	#	#	#	#	#	#	#		
28	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[6:0]	0
		0	0	-	#	#	#	#	#	#	#		
29	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[6:0]	159
		0	0	-	#	#	#	#	#	#	#		
30	Set Window Program Starting Column Address	0	0	1	1	1	1	0	1	0	0	Shared with MTP commands: Set WPC0	0
		0	0	-	#	#	#	#	#	#	#		
31	Set Window Program Starting Row Address	0	0	1	1	1	1	0	1	0	1	Shared with MTP commands: Set WPP0	0
		0	0	#	#	#	#	#	#	#	#		
32	Set Window Program Ending Column Address	0	0	1	1	1	1	0	1	1	0	Shared with MTP commands: Set WPC1	127
		0	0	-	#	#	#	#	#	#	#		
33	Set Window Program Ending Row Address	0	0	1	1	1	1	0	1	1	1	Shared with MTP commands: Set WPP1	159
		0	0	#	#	#	#	#	#	#	#		
34	Window Program Mode	0	0	1	1	1	1	1	0	0	#	Set AC[3]	0: Inside
35	Set MTP Operation control	0	0	1	0	1	1	1	0	0	0	Set MTPC[4:0]	10H
		0	0	-	-	-	#	#	#	#	#		

Note: *1.For the details, please refer to UC1698 Data sheet.
*2. C/D: 0:Control, 1:Data; W/R: 0: Write Cycle, 1:Read Cycle(Read available in 68 mode); #: Useful Data bIts; - Don't Care

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