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LM192160BCW-2

LCD Module User Manual

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Date: 2017-2-13	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary release	2017-2-13

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1. Basic Specifications

1.1 Display Specifications

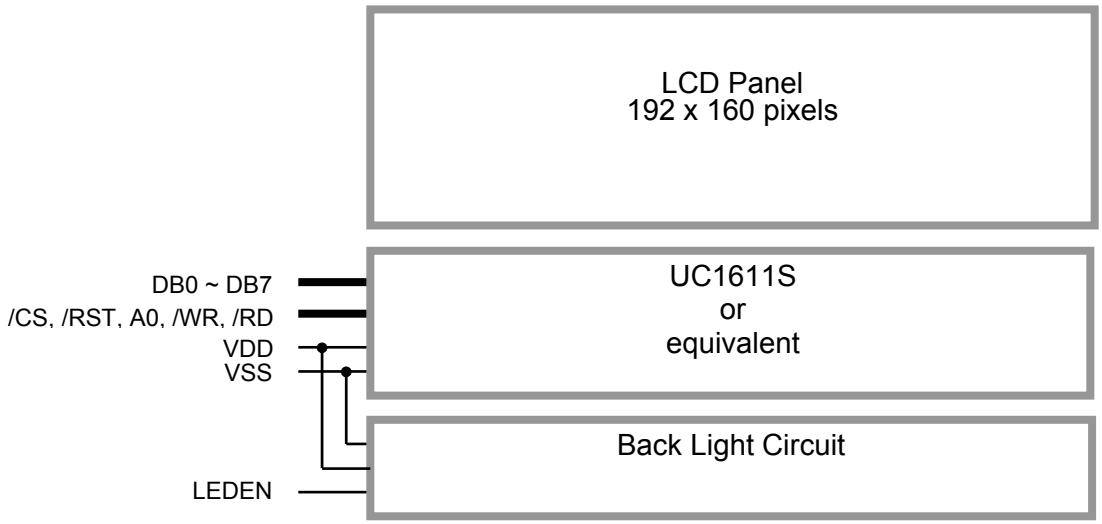
1) LCD Display Mode : FSTN, Positive, Transflective
2) Display Color : Display Data = “1” : Dark Gray (*1)
: Display Data = “0” : Light Gray (*2)
3) Viewing Angle : 6H
4) Driving Method : 1/160 duty, 1/12 bias
5) Back Light : White LED backlight

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 11.5 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	Serial mode	I^2C 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	Not use, connect to VSS	
3	/WR	Input	/WR=H, /RD=L; Data or Status read form the LCD module /WR=L→H, /RD=H; Data or Instruction latch into the LCD module	Not use, connect to VSS	
4	/RD	Input		Not use, connect to VSS	
5	/CS	Input	Chip Select /CS=L : Data IO is enabled		Not use, connect to VSS
6	/RST	Input	Reset: /RST=L: Initialization is executed /RST=H: Normal		
7	VDD	Power	Positive Power Supply		
8	DB0(SCL)	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(SDA)			Serial data input(DB3)	
:	:			Not use, connect to VDD or VSS	
15	DB7				
16	NC	-	-		
17	LEDEN	Input	Backlight Control Input;		
18	NC	-	-		
19	NC	-	-		
20	NC	-	-		
21	NC	-	-		
22	NC	-	-		
23	NC	-	-		
24	NC	-	-		

Interface setting:

Setting	8080 mode(Default)	SPI mode	I^2C 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
JP7	OPEN	CLOSE	CLOSE
JP8	OPEN	CLOSE	CLOSE
JP9	OPEN	OPEN	CLOSE
JP10	OPEN	OPEN	CLOSE

Note:
*1. In I^2C Interface setting, R2 and R3 should be setup (10kΩ).

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}	-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

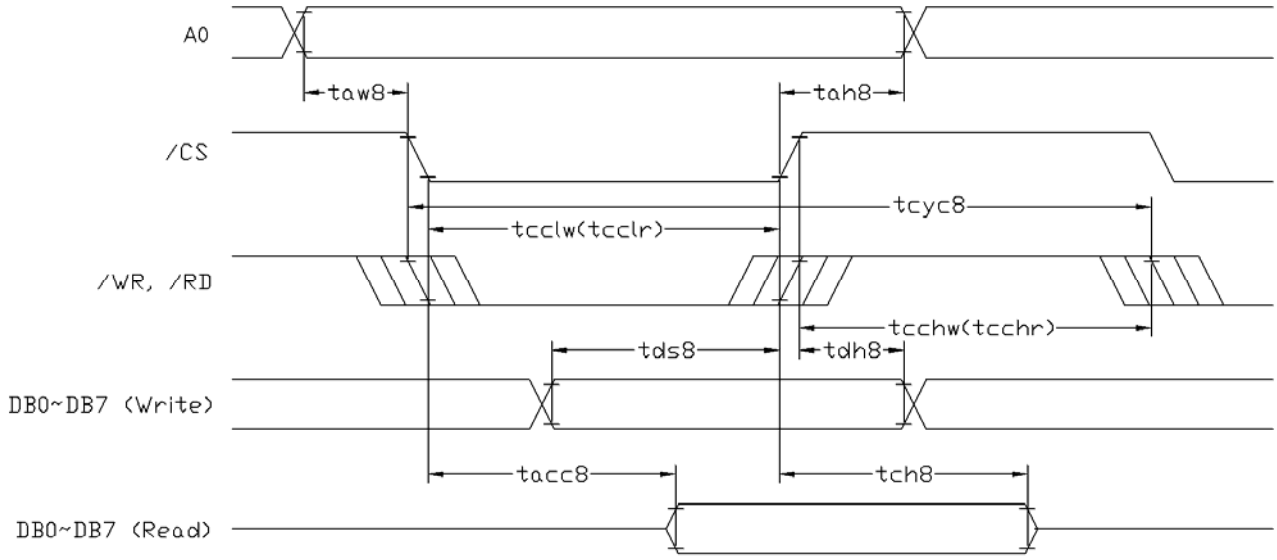
3.1 DC Characteristics

V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition / Application Pin
Operating Voltage	V_{DD}	3.0	3.3	3.6	V	VDD
Input High Voltage	V_{IH}	0.8xV_{DD}	-	V_{DD}	V	/RST, /CS, RS, /WR, /RD, DB0~DB7
Input Low Voltage	V_{IL}	0	-	0.2xV_{DD}	V	
Operating Current 1	I_{DD}	-	1.5	7.0	mA	VDD (Backlight OFF)
Operating Current 2	I_{DD}	-	76.5	107	mA	VDD (Backlight ON)

3.2 AC Characteristics

3.2.1 8080 Mode System Bus Timing

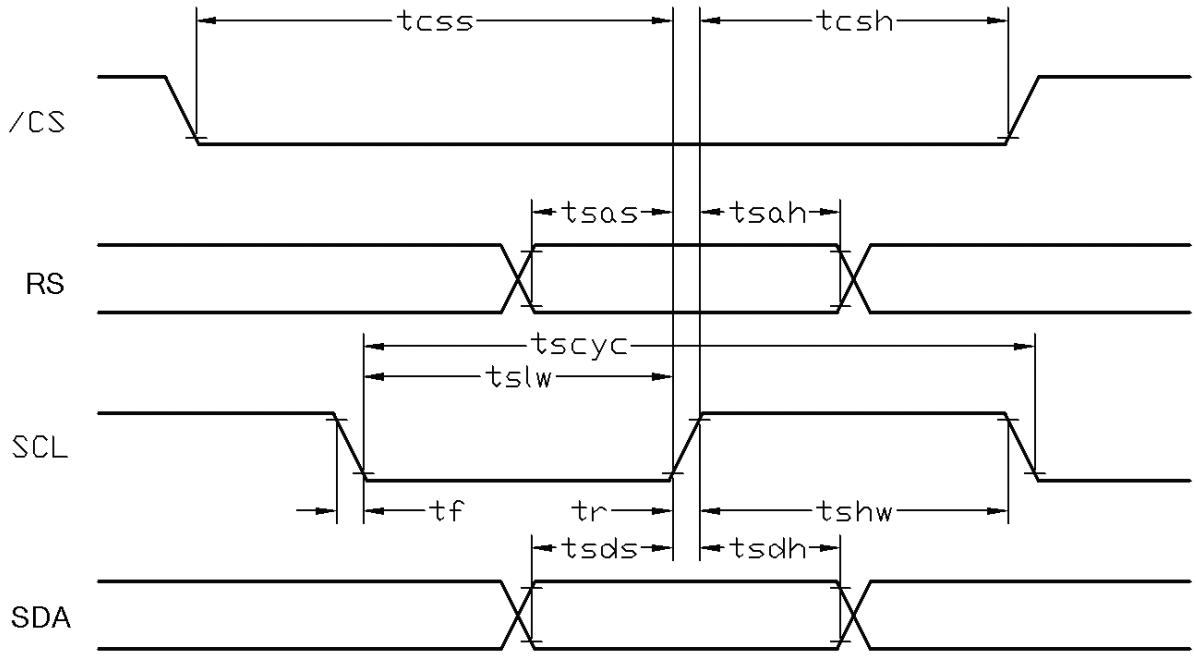


V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
System cycle time	tcyc8	195	-	-	ns
Address setup time (A0)	taw8	10	-	-	ns
Address hold time (A0)	tah8	10	-	-	ns
Control LOW pulse width (/WR)	tcclw	98	-	-	ns
Control LOW pulse width (/RD)	tcclr	98	-	-	ns
Control HIGH pulse width (/WR)	tcchw	98	-	-	ns
Control HIGH pulse width (/RD)	tcchr	98	-	-	ns
Data setup time	tds8	40	-	-	ns
Data hold time	tdh8	0	-	-	ns
/RD access time (*2)	tacc8	-	-	78	ns
Output disable time (*2)	tch8	21	-	-	ns

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

3.2.2 Serial Mode Interface

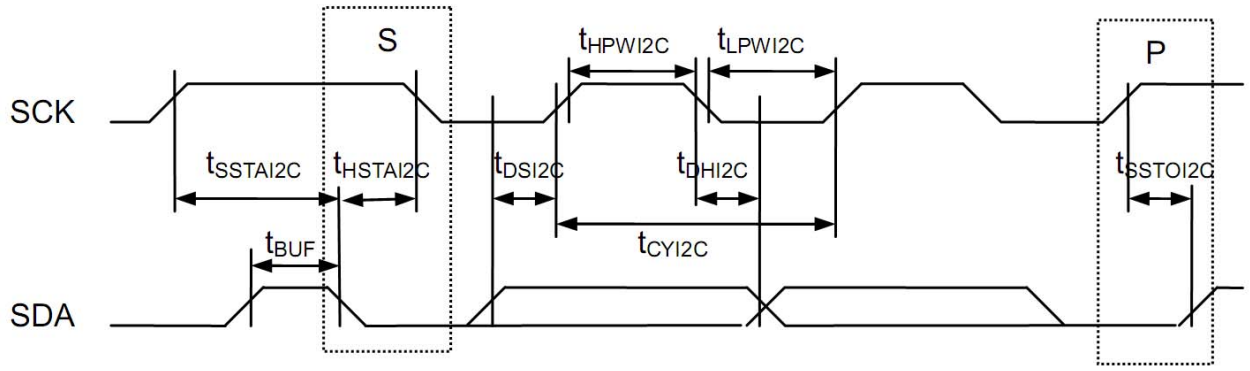


V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Serial Clock Period	tscyc	47	-	-	ns
Address setup time (A0)	tsas	10	-	-	ns
Address hold time (A0)	tsah	10	-	-	ns
SCL “H” pulse width	tshw	24	-	-	ns
SCL “L” pulse width	tslw	24	-	-	ns
Data setup time	tsds	20	-	-	ns
Data hold time	tsdh	10	-	-	ns
CS-SCL time	tcss	10	-	-	ns
CS-SCL time	tcsh	10	-	-	ns

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

3.2.3 I²C mode Interface

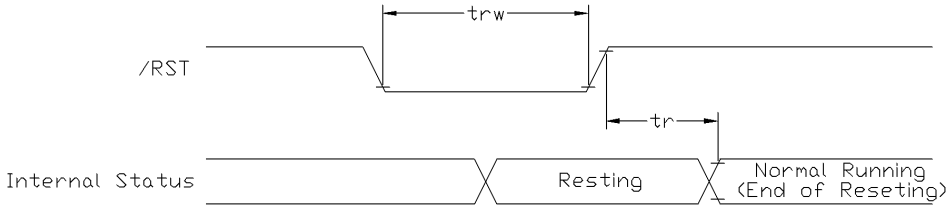


V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
SCK cycle time	t_{CYI2C}	750	-	-	ns
Low pulse width	t_{LPWI2C}	375	-	-	ns
High pulse width	t_{HPWI2C}	375	-	-	ns
Data setup time	t_{DSI2C}	42	-	-	ns
Data hold time	t_{DHI2C}	15	-	-	ns
START Setup time	$t_{SSTAI2C}$	37	-	-	ns
START Hold time	$t_{HSTAI2C}$	65	-	-	ns
STOP setup time	$t_{SSTOI2C}$	37	-	-	ns
Bus Free time	t_{BUF}	215	-	-	ns

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

3.3 Reset Timing



V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset time	tr	-	-	15	ms
Reset LOW pulse width	trw	5	-	-	μs

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

4. Function Specifications

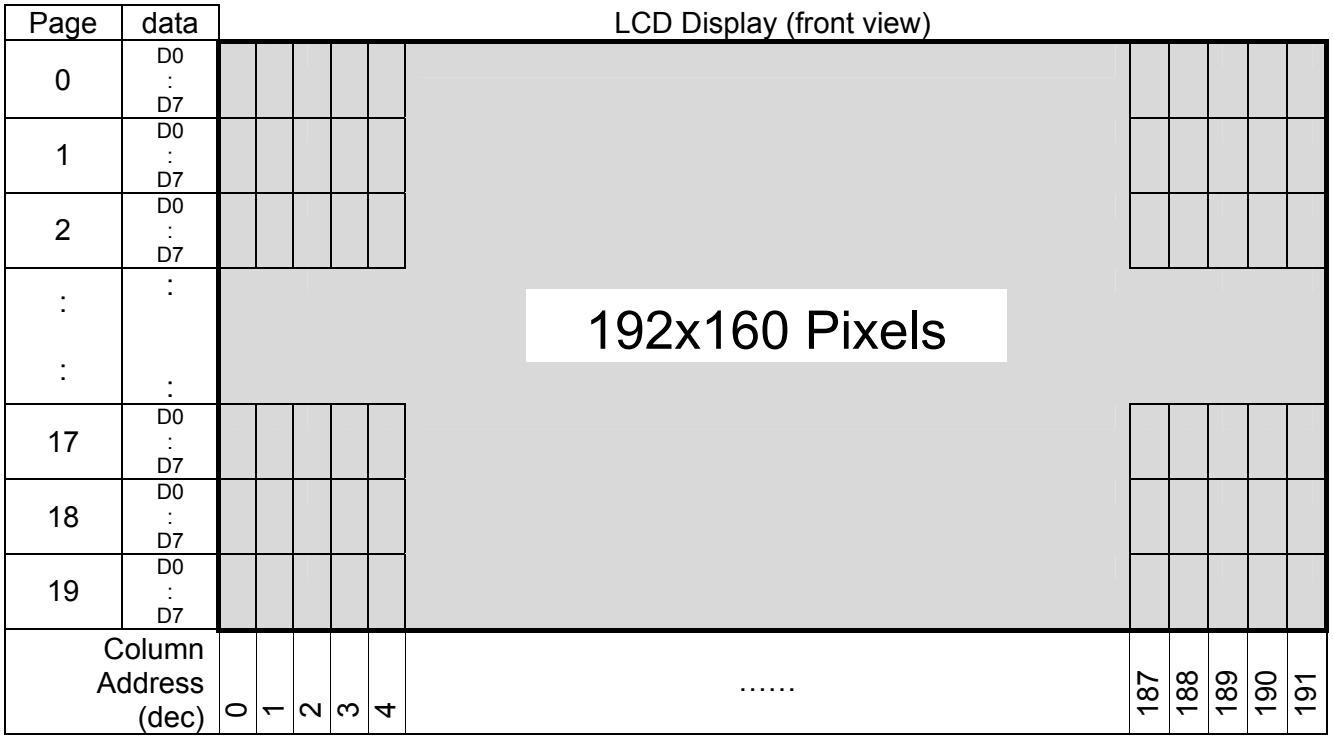
4.1 Adjusting the Display Contrast

- 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 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 Memory Map



Pixel mapping (Top View)

Note:
*1. Based on the top view of the LCD module,
*2. The above is memory map based on:
On/Off mode setting, DC[5:3]=100 (1bpp),the Page value range:**0**～**19**
LC[0]=MSF=0
LC[1]=MX=1
LC[2]=MY=0
SL=0
*3. For 4,8 and 16 Gray-shade operation please refer to UC1611 datasheet.

4.4 Command Table

The following setting should be issue to LCD module after hardware reset.
(It is an example only; it could be adjusted if necessary.)

	Command	A0	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	0	1	Ver	MX	MY	WA	DE	WS	MD	MS	Get Status	N/A
				ID[1:0]		PMO[5:0]							
				Product Code				0	0	0	EF		
4.	Set Column Addr. LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Addr. MSB	0	0	0	0	0	1	#	#	#	#	Set CA[7:4]	0
5.	Temp. Compensation.	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b: -0.05%/°C
6.	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC [1:0]	11b: 33~55 nF
7.	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC [3:2]	11b
8.	Set Adv. Program Control (double-byte command)	0	0	0	0	1	1	0	0	R	R	Set APC[R][7:0] R = 0~3	N/A
				#	#	#	#	#	#	#	#		
9.	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0
	Set Scroll Line MSB			0	1	0	1	#	#	#	#	Set SL[7:4]	0
10.	Set Page Address LSB	0	0	0	1	1	0	#	#	#	#	Set PA[3:0]	0
	Set Page Address MSB			0	1	1	1	0	#	#	#	Set PA[6:4]	0
11.	Set Potentiometer (double-byte command)	0	0	1 #	0 #	0 #	0 #	0 #	0 #	0 #	1 #	Set PM[7:0]	PM=EAH
12.	Set Isolation Clock Front	0	0	1	0	0	0	0	0	1	0	Set ISOF[3:0]	1H
				0	0	0	1	0	0	1	1		
				-	-	-	-	#	#	#	#		
13.	Set Isolation Clock Back	0	0	1	0	0	0	0	0	1	0	Set ISOB[3:0]	0H
				0	0	0	1	0	1	0	0		
				-	-	-	-	#	#	#	#		
14.	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[9:8]	00b: Disable
15.	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
16.	Set Fixed Lines	0	0	1	0	0	1	#	#	#	#	Set FL[3:0]	0
17.	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[5:4]	10b:28klps
18.	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
19.	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
20.	Set Display Enable	0	0	1	0	1	0	1	#	#	#	Set DC[4:2]	110b
21.	Set LCD Mapping Control (double-byte command)	0	0	1	1	0	0	0	0	0	0	Set LC[3:0]	0
				0	0	0	0	#	#	#	#		
22.	Set N-line Inversion (double-byte command)	0	0	1	1	0	0	1	0	0	0	Set NIV[6:0]	00H
				-	#	#	#	#	#	#	#		
23.	Set Display Pattern	0	0	1	1	0	1	0	#	#	#	Set DC[7:5]	000b
24.	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
25.	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
26.	Set test control (double-byte command)	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		
27.	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	10b: 11
28.	Set COM End	0 0	0 0	1 #	1 #	1 #	1 #	0 #	0 #	0 #	1 #	Set CEN[7:0]	159
29.	Set Partial Display Start	0 0	0 0	1 #	1 #	1 #	1 #	0 #	0 #	1 #	0 #	Set DST[7:0]	0
30.	Set Partial Display End	0 0	0 0	1 #	1 #	1 #	1 #	0 #	0 #	1 #	1 #	Set DEN[7:0]	159

Note:
Please refer to UC1611 data sheet for details
R/W=0 means it is a write function, R/W=1 means it is a read function
RS=0 means it is a control data, RS=1 means it is a display data

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