

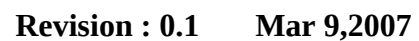


MULTI-INNO TECHNOLOGY CO., LTD.

LCD MODULE SPECIFICATION

Model : MI12864BO

Revision	
Engineering	
Date	
Our Reference	



Rev.	Contents	Date
0.0	Preliminary	2006-7-28
0.1	Update EOC data & lifetime data	2007-3-9

■ PHYSICAL DATA

No.	Items:	Specification:	Unit
1	Diagonal Size	1.02	Inch
2	Resolution	128(H) x 64(V)	Lines
3	Display Format	8,192	Pixels
4	Active Area	23.02(W) x 11.86(H)	mm
5	Outline Dimension (Panel)	30.00(W) x 20.16(H)	mm
6	Pixel Pitch	0.18(W) x 0.18(H)	mm
7	Pixel Size	0.16(W) x 0.16(H)	mm
8	Encapsulation type	Glass Can	-
9	Display color	RED	-
10	IC package type	TCP	-
11	Thickness	1.6 MAX	mm
12	Weight	<2.5	g
13	Duty	1/64	-

■ ABSOLUTE MAXIMUM RATINGS

Unless otherwise specified, $V_{SS} = 0V$

($T_a = 25^{\circ}C$)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	V_{DD}	-0.3	-	3.6	V
	Driving	V_{CC}	-0.3	-	18.0	V
Operating Temperature		T_{op}	-20	-	70	$^{\circ}C$
Storage Temperature		T_{st}	-30	-	80	$^{\circ}C$
Humidity		-	-	-	90	%RH

NOTE:

Permanent device damage may occur if **ABSOLUTE MAXIMUM RATINGS** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Customer No.:



1. GENERAL TOLERANCE : $\pm 0.2\text{MM}$
2. OPERATING TEMPERATURE: -20°C TO 70°C
3. STORAGE TEMPERATURE: -30°C TO 80°C
4. DRIVE IC : SH101

■ ELECTRICAL CHARACTERISTICS

DC Characteristics

Unless otherwise specified, $V_{SS} = 0V$, $V_{DD} = 2.4V$ to $3.3V$ ($T_a = 25^{\circ}C$)

Items		Symbol	Min	Typ.	Max	Unit
Supply Voltage	Logic	V_{DD}	2.4	3.0	3.5	V
	Operating	V_{CC}	11.0	12.0	13.0	V
Input Voltage	High Voltage	V_{IH}	$0.8 \times V_{DD}$	-	V_{DD}	V
	Low Voltage	V_{IL}	0	-	$0.2 \times V_{DD}$	V
Output Voltage	High Voltage	V_{OH}	$0.8 \times V_{DD}$	-	V_{DD}	V
	Low Voltage	V_{OL}	0	-	$0.2 \times V_{DD}$	V

Note:

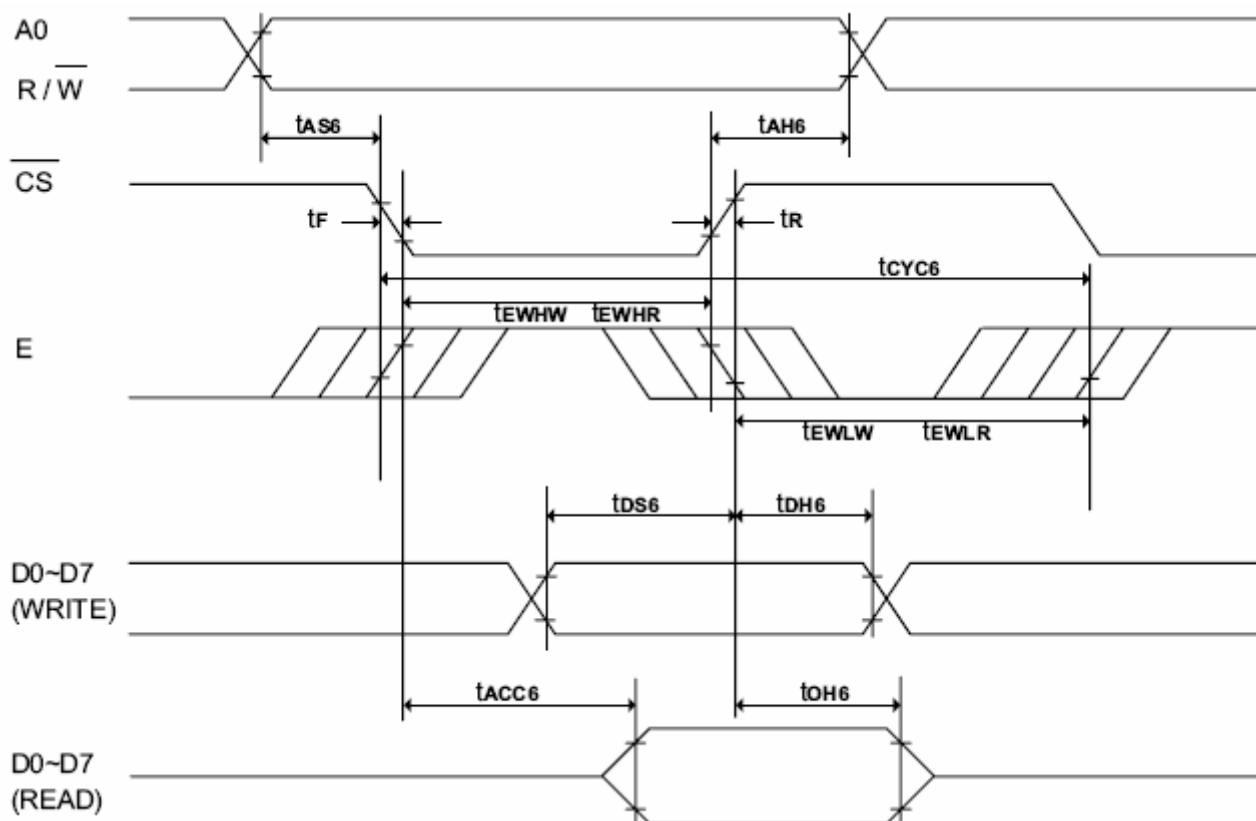
(1)50 [cd/m^2], $V_{dd} = 3.0[V]$, I/O $V_{dd} = 3.0[V]$, $V_{cc} = 12.0[V]$, contrast setting=0x28H

◆AC Characteristics

Use 8080/6800-Series MPU Parallel Interface or Serial Interface

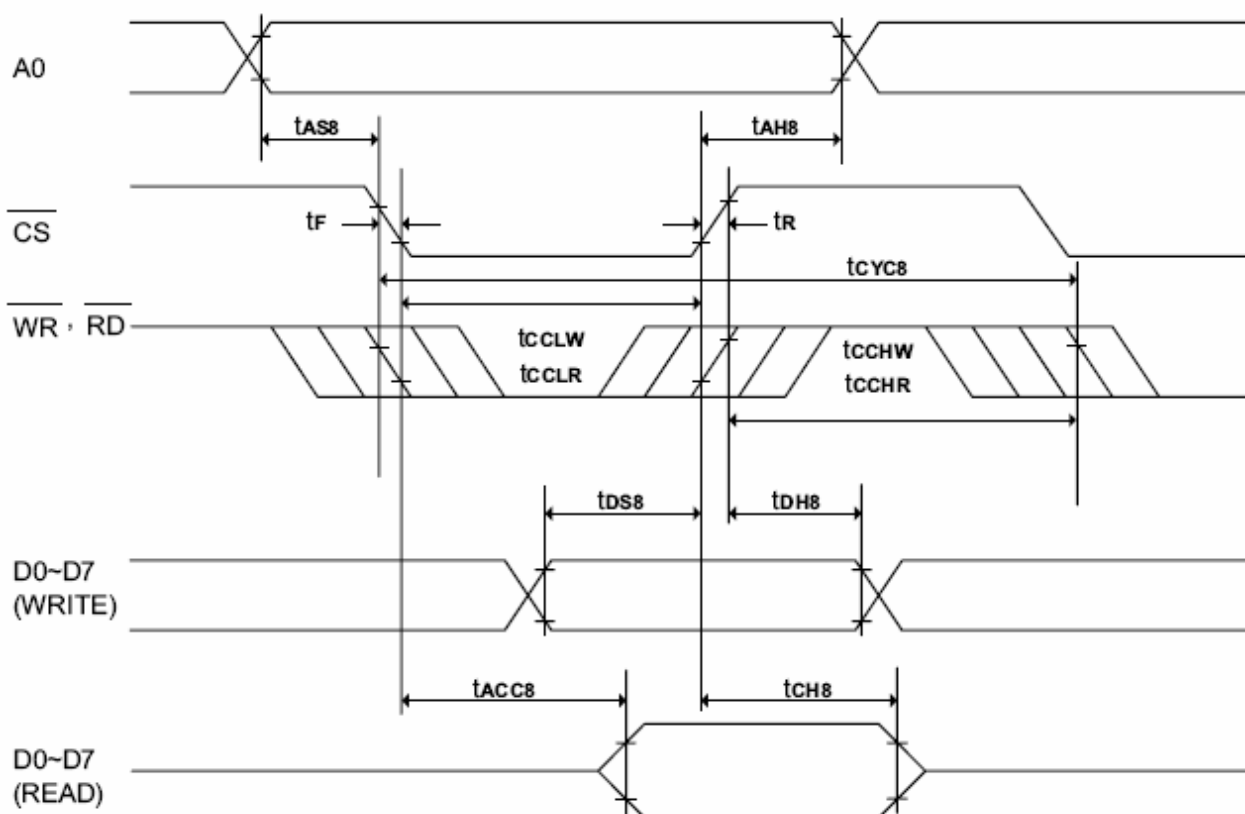
1:6800 Series MPU Parallel Interface

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
t _{CYC6}	System cycle time	300	-	-	ns	
t _{AS6}	Address setup time	0	-	-	ns	
t _{AH6}	Address hold time	0	-	-	ns	
t _{DS6}	Data setup time	40	-	-	ns	
t _{DH6}	Data hold time	15	-	-	ns	
t _{OH6}	Output disable time	10	-	70	ns	C _L =100pF
t _{ACC6}	Access time	-	-	140	ns	C _L =100pF
t _{EWHW}	Enable H pulse width (Write)	100	-	-	ns	
t _{EWHR}	Enable H pulse width (Read)	120	-	-	ns	
t _{EWLW}	Enable L pulse width (Write)	100	-	-	ns	
t _{EWLR}	Enable L pulse width (Read)	100	-	-	ns	
t _R	Rise time	-	-	15	ns	
t _F	Fall time	-	-	15	ns	



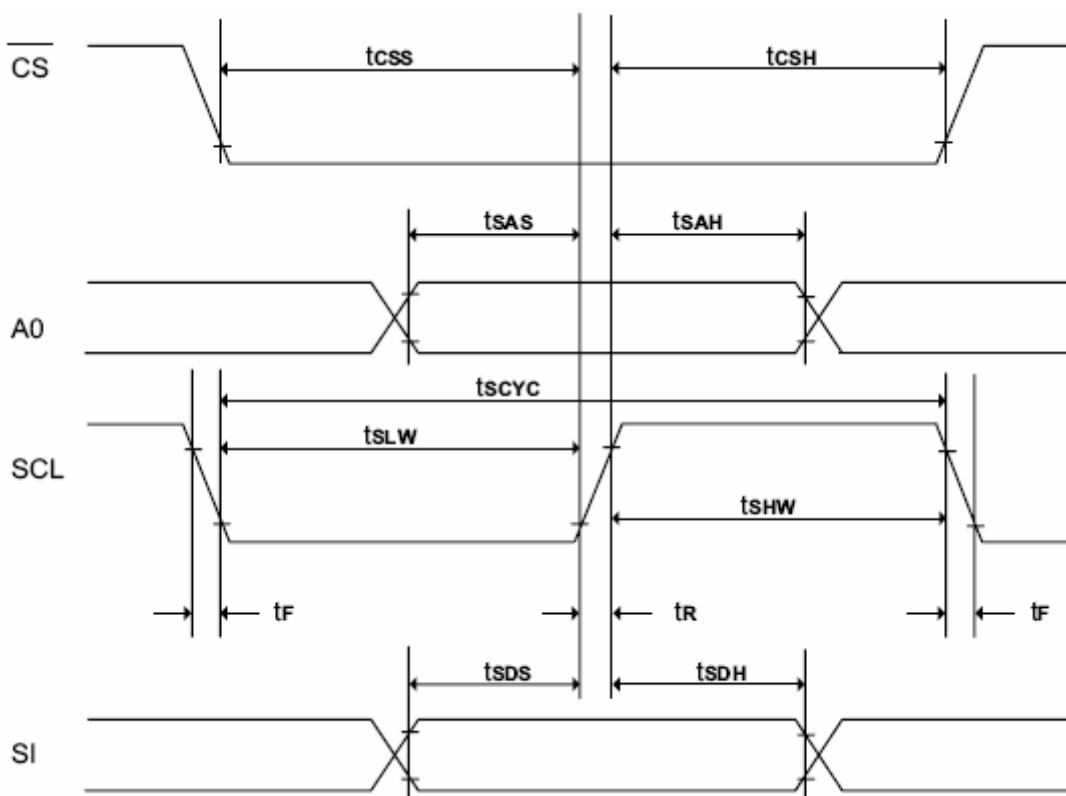
2:8080 Series MPU Parallel Interface

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
t _{CYC8}	System cycle time	300	-	-	ns	
t _{AS8}	Address setup time	0	-	-	ns	
t _{AH8}	Address hold time	0	-	-	ns	
t _{DS8}	Data setup time	40	-	-	ns	
t _{DH8}	Data hold time	15	-	-	ns	
t _{CH8}	Output disable time	10	-	70	ns	C _L =100pF
t _{ACC8}	$\overline{RD}$ access time	-	-	140	ns	C _L =100pF
t _{CCLW}	Control L pulse width (WR)	100	-	-	ns	
t _{CCLR}	Control L pulse width (RD)	120	-	-	ns	
t _{CCHW}	Control H pulse width (WR)	100	-	-	ns	
t _{CCHR}	Control H pulse width (RD)	100	-	-	ns	
t _R	Rise time	-	-	15	ns	
t _F	Fall time	-	-	15	ns	

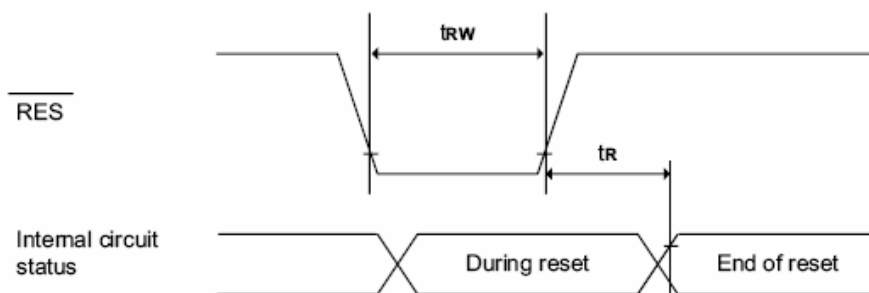


3:Serial Interface

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
TSCYC	Serial clock cycle	250	-	-	ns	
TSAS	Address setup time	150	-	-	ns	
TAH	Address hold time	150	-	-	ns	
TSDS	Data setup time	100	-	-	ns	
TDH	Data hold time	100	-	-	ns	
TCSS	$\overline{CS}$ setup time	120	-	-	ns	
TCSH	$\overline{CS}$ hold time	60	-	-	ns	
TSHW	Serial clock H pulse width	100	-	-	ns	
TS LW	Serial clock L pulse width	100	-	-	ns	
t _R	Rise time	-	-	15	ns	
t _F	Fall time	-	-	15	ns	



4 Reset Timing



(VDD1=2.4 – 3.5V, TA =25°C)

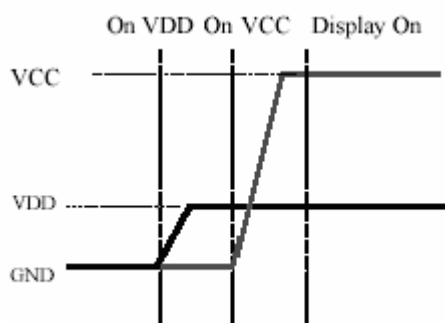
Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
TR	Reset time	-	-	1.0	μs	
TRW	Reset low pulse width	5.0	-	-	μs	

■ TIMING OF POWER SUPPLY

To Protect OLED panel and extend the panel life time, the driver IC power up/down routine should include a delay period between high voltage and low voltage power sources turn on/off.

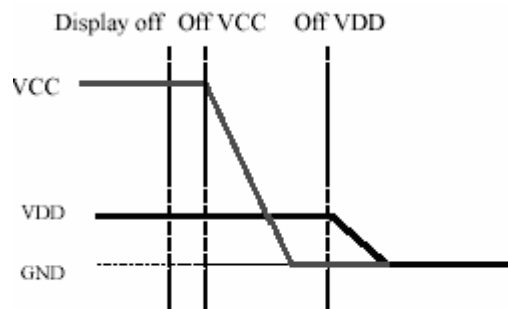
Power up Sequence:

1. Power up VDD
2. Delay 100ms
3. Power up VCC(High Voltage)
4. Delay 100ms
5. Send Display ON command



Power down Sequence:

1. Send Display OFF command
2. Power down VCC(High Voltage)
3. Delay 100ms
4. Power down VDD



■ ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

Items		Symbol	Min.	Typ.	Max.	Unit	Remark
Luminance		L	40	50	-	cd /m ²	30% pixels ON
Power Consumption		P	-	42	52	mW	30% pixels ON
Frame Frequency		Fr	-	100	-	Hz	-
Color Coordinate		CIE x	0.62	0.66	0.70	CIE1931	RED
		CIE y	0.29	0.33	0.37		
Response Time	Rise	Tr	-	-	0.02	ms	-
	Decay	Td	-	-	0.02	ms	-
Contrast Ratio		Cr	10000:1	-	-	-	Darkroom
Viewing Angle		$\triangle \theta$	170	-	-	Degree	-
Operating Life Time*		Top	75,000	-	-	Hours	L ₀ =50cd/m ²

Note:

1、 50 [cd/m²], Vdd=3.0[V], I/O Vdd=3.0[V], Vcc=12.0[V], contrast setting=0x28H

2、 **Contrast ratio** is defined as follows:

$$\text{Contrast ratio} = \frac{\text{Photo - detector output with OLED being "white"}}{\text{Photo - detector output with OLED being "black"}}$$

3、 **Life Time** is defined when the Luminance has decayed to less than 50% of the initial Luminance(L₀) specification. (30% pixels scrolling display ON)
(The initial value should be closed to the typical value after adjusting.)

■ INTERFACE PIN CONNECTIONS

No	Symbol	Description
1	NC	No connection
2	VCC	High voltage supply for OLED panel
3	VCOMH	High level voltage output of COM signal
4	IREF	Current reference pin
5	D7	Data bus
6	D6	Data bus
7	D5	Data bus
8	D4	Data bus
9	D3	Data bus
10	D2	Data bus
11	D1	Data bus
12	D0	Data bus
13	/RD	MCU interface input pin
14	/WR	MCU interface input pin
15	A0	Data/Command data control pin
16	/RES	MCU control or RC for low pulse start up
17	/CS	The chip select pin. Low is enabled
18	NC	No connection
19	P/S	It is a switch to select the input data to parallel or series
20	C86	It is the MPU interface switched pad(L:6800; H:8080)
21	VDD1	Logic voltage supply for IC
22	NC	No connection
23	NC	No connection
24	NC	No connection
25	VBREF	Internal voltage reference pad for the booster circuit
26	SENSE	A source current pad of the external NMOS of the booster circuit
27	FB	A feedback voltage for the booster circuit
28	VDD2	Voltage supply for the booster circuit
29	SW	Driving the gate of the external NMOS of the booster circuit
30	VSS	Ground
31	NC	No connection

COMMAND TABLE

◆Write Command Table(D/C=0,R/W=0,E=1)

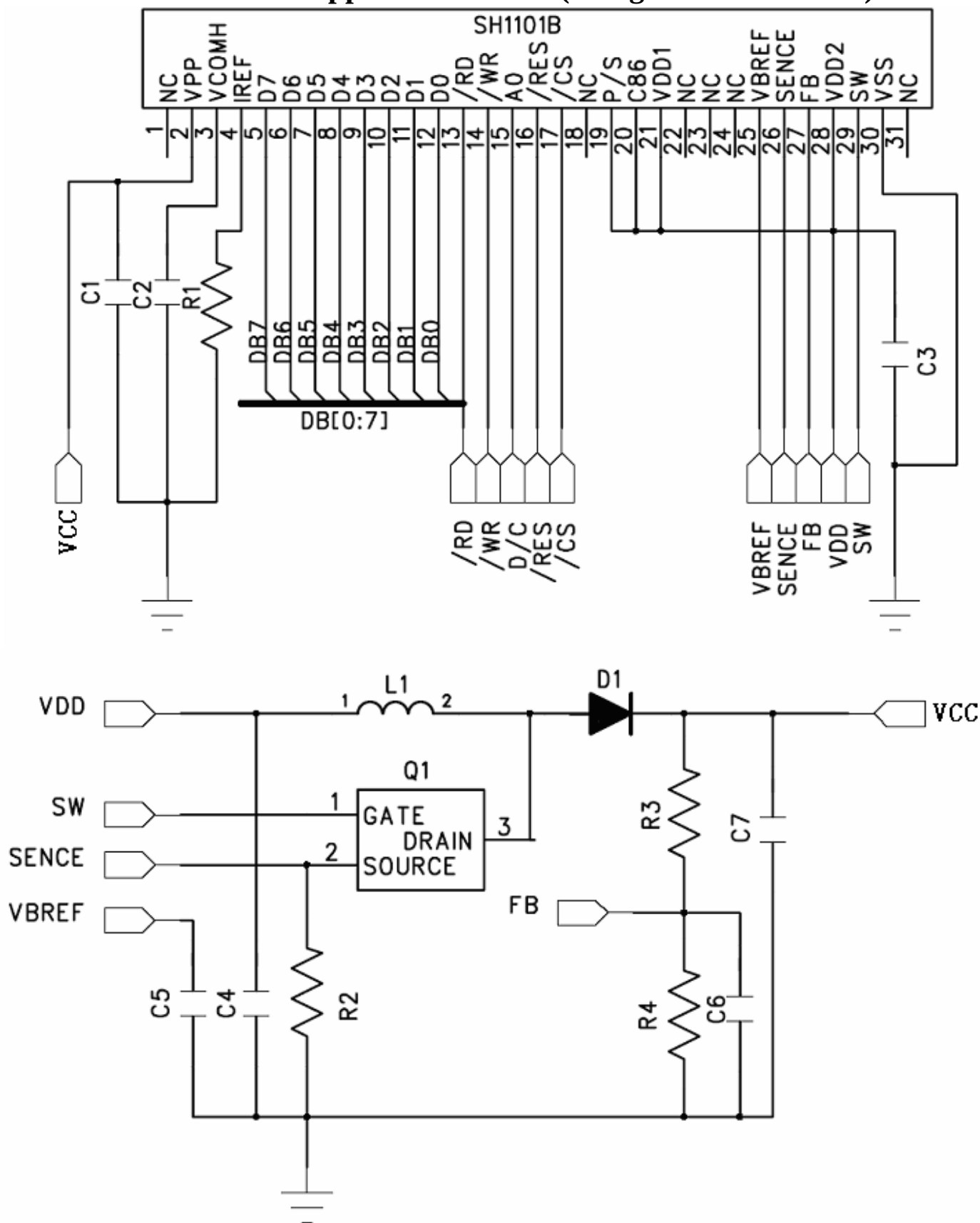
Command	Code											Function
	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	
1. Set Column Address 4 lower bits	0	1	0	0	0	0	0	Lower column address				Sets 4 lower bits of column address of display RAM in register. (POR=00H)
2. Set column Address 4 higher bits	0	1	0	0	0	0	1	Higher column address				Sets 4 higher bits of column address of display RAM in register. (POR=10H)
3. Additional Horizontal Scroll Setup Mode Set Start Column Position Set End Column Position Set	0	1	0	0	0	1	0	0	1	0	0	This command consists of 3 consecutive bytes to set up the horizontal scroll parameters. It determined the scrolling start column position(POR=00H) and end column position(POR=83H).
	0	1	0	Start Column Position								
	0	1	0	End Column Position								
4. Horizontal Scroll Setup Mode Set Number of Horizontal Scroll Per Step Set Start Page Address Set Time Interval Set End Page Address Set	0	1	0	0	0	1	0	0	1	1	0	This command consists of 5 consecutive bytes to set up the horizontal scroll parameters. It determined the number of horizontal scroll per step(POR=00H) , scrolling start page (POR=00H), time interval (POR=00H)and end page(POR=00H).
	0	1	0	*	*	*	*	*	Number of Horizontal Scroll per step			
	0	1	0	*	*	*	*	*	Start Page Address			
	0	1	0	*	*	*	*	*	*	Time Interval		
	0	1	0	*	*	*	*	*	End Page Address			
5. Set Deactivate / Activate Horizontal Scroll	0	1	0	0	0	1	0	1	1	1	D	Stop(0) or Start(1) motion of horizontal scrolling. (POR=2EH)
6. Set Display Start Line	0	1	0	0	1	Line address						Specifies RAM display line for COM0. (POR=40H)
7. The Contrast Control Mode Set Contrast Data Register Set	0	1	0	1	0	0	0	0	0	0	1	This command is to set Contrast Setting of the display. The chip has 256 contrast steps from 00 to FF. (POR=80H)
	0	1	0	Contrast Data								
8. Set Segment Re-map (ADC)	0	1	0	1	0	1	0	0	0	0	ADC	The right(0) or left(1) rotation. (POR=A0H)
9. Set Entire Display OFF/ON	0	1	0	1	0	1	0	0	1	0	D	Selects normal display (0) or Entire Display ON (1). (POR=A4H)
10. Set Normal/ Reverse Display	0	1	0	1	0	1	0	0	1	1	D	Normal indication(0) when low, but reverse indication(1) when high. (POR=A6H)
11. Multiplex Ration Mode Set Multiplex Ration Data Set	0	1	0	1	0	1	0	1	0	0	0	This command switches default 63 multiplex mode to any multiplex ratio from 1 to 64. (POR=3FH)
	0	1	0	*	*	Multiplex Ratio						

Command	Code											Function
	A0	$\overline{RD}$	$\overline{WR}$	D7	D6	D5	D4	D3	D2	D1	D0	
12. DC-DC Control Mode Set	0	1	0	1	0	1	0	1	1	0	1	This command is to control the DC-DC voltage DC-DC will be turned on when display on converter(1) or DC-DC OFF (0).(POR=8BH)
DC-DC ON/OFF Mode Set	0	1	0	1	0	0	0	1	0	1	D	
13. Display OFF/ON	0	1	0	1	0	1	0	1	1	1	D	Turns on OLED panel(1) or turns off(0) .(POR=AEH)
14. Set Page Address	0	1	0	1	0	1	1	Page Address				Specifies page address to load display RAM data to page address register.(POR=B0H)
15. Set Common Output Scan Direction	0	1	0	1	1	0	0	D	*	*	*	Scan from COM0 to COM[N -1](0) or Scan from COM[N -1] to COM0 (1). (POR=C0H)
16. Display Offset Mode Set	0	1	0	1	1	0	1	0	0	1	1	This is a double byte command which specifies the mapping of display start line to one of COM0-63. (POR=00H)
Display Offset Data Set	0	1	0	*	*	COMx						
17. Set Display Divide Ratio / Oscillator Frequency Mode Set	0	1	0	1	1	0	1	0	1	0	1	This command is used to set the frequency of the internal display clocks. (POR=50H)
Divide Ratio / Oscillator Frequency Data Set	0	1	0	Oscillator Frequency				Divide Ratio				
18. Dis-charge / Pre-charge Period Mode Set	0	1	0	1	1	0	1	1	0	0	1	This command is used to set the duration of the dis-charge and pre-charge period. (POR=22H)
Dis-charge /Pre-charge Period Data Set	0	1	0	Dis-charge Period				Pre-charge Period				
19. Common Pads Hardware Configuration Mode Set	0	1	0	1	1	0	1	1	0	1	0	This command is to set the common signals pad configuration. (POR=12H)
Sequential / Alternative Mode Set	0	1	0	0	0	0	D	0	0	1	0	
20. VCOM Deselect Level Mode Set	0	1	0	1	1	0	1	1	0	1	1	This command is to set the common pad output voltage level at deselect stage. (POR=35H)
VCOM Deselect Level Data Set	0	1	0	VCOM($\beta \times V_{REF}$)								
21. Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	Read-Modify-Write start.
22. End	0	1	0	1	1	1	0	1	1	1	0	Read-Modify-Write end.
23. NOP	0	1	0	1	1	1	0	0	0	1	1	Non-Operation Command

Command	Code											Function
	A0	$\overline{RD}$	$\overline{WR}$	D7	D6	D5	D4	D3	D2	D1	D0	
24. Write Display Data	1	1	0	Write RAM data								
25. Read Status	0	0	1	BUSY	ON/OFF	*	*	*	0	0	0	
26. Read Display Data	1	0	1	Read RAM data								

■ SCHEMATIC EXAMPLE

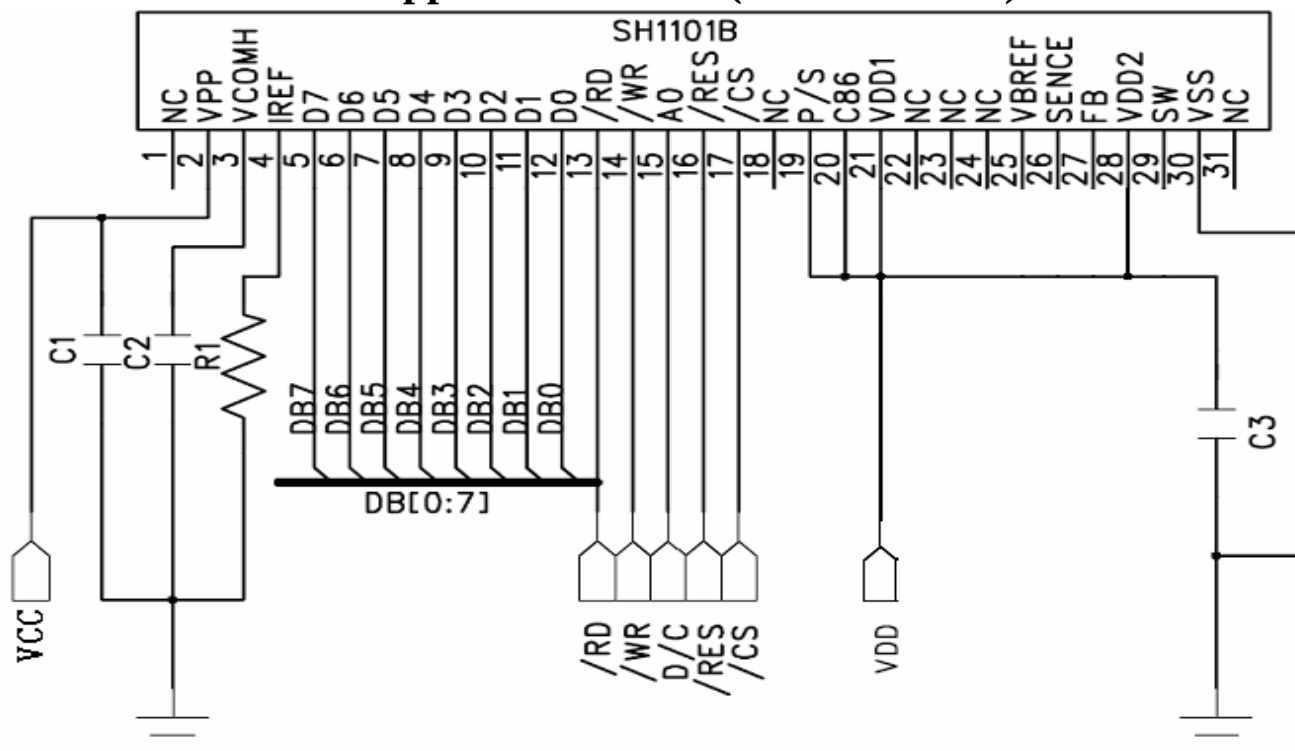
◆ 8080 Series Interface Application Circuit(Using Internal DC-DC):



The Component List Of Using Internal DC-DC

Symbol	Value	Remark
L1	10uH	LQH3C100K24
D1	SCHOTTKY DIODE	MBR0520
Q1	MOSFET	N-FET WITH LOW $R_{DS(ON)}$ AND LOW V_{TH} (MGSF1N02LT1)
R1	910K ohm	1%,1/8W
R2	0.12 ohm or 0ohm	1%,1/2W
R3	910K ohm	1%,1/8W
R4	100K ohm	1%,1/8W
C1	4.7uF	CERAMIC/16V
C2	0.01uF	CERAMIC/16V
C3	1.0uF	CERAMIC/16V
C4	1-10uF	CERAMIC/16V
C5	1uF	CERAMIC/16V
C6	1000pF	CERAMIC/16V
C7	6.8uF	LOWER ESR/25V

◆8080 Series Interface Application Circuit(External VCC):



NOTE:

1. R1,C1,C2,C3 are reference to the front chart.
- 2.The V_{CC} should connect a external voltage with 12V.
- 3.VBREF、SENCE、FB and SW pin should be open.

■ CAUTIONS IN USE OF OLED MODULE

◆ Precautions For Handling OLED Module:

1. OLED module consists of glass and polarizer. Pay attention to the following items when handling:
 - i. Avoid drop from high, avoid excessive impact and pressure.
 - ii. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead.
 - iii. If the surface becomes dirty, breathe on the surface and gently wipe it off with a soft dry cloth. If it is terrible dirty, moisten the soft cloth with Isopropyl alcohol or Ethyl alcohol. Other solvents may damage the polarizer. Especially water, Ketone and Aromatic solvents.
 - iv. Wipe off saliva or water drops immediately, contact the polarizer with water over a long period of time may cause deformation.
 - v. Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peeling-off may occur with high temperature and high humidity.
 - vi. Condensation on the surface and the terminals due to cold or anything will damage, stain or dirty the polarizer, so make it clean as the way of iii.
2. Do not attempt to disassemble or process the OLED Module.
3. Make sure the TCP or the FPC of the Module is free of twisting, warping and distortion, do not pull or bend them forcefully, especially the soldering pins. On the other side, the SLIT part of the TCP is made to bend in the necessary case.
4. When assembling the module into other equipment, give the glass enough space to avoid excessive pressure on the glass, especially the glass cover which is much more fragile.
5. Be sure to keep the air pressure under 120 kPa, otherwise the glass cover is to be cracked.
6. Be careful to prevent damage by static electricity:
 - i. Be sure to ground the body when handling the OLED Modules.
 - ii. All machines and tools required for assembling, such as soldering irons, must be properly grounded.
 - iii. Do not assemble and do no other work under dry conditions to reduce the amount of static electricity generated. A relative humidity of 50%-60% is recommended.
 - iv. Peel off the protective film slowly to avoid the amount of static electricity generated.
 - v. Avoid to touch the circuit, the soldering pins and the IC on the Module by the body.
 - vi. Be sure to use anti-static package.
7. Contamination on terminals can cause an electrochemical reaction and corrode the terminal circuit, so make it clean anytime.
8. All terminals should be open, do not attach any conductor or semiconductor on the terminals.
9. When the logic circuit power is off, do not apply the input signals.
10. Power on sequence: Vdd → Vcc, and power off sequence: Vcc → Vdd.
11. Be sure to keep temperature, humidity and voltage within the ranges of the spec, otherwise shorten Module' s life time, even make it damaged.
12. Be sure to drive the OLED Module following the Application Note, otherwise something wrong may be seen.

13. When displaying images, keep them rolling, and avoid one fixed image displaying more than 30 seconds, otherwise the residue image is to be seen. This is the speciality of OLED.

◆ Precautions For Soldering OLED Module:

1. Soldering temperature : $260^{\circ}\text{C} \pm 10^{\circ}\text{C}$.
2. Soldering time : 3-4 sec.
3. Repeating time : no more than 3 times.
4. If soldering flux is used, be sure to remove any remaining flux after finishing soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended to protect the surface with a cover during soldering to prevent any damage due to flux spatters.

◆ Precautions For Storing OLED Module:

1. Be sure to store the OLED Module in the vacuum bag with dessicant.
2. If the Module can not be used up in 1 month after the bag being opened, make sure to seal the Module in the vacuum bag with dessicant again.
3. Store the Module in a dark place, do not expose to sunlight or fluorescent light.
4. The polarizer surface should not touch any other objects. It is recommended to store the Module in the shipping container.
5. It is recommended to keep the temperature between 0°C and 30°C , the relative humidity not over 60%.

◆ Limited Warranty

Unless agreed between Multi-Inno and customer, Multi-Inno will replace or repair any of its OLED modules which are found to be functional defect when inspected in accordance with Multi-Inno OLED acceptance standards (copies available upon request) for a period of 6 months from date of shipment. Cosmetic/visual defects must be returned to Multi-Inno within 90 days of shipment. Confirmation of such date should be based on freight documents. The warranty liability of Multi-Inno limited to repair and/or replacement on the terms above. Multi-Inno will not be responsible for any subsequent or consequential events.

◆ Return OLED Module Under Warranty:

1. No warranty in the case that the precautions are disregarded.
2. Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects.