Display Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 240128E SBH-PW-N

Product Specification **Ver.: 0**

30/Oct./2009

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
0	Oct-30-2009	First Issue	MH

CONTENTS

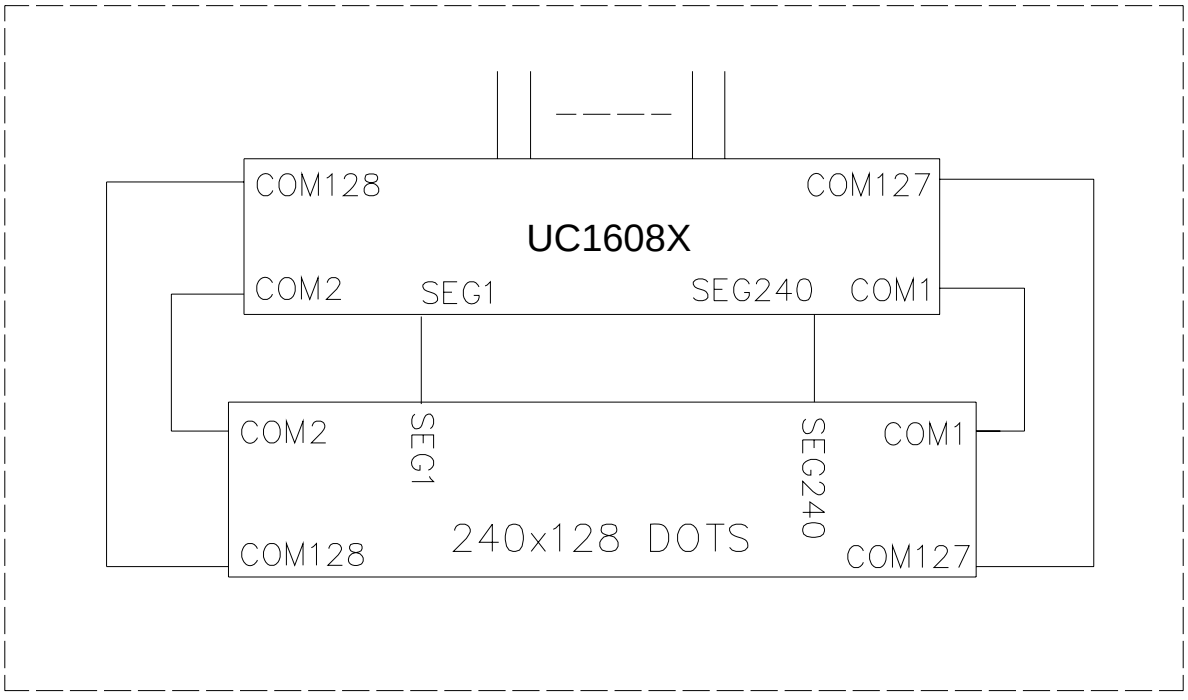
1. FUNCTIONS & FEATURES

Display Format	: 240 x 128 Dots
LCD Mode	: STN-BLUE / Negative Mode / Transmissive
Viewing Direction	: 6 o'clock
Driving Scheme	: 1/128 Duty cycle, 1/12 Bias
Power Supply Voltage (V_{DD})	: 3.3 Volt (typ.)
LCD Driving Voltage (V_{LCD})	: 14.5 Volt (Typ. Reference Voltage)
Operation Temperature	: -20°C to +70°C
Storage Temperature	: -30°C to +80°C
Backlight	: LED, White, Lightguide

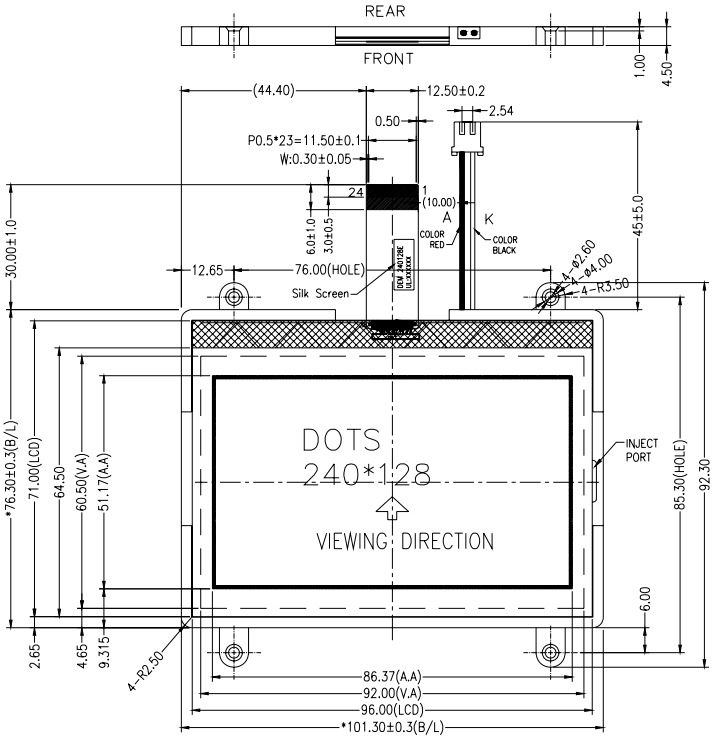
2. MECHANICAL SPECIFICATIONS

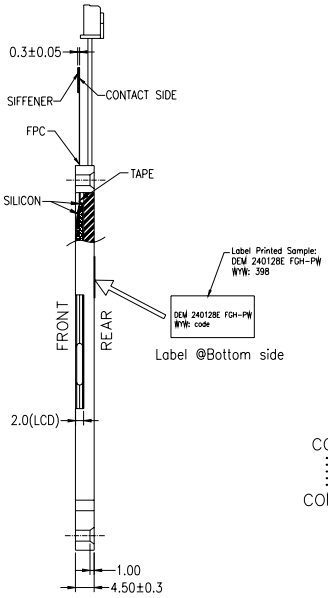
Module Size	: 101.30 x 92.30 x 4.50 mm
Viewing Area	: 92.00 x 60.50 mm
Dot Pitch	: 0.36 x 0.40 mm
Dot Size	: 0.33 x 0.37 mm

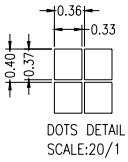
3. BLOCK DIAGRAM

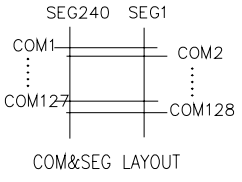


4. DIMENSIONAL OUTLINE









PIN	1	2	3	4	5	6	7	8	9	10	11	12	13
CONNECTION	NC	VB1-	VB1+	VB0-	VB0+	VLCD	VBIAS	VSS	VDD	DB7	DB6	DB5	DB4
PIN	14	15	16	17	18	19	20	21	22	23	24		
CONNECTION	DB3	DB2	DB1	DB0	RD(WR1)	WR	CD	RST	CS	BM0	BM1		

Specification:

1). Driving: Duty: 1/128, Bias: 1/12, VLCD: 14.5V, VDD: 3.3V
2). Viewing Direction: 6 O'clock
3). Display mode: STN-BLUE/ Negative/ Transmissive
4). Operating temp.: -20°C~+70°C
Storage temp.: -30°C~+80°C
5). IC: UC1608x (or compatible)
6). Backlight: EDGE WHITE (6 Dies ,Vf=3.5V ,If=90mA typ.)
7). Dimensions with mark "*" are important,
with mark "()" are referenced
8). All the raw materials are RoHS compliant

5. LCD DRIVING VOLTAGE GENERATOR AND BIAS REFERENCE CIRCUIT

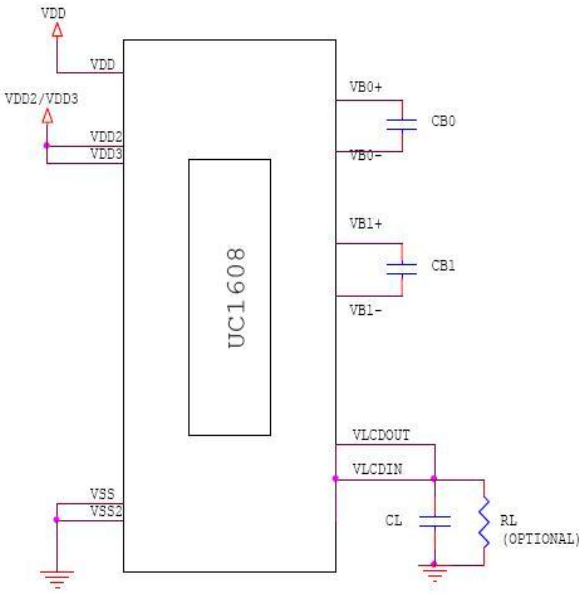


FIGURE 1: Reference circuit using internal Hi-V generator circuit

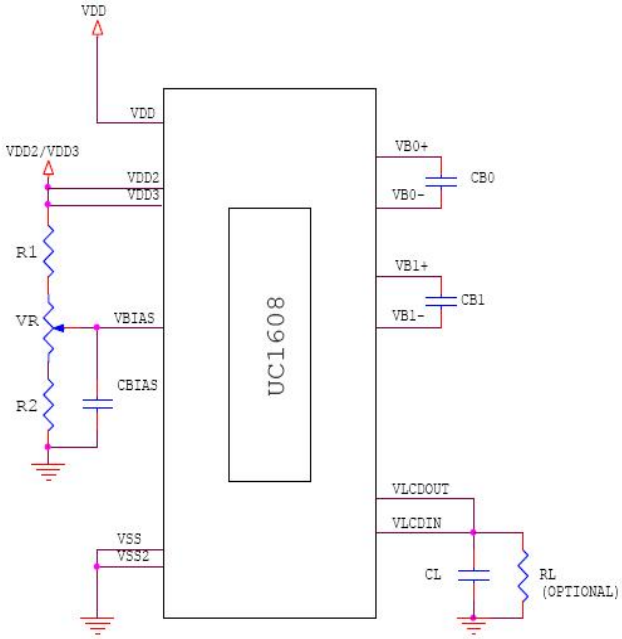


Figure 2: Reference circuit using external Bias source

NOTE: Recommended component values.
CB: 150~250xLCD load capacitance or 4.7 uF (2V). whichever is higher.
CL: 50Nf~0.1uF(25V)is appropriate for most applications..
Rl: 10MΩ Acts as a draining circuit when the power is abnormally shut down.
VR: 1MΩ.
R1,R2: See instructions below.
CBIAS: 10nF~0.1Nf.

- The above component values are for reference only. Please optimize the values for individual requirements of each specific application.
- To ensure consistency of LCM contrast. VLCD fine tuning is highly recommended.

  Since the value of R1/R2 depends strongly on the GN,PM,BR settings, and vary slightly depends on the value of VDD2,each LCM design will need to be optimized individually.

  The following is the recommended procedures for selecting R1, R2 and VR values.

  Step 1: adjust LCM for best contrast which CBIAS. But without R1, R2, VR.
  Step 2: measure VBIAS voltage.
  Step 3: select VR and R2 (recommend to start with VR=1MΩ, R2=200K)
  Step 4: calculate R1 by: R1 = R2 x (VDD2/VBIAS-1)
  Step 5: install R1, R2, VR . The "neutral position" of VR is at VBIAS/VDD2 .
  Step 6: Test the fine tuning range by adjusting VR over the full range.
  Step7 : if adjustment fang is too narrow, reduce R2,… and vise versa.
  Step 8: repeat from Sept 4.

6. PIN DESCRIPTION

<table>
<tr><th>No.</th><th>Symbol</th><th>Function</th></tr>
<tr><td>1</td><td>NC</td><td>No connection</td></tr>
<tr><td>2~5</td><td>VB1-,VB1+
VB0-,VB0+</td><td>LCD Bias voltage. These are the voltage source to provide SEG driving currents. These voltages are generated internally. Connect capacitors of CBX between VBX- and VBX+</td></tr>
<tr><td>6</td><td>VLCD</td><td>Main LCD power supply, capacitor CL should be connected between VLCD and VSS.</td></tr>
<tr><td>7</td><td>VBIAS</td><td>This is the reference voltage to generate the actual SEG driving voltage.</td></tr>
<tr><td>8</td><td>VSS</td><td>Power GND.</td></tr>
<tr><td>9</td><td>VDD</td><td>Power Supply (+3.3V).</td></tr>
<tr><td>10~17</td><td>DB7~DB0</td><td>Bi-directional bus for both serial and parallel host interfaces.
<table>
<tr><td></td><td>BM=1X</td><td>BM=0X</td><td>BM=01</td><td>BM=00</td></tr>
<tr><td>D0</td><td>D0</td><td>D0/D4</td><td>SCK</td><td>SCK</td></tr>
<tr><td>D1</td><td>D1</td><td>D1/D5</td><td>-</td><td>-</td></tr>
<tr><td>D2</td><td>D2</td><td>D2/D6</td><td>-</td><td>-</td></tr>
<tr><td>D3</td><td>D3</td><td>D3/D7</td><td>SDA</td><td>SDA</td></tr>
<tr><td>D4</td><td>D4</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>D5</td><td>D5</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>D6</td><td>D6</td><td>-</td><td>S9</td><td>S8/s8uc</td></tr>
<tr><td>D7</td><td>D7</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="5">Connect the unused pins to VDD OR VSS</td></tr>
</table></td></tr>
<tr><td>18</td><td>RD(WR1)</td><td rowspan="2">These terminals controls the read/write operation of host interface.
<table>
<tr><td></td><td>8080</td><td>6800</td><td>Serial</td></tr>
<tr><td>WR</td><td>/RW</td><td>R/W</td><td>0</td></tr>
<tr><td>RD(WR1)</td><td>/RD</td><td>EN</td><td>0</td></tr>
</table></td></tr>
<tr><td>19</td><td>WR</td></tr>
<tr><td>20</td><td>CD</td><td>Select control data or display data for read/write operation. In S9 mode, CD pin is no used, connect CD to VSS when not use, “L”: control data. “H”: display data</td></tr>
<tr><td>21</td><td>RST</td><td>Reset signal.</td></tr>
<tr><td>22</td><td>CS</td><td>Chip select signal</td></tr>
<tr><td>23</td><td>BM0</td><td rowspan="2">The interface bus mode is determined by MB[1:0] and D[7:6] by the following relationship.
<table>
<tr><td>BM[1:0]</td><td>D[7:6]</td><td>MODE</td></tr>
<tr><td>11</td><td>Data</td><td>6800/8bit</td></tr>
<tr><td>10</td><td>Data</td><td>8080/8bit</td></tr>
<tr><td>01</td><td>0x</td><td>6800/4bit</td></tr>
<tr><td>00</td><td>0x</td><td>8080/4bit</td></tr>
<tr><td>01</td><td>10</td><td>3-wire SPI w/9-bit token.(s9:conventional)</td></tr>
<tr><td>00</td><td>10</td><td>4-wire SPI w/8-bit token.(s8:conventional)</td></tr>
<tr><td>00</td><td>11</td><td>3-or 4-wire SPI w/8-bit token.(s8ul)</td></tr>
</table></td></tr>
<tr><td>24</td><td>BM1</td></tr>
</table>

7. MAXIMUM ABSOUTE LIMIT

(Voltage Reference to VSS)(for IC)

Symbol	Parameter	Min.	Max.	Unit
V_{DD}	Logic Supply voltage	-0.3	+4.0	V
V_{DD2}	LCD Generator Supply voltage	-0.3	+4.0	V
V_{DD3}	Analog Circuit Supply voltage	-0.3	+4.0	V
$V_{DD2/3}$-V_{DD}	Voltage difference between V_{DD} and $V_{DD2/3}$	--	1.6	V
V_{LCD}	LCD Generated voltage (-30°C ~ +80°C)	-0.3	+17.0	V
V_{IN}	Any input voltage	-0.4	V_{DD} + 0.5	V
T_{OPR}	Operating temperature range	-30	+85	°C
T_{STR}	Storage temperature	-55	+125	°C

Note:

1. V_{DD} is based on V_{SS} = 0V
2. Stress values listed above may cause permanent damages to the device.

8. ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply for digital circuit		2.7	2.8~3.3	3.6	V
$V_{DD2/3}$	Supply for bias & pump		2.7	2.8~3.3	3.6	V
V_{LCD}	Charge pump output	$V_{DD2/3} \geq$ 2.7V, 25°C		12.5	16	V
V_D	LCD data voltage	$V_{DD2/3} \geq$ 2.7V, 25°C			1.53	V
V_{IL}	Input logic LOW				$0.2V_{DD}$	V
V_{IH}	Input logic HIGH		$0.8V_{DD}$			V
V_{OL}	Output logic LOW				$0.2V_{DD}$	V
V_{OH}	Output logic HIGH		$0.8V_{DD}$			V
I_{IL}	Input leakage current				1.5	µA
C_{IN}	Input capacitance			5	10	PF
C_{OUT}	Output capacitance			5	10	PF
$R_{0(SEG)}$	SEG output impedance	V_{LCD} = 12.5V		1.5	3	k Ω
$R_{0(COM)}$	COM output impedance	V_{LCD} = 9		1.5	3	k Ω
f_{LINE}	Average frame rate		69	75	--	Hz

POWER CONSUMPTION

V_{DD} = 2.7V, $V_{DD2/3}$ = 2.7V, Bias Ratio (BR) = 10b, GN = 11b, PM = 000000b,
Panel Loading (PL): 26~43nF, MR = 128, Bus mode = 6800, C_L = 0.1µF, C_B = 4.7µF.
All outputs are open circuit.

Display Pattern	Conditions	Typ. (µA)	Max. (µA)
All-OFF	Bus = idle	580	870
2-pixel checker	Bus = idle	730	1095
--	Bus = idle (standby current)	--	5

9. TIMING CHARACTERISTICS

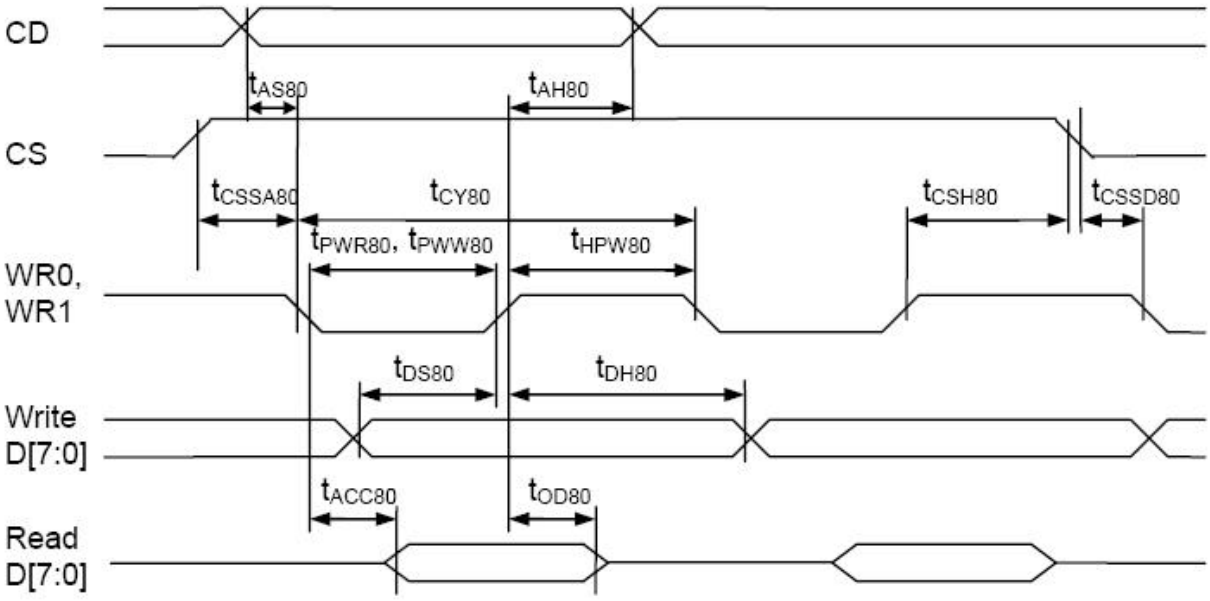


FIGURE 15: Parallel Bus Timing Characteristics (for 8080 MCU)

($2.7V \leq V_{DD} < 3.6V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS80} t_{AH80}	CD	Address setup time Address hold time		0 20	–	nS
t_{CY80}		System cycle time 8-bit bus (read) 8-bit bus (write) 4-bit bus (read) 4-bit bus (write)		 140 140 140 140	–	nS
t_{PWR80}	WR1	Pulse width 8-bit bus (read) 4-bit bus (read)		 65 65	–	nS
t_{PWW80}	WR0	Pulse width 8-bit bus (write) 4-bit bus (write)		 35 35	–	nS
t_{HPW80}	WR0, WR1	High pulse width 8-bit bus (read) (write) 4-bit bus (read) (write)		 65 35 65 35	–	nS
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 20	–	nS
t_{ACC80} t_{OD80}		Read access time Output disable time	C_L = 100pF	– 12	60 20	nS
t_{SSA80} t_{CSSD80} t_{CSH80}	CS1/CS0	Chip select setup time		10 10 20		nS

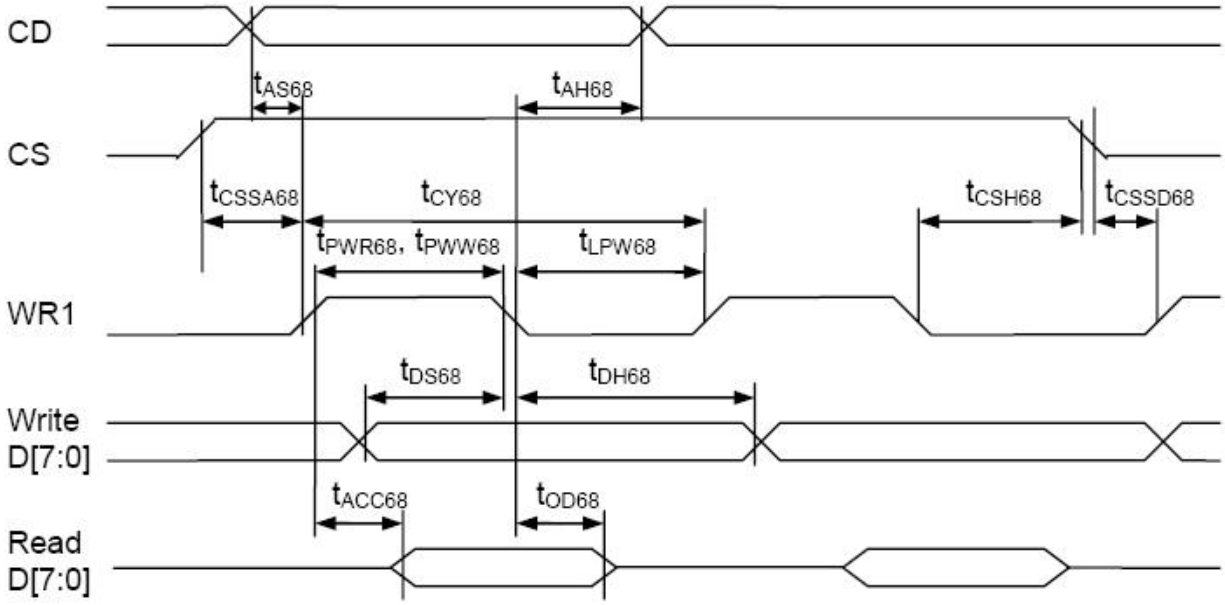


FIGURE 16: Parallel Bus Timing Characteristics (for 6800 MCU)

($2.7V \leq V_{DD} < 3.6V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS68} t_{AH68}	CD	Address setup time Address hold time		0 20	–	nS
T_{CY68}		System cycle time 8-bit bus (read) 8-bit bus (write) 4-bit bus (read) 4-bit bus (write)		 140 140 140 140	–	nS
t_{PWR68}	WR1	Pulse width 8-bit bus (read) 4-bit bus (read)		 65 65	–	nS
t_{PWW68}	WR0	Pulse width 8-bit bus (write) 4-bit bus (write)		 35 35	–	nS
t_{LPW68}	WR0, WR1	Low pulse width 8-bit bus (read) 8-bit bus (write) 4-bit bus (read) 4-bit bus (write)		 65 35 65 35	–	nS
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 20	–	nS
t_{ACC68} t_{OD68}		Read access time Output disable time	C_L = 100pF	– 12	60 20	nS
t_{CSSA68} t_{CSSD68} t_{CSH68}	CS1/CS0	Chip select setup time		10 10 20		nS

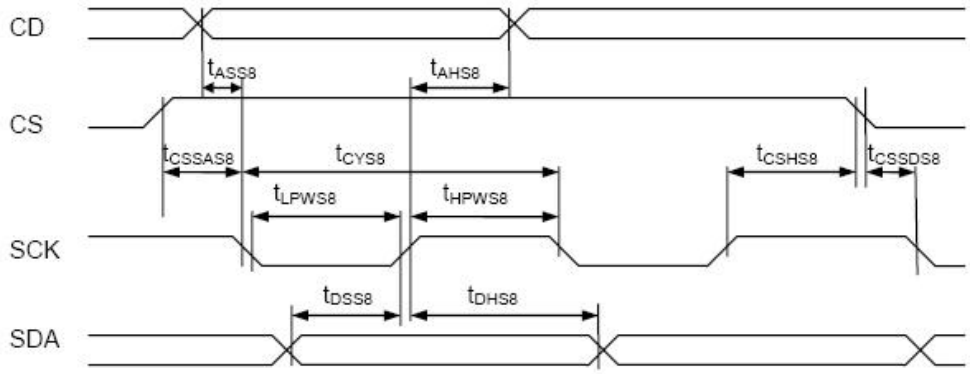


FIGURE 17: Serial Bus Timing Characteristics (for S8 / S8uc)

($2.7V \leq V_{DD} < 3.6V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{ASS8}	CD	Address setup time		0	–	nS
t_{AHS8}		Address hold time		20	–	nS
t_{CYS8}	SCK	System cycle time		140	–	nS
t_{LPWS8}		Low pulse width		65	–	nS
t_{HPWS8}		High pulse width		65	–	nS
t_{DSS8} t_{DHS8}	SDA	Data setup time Data hold time		30 20	–	nS
t_{CSSAS8} t_{CSSDS8} t_{CSHS8}	CS	Chip select setup time		10 20 10		nS

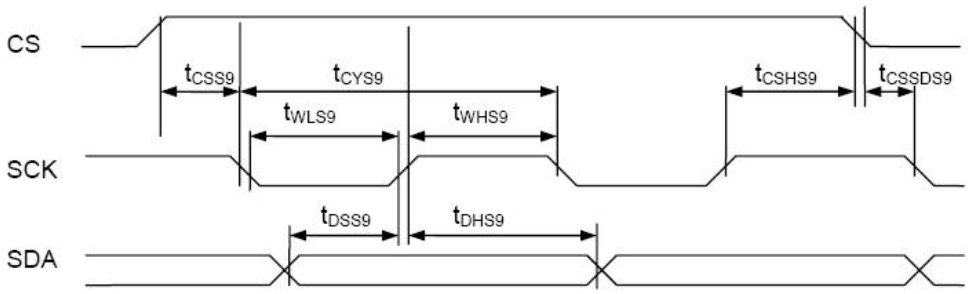


FIGURE 18: Serial Bus Timing Characteristics (for S9)

($2.7V \leq V_{DD} < 3.6V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{CYS9}	SCK	System cycle time		140	–	nS
t_{LPWS9}		Low pulse width		65	–	nS
t_{HPWS9}		High pulse width		65	–	nS
t_{DSS9} t_{DHS9}	SDA	Data setup time Data hold time		30 20	–	nS
t_{CSSAS9} t_{CSSDS9} t_{CSHS9}	CS	Chip select setup time		10 20 10		nS

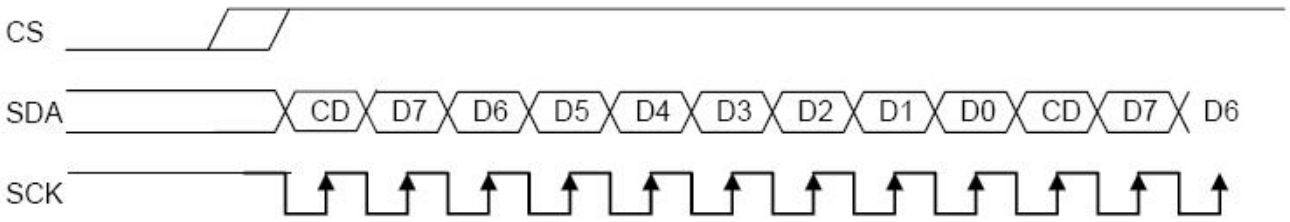
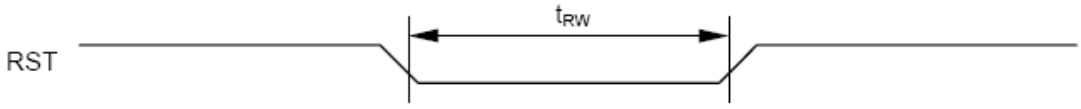


FIGURE 4.c: 3-wire Serial Interface (S9)

RESET TIMING



Reset Characteristics

(2.7V ≤ V_{DD} < 3.6V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{RW}	RST	Reset low pulse width		1000	–	nS

10. CONTROL AND DISPLAY INSTRUCTION

\# Useful Data bits
– Don't Care

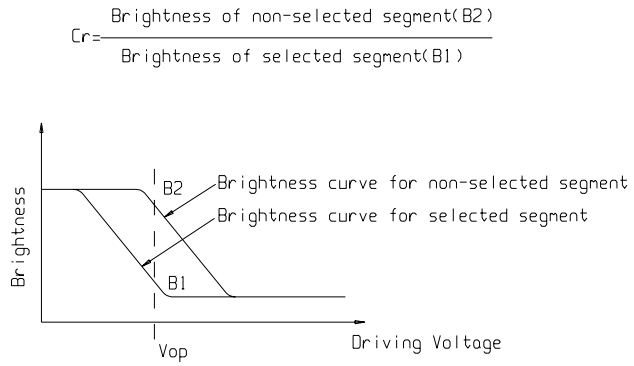
	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status	0	1	BZ	MX	DE	RS	WA	GN1	GN0	1	Get Status	N/A
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	#	#	#	#	Set CA[7:4]	0
5	Set Mux Rate and temperature compensation.	0	0	0	0	1	0	0	#	#	#	Set {MR, TC[1:0]}	MR: 1b TC: 00b
6	Set Power Control	0	0	0	0	1	0	1	#	#	#	Set PC[2:0]	101b
7	Set Adv. Program Control. (double byte command)	0	0	0	0	1	1	0	0	0	R	For UltraChip only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		
8	Set Start Line	0	0	0	1	#	#	#	#	#	#	Set SL[5:0]	0
9	Set Gain and Potentiometer (double-byte command)	0 0	0 0	1 #	0 #	0 #	0 #	0 #	0 #	0 #	1 #	Set {GN[1:0], PM[5:0]}	GN=3 PM=0
10	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
11	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0=disable
12	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0=disable
13	Set Display Enable	0	0	1	0	1	0	1	1	1	#	Set DC[2]	0=disable
14	Set Fixed Lines	0	0	1	0	0	1	#	#	#	#	Set FL[3:0]	0
15	Set Page Address	0	0	1	0	1	1	#	#	#	#	Set PA[3:0]	0
16	Set LCD Mapping Control	0	0	1	1	0	0	#	#	#	#	Set LC[3:0]	0
17	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
18	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
19	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	10b=12
20	Reset Cursor Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	N/A
21	Set Cursor Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	N/A
22	Set Test Control (double byte command)	0	0	1	1	1	0	0	1	TT		For UltraChip only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		

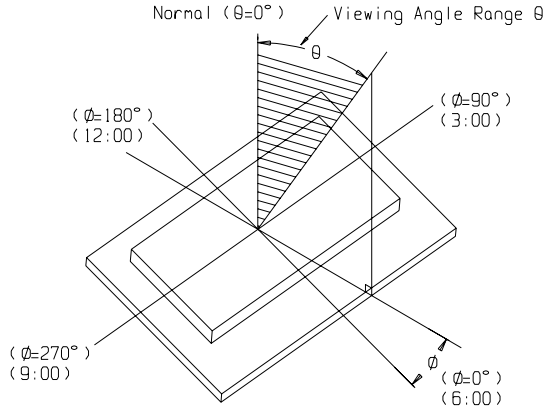
* Other than commands listed above, all other bit patterns may result in undefined behavior.

11. ELECTRO-OPTICAL CHARACTERISTICS

(V_{DD} = 3.3V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage for LCD	Vop	Ta =-20°C	14.7	15.0	15.3	V
		Ta = 25°C	14.2	14.5	14.8	
		Ta = 70°C	13.7	14.0	14.3	
Response time	Tr	Ta = 25°C	---	250	500	ms
	Tf		---	300	600	ms
Contrast	Cr	Ta = 25°C	2	4	---	---
Viewing angle range	θ	Cr≥ 2	-35	---	+35	deg
	Φ		-35	---	+40	deg





12. BACK LIGHT CHARACTERISTICS

LCD Module with Edge white LED Backlight

ELECTRICAL RATINGS. Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Curret	IF	VF=3.5V	---	90	110	mA
Reverse Current	IR	VR=0.8V	---	30	---	mA
Luminous Intensity(Without LCD)	Lv	VF=3.5V	300	380	---	cd/m2
Color coordinates	X Y	VF=3.5V	0.27 0.26	---	0.31 0.30	
Color	white					

Note:

when the temperature exceed 25°C, the approved current decrease rate for Backlight change as the temperature increase is: -0.36x6mA/°C(below 25°C, the current refer to constant, which would not change with temperature).

13. PRECAUTION FOR USING LCD/LCM

After reliability test, recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours (average) under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light. Using LCM beyond these conditions will shorten the life time.

Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting DISPLAY.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 350°C ± 10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

Limited Warranty

DISPLAY LCDs and modules are not consumer products, but may be incorporated by DISPLAY's customers into consumer products or components thereof, DISPLAY does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of DISPLAY is limited to repair or replacement on the terms set forth below. DISPLAY will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between DISPLAY and the customer, DISPLAY will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with DISPLAY general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.