

**DLC Display Co., Limited**

**德爾西顯示器有限公司**



MODEL No: DLC320160BFWG

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### Record of Revision

Date	Revision No.	Summary
2017-03-14	1.0	Rev 1.0 was issued

### 1. Scope

The DLC320160BFWG LCM unit consists of 320x160 dot-matrix LCD panel, Driver IC UC1698U on the glass and white LED.

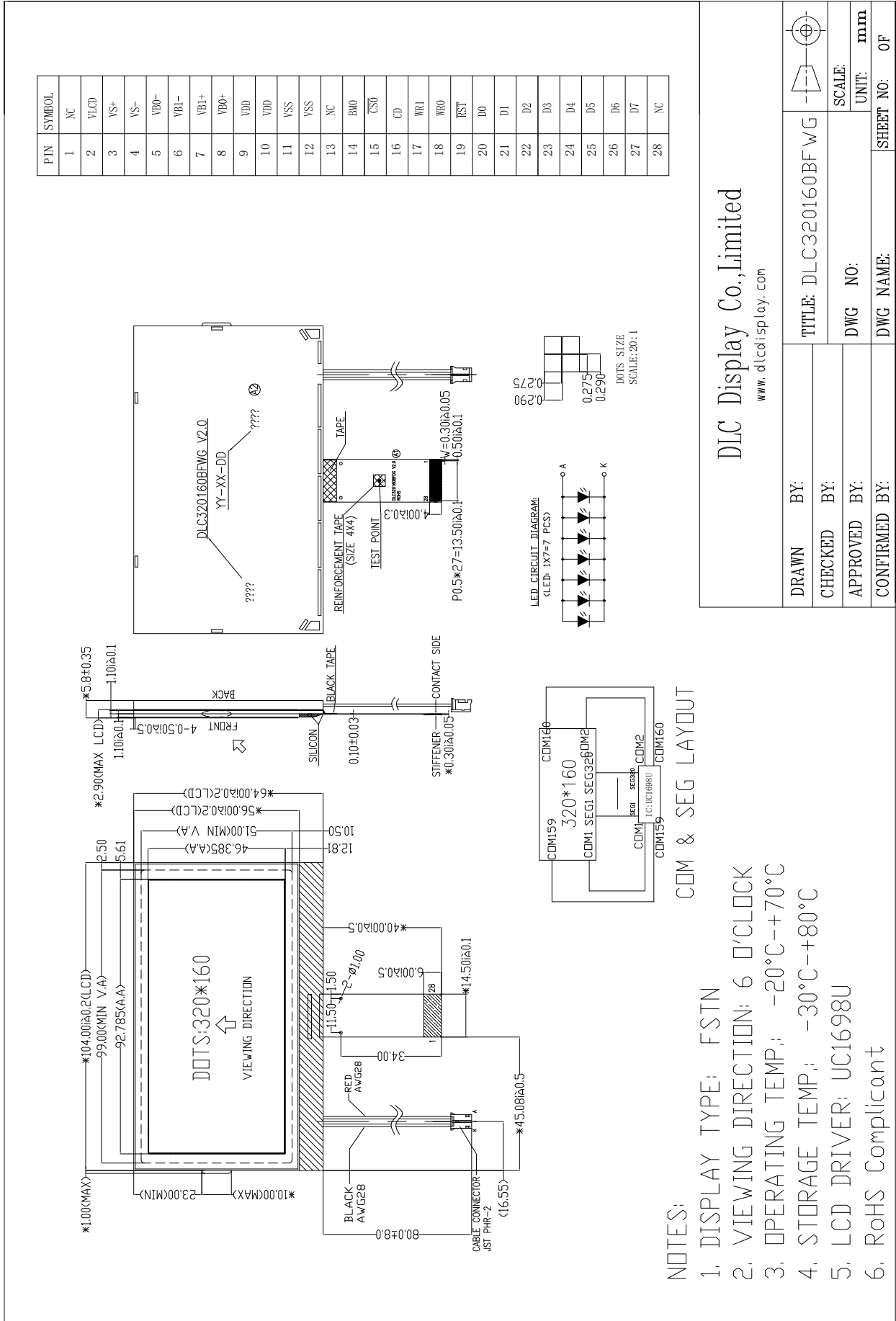
### 2. Application

Digital equipments which need display, instrumentation, remote control, electronic product.

### 3. General Information

Item	Contents	Unit
LCD Type	FSTN	
Polarizer Type	Transflective / Positive	
Viewing Direction	6:00	
Interface	8-bit parallel mode	
Number of Dots	320 x 160	dot
Dot size (W×H)	0.275(W) x 0.275(H)	mm
Active Area	92.785 (W) x 46.385 (H)	mm
Outline Dimension (W x H x D)	104(W) x 64(H) x 5.8(T)max	mm
LCD Controller & Driver	UC1698U	
LCD Driving Method	1/160 Duty ,1/12 Bias	
Backlight Type	LED	
Backlight Color	White	
Operating Temperature	-20℃ ~ +70℃	
Storage Temperature	-30℃ ~ +80℃	

### 4. Outline Drawing



## 5. Interface signals

Pin No.	Symbol	Description
1	NC	No connection
2	VLCD	High voltage LCD Power Supply
3	VS+	LCD SEG driving voltages Connect capacitors of CS value between VS+ and VS- CS=150~220nF/25V
4	VS-	
5	VB0-	LCD SEG driving voltages Connect capacitors of CB value between VB0+ and VB0-,VB1+ and VB1- CB=2.2uF/5V
6	VB1-	
7	VB1+	
8	VB0+	
9	VDD	3.3V
10	VDD	
11	VSS	Ground
12	VSS	
13	NC	No connection
14	BM0	Bus mode selection
15	CS0	Chip select input pin
16	CD	Selects Control data or Display data for read/write operation
17	WR1	WR[1:0] control the read/write operation of the host interface
18	WR0	
19	RST	Reset input pin
20	D0	Bi-directional bus for parallel host interfaces.
21	D1	
22	D2	
23	D3	
24	D4	
25	D5	
26	D6	
27	D7	
28	NC	No connection

## 6. Absolute maximum Ratings

### 6.1. Electrical Absolute max. ratings

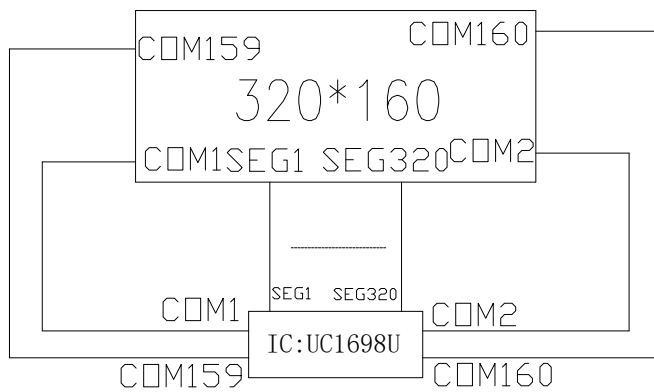
Items	Symbol	MIN.	MAX.	Unit	Condition
Supply Voltage	VDD	3.1	3.5	V	
	VLCD	15.8	16.2	V	

### 6.2. Environment Conditions

Item	Symbol	MIN	MAX	Unit	Remark
Operating Temperature	TOPR	-20	+70	°C	
Storage Temperature	TSTG	-30	+80	°C	

## 7. Electrical Specifications

### 7.1 Block Diagram



COM & SEG LAYOUT

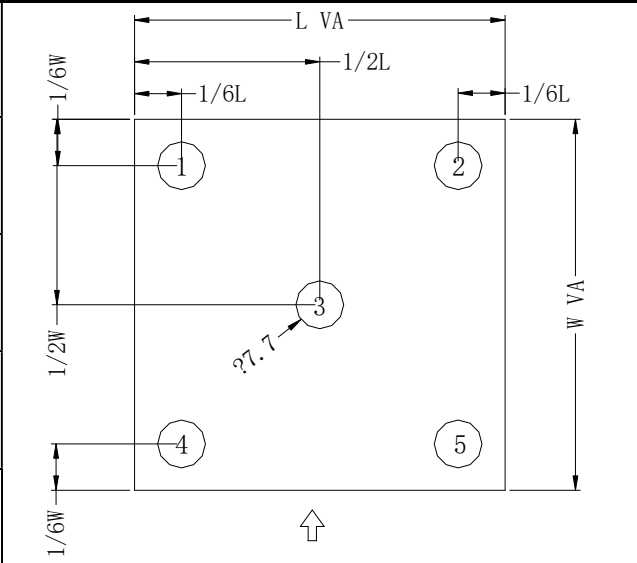
### 7.2 Electrical Characteristics

( $V_{DD} = 3.3V, T_a = 25^\circ C$ )

Items	Symbol	MIN.	TYP.	MAX.	Unit
Power supply for digital circuit	VDD	3.1	3.3	3.5	V
Charge pump output	VLCD	15.8	16.0	16.2	V
Input High Voltage	VIH	0.8*VDD	-	-	V
Input Low Voltage	VIL	-	-	0.2*VDD	V
Output High Voltage	VOH	0.8*VDD	-	-	V
Output Low Voltage	VOL	-	-	0.2*VDD	V
Consumption current	IDD	-	-	5.0	mA
LCM Surface Brightness	BLCM	126	158	-	cd//m <sup>2</sup>

### 7.3 Backlight Parameters

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	VF	If =105mA Ta = 25 °C	2.8	3.1	3.4	V
Average Luminous Intensity	Iv		1000	1300	-	cd/m <sup>2</sup>
Color coordinates	X		0.26	-	0.33	-
	Y		0.26	-	0.33	
Wavelength	λd		-	-	-	nm
Uniformity	A <sub>VG</sub>		75	-	-	%

Backlight Test Point :		
1.Environment Luminance	≤0.1cd/m	
2.Test Instrument	CS2000	
3.Test Distance	500 mm	
4.Aperture Diameter	1°	

## 8. Command/AC Timing

### 8.1. Command

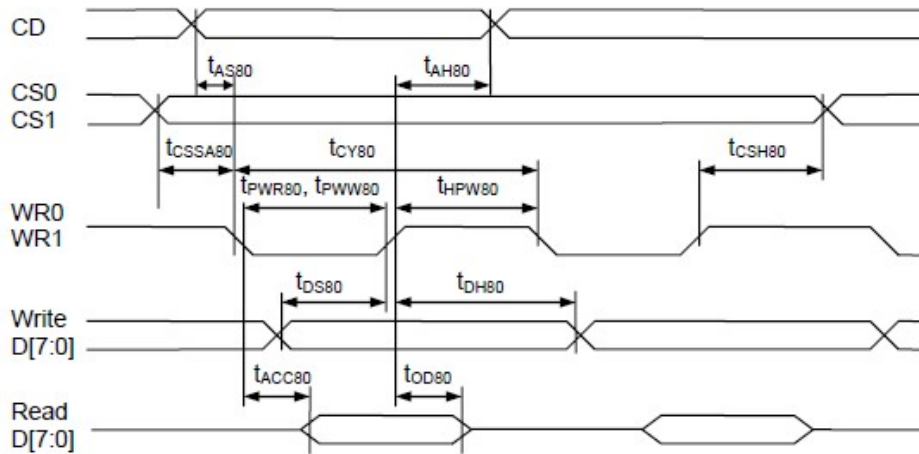
	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status & PM	0	1	GE	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A
				Ver	PMO[6:0]								
				Product Code (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 (double-byte command)	0	0	0	0	1	1	0	0	0	R	Set APC[R][7:0], R = 0 or 1	N/A
		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 VBIAS Potentiometer (double-byte command)	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	40H
		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
		0	0	-	-	-	#	#	#	#	#		
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 (double-byte command)	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
		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	-	#	#	#	#	#	#	#		Set WPP0	0
31	Set Window Program Starting Row Address	0	0	1	1	1	1	0	1	0	1		Set WPC1	127
		0	0	#	#	#	#	#	#	#	#		Set WPP1	159
32	Set Window Program Ending Column Address	0	0	1	1	1	1	0	1	1	0			
		0	0	-	#	#	#	#	#	#	#	#	#	
33	Set Window Program Ending Row Address	0	0	1	1	1	1	0	1	1	1			
		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	-	-	-	#	#	#	#	#			#
36	Set MTP Write Mask	0	0	1	0	1	1	1	0	0	1	Set MTPM[6:0] MTPM1[1:0]	0	
		0	0	-	#	#	#	#	#	#	#			#
		0	0	-	-	-	-	-	-	#	#			#
37	Set V <sub>MTP1</sub> Potentiometer	0	0	1	1	1	1	0	1	0	0	Shared with Window Program commands	Set MTP1	N/A
		0	0	#	#	#	#	#	#	#	#		#	
38	Set V <sub>MTP2</sub> Potentiometer	0	0	1	1	1	1	0	1	0	1		Set MTP2	N/A
		0	0	#	#	#	#	#	#	#	#		#	
39	Set MTP Write Timer	0	0	1	1	1	1	0	1	1	0	Set MTP3	N/A	
		0	0	#	#	#	#	#	#	#	#	#		
40	Set MTP Read Timer	0	0	1	1	1	1	0	1	1	1	Set MTP4	N/A	
		0	0	#	#	#	#	#	#	#	#			#

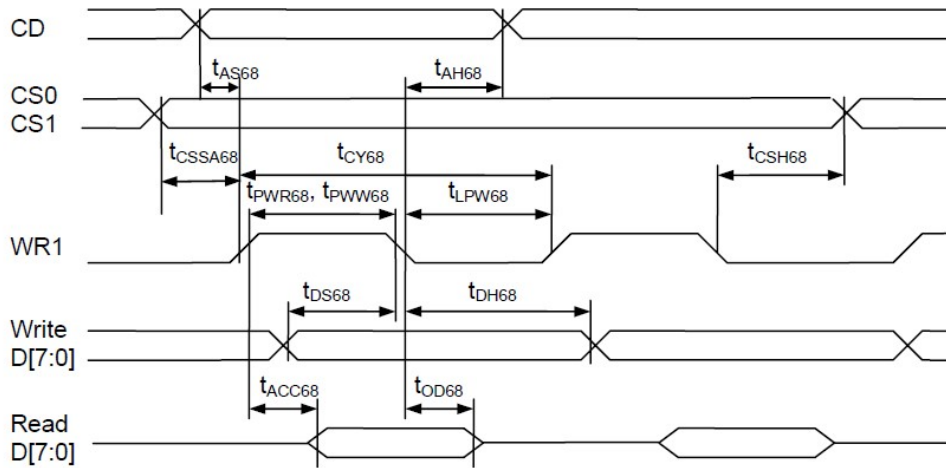
## 8.2. Interface Timing characteristics



Parallel Bus Timing Characteristics (for 8080 MCU)

(2.5V &lt; VDD &lt; 3.3V, Ta = -30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{AS80}$ $t_{AH80}$	CD	Address setup time Address hold time		0 0	-	nS
$t_{CY80}$		System cycle time 16-bit bus (read) (write) 8-bit bus (read) (write)	LC[7:6]=10b LC[7:6]=01b	170 130 100 80 90	-	nS
$t_{PWR80}$	WR1	Pulse width 16-bit (read) 8-bit		85 50	-	nS
$t_{PWW80}$	WR0	Pulse width 16-bit (write) 8-bit	LC[7:6]=10b LC[7:6]=01b	65 40 45	-	nS
$t_{HPW80}$	WR0, WR1	High pulse width 16-bit bus (read) (write) 8-bit bus (read) (write)	LC[7:6]=10b LC[7:6]=01b	85 65 50 40 45	-	nS
$t_{DS80}$ $t_{DH80}$	D0~D15	Data setup time Data hold time		30 0	-	nS
$t_{ACC80}$ $t_{OD80}$		Read access time Output disable time	CL = 100pF	- 15	60 30	nS
$T_{CSSA80}$ $t_{CSH80}$	CS1/CS0	Chip select setup time		5 5		nS

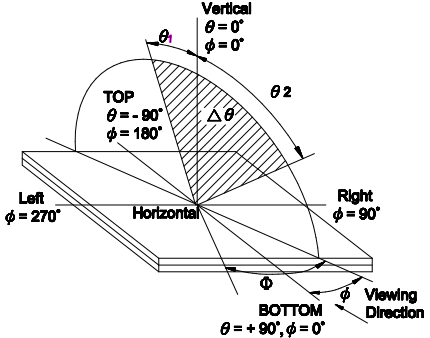
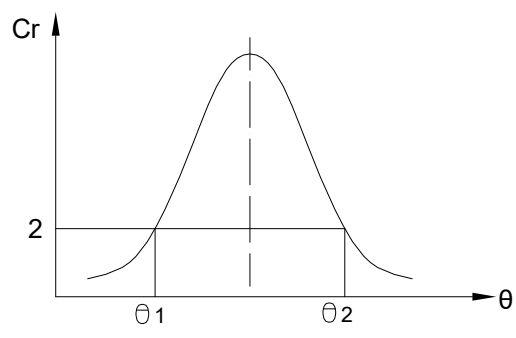
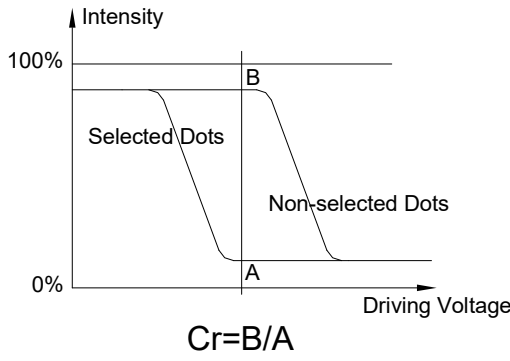
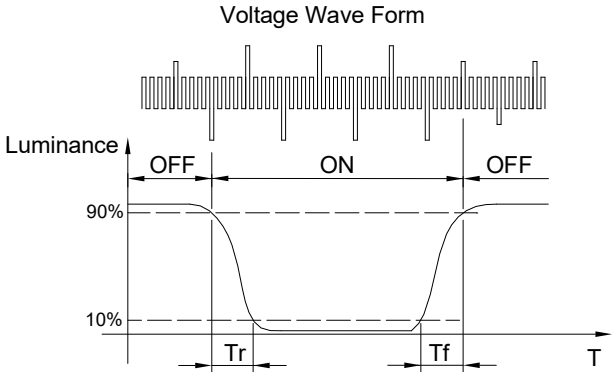


Parallel Bus Timing Characteristics (for 6800 MCU)

(2.5V &lt; VDD &lt; 3.3V, Ta = -30 to +85° C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{AS68}$	CD	Address setup time		0	-	nS
$t_{AH68}$		Address hold time		0		
$t_{CY68}$		System cycle time			-	nS
		16-bit bus (read)		170		
		(write)		130		
		8-bit bus (read)		100		
		(write)	LC[7:6]=10b	80		
			LC[7:6]=01b	90		
$t_{PWR68}$	WR1	Pulse width 16-bit (read)		85	-	nS
		8-bit		50		
$t_{PWW68}$		Pulse width 16-bit (write)		65	-	nS
		8-bit	LC[7:6]=10b	40		
			LC[7:6]=01b	45		
$t_{LPW68}$		Low pulse width			-	nS
		16-bit bus (read)		85		
		(write)		65		
		8-bit bus (read)		50		
		(write)	LC[7:6]=10b	40		
			LC[7:6]=01b	45		
$t_{DS68}$	D0~D7	Data setup time		30	-	nS
$t_{DH68}$		Data hold time		0		
$t_{ACC68}$		Read access time	CL = 100pF	-	60	nS
$t_{OD68}$		Output disable time		15	30	
$t_{CSSA68}$	CS1/CS0	Chip select setup time		5		nS
$t_{CSH68}$				5		

## 9. Electro-Optical Characteristics

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit	Conditions	Note
Viewing Angle	Up 上视角 $\Theta 1$	25°C	-	20	-	Deg.	$Cr \geq 2$	1,2
	Down 下视角 $\Theta 2$		-	30	-			
	Left 左视角 $\Theta 3$		-	30	-			
	Right 右视角 $\Theta 4$		-	30	-			
Frame Frequency	$f_F$	25°C	-	75	-	Hz		
Contrast Ratio	Cr	25°C	-	-	4	-	$\Theta = 0^\circ$ $\Phi = 0^\circ$	3
Response Time	Tr	25°C	-	350	450			
	Tf	25°C	-	260	360			
Note1 . Definition of Angle $\Theta$ & $\Phi$				Note2. Definition of Viewing Angle $\Theta 1$ & $\Theta 2$				
								
Note3 . Definition of Contrast Cr				Note4. Definition of Optical Response				
								

10. Environmental / Reliability Tests

NO.	Item	Condition	Criterion
1	High Temperature Operating	70°C, 96Hrs	No defect in cosmetic and operational function allowable.
2	Low Temperature Operating	-20°C, 96Hrs	
3	High Humidity	40°C, 90%RH, 96Hrs	
4	High Temperature Storage	80°C, 96Hrs	
5	Low Temperature Storage	-30°C, 96Hrs	
6	Vibration	Frequency : 3.3 Hz Amplitude : X=25mm , Z=30mm Time : 4 Hour Y=25mm , Z=30mm Time : 4 Hour	Total current Consumption should be below double of initial value.
7	Thermal Shock	-30°C to 25°C to 80°C (60Min) (5Min) (60Min) 10Cycles	
8	ESD Testing	Discharge modality Contact voltage : ±4KV Air voltage : ±8KV (Discharge R=330Ω,C=150PF) 10 times each	There will be discharged ten times at every discharging voltage cycle. The voltage gap is 1kV.

Note: 1) Above conditions are suitable for our company standard products.  
2) For restrict products, the test conditions listed as above must be revised.

INSPECTION	CRITERION(after test)
Appearance	No Crack on the FPC, on the LCD Panel
Alignment of LCD Panel	No Bubbles in the LCD Panel No other Defects of Alignment in Active area
Electrical current	Within device specifications
Function / Display	No Broken Circuit, No Short Circuit or No Black line No Other Defects of Display

## 11. Precautions for Use of LCD Modules

### 1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

### (2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichloro trifluro thane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- Water
- Ketone
- Aromatics

### (3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

### (4) Packaging

- Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.
- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

### (5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is reequired.

### (6) Storage

In the case of storing for a long period of time (for instance.) For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

### (7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol Which should be burned up later. When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.