Display Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 128128D FGH SERIES

Product Specification **Version: 1**

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
0	04.12.2007	First issue	MH
0.1	11.01.2010	Update name	MHO
1	09.10.2014	Update	MHO

CONTENTS

1. FUNCTIONS & FEATURES

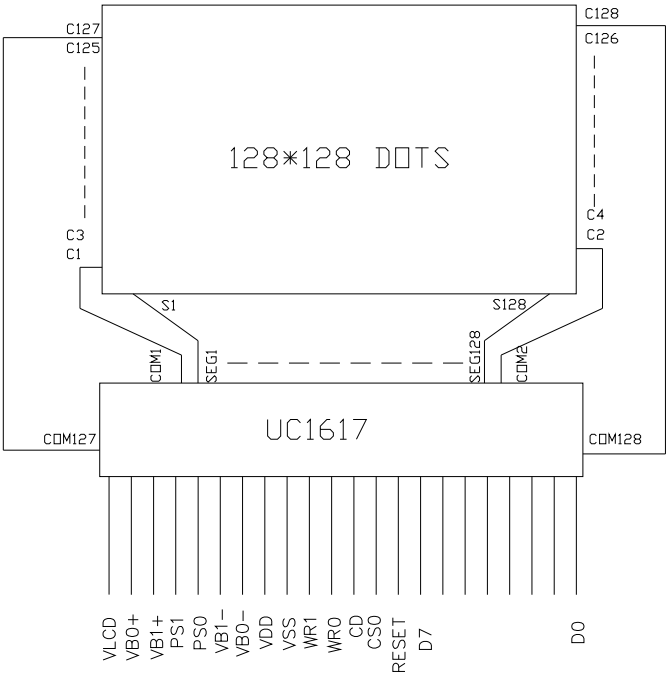
MODULE NAME	LCD TYPE
DEM 128128D FGH (FPCF, refl.)	FSTN Grey Reflective Positive Mode
DEM 128128D FGH (FPCF, transfl.)	FSTN Grey Transflective Positive Mode

- Format : COG, 128 x 128dots
- LCD mode : FSTN / Positive
- Viewing direction : 6 o'clock
- Driving scheme : 1/128 Duty cycle, 1/11Bias
- Power supply voltage range (V_{DD}) : 3.0 Volt (typ.)
- LCD driving voltage : 12.5 Volt (typ.)
- Operation temp : -20 to 70°C
- Storage temp : -30 to 85°C
- LCD-Driver : UC1617 (Ultrachip)
- RoHS : compliant

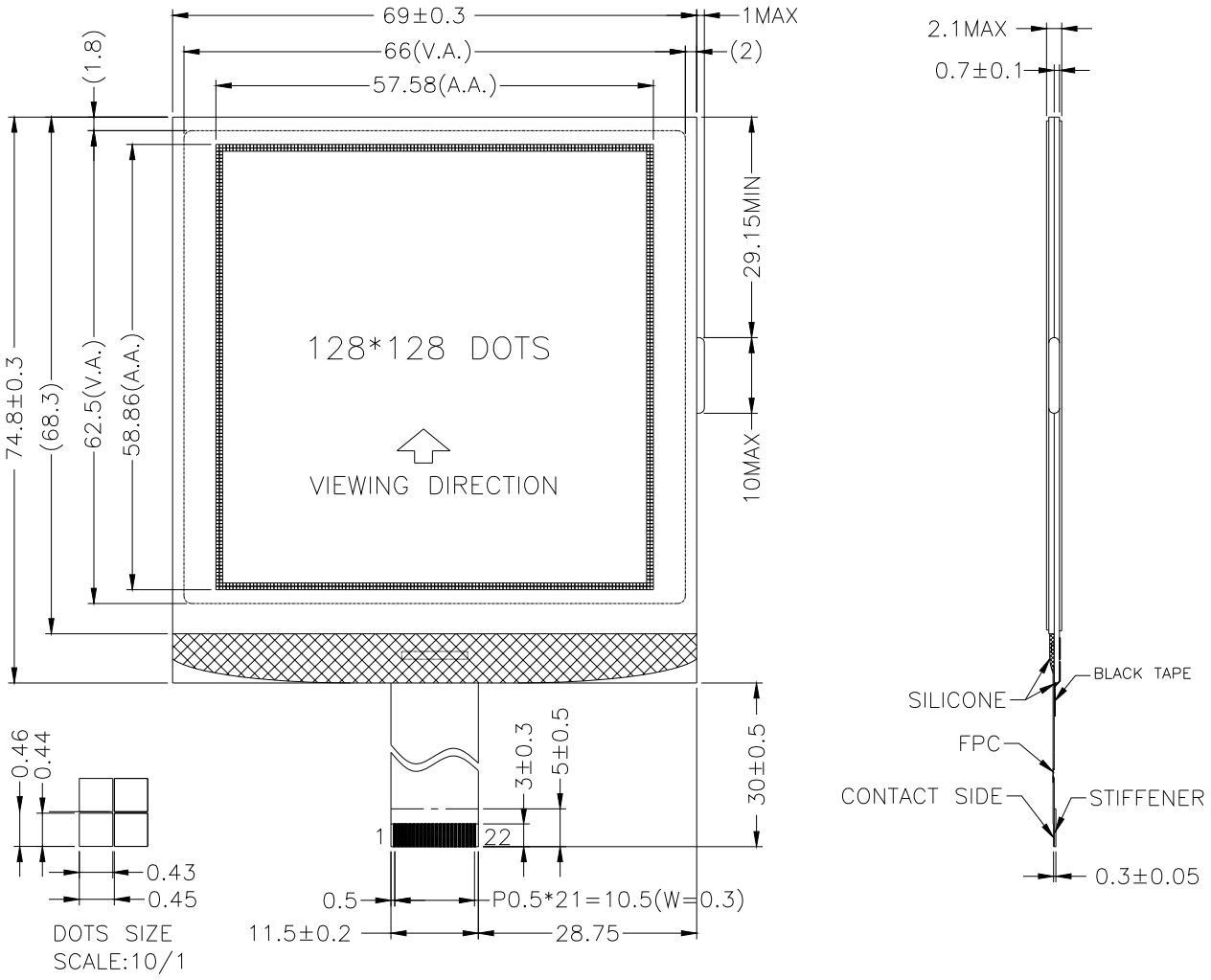
2. MECHANICAL SPECIFICATIONS

- Module size : 69.00 x 74.8 x 2.1 mm
- Viewing area : 66.00 x 62.50 mm
- Dot pitch : 0.45 x 0.46 mm
- Dot size : 0.43 x 0.44 mm

3. BLOCK DIAGRAM AND ICON TABLE



4. DIMENSIONAL OUTLINE



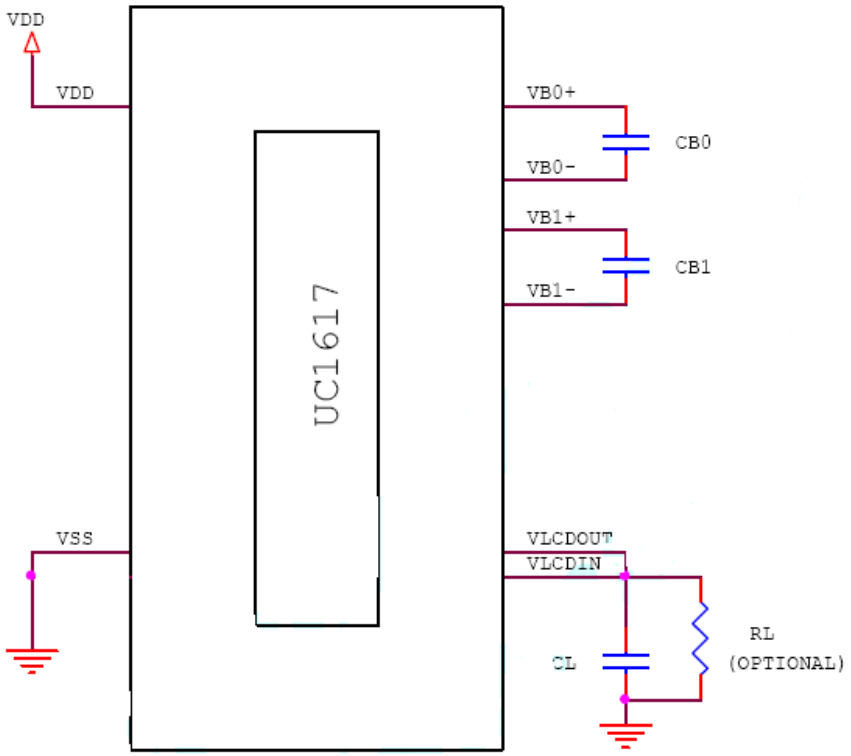
5. PIN DESCRIPTION

No.	Symbol	Function
1	VLCD	High voltage LCD power supply
2	VB0+	LCD bias voltage
3	VB1+	LCD bias voltage
4	PS1	Bus mode. PS1:PS0 (1:1 6800 series interface) (1:0 8080 series interface)
5	PS0	
6	VB1-	LCD bias voltage
7	VB0-	LCD bias voltage
8	VDD	Power supply
9	VSS	Ground
10	WR1	Controls the read/write operation of the host interface.(In 6800 series
11	WR0	WR1:EN,WR0:R/W. In 8080 series WR1:/RD,WR0:/WR)
12	CD	Register selection(L: Control data H: Display data)
13	CS0	Chip select(When CS0=L chip is select)
14	RESET	Reset signal
15-22	D7-D0	Data bus

6. MAXIMUM ABSOUTE LIMIT

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	+18.0	V
V_{IN}	Digital input signal	-0.4	V_{DD} + 0.5	V
T_{OPR}	Operating temperature range	-30	+85	°C
T_{STR}	Storage temperature	-55	+125	°C

7. REFERENCE CIICUIT



Reference circuit using internal Hi-V generator circuit

8. ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply for digital circuit		1.65		3.3	V
$V_{DD2/3}$	Supply for bias & pump		2.5		3.3	V
V_{LCD}	Charge pump output	$V_{DD2/3} \geq 2.6V$, 25°C		14	15	V
V_D	LCD data voltage	$V_{DD2/3} \geq 2.6V$, 25°C	0.89		1.78	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
$R_{ON(SEG)}$	SEG output impedance	V_{LCD} = 15V		1.5	2.0	kΩ
$R_{ON(COM)}$	COM output impedance	V_{LCD} = 15V		1.5	2.0	kΩ
f_{LINE}	Average Line rate	LC[4:3] = 00b	-10%	14.2	+10%	kHz

9. TIMING CHARACTERISTICS

AC CHARACTERISTICS

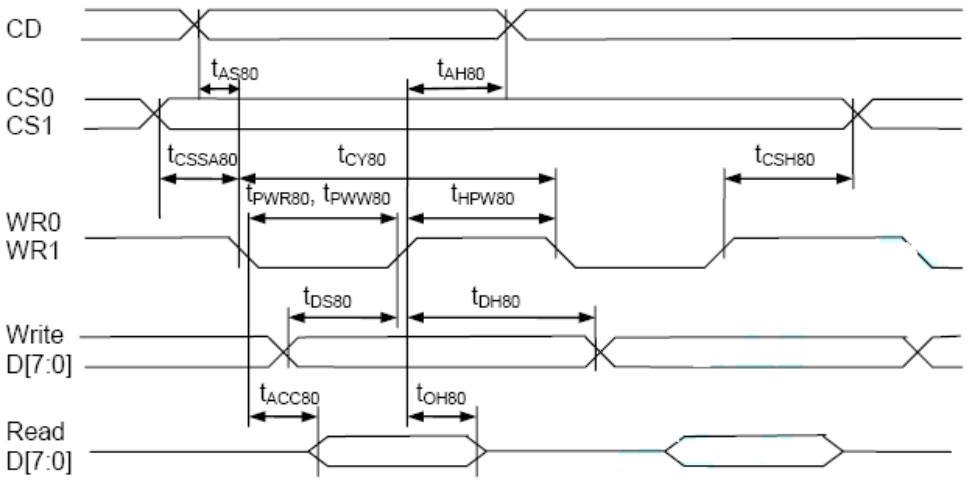


FIGURE 13: Parallel Bus Timing Characteristics (for 8080 MCU)

(2.5V ≤ V_{DD} < 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 (read) (write)		170 130	–	nS
t_{PWR80}	WR1	Pulse width (read)		70	–	nS
t_{PWW80}	WR0	Pulse width (write)		70	–	nS
t_{HPW80}	WR0, WR1	High pulse width (read) (write)		100 60	–	nS
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC8U} t_{OH80}		Read access time Output hold time	C_L = 100pF	– –	60 25	nS
t_{CSSA80} t_{CSH80}	CS1/CS0	Chip select setup time		5 5		nS

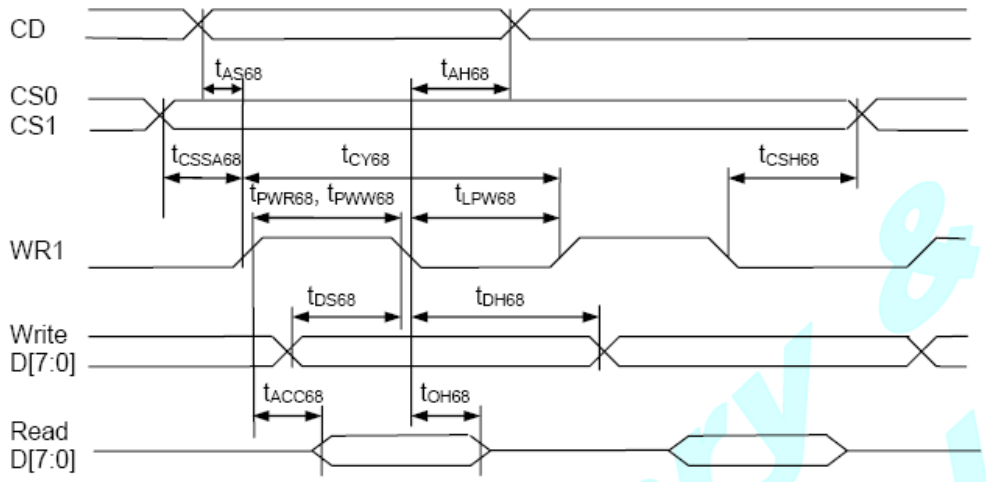
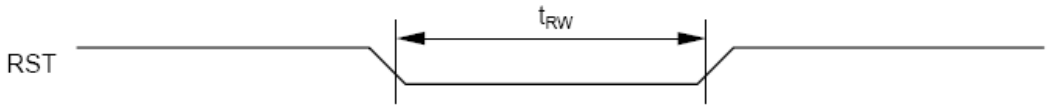


FIGURE 14: Parallel Bus Timing Characteristics (for 6800 MCU)

($2.5V \leq V_{DD} < 3.3V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS68} t_{AH68}	CD	Address setup time Address hold time		0 0	–	nS
t_{CY68}		System cycle time (read) (write)		170 130	–	nS
t_{PWR68}	WR1	Pulse width (read)		70	–	nS
t_{PWW68}		Pulse width (write)		70	–	nS
t_{LPW68}		Low pulse width (read) (write)		100 60	–	nS
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC68} t_{OH68}		Read access time Output hold time	C_L = 100pF	– –	60 25	nS
t_{CSSA68} t_{CSH68}	CS1/CS0	Chip select setup time		5 5		nS

10. Reset Timing



($1.65V \leq V_{DD} < 3.3V$, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{RW}	RST	Reset low pulse width		3	–	µS
t_{RD}	RST, WR	Reset to WR pulse delay		10	–	mS

11. CONTROL AND DISPLAY INSTRUCTION

	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	1	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A
				Ver		PMO[5:0]							
				Product Code				PID		MID			
4	Set Page_C Address	0	0	0	0	0	#	#	#	#	#	Set CA[4:0]	0H
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b
6	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b
7	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[3:2]	11b
8	Set Adv. Program Control	0	0	0	0	1	1	0	0	R	R	Set APC[R][7:0], R = 0, 1 or 2	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
9	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0H
	Set Scroll Line MSB	0	0	0	1	0	1	-	#	#	#	Set SL[6:4]	0H
10	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	00H
	Set Row Address MSB	0	0	0	1	1	1	-	#	#	#	Set RA[6:4]	00H
11	Set V_{BIAS} Potentiometer	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	4EH
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
12	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[9:8]	00b: Disable
13	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
14	Set Fixed Lines	0	0	1	0	0	1	0	0	0	0	Set {FLT, FLB}	0
				#	#	#	#	#	#	#	#		
15	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	00b
16	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0b
17	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0b
18	Set Display Enable	0	0	1	0	1	0	1	1	#	#	Set DC[3:2]	10b
19	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	000b
20	Set N-Line Inversion	0	0	1	1	0	0	1	0	0	0	Set NIV[3:0]	6H
				-	-	-	-	#	#	#	#		
21	Set LCD Gray Shade	0	0	1	1	0	1	0	#	#	#	Set LC[7:5]	001b
22	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
23	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
24	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	#	#	#	#	#	#	#	#		
25	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 11
26	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	AC[3]=0
27	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	AC[3]=1
28	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[6:0]	127
		0	0	-	#	#	#	#	#	#	#		
29	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[6:0]	0
		0	0	-	#	#	#	#	#	#	#		
30	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[6:0]	127
		0	0	-	#	#	#	#	#	#	#		
31	Set Window Program	0	0	1	1	1	1	0	1	0	0	Set WPC0[4:0]	0
	Starting Page_C Address	0	0	-	-	-	#	#	#	#	#		
32	Set Window Programming	0	0	1	1	1	1	0	1	0	1	Set WPP0[6:0]	0
	Starting Row Address	0	0	-	#	#	#	#	#	#	#		
33	Set Window Programming	0	0	1	1	1	1	0	1	1	0	Set WPC1[4:0]	31
	Ending Page_C Address	0	0	-	-	-	#	#	#	#	#		

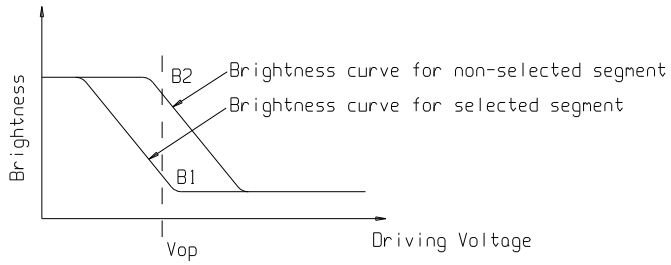
	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
34	Set Window Programming Ending Row Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	1 #	1 #	Set WPP1[6:0]	127
35	Enable window program	0	0	1	1	1	1	1	0	0	#	Set AC[4]	0: Disable
36	Set MTP Operation control	0 0	0 0	1 -	0 -	1 #	1 #	1 #	0 #	0 #	0 #	Set MTPC[5:0]	10H
37	Set MTP Write Mask	0 0	0 0	1 #	0 #	1 #	1 #	1 #	0 #	0 #	1 #	Set MTPM[7:0]	0
38	Set V_{MTP1} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	0 #	Shared with Window Programming commands	N/A
39	Set V_{MTP2} Potentiometer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	1 #		
40	Set MTP Write Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	0 #		
41	Set MTP Read Timer	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	1 #		

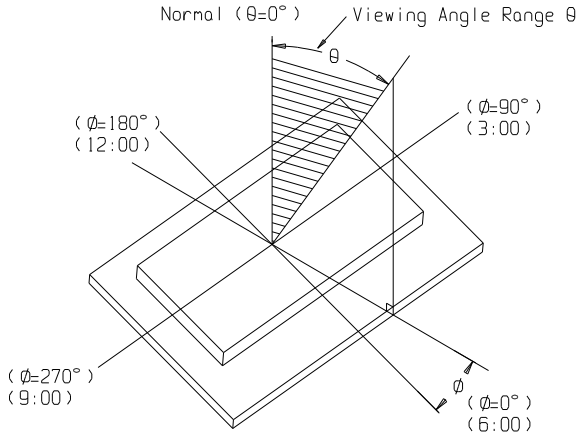
12. ELECTRO-OPTICAL CHARACTERISTICS

(V_{DD} = 3.0V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage of LCD	Vop	Ta = -20°C	12.6	12.9	13.2	V
		Ta = 25°C	12.2	12.5	12.8	
		Ta = 70°C	11.8	12.1	12.4	
Response time	Tr	Ta = 25°C	---	250	---	ms
	Tf		---	300	---	ms
Contrast	Cr	Ta = 25°C	---	4	---	---
Viewing angle range	θ	Cr≥2	-40	---	+40	deg
	Φ		-40	---	+40	deg

$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$





13. 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: 280°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.