

**Display Elektronik GmbH**

# DATA SHEET

**LCD MODULE**

## **DEM 16103 SYH-LY**

**Product specification**

**Version : 1**

**22/Dec./2006**

**DOCUMENT REVISION HISTORY: DEM 16103 SYH-LY**

<b>Version</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>CHANGED BY</b>
00	21.10.2006	Original	-
01	22.12.2006	Change the LCD viewing direction	MH

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### 1. FUNCTIONS & FEATURES

- 1.1. Format : 16x1 characters
- 1.2. LCD mode : STN / Positive transfective mode /Yellow-green
- 1.3. Viewing direction : 6 o'clock
- 1.4. Driving scheme : 1/16 Duty , 1/5 Bias
- 1.5. Power supply voltage (V<sub>DD</sub>) : 5.0 Volt (typ.)
- 1.6. LCD driving voltage(V<sub>op</sub>) : 4.0 Volt (typ.) (4.5 Volt at -20°C)
- 1.7. Operation temp : -20 to 70°C
- 1.8. Storage temp : -30 to 80°C
- 1.9. Backlight color : Yellow-green, Lightbox

### 2. MECHANICAL SPECIFICATIONS

- 2.1. Module size : 122.0 x 33.0 x 14.mm
- 2.2. Viewing area : 99.0 x 13.0 mm
- 2.3 Character pitch : 6.00 x 9.68 mm
- 2.4 Character size : 4.92 x 9.68 mm
- 2.5. Dot pitch : 1.00 x 1.18 mm
- 2.6. Dot size : 0.92 x 1.10 mm

### 3. BLOCK DIAGRAM

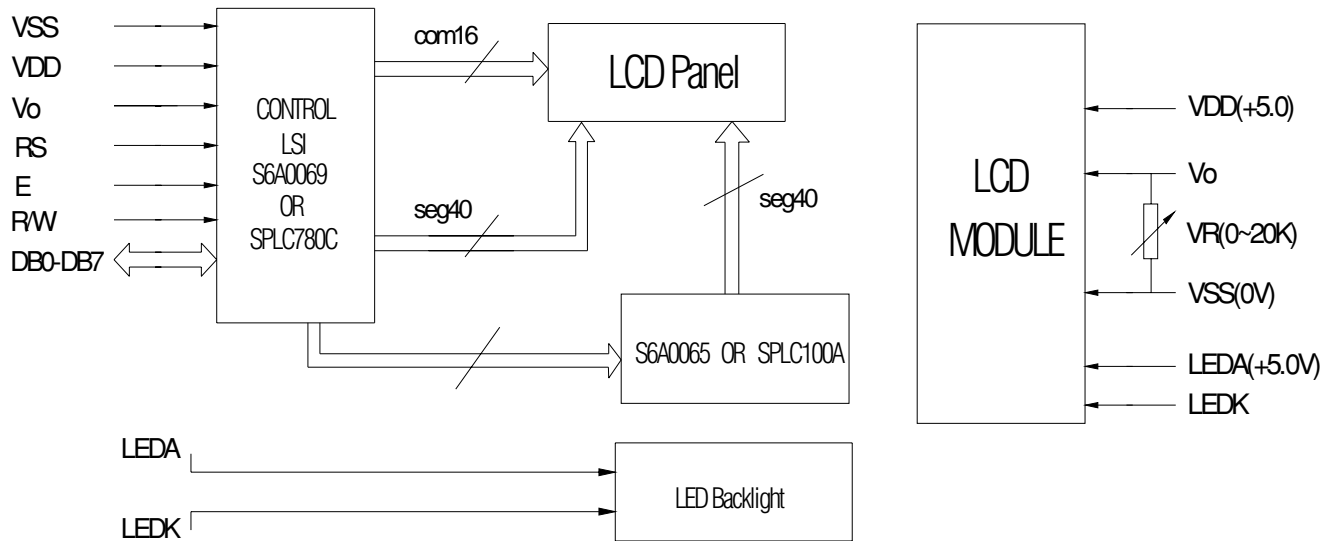


Figure 1. Block diagram

4. DIMENSIONAL OUTLINE

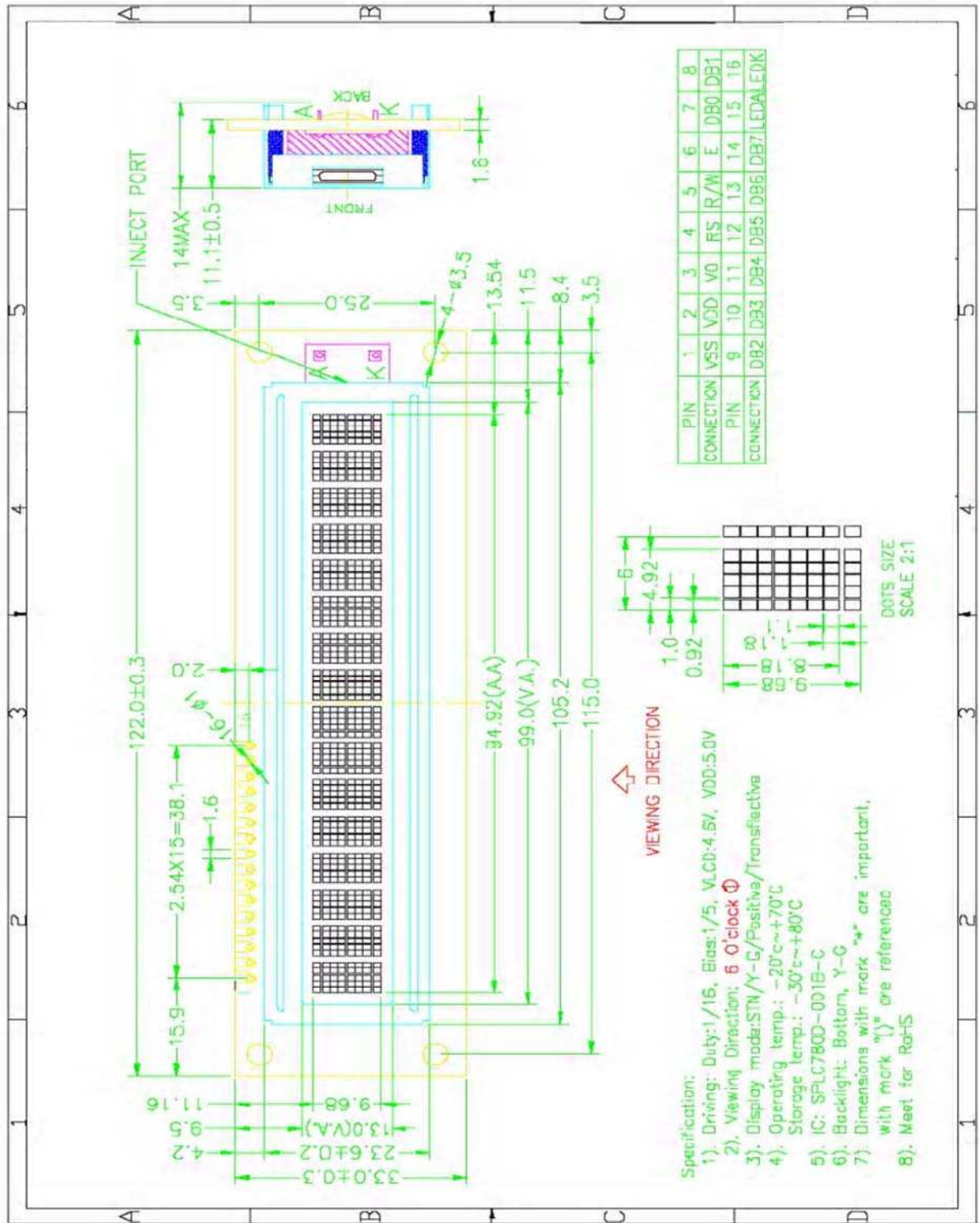


Figure 2. Dimensional outline

## 5. PIN DESCRIPTION

No.	Symbol	Function
1	VSS	GND(0V)
2	VDD	Power supply for Logic(+5.0V)
3	V0	Power supply for LCD drive
4	RS	Register selection (H: Data register , L :Instruction register)
5	R/W	Read/write selection (H: Read , L: Write)
6	E	Enable signal for LCM
7~14	DB0~DB7	Data Bus lines
15	LEDA	Supply for Backlight(+5.0V)
16	LEDK	Supply for Backlight(-)

## 6. MAXIMUM ABSOLUTE LIMIT (IC)

### Maximum Absolute Power Ratings

Characteristic	Symbol	Unit	Value
Power Supply Voltage(1)	$V_{DD}$	V	-0.3 ~ +7.0
Power Supply Voltage(2)	$V_{LCD}$	V	$V_{DD}-15.0 \sim V_{DD}+0.3$
Input Voltage	$V_{IN}$	V	-0.3 ~ $V_{DD}+0.3$

NOTE: Voltage greater than above may damage the circuit.  $V_{DD} > V1 > V2 > V3 > V4 > V5$

## 7. ELECTRICAL CHARACTERISTICS

### 7.1 DC CHARACTERISTICS (V<sub>DD</sub> = 4.5V ~ 5.5V, T<sub>a</sub> = 25°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Voltage	V <sub>DD</sub>	-	4.5	-	5.5	V
Supply Current	I <sub>DD</sub>	Internal oscillation or external clock. (V <sub>DD</sub> =5.0 V, f <sub>osc</sub> = 270 kHz)	-	0.35	0.6	mA
Input Voltage (1) (except OSC1)	V <sub>IH1</sub>	-	2.2	-	V <sub>DD</sub>	V
	V <sub>IL1</sub>	-	-0.3	-	0.6	
Input Voltage (2) (OSC1)	V <sub>IH2</sub>	-	V <sub>DD</sub> -1.0	-	V <sub>DD</sub>	V
	V <sub>IL2</sub>	-	-0.2	-	1.0	
Output Voltage (1) (DB0 to DB7)	V <sub>OH1</sub>	I <sub>OH</sub> = -0.205 mA	2.4	-	-	V
	V <sub>OL1</sub>	I <sub>OL</sub> = 1.2 mA	-	-	0.4	
Output Voltage (2) (except DB0 to DB7)	V <sub>OH2</sub>	I <sub>O</sub> = -40 μA	0.9V <sub>DD</sub>	-	-	V
	V <sub>OL2</sub>	I <sub>O</sub> = 40 μA	-	-	0.1V <sub>DD</sub>	
Voltage Drop	V <sub>dCOM</sub>	I <sub>O</sub> = ± 0.1 mA	-	-	1	V
	V <sub>dSEG</sub>		-	-	1	
Input Leakage Current	I <sub>IKG</sub>	V <sub>IN</sub> = 0 V to V <sub>DD</sub>	-1	-	1	μA
Input Low Current	I <sub>IL</sub>	V <sub>IN</sub> = 0 V, V <sub>DD</sub> = 5 V (PULL UP)	-50	-125	-250	
Internal Clock (external Rf)	f <sub>OSC1</sub>	Rf = 91 kΩ ± 2% (V <sub>DD</sub> = 5 V)	190	270	350	kHz
External Clock	f <sub>OSC</sub>	-	125	270	410	kHz
	duty		45	50	55	%
	t <sub>R</sub> , t <sub>F</sub>		-	-	0.2	μs
LCD Driving Voltage	V <sub>LCD</sub>	V <sub>DD</sub> -V <sub>5</sub> (1/5, 1/4 Bias)	3.0	-	13.0	V

7.2 AC Characteristics (V<sub>dd</sub> = 4.5V ~ 5.5V, T<sub>a</sub> = -30 °C~ +85°C)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode (Refer to Fig-6)	E Cycle Time	t <sub>c</sub>	500	-	-	ns
	E Rise / Fall Time	t <sub>R,F</sub>	-	-	20	
	E Pulse Width (High, Low)	t <sub>w</sub>	230	-	-	
	R/W and RS Setup Time	t <sub>su1</sub>	40	-	-	
	R/W and RS Hold Time	t <sub>h1</sub>	10	-	-	
	Data Setup Time	t <sub>su2</sub>	80	-	-	
	Data Hold Time	t <sub>h2</sub>	10	-	-	
Read Mode (Refer to Fig-7)	E Cycle Time	t <sub>c</sub>	500	-	-	ns
	E Rise / Fall Time	t <sub>R,F</sub>	-	-	20	
	E Pulse Width (High, Low)	t <sub>w</sub>	230	-	-	
	R/W and RS Setup Time	t <sub>su</sub>	40	-	-	
	R/W and RS Hold Time	t <sub>h</sub>	10	-	-	
	Data Output Delay Time	t <sub>D</sub>	-	-	120	
	Data Hold Time	t <sub>DH</sub>	5	-	-	

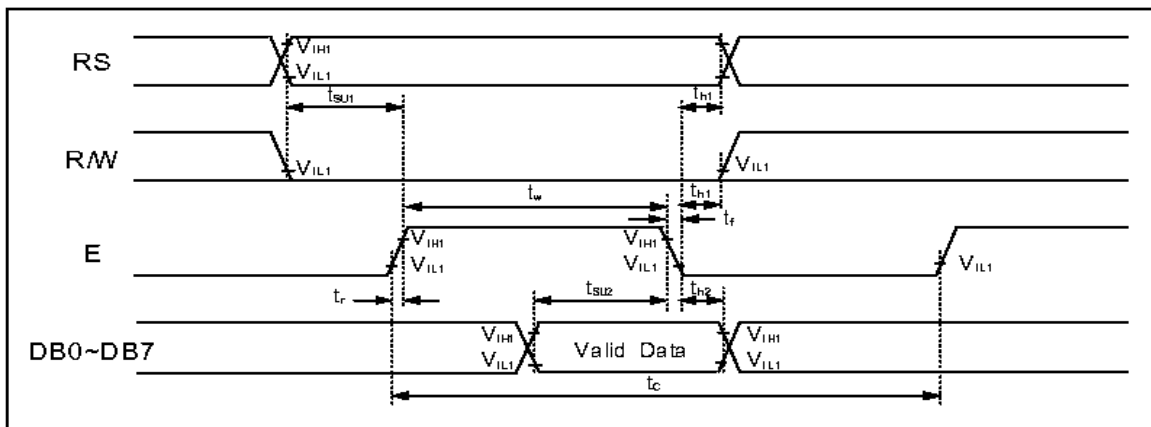


Figure 6 . Write Mode Timing Diagram

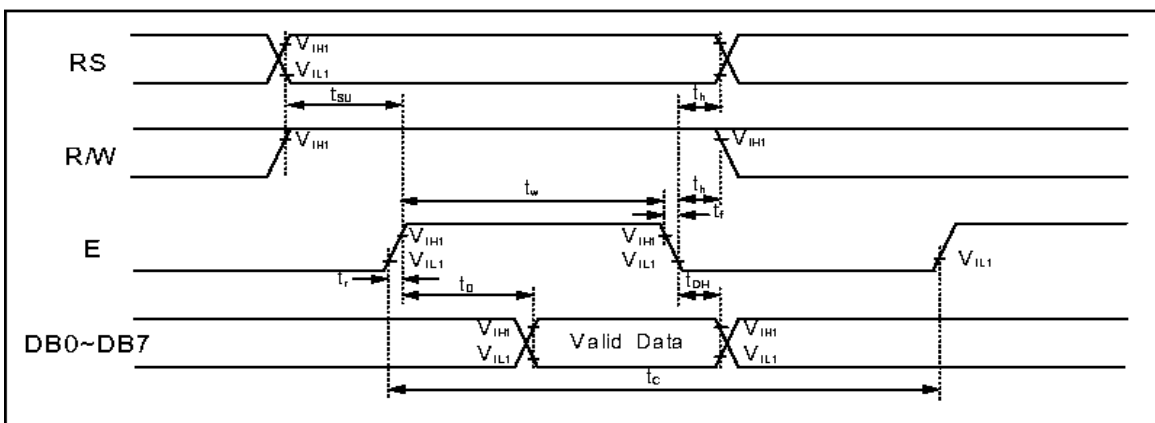


Figure 7 . Read Mode Timing Diagram



## 8. CONTROL AND DISPLAY INSTRUCTION

Instruction	Instruction Code										Description Instruction Code	Execution time {fsoc=270kHz}	
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Write "2DH" to DDRAM, and set DDRAM address to "00H" from AC.	1.53ms
Return Home	0	0	0	0	0	0	0	0	0	1	X	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and make shift of entire display enable.	39μs
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	39μs
Cursor or Display Shift	0	0	0	0	0	0	1	S/C	R/L	X	X	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	39μs
Function Set	0	0	0	0	1	DL	N	F	X	X	X	Set interface data length (DL : 4-bit/8-bit), numbers of display line (N : 1-line/2-line), display font type(F : 5 X 8 dots/ 5 X 11 dots)	39μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	AC0	Set CGRAM address in address counter.	39μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	AC0	Set DDRAM address in address counter.	39μs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	D0	Write data into internal RAM (DDRAM/CGRAM).	43μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	D0	Read data from internal RAM (DDRAM/CGRAM).	43μs

NOTE: When an MPU program with checking the Busy Flag (DB7) is made, it must be necessary  $\frac{1}{2}$  Fosc is necessary for executing the next instruction by the falling edge of the 'E' signal after the Busy Flag (DB7) goes to "Low".

9. Character table

Upper 4 bit Lower 4 bit	0.0.0.0	1.0.0.0	2.0.0.0	3.0.0.0	4.0.0.0	5.0.0.0	6.0.0.0	7.0.0.0	8.0.0.0	9.0.0.0	A.0.0.0	B.0.0.0	C.0.0.0	D.0.0.0	E.0.0.0	F.0.0.0
1.1.1.1				0	1	2	3	4	5	6	7	8	9	0	1	2
1.1.1.0			!	1	2	3	4	5	6	7	8	9	0	1	2	3
1.1.0.0			"	2	3	4	5	6	7	8	9	0	1	2	3	4
1.1.0.1			#	3	4	5	6	7	8	9	0	1	2	3	4	5
1.1.0.1			\$	4	5	6	7	8	9	0	1	2	3	4	5	6
1.1.0.1			%	5	6	7	8	9	0	1	2	3	4	5	6	7
1.1.0.1			&	6	7	8	9	0	1	2	3	4	5	6	7	8
1.1.0.1			'	7	8	9	0	1	2	3	4	5	6	7	8	9
1.1.0.1			(	8	9	0	1	2	3	4	5	6	7	8	9	0
1.1.0.1			)	9	0	1	2	3	4	5	6	7	8	9	0	1
1.1.0.1			*	0	1	2	3	4	5	6	7	8	9	0	1	2
1.1.0.1			+	1	2	3	4	5	6	7	8	9	0	1	2	3
1.1.0.1			,	2	3	4	5	6	7	8	9	0	1	2	3	4
1.1.0.1			=	3	4	5	6	7	8	9	0	1	2	3	4	5
1.1.0.1			.	4	5	6	7	8	9	0	1	2	3	4	5	6
1.1.0.1			/	5	6	7	8	9	0	1	2	3	4	5	6	7

### 10. BACKLIGHT CHARACTERISTICS

**ELECTRICAL RATINGS** (Ta = 25°C)

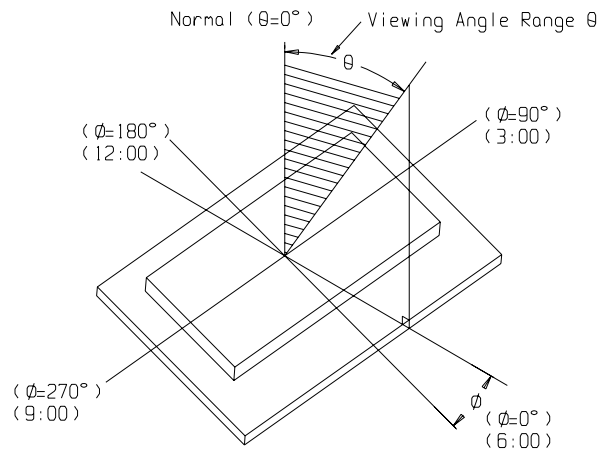
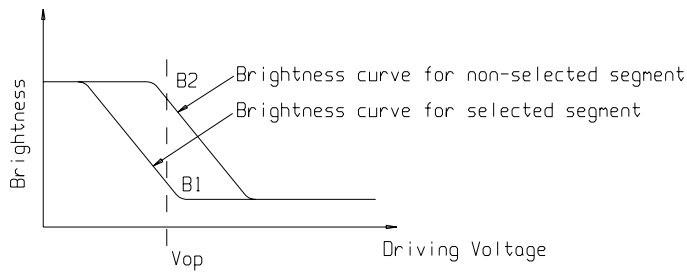
Item	Symbol	Condition	Min	Type	Max	Unit
Forward Voltage	VF	IF=160mA	4.0	4.2	4.4	V
Reverse Current	IR	VR=10V	---	---	80	uA
Operation temperature	Topr	IF=160mA	-20 ~ +70			°C
WDisplay Elektronike length	λρ	IF=160mA	565	568	571	nm
Color	Yellow-green					
5Volt (7,5 Ohm- resistor)	typ. 125mA					

### 11. ELECTRO-OPTICAL CHARACTERISTICS

 (Vop = 4.5V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	Vop	Ta = -20°C	4.9	5.1	5.3	V
		Ta = 25°C	4.4	4.6	4.8	
		Ta = 70°C	4.3	4.5	4.7	
Response time	Tr	Ta = 25°C	---	185	---	ms
	Tf		---	200	---	ms
Contrast	Cr	Ta = 25°C	---	4	---	---
Viewing angle range	θ	Cr ≥ 2	-40	---	+40	deg
	Φ		-40	---	+40	deg

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



## 12 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 isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, 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 Elektronik.
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:  $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$
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  $V_o$ .
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**

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

1. The liability of DISPLAY ELEKTRONIK is limited to repair or replacement on the terms set forth below. DISPLAY ELEKTRONIK 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 ELEKTRONIK and the customer, DISPLAY ELEKTRONIK will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with DISPLAY ELEKTRONIK 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.