PACIFIC DISPLAY DEVICES

LCD Component Data Sheet
Model Number: 12232-26

122 x 32 Dot
Graphic LCD Assembly
With SED1520 Graphics Controller
LED Panel Backlight

CONTENTS

139 Avenida Victoria – Suite 100 – San Clemente, CA – 92672
Tel: 949-361-8957 – Fax: 949-361-9158 – Web: www.pacificdisplay.com

1. GENERAL INFORMATION

1.1 Product Overview

- 122 x 32 dot matrix LCD
- STN (Super Twisted Nematic) Technology
- SED1520 (or equivalent) Graphics Controller
- Multiplex drive : 1/32 duty, 1/5 bias
- LCD Module Service Life: 100,000 hours minimum

1.2 Part Options and Numbering System

12232	-26	-SL	-F	-ST	-ELED	-GY	-6	-13

➢ **Custom Option Designator:**
- (-26) SED1520 Controller x2 & Mechanical Configuration

➢ **Operating Mode:**
- (-SL) STN Silver / Gray
- (-GR) STN Green
- (-BN) STN Blue Negative Image

➢ **Rear Polarizer Options:**
- (-F) Transflective
- (-M) Transmissive
- (-R) Reflective (No Backlight)

➢ **Operating Temperature:**
- (-ST) Standard (0 to +50 ºC)
- (-ET) Extended (-20 to +70 ºC)

➢ **Backlight Options:**
- (-ELED) Edge Lit LED Backlight

➢ **Backlight Coloration Options:**
- (-GY) LED - Green/Yellow
- (-AM) LED - Amber

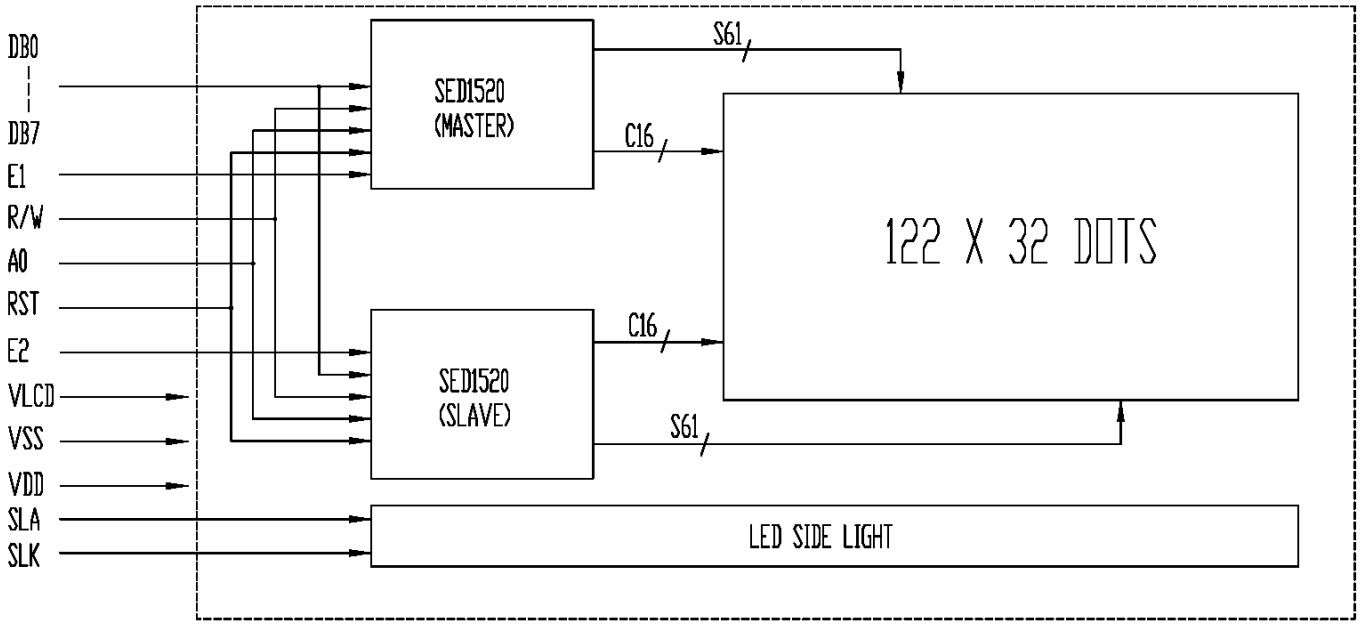
➢ **Viewing Angle:**
- (-6) 6 o'clock
- (-12) 12 0'clock

➢ **Additional Options:**
- (-13) 13mm FFC Interface Cable
- (-64) 64mm FFC Interface Cable

1.3 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	$V_{DD} - V_{SS}$	-0.3	6.7	V
Supply voltage for LCD	$V_{DD} - V_O$	– 0.3	13.0	V
Input voltage	VI	-0.3	V_{DD} +0.3	V
Standard Operating temperature	TOP (-ST)	0	50	ºC
Standard Storage temperature	TST (-ST)	-10	60	ºC
Extended Operating temperature	TOP (-ET)	-20	70	ºC
Extended Storage temperature	TST (-ET)	-30	80	ºC
Soldering Temp	Tsolder	260		ºC

1.4 Circuit Block Diagram



1.5 Mechanical Characteristics

Item	Contents	Unit
Module size (W×H×T)	45.05 x 22.32 x 6.6 Max	mm
Viewing area (W×H)	38.56 x 13.16	mm
Active area (W×H)	36.56 x 10.20	mm
Number of dots	122 x 32	dots
Dot size (W×H)	0.26 x 0.28	mm
Dot pitch (W×H)	0.30 x 0.32	mm

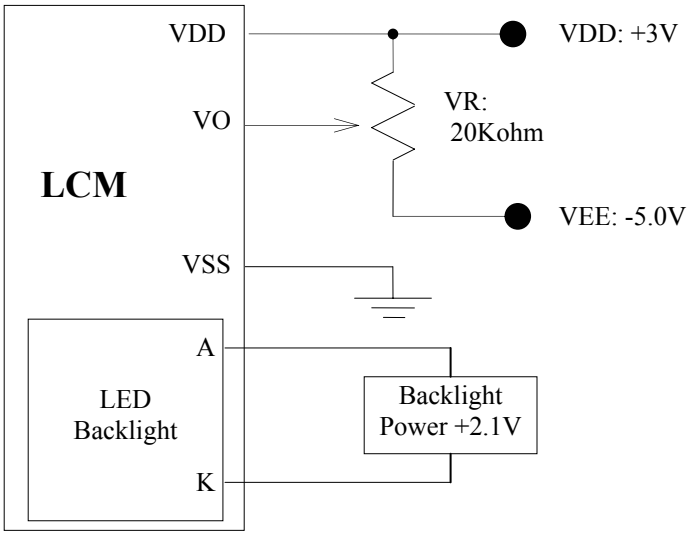
1.6 Input Signal Function

Pin No.	Symbol	Level	Description	Notes*
1	VDD	3.0V	Supply voltage for logic	1
2	VSS	0V	Ground	
3	VO	*	V5 Input voltage for LCD backplane (Contrast)	1
4	RES	L → H	Rising Edge Reset – Selects 6800 Interface Must be left "High" during normal module operation	3
5	E1	H	Active H: Read/Write enable signal (Master SED 1520)	2, 4
6	E2	H	Active H: Read/Write enable signal (Slave SED 1520)	2, 4
7	R/W	H/L	H: Read Mode / L : Write mode	
8	A0	H/L	H : Data signal / L : Instruction signal	
9	DB0	H/L	Data bit 0	
10	DB1	H/L	Data bit 1	
11	DB2	H/L	Data bit 2	
12	DB3	H/L	Data bit 3	
13	DB4	H/L	Data bit 4	
14	DB5	H/L	Data bit 5	
15	DB6	H/L	Data bit 6	
16	DB7	H/L	Data bit 7	
17	LED-A	2.1V	LED Backlight Anode	
18	LED-K	0V	LED Backlight Cathode	

***Notes:**

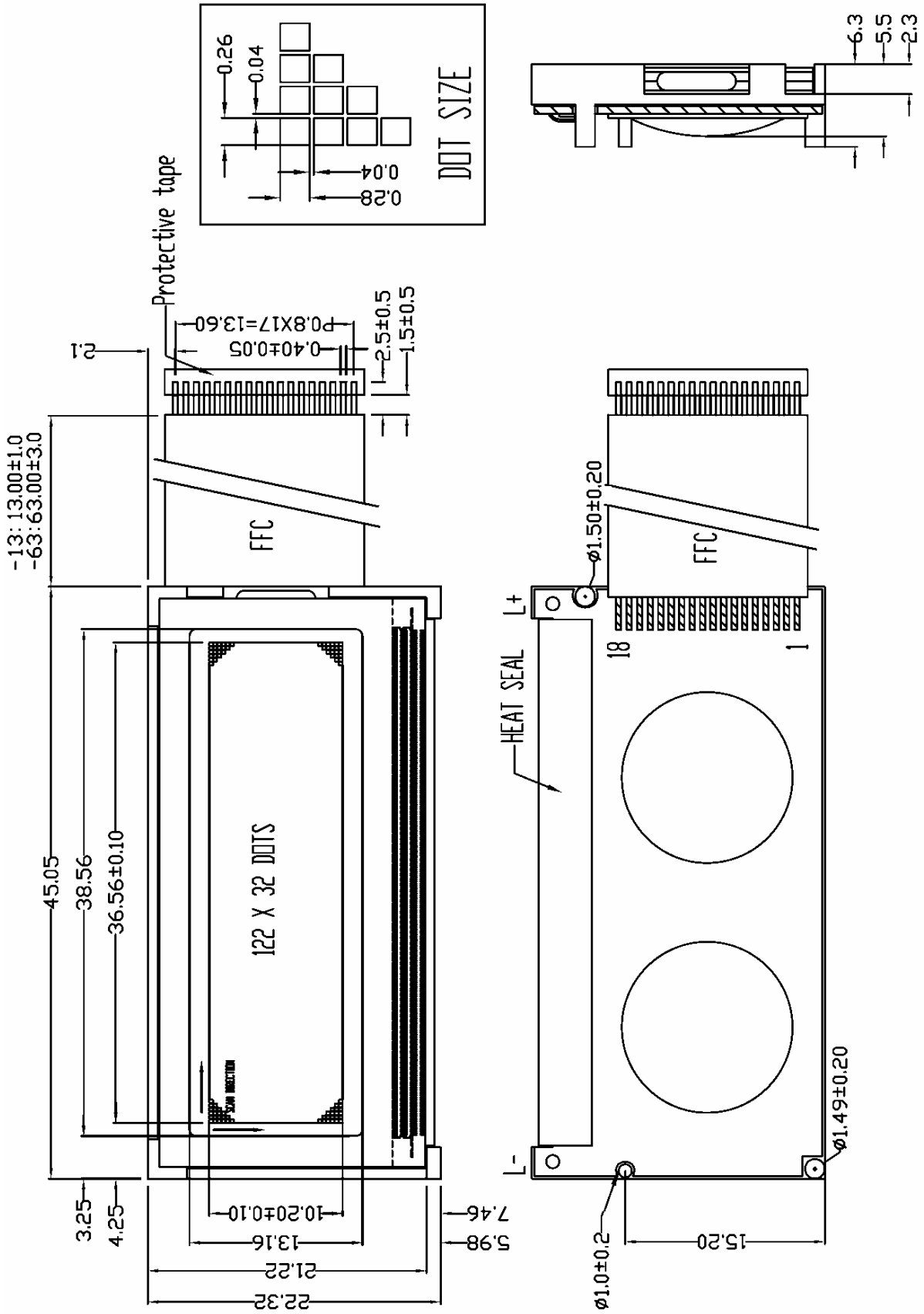
1) VO is referenced to both VDD and temperature. See table on page 6 for exact value(s).
2) /CS pins on both SED-1520 controllers are not accessible and internally set to generate an internal clock signal. Use "E1" & "E2" for Master/Slave SED 1520 Controller select.
3) This module can only use the 6800 style interface, and it is set by the state of the reset line. Reset occurs when reset line transitions Low to High. Reset line MUST be left in "High" signal level condition during normal module operation
4) If E1 & E2 are both active (high), and R/W line is set to Read (high), damage can occur to module due to bus contention causing serious over-current conditions.

1.7 LCM Power, Contrast Control and Bias



1.8 LCM Dimensions

■ **Module Dimensions**

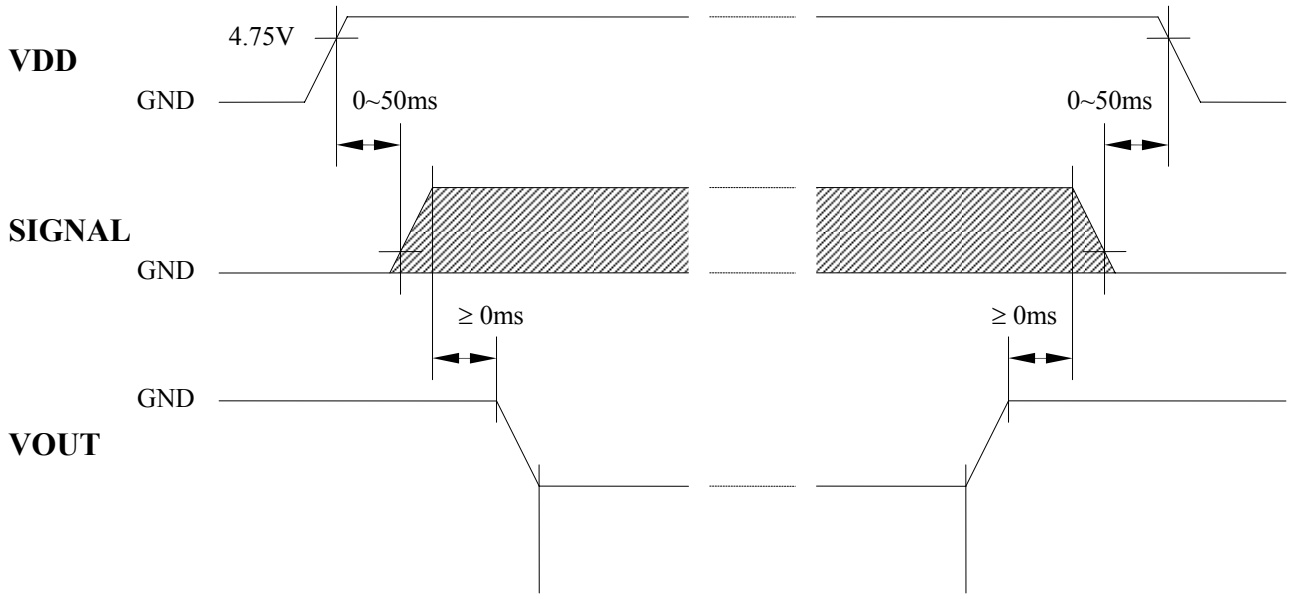


2. ELECTRICAL / OPTICAL CHARACTERISTICS

2.1 DC Electrical Characteristics (V_{DD} = +5V±10% , V_{SS} = 0V, Ta = 25°C)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for logic	V_{DD}	---	2.7	5.0	5.5	V
Supply current for logic	I_{DD}	---	---	0.3	1.0	mA
		0°C	5.2	5.5	5.8	V
Operating voltage for LCD	V_{DD} - Vo	25°C	4.8	5.1	5.4	V
		+50°C	4.7	5.0	5.1	V
Input voltage ' H ' level	VIH	---	0.7 V_{DD}	---	V_{DD}	V
Input voltage ' L ' level	VIL	---	0	---	0.3 V_{DD}	V

■ TIMING OF POWER SUPPLY



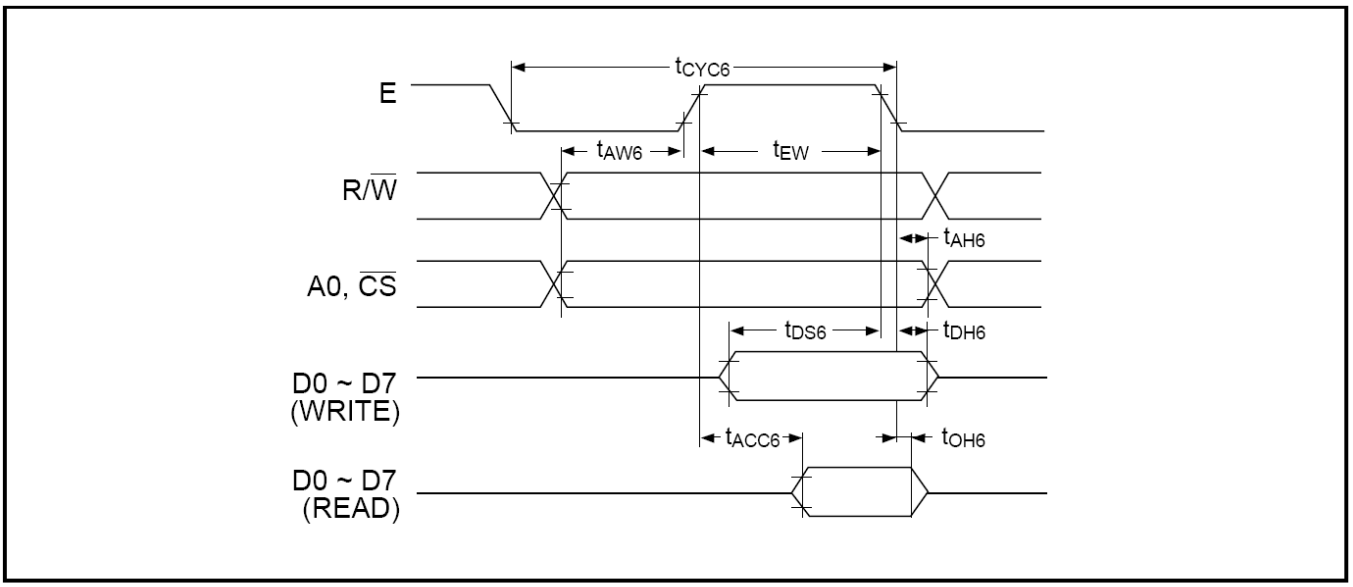
POWER ON POWER OFF

Note : The missing pixels may occur when the LCM is driven except above power supply timing sequence.

2.2 AC Electrical Characteristics

SED 1520 Graphic Controller IC AC Waveform Interface

6800 Family MPU Selected



Ta = –20 to 75°C, Vss = –5.0V ± 10%, Unit: ns

Signal	Symbol	Parameter		Min.	Max.	Condition
A0, CS R/W	t CYC6*1 t AW6 t AH6	System cycle time Address setup time Address hold time		1000 20 10		
D0–D7	t DS6 t DH6 tOH6 t ACC6	Data setup time Data hold time Output disable time Access time		80 10 10	 60 90	 CL = 100pF
E	t EW	Enable pulse width	Read Write	100 80	 	

*1. t CYC6 indicates the cycle time during which CS•E = "H". It does not mean the cycle time of signal E.

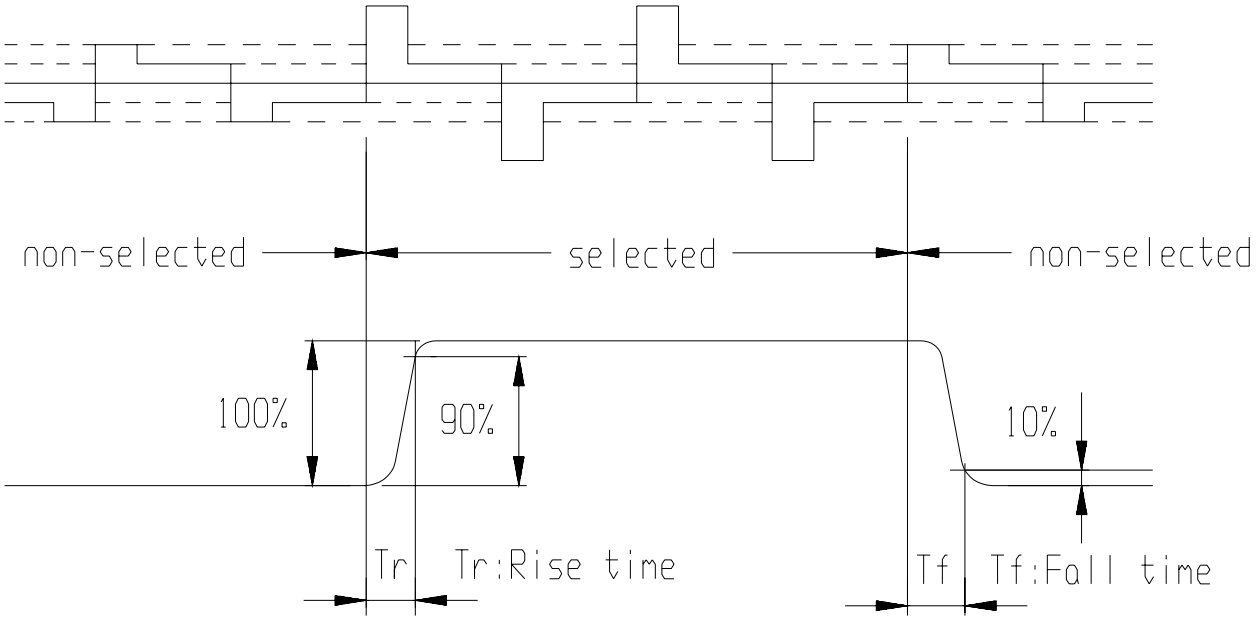
*2. Each of the values where Vss = –3.0V is about 200% of that where Vss = –5.0V (i.e., the listed value).

*3. The rise or fall time of input signals should be less than 15 ns.

2.3 Optical Characteristics (V_{OP} = 4.7V, Ta = 25°C)

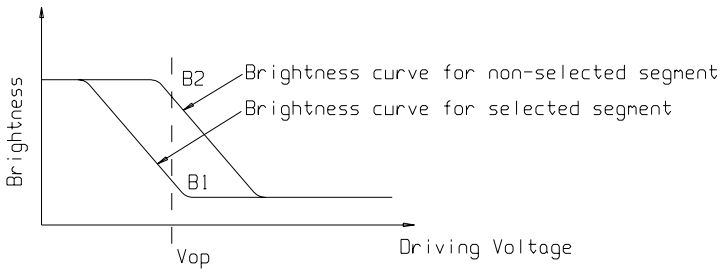
Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Response time	Tr	---	---	182	---	ms	---	1
	Tf	---	---	98	---	ms	---	1
Contrast ratio	Cr	---	---	26.9	---	---	---	2
Viewing angle range	θ	Cr ≥ 2	31	---	---	deg	∅ = 90°	3
			30	---	---	deg	∅ = 270°	3
			53	---	---	deg	∅ = 0°	3
			39	---	---	deg	∅ = 180°	3

Note1: Definition of response time.

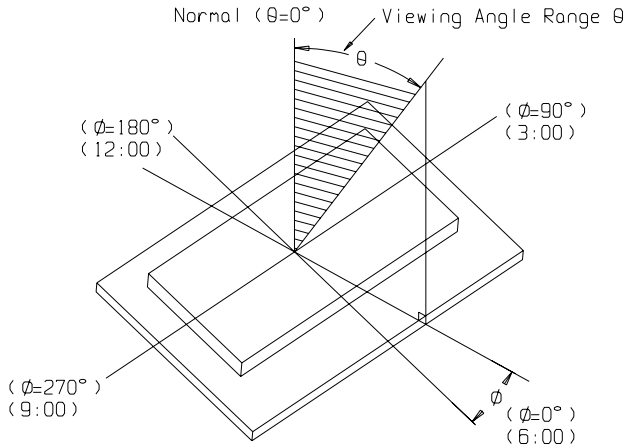


Note2: Definition of contrast ratio 'Cr' .

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



Note3: Definition of viewing angle range 'θ'.



2.4 LED Backlight Characteristics

■ Yellow-Green LED Operating Characteristics (Edge Lit)

Item	Symbol	Conditions	Standard			Unit
			Min.	Typ.	Max.	
Forward voltage	V_f	---	---	2.1	2.6	VDC
Forward Current	I_F	---	---	80	140	mA

Item	Conditions	Standard		Unit
		Min.	Max.	
Life	Ta= 25 °C	100,000	---	hrs

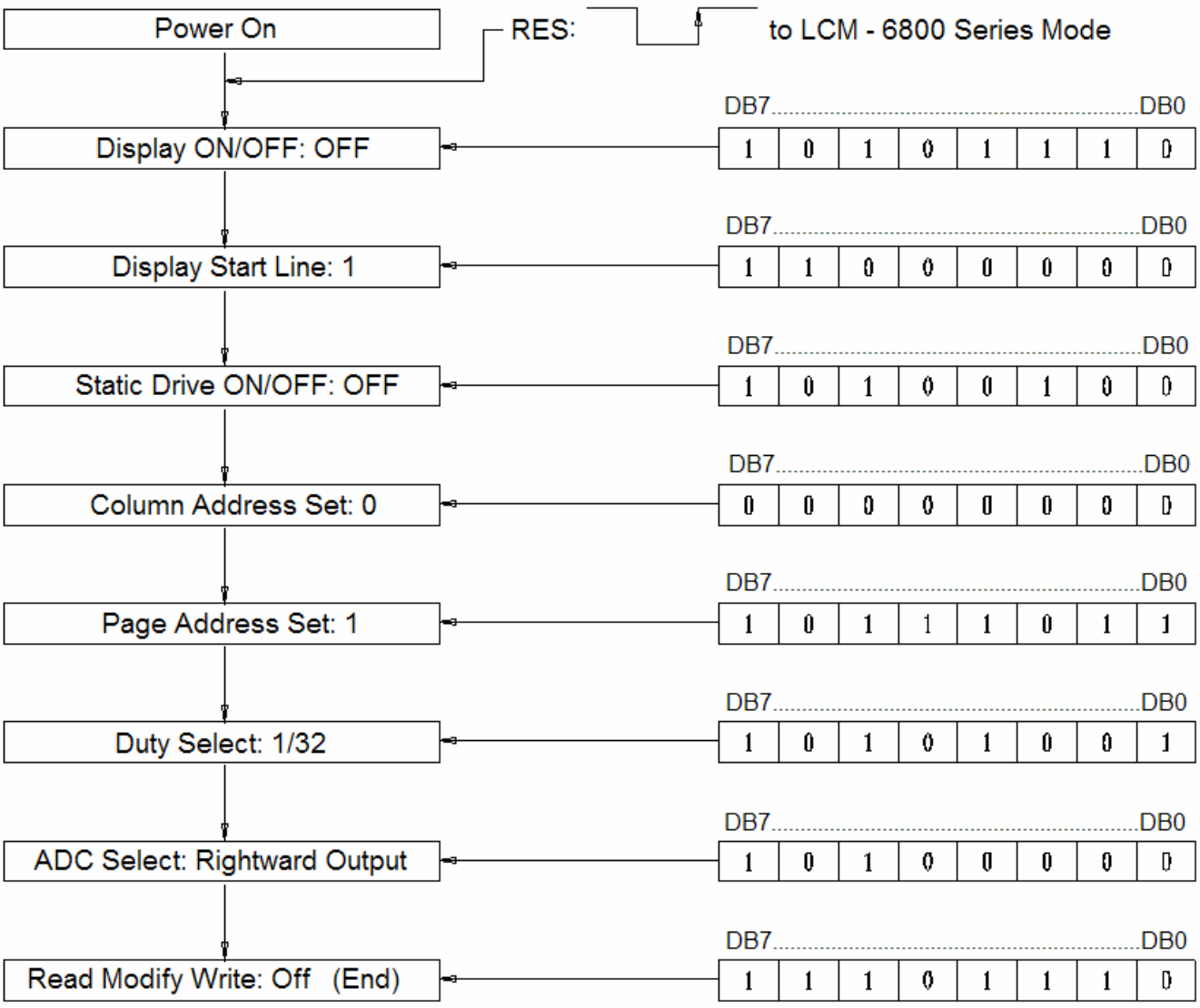
3. OPERATING PRINCIPALS AND METHODS

3.1 LCD Controller Display and Control Functions (SED1520 Controller)

Command	R/W	A0	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display ON/OFF	0	0	1	0	1	0	1	1	1	0/1	Switches the entire display ON or OFF, regardless of the display RAM担 data or the internal status. 1 : ON , 0 : OFF *1
Display Start Line	0	0	1	1	0	Display Start Address (0 ~ 31)					Determines the line of RAM data to be displayed at the display担 top line (COM0).
Page Address Set	0	0	1	0	1	1	1	0	Page (0 ~ 3)		Sets the page of the Display RAM in the Page Address register.
Column Address Set	0	0	0	Column Address (0 ~ 79)							Sets the column of the Display RAM in the Column Address register.
Status Read	1	0	BUSY	ADC	ON/OFF	RESET	0	0	0	0	Reads status. BUSY 0 : Ready 1 : Busy ADC 0 : Leftward output 1 : Rightward output ON/OFF 0 : Display ON 1 : Display OFF RESET 0 : Normal 1 : Reset
Write Display Data	0	1	Display Data								Writes the data on the data bus to Display RAM. These commands access a previously-specified address of the display RAM, after which the column address is incremented by one.
Read Display Data	1	1	Display Data								Reads the data from the Display RAM onto the data bus. These commands access a previously-specified address of the display RAM, after which the column address is incremented by one.
ADC Select	0	0	1	0	1	0	0	0	0	0/1	Used to reverse the correspondence between the Display RAM担 column address and segment driver output ports. 0 : Rightward output 1 : Leftward output
Static Drive ON/OFF	0	0	1	0	1	0	0	1	0	0/1	Selects normal display operation or static all-lit drive display operation. 0 : Normal display operation 1 : Static drive (Power save) *1
Duty Select	0	0	1	0	1	0	1	0	0	0/1	Select LCD duty cycle. 1: 1/32 , 0: 1/16
Read Modify Write	0	0	1	1	1	0	0	0	0	0	Increments the column address counter by one only when display data is written but not when it is read.
End	0	0	1	1	1	0	1	1	1	0	Cancels the Ready Modify Write mode.
Reset	0	0	1	1	1	0	0	0	1	0	Resets the Display Start Line to the 1st line in the register. Resets the column address counter to 0 and page address register to 3.

*1. Power Save Mode is entered by selecting static drive in the Display OFF status.

■ Initialization



3.2 LCD Controller Display Data Ram Address Map

■ DISPLAY DATA RAM ADDRESS MAP

<table>
<tr><td>Page</td><td>Data</td><td colspan="2"></td><td>Com NO.</td><td>Driver</td></tr>
<tr><td>1</td><td>DB0
.....
DB7</td><td colspan="2" rowspan="2">122 X 16 Pixels</td><td rowspan="2">0
|
15</td><td rowspan="2">Master</td></tr>
<tr><td>2</td><td>DB0
.....
DB7</td></tr>
<tr><td>3</td><td>DB0
.....
DB7</td><td colspan="2" rowspan="2">122 X 16 Pixels</td><td rowspan="2">16
|
31</td><td rowspan="2">Slave</td></tr>
<tr><td>4</td><td>DB0
.....
DB7</td></tr>
<tr><td></td><td>Seg NO.</td><td>0 —— 60</td><td>0 —— 60</td><td colspan="2"></td></tr>
<tr><td></td><td>Driver</td><td>Master</td><td>Slave</td><td colspan="2"></td></tr>
</table>

4. RELIABILITY

Environmental Test				
No.	**Test Item**	**Content of Test**	**Test Condition**	**Applicable Standard**
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	60 °C 200 hrs	------
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-10 °C 200 hrs	------
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50 °C 200 hrs	------
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	0 °C 200 hrs	------
5	High temperature / Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	60 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature / Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -20°C 30min ⇌ 25°C 5min. ⇌ 70°C 30min ⟷ 1 cycle	-10°C / 60°C 10 cycles	------
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz → 1.5mmp-p 22~500Hz → 1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msedc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V , RS=1.5 kΩ CS=100 pF 1 time	MIL-883B-3015.1

*** Supply voltage for logic system = VDD. Supply voltage for LCD system = Operating voltage at 25°C

■ LCD Panel Service Life

Definition of panel service life

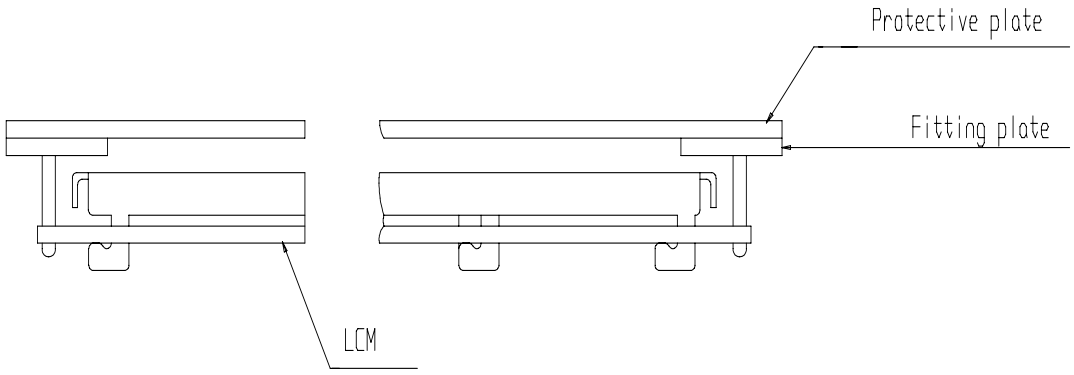
- 100,000 hours minimum at 25° C ±10%
- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCD cell layer
- Unusual operation occurs in display functions

5. PRECAUTIONS FOR USING LCD MODULES

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

Precaution for Handing LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.
2) Do not alter, modify or change the shape of the tab on the metal frame.
3) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
4) Do not damage or modify the pattern writing on the printed circuit board.
5) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
6) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
7) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

1) Make certain that you are grounded when handing LCM.
2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

Precaution for soldering to the LCM

1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
   a) Soldering iron temperature : 280°C ± 10°C.
   b) Soldering time : 3-4 sec.
2) Solder : eutectic solder.

3) If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.
4) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
5) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.
2) Driving the LCD in the voltage above the limit shortens its life.
3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

Safety

- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling

- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :
    - Isopropyl alcohol
    - Ethyl alcohol
- Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
    - Water
    - Ketone
    - Aromatic solvents
- Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- Do not attempt to disassemble or process the LCD module.
- NC terminal should be open. Do not connect anything.
- If the logic circuit power is off, do not apply the input signals.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
    - Be sure to ground the body when handling the LCD modules.
    - Tools required for assembling, such as soldering irons, must be properly grounded.
    - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
    - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage

- When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps
- Store the module in a dark place where the temperature is 25 ^{o}C ±10 ^{o}C and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crush, shake, or jolt the module (including accessories).

Cleaning

- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with soft cloth soaked with a petroleum benzene.
- Do not use ketonic solvents (ketone and acetone) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

Others:

- Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.
    - Exposed area of the printed circuit board.
    - Terminal electrode sections.