

■ Absolute Maximum Ratings

Item	Symbol	Value	Unit
Power Supply Voltage	$V_{DD} - V_{SS}$	$-0.3 \sim +7.0$	V
Driver Supply Voltage	V_{LCD}	$-0.3 \sim V_{DD} + 0.3$	
Input Voltage	V_{IN}	$-0.3 \sim V_{DD} + 0.3$	
Operating temperature range	T_{OP}	$0 \sim +50$	°C
Storage temperature range	T_{ST}	$-20 \sim +60$	

■ Description of Terminals

Symbol	Input/ Output	External Connection	Function				
R S	Input	M P U	Register selection input				
			<table><tr><td>High</td><td>Data register (for read and write)</td></tr><tr><td>Low</td><td>Instruction register (for write) Busy flag, address counter (for read)</td></tr></table>	High	Data register (for read and write)	Low	Instruction register (for write) Busy flag, address counter (for read)
High	Data register (for read and write)						
Low	Instruction register (for write) Busy flag, address counter (for read)						
R / W	Input	M P U	R/W signal input is used to select the read/write mode				
			<table><tr><td>High</td><td>Read mode</td></tr><tr><td>Low</td><td>Write mode</td></tr></table>	High	Read mode	Low	Write mode
High	Read mode						
Low	Write mode						
E	Input	M P U	Start enable signal to read or write the data				
DB 4 DB 7	Input/ Output	M P U	Four high order bidirectional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.				
DB 0 DB 3	Input/ Output	M P U	Four low order bidirectional three-state data bus lines. Used for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.				
V d d V s s		Power Supply	V d d : + 5 V V s s : G N D				
V o		Power Supply	Contrast adjustment voltage				

ELECTRICAL CHARACTERISTICS Dc Characteristics

Parameter	Symbol	Condition	Applicable PIN	Min.	Typ	Max.	Unit
H level input voltage(1)	Vih1	—	D80 ~ D87	2.0	—	Vdd	V
L level input voltage(1)	Vil1	—	RS, R/W, E	Vss	—	0.8	V
H level input voltage(2)	Vih2	—	OSC1	Vdd-1.0	—	Vdd	V
L level input voltage(2)	Vil2	—		Vss	—	1.0	V
H level output voltage(1)	Voh1	Ioh=-0.205mA	D80 ~ D87	2.4	—	—	V
L level output voltage(1)	Vol1	Iol=1.6mA		—	—	0.4	V
H level output voltage(2)	Voh2	Ioh=-40uA	XSC LP D0	0.9Vdd	—	—	V
L level output voltage(2)	Vol2	Iol=40uA		—	—	0.1Vdd	V
I/o leakage current	Iil	Vl=0 to Vdd		—	—	1	uA
Pull-UP Mos Current	-Ip	Vdd=5V		50	125	250	uA
Supply current	Iop	Rf oscillation .from external clock Vdd=5v fosc= fcp=270kHz	Vdd	—	0.5	0.8	mA

Internal clock operation (Rf oscillation)

Oscillation frequency	fosc	Rf=91kΩ ± 2%	OSC1 OSC2	190	270	350	kHz
Oscillation frequency	fosc	Ceramic filter	OSC1 OSC2	245	250	255	kHz
LCD driving voltage	Vlcd	Vdd-V5	V1~V5	3.0	—	Vdd	V

AC Characteristics (Vdd=5V±10%, Vss=0V, Ta=25℃)
Read Cycle

Parameter	Symbol	Min	Typ	Max	Unit	TEST PIN
Enable cycle time	tc	500	—	—	ns	E
Enable "H" level pulse width	tw	220	—	—	ns	E
Enable rise/fall time	tr,tf	—	—	25	ns	E
RS,R/W setup time	tsu	40	—	—	ns	R/W,RS
RS,R/W address hold time	th	10	—	—	ns	R/W,RS
Read data output delay	td	—	—	120	ns	DB0~DB7
Read data hold time	tdh	20	—	—	ns	DB0~DB7

Write Cycle

Parameter	Symbol	Min	Typ	Max	Unit	TEST PIN
Enable Cycle time	tc	500	—	—	ns	E
Enable H level pulse width	tw	220	—	—	ns	E
Enable rise/fall time	tr,tf	—	—	25	ns	E
RS,R/W setup time	tsu1	40	—	—	ns	R/W,RS
RS,R/W address hold time	th1	10	—	—	ns	R/W,RS
Data setup time	tsu2	60	—	—	ns	DB0~DB7
Write data hold time	th2	10	—	—	ns	DB0~DB7

Optical Characteristics

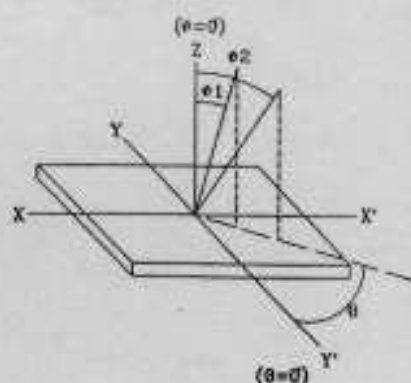
1. STN TYPE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	$\phi 2 - \phi 1$	$K=1.4$	40	—	—	deg.	*1,*2
Contrast Ratio	K	$\phi = 10^{\circ}\text{C}$ $\theta = 0^{\circ}\text{C}$	—	3	—	—	*3
Response Time(Rise)	tr	$\phi = 10^{\circ}\text{C}$ $\theta = 0^{\circ}\text{C}$	—	150	250	ms	*4
Response Time(Fall)	tf	$\phi = 10^{\circ}\text{C}$ $\theta = 0^{\circ}\text{C}$	—	200	300	ms	*4

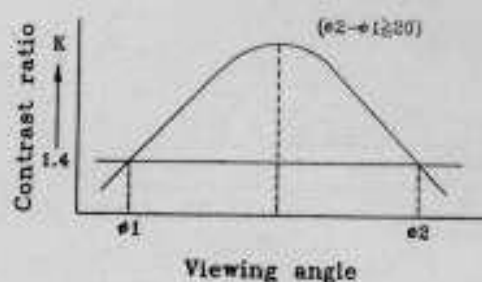
2. TN TYPE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	$\phi 2 - \phi 1$	$K=1.4$	60	—	—	deg.	*1,*2
Contrast Ratio	K	$\phi = 25^{\circ}\text{C}$ $\theta = 0^{\circ}\text{C}$	—	3	—	—	*3
Response Time(Rise)	tr	$\phi = 25^{\circ}\text{C}$ $\theta = 0^{\circ}\text{C}$	—	80	120	ms	*4
Response Time(Fall)	tf	$\phi = 25^{\circ}\text{C}$ $\theta = 0^{\circ}\text{C}$	—	60	90	ms	*4

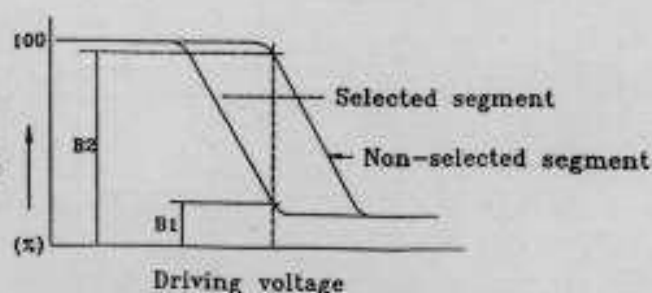
*1. Definition of ϕ AND θ



*2. Contrast vs viewing angle

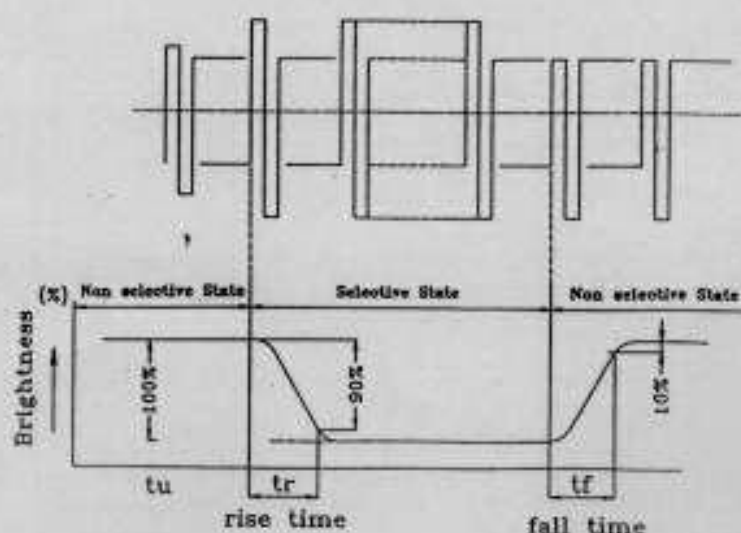


*3. definition of contrast ratio



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

*4. Definition of optical response



■ LED BACKLIGHT

Long life, low power consumption and simple power supply. Three different color of red, green and orange are available, or color can be changed alternatively. 2 back light methods are available, beneath illumination and side illumination.

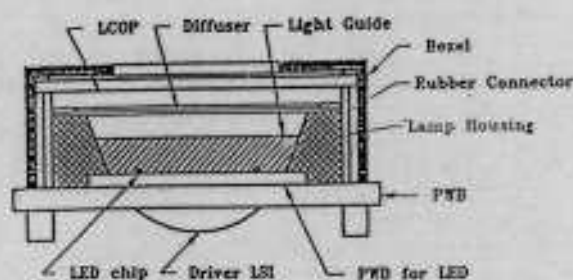
Features

- Low voltage deiving(DC) is available.
- Low life time 100,000 hours (average).
- No noise occurrence.

- Various color of red, green and orange etc.
(multi-color by alternative switch is also available)
- Operating characteristics
EX:PC 2002-A series is $IF=210mA$,
 $IV=250\text{ cd/m}^2$.

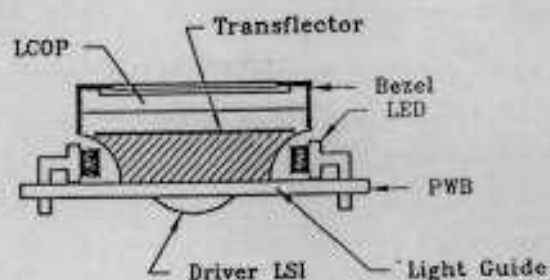
■ Beneath Illumination

Less quantity of chip even illumination.



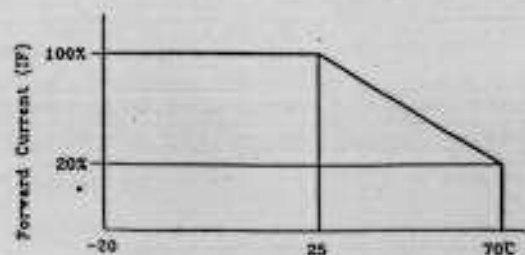
■ Side Illumination

Combination LED with light guide offers thin structure type of illumination.

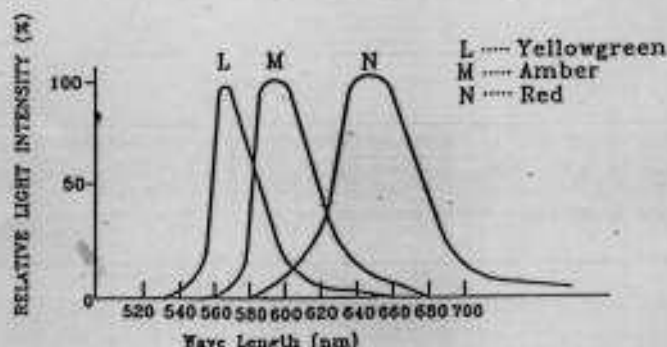


Electrical Characteristics (Reference Date)

- Forward current
Derating Curve

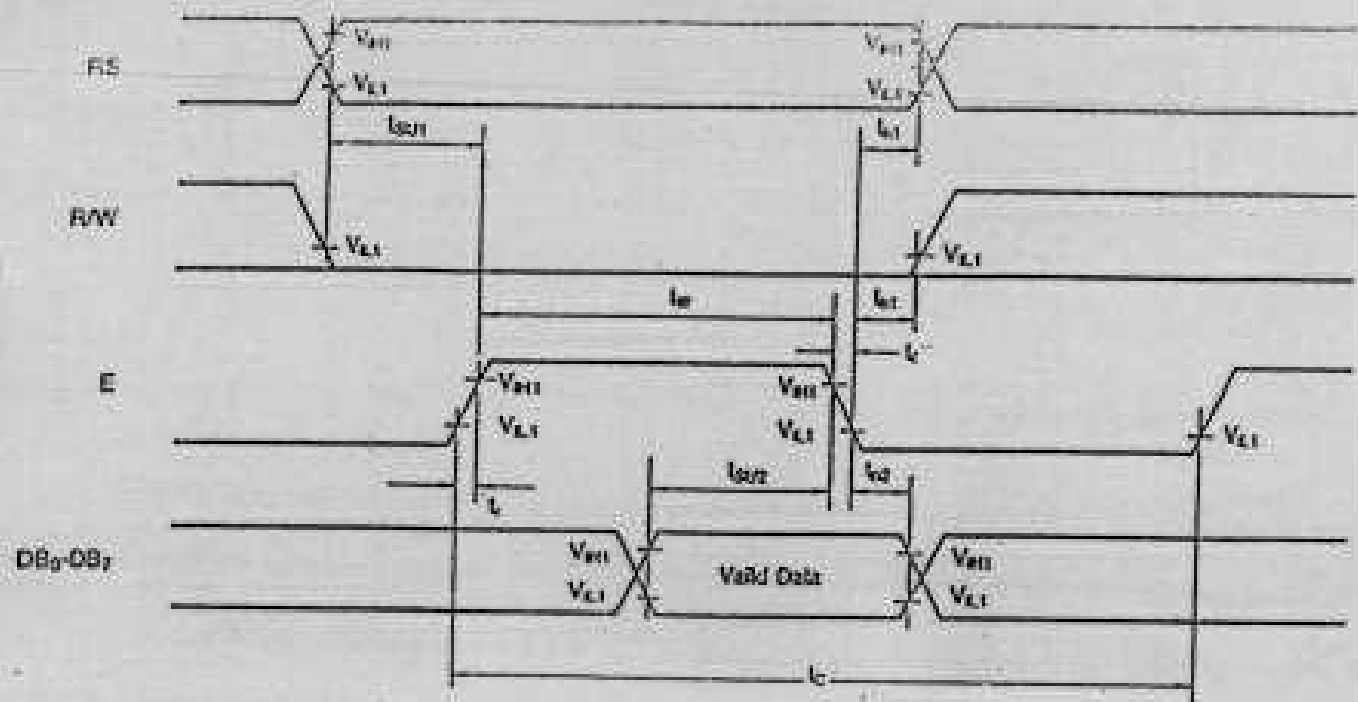


- Wave Length vs Relative Light Intensity

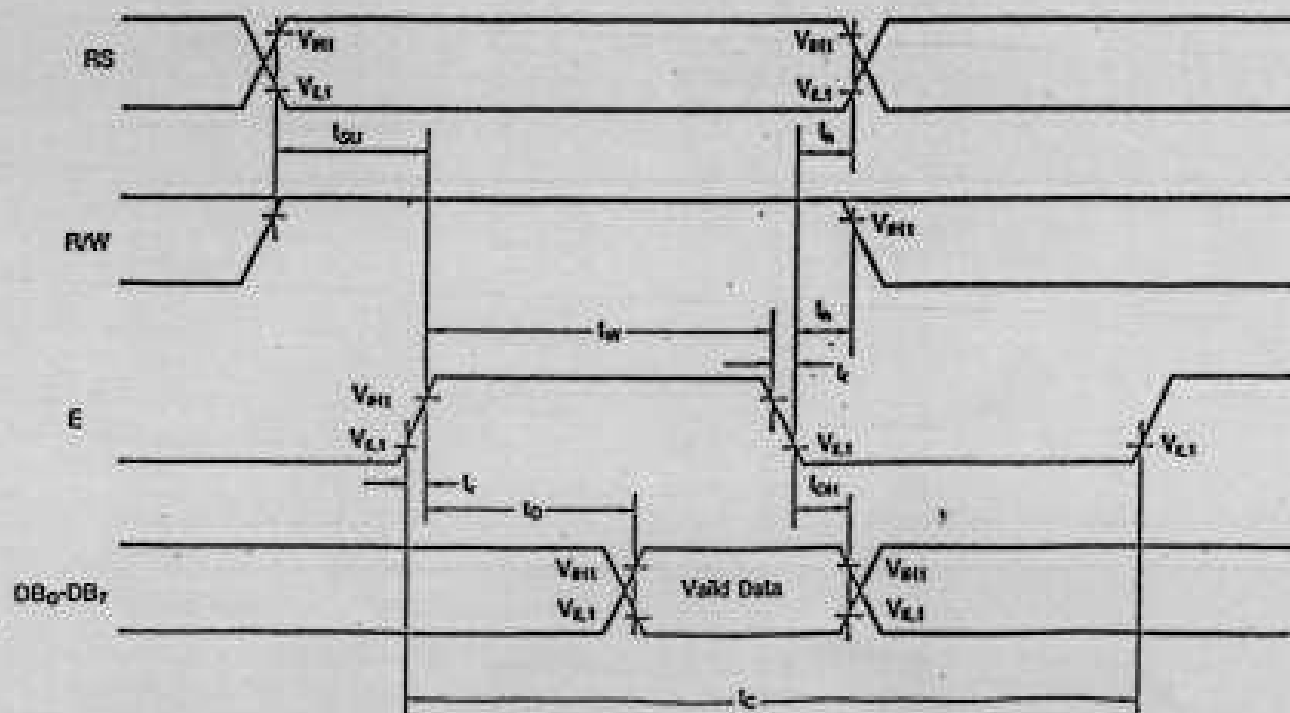


Timing Characteristics

(1) Write mode



(2) Read mode



■ DISPLAY COMMAND

■ DISPLAY COMMAND											
Parameter	XS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	DESCRIPTION
CLEAR DISPLAY	0	0	0	0	0	0	0	0	0	1	
CURSOR HOME	0	0	0	0	0	0	0	0	1	*	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	SR	DB1=1: Increment DB1=0: Decrement DB0=1: The display is shifted DB0=0: The display is not shifted
DISPLAY ON/OFF	0	0	0	0	0	0	1	0	C	B	DB2=1: Display on DB2=0: Display off DB1=1: Cursor on DB1=0: Cursor off DB0=1: Breathing on DB0=0: Breathing off
CURSOR/ DISPLAY SHIFT	0	0	0	0	0	1	S/C	R/L	=	=	DB3=1: Shifts display one character DB2=1: Right shift DB2=0: Left shift
FUNCTION SET	0	0	0	0	1	DL	N	F	=	=	DB4=1: 8 bits DB4=0: 4 bits DB3=1: 2 lines display (1/16 duty) DB3=0: 1 line display (DB2=1: 5×10 dots, 1/ 11 duty DB2=0: 5×7 dots, 1/8 duty)
SET COMMAND ADDRESS	0	0	0	1	ACC						The address length that can be set is 16 addresses
SET DATA ADDRESS	0	0	1	ADD						The address length that can be set is 80 addresses	
READ BUSY FLAG/ ADDRESS COUNTER	0	1	13/F	A/C						DB7=1: Busy (instruction not accepted) DB7=0: Ready (instruction accepted)	
WRITE DATA	1	0	Write Data								
READ DATA	1	1	Read Data								

NOTE: = Don't care.

[illegible]