

■ Absolute Maximum Rating

I T E M	S y m b o l	V a l u e	U n i t
Power Supply Voltage	Vdd -Vss	-0.3~+7.0	V
Driver Supply Voltage	Vlcd	-0.3~Vdd+0.3	
Input Voltage	Vin	-0.3~Vdd+0.3	
Operating temperature range	Top	0~+50	℃
Storage temperature range	Tst	-20~+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				
D B 4 D B 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.				
D B 0 D B 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				

ELECTRAL CHARACTERISTICS Dc Characteristics

Parameter	Symbol	Condition	Applicable PIN	Min.	Typ	Max.	Uni
H level input voltage(1)	Vih1	—	DB0 ~ DB7	2.0	—	Vdd	V
L level input voltage(1)	Vil1	—	RS,R/V,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	DB0 ~ DB7	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 DO	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	Vled	Vdd-V5	V1~V5	3.0	—	Vdd	V

AC Characteristics (V_{dd}=5V±10%, V_{ss}=0V, T_a=25℃)
Read Cycle

Parameter	Symbol	Min	Typ	Max	Unit	TEST PIN
Enable cycle time	t _c	500	—	—	ns	E
Enable "H" level pulse width	t _w	220	—	—	ns	E
Enable rise/fall time	t _r , t _f	—	—	25	ns	E
RS, R/W setup time	t _{su}	40	—	—	ns	R/W, RS
RS, R/W address hold time	t _h	10	—	—	ns	R/W, RS
Read data output delay	t _d	—	—	120	ns	DB0~DB7
Read data hold time	t _{dh}	20	—	—	ns	DB0~DB7

Write Cycle

Parameter	Symbol	Min	Typ	Max	Unit	TEST PIN
Enable Cycle time	t _c	500	—	—	ns	E
Enable H level pulse width	t _w	220	—	—	ns	E
Enable rise/fall time	t _r , t _f	—	—	25	ns	E
RS, R/W setup time	t _{su1}	40	—	—	ns	R/W, RS
RS, R/W address hold time	t _{h1}	10	—	—	ns	R/W, RS
Data setup time	t _{su2}	60	—	—	ns	DB0~DB7
Write data hold time	t _{h2}	10	—	—	ns	DB0~DB7

Optical Characteristics

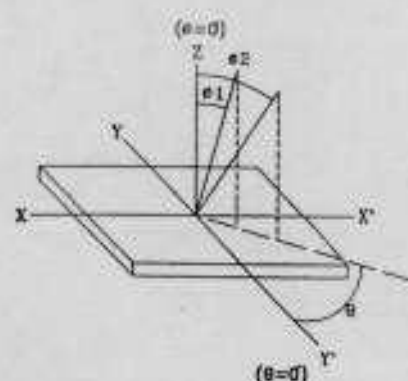
1. STN TYPE

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

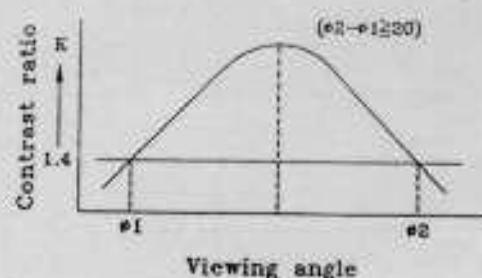
2. TN TYPE

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

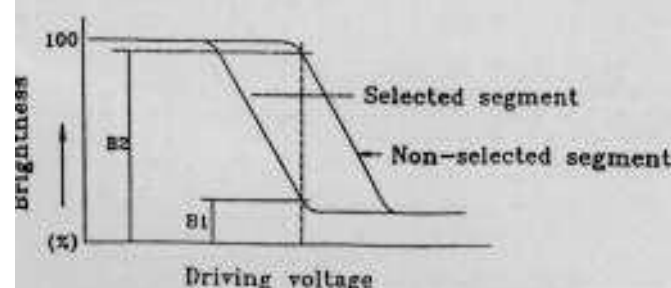
*1. Definition of Q AND ϕ



*2. Contrast vs viewing angle

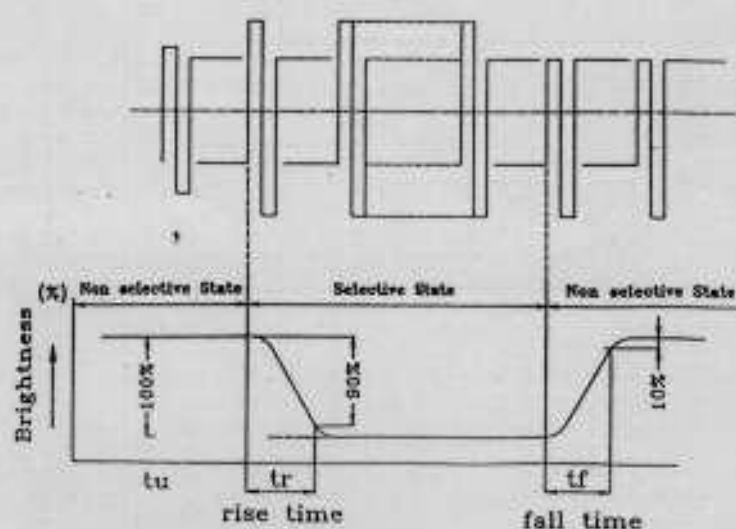


*3. definition of contrast ratio



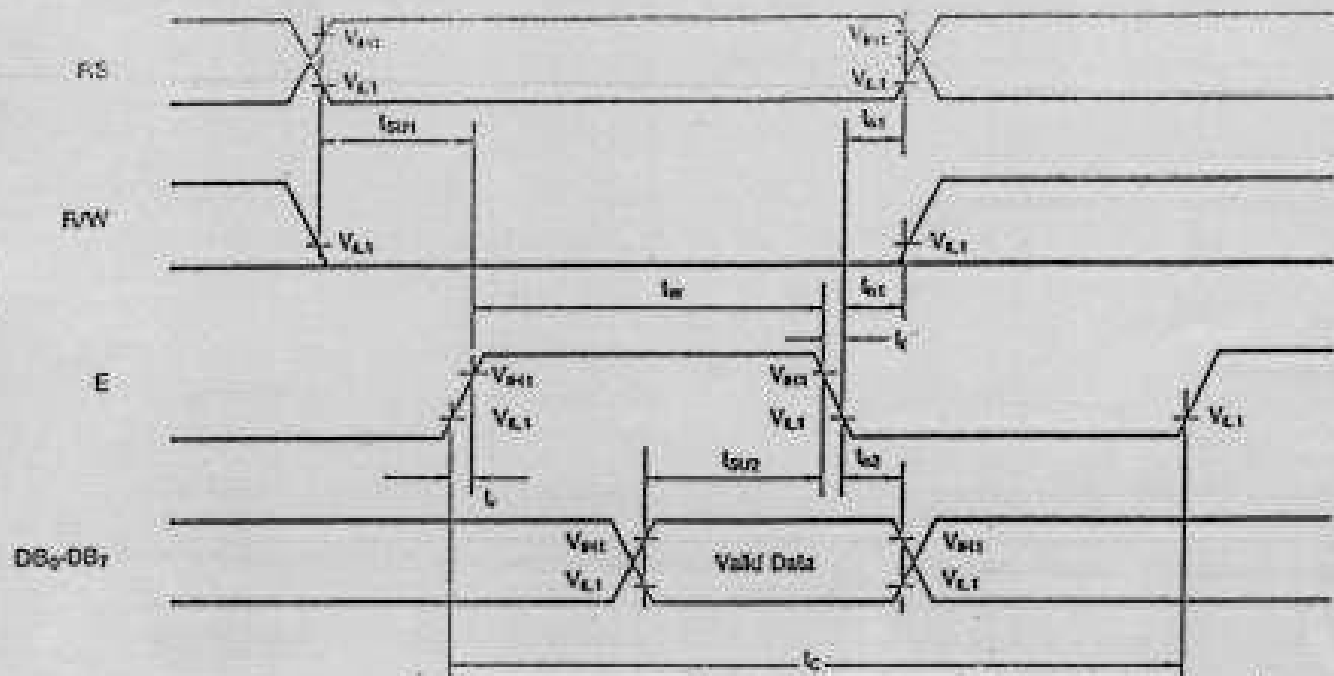
$$K = \frac{\text{Brightness of non-selected segment}(B2)}{\text{Brightness of selected segment}(B1)}$$

*4. Definition of optical response

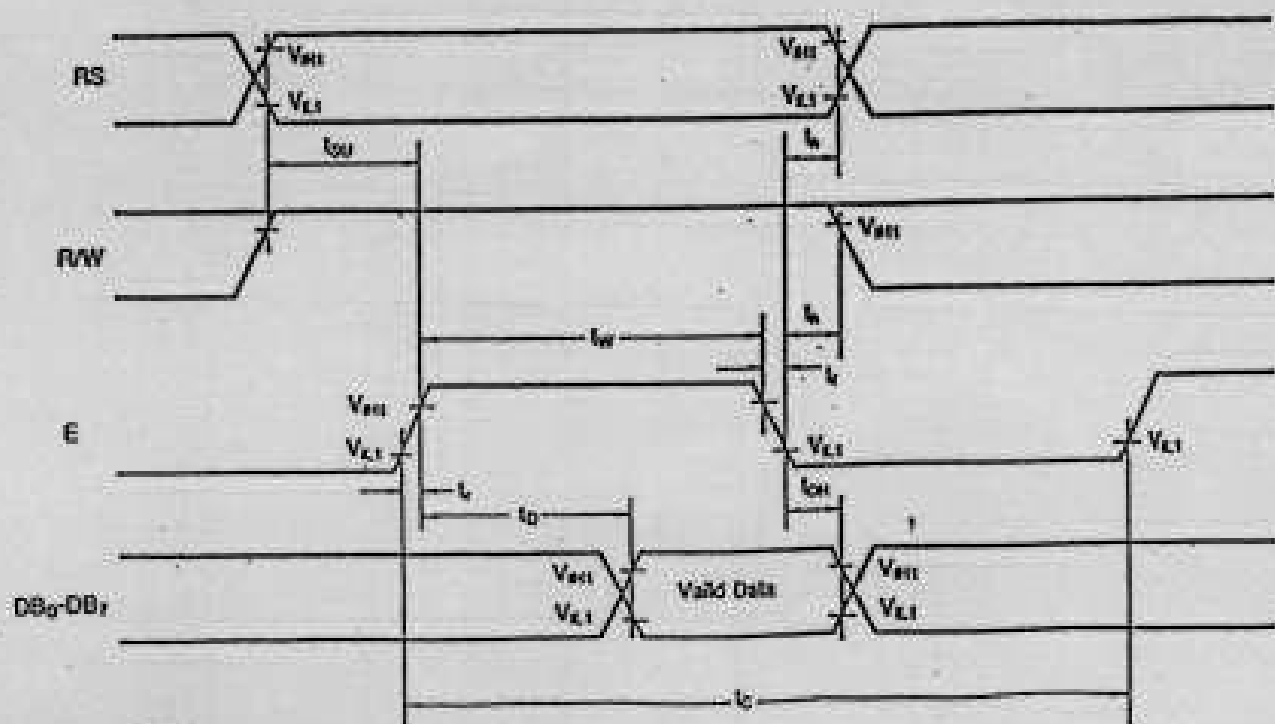


■ Timing Characteristics

(1) Write mode



(2) Read mode



■ DISPLAY COMMAND

4 DISPLAY COMMAND											
Parameter	RS	R/V	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	0	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	S/H	DB3=1: Increment DB3=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	D	C	B	DB2=1: Display on DB2=0: Display off DB1=1: Cursor on DB1=0: Cursor off DB0=1: Blinking on DB0=0: Blinking 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	H	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 CORAM ADDRESS	0	0	0	1	A C0						The address length that can be set is 64 addresses
SET DDRAH ADDRESS	0	0	1	A D0						The address length that can be set is 80 addresses	
READ BUSY FLAG/ ADDRESS COUNTER	0	1	BF	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								

