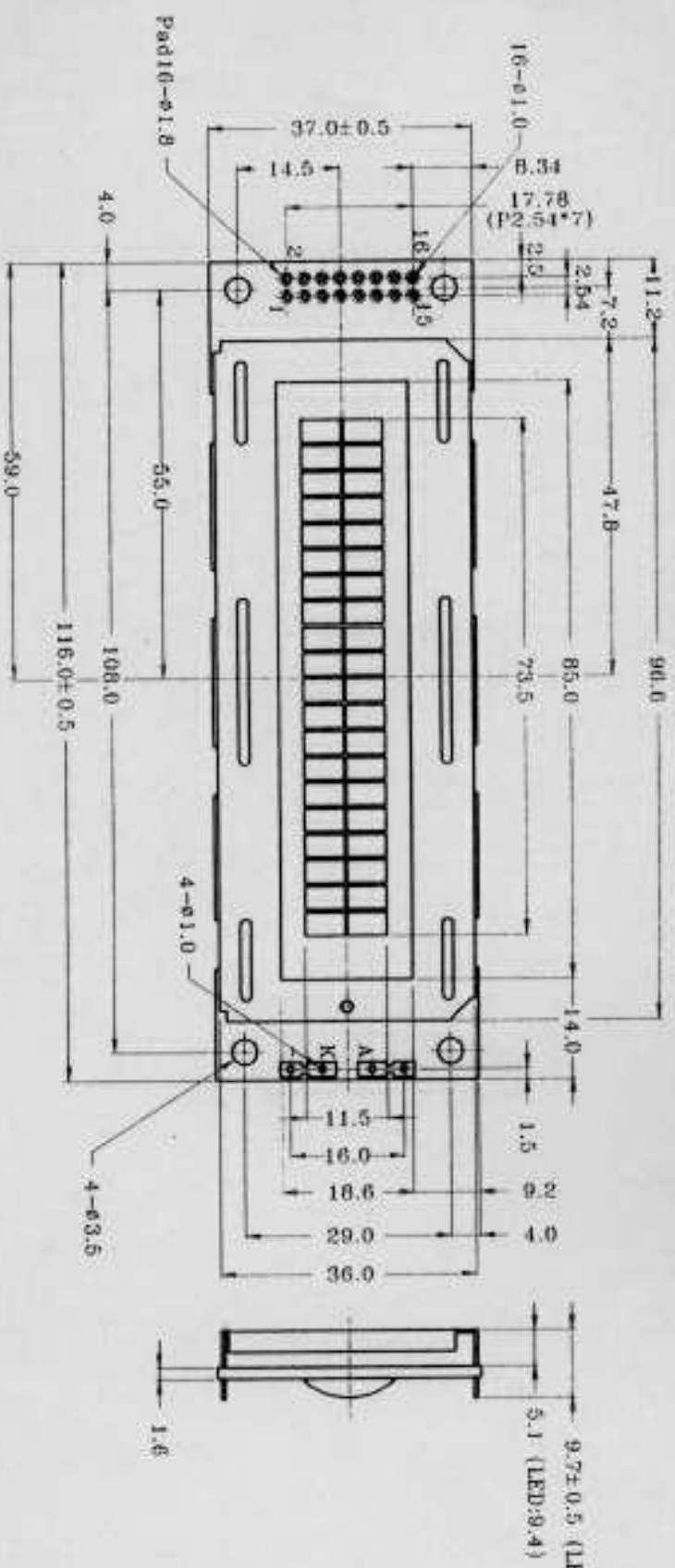
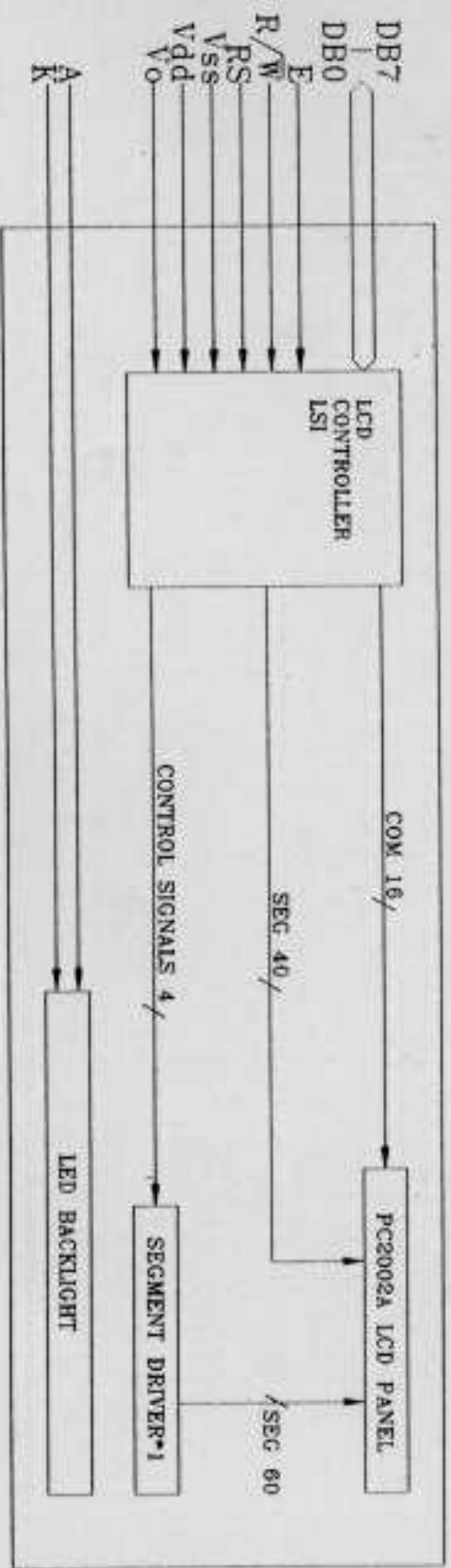




SCALE: 4/1



The tolerance unless classified $\pm 0.3\text{mm}$

UNIT:mm

PIN NO.	SIGNAL
1	VSS
2	Vdd
3	Vo
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K

■ 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	$V_{dd} - V_{ss}$	$-0.3 \sim +7.0$	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

S y m b o l	I n p u t / O u t p u t	E x t e r n a l C o n n e c t i o n	F u n c t i o n
R S	Input	M P U	Register selection input
			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
			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

ELECTRAL CHARACTERISTICS Dc Characteristics

Parameter	Symbol	Condition	Applicable PIN	Min.	Typ	Max.	Unit
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 D0	0.9Vdd	—	—	V
L level output voltage(2)	Vol2	Iol=40uA		—	—	0.1Vdd	V
I/o leakage current	Iil	VI=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

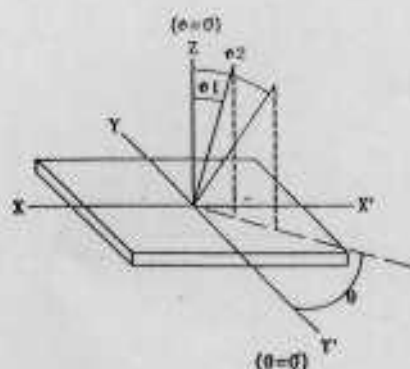
1. STN TYPE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	ϕ 2- ϕ 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	ns	#4
Response Time(Fall)	tf	$\phi = 10^\circ$ $\theta = 0^\circ$	—	200	300	ns	#4

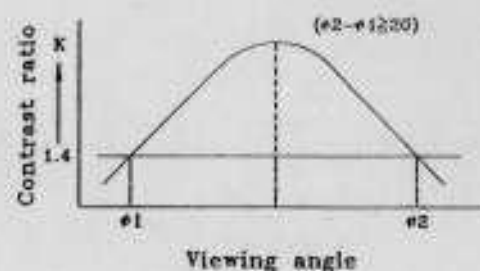
2. TN TYPE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	ϕ 2- ϕ 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	ns	#4
Response Time(Fall)	tf	$\phi = 25^\circ$ $\theta = 0^\circ$	—	60	90	ns	#4

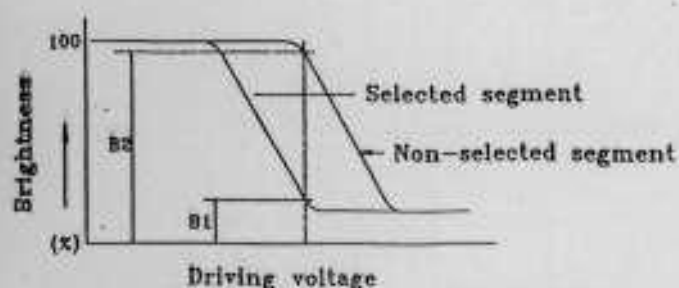
*1. Definition of ϕ AND θ



*2. Contrast vs viewing angle

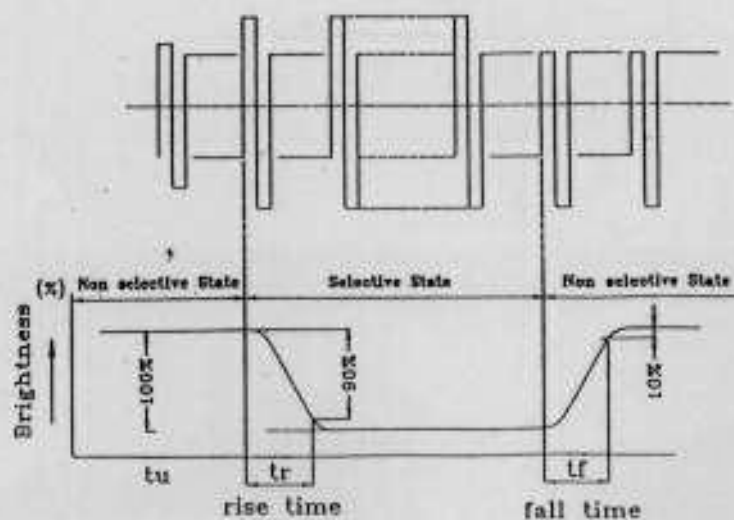


*3. definition of contrast ratio



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

*4. Definition of optical response



■ LED BACKLIGHT

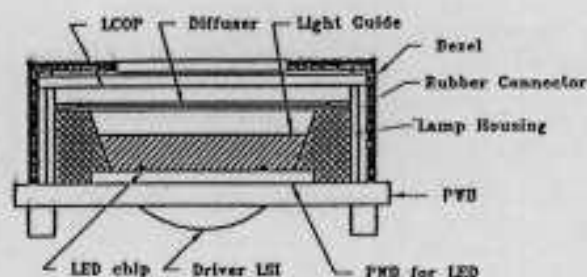
Long life, low power consumption and simple power supply. Three different color of red, green and orange are available, or color can be changed alternatively. 2 back light methods are available, beneath illumination and side illumination.

Features

- Low voltage driving (DC) is available.
- Long 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 $IF=210mA$, $IV=250\text{ cd/m}^2$.

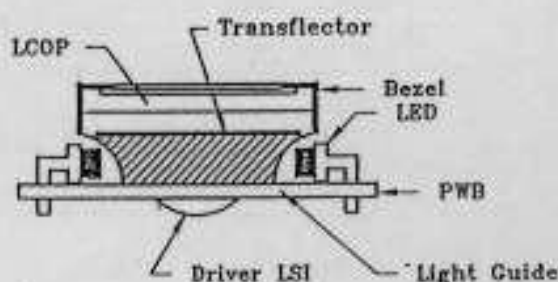
■ Beneath Illumination

Less quantity of chip even illumination.



■ Side Illumination

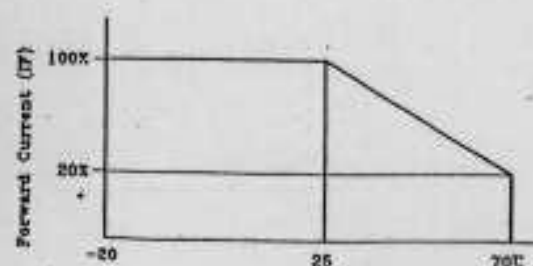
Combination LED with light guide offers thin structure type of illumination.



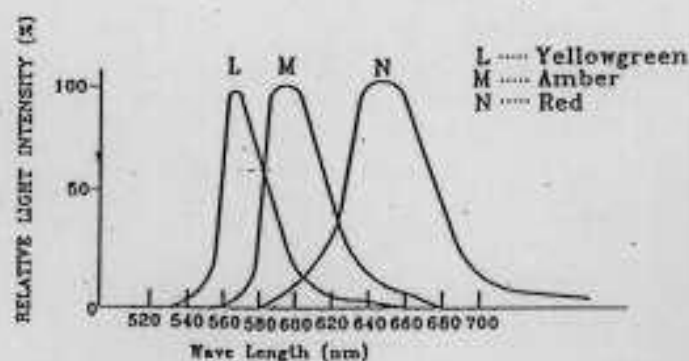
Electrical Characteristics

(Reference Date)

- Forward current Derating Curve

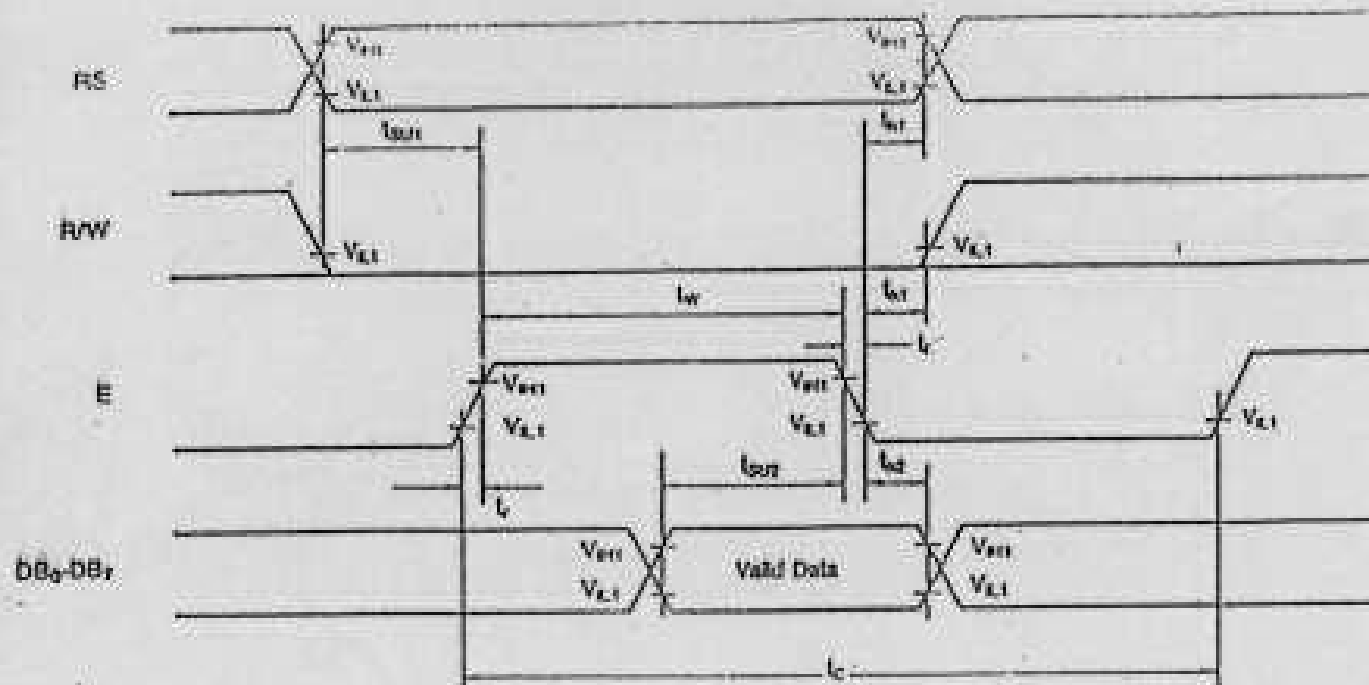


- Wave Length vs Relative Light Intensity

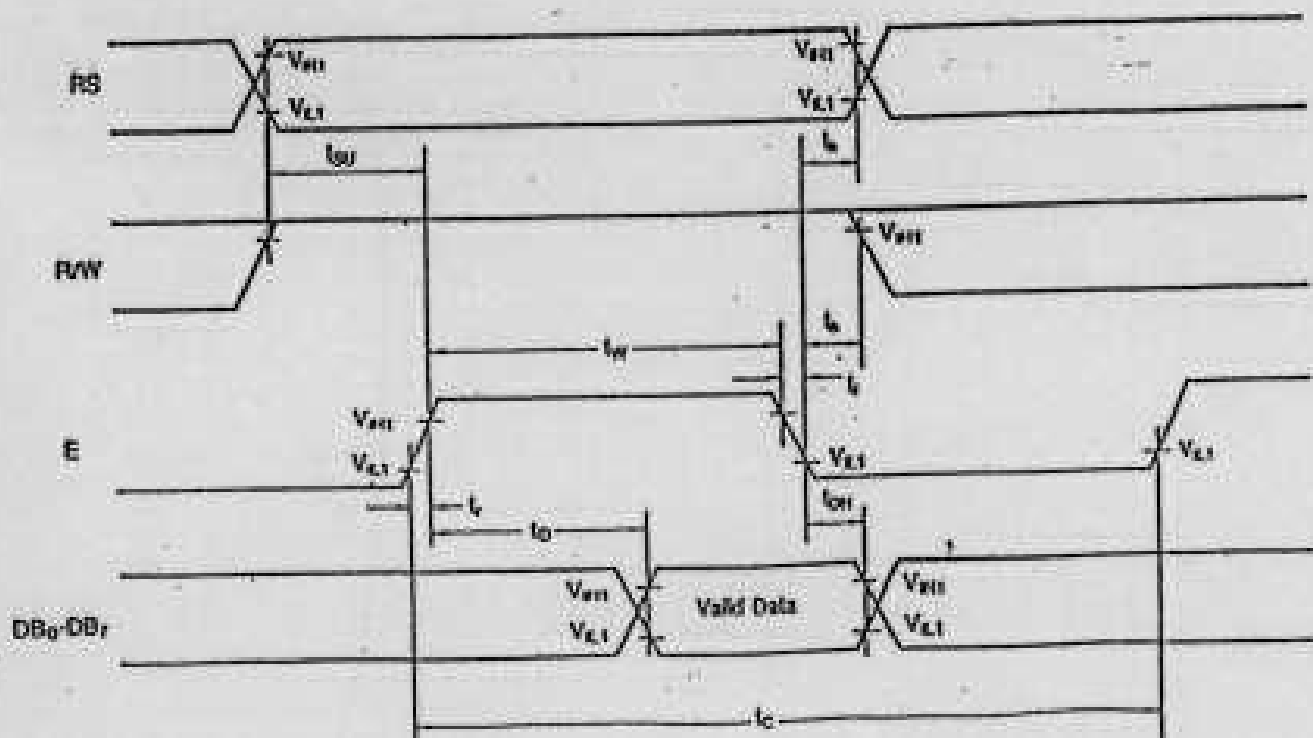


Timing Characteristics

(1) Write mode



(2) Read mode



M 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	±	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/O	SH	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-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 CGRAM ADDRESS											The address length that can be set in 80 addresses
SET DDRAW ADDRESS	0	0	1								The address length that can be set in 80 addresses
READ BUSY FLAG/ ADDRESS COUNTER	0	1	B F								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.

