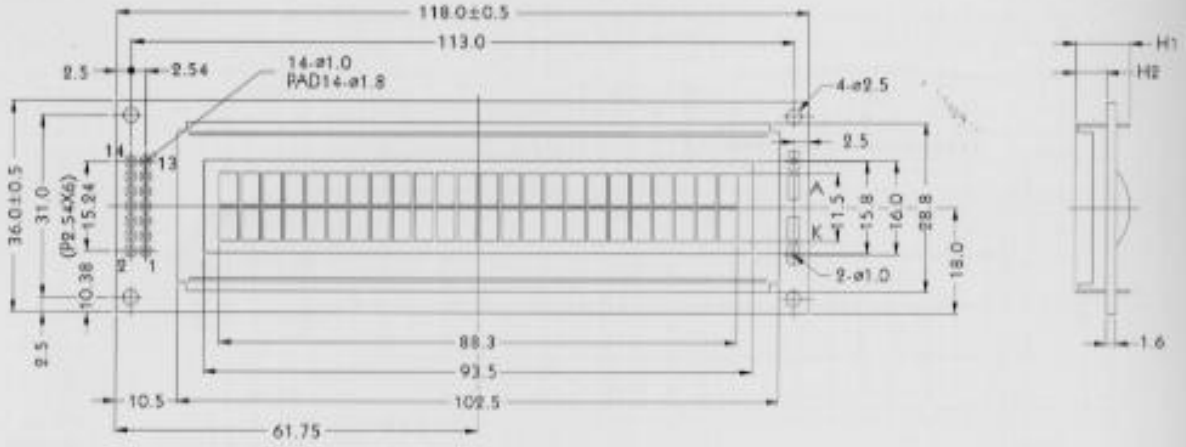
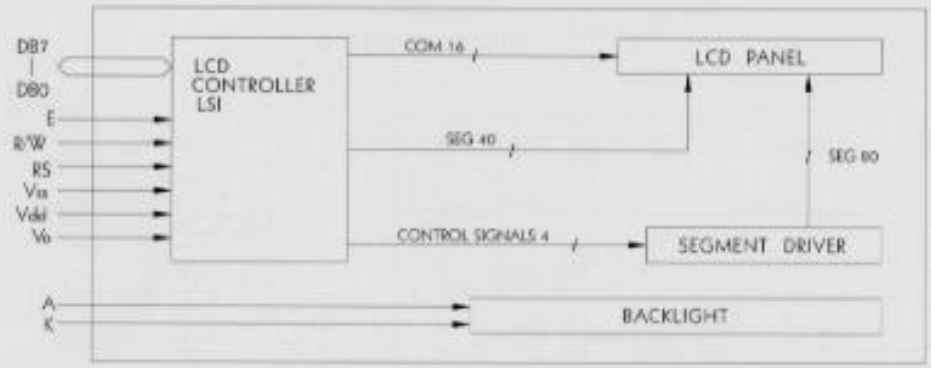
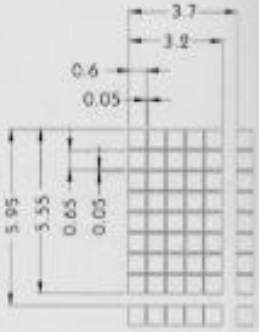
POWERTIP

PC 2402-A

OUTLINE DIMENSION & BLOCK DIAGRAM







The tolerance unless classified ±0.3mm

MECHANICAL SPECIFICATION			
Overall Size	118.0 * 36.0	Module	H2 / H1
View Area	93.5 * 15.8	W/O B/L	5.4 / 9.5
Dot Size	0.60 * 0.65	EL B/L	5.4 / 9.5
Dot Pitch	0.65 * 0.70	LED B/L	8.7 / 13.3

PIN ASSIGNMENT

Pin no.	Symbol	Function
1	V_{SS}	Power supply (GND)
2	Vdd	Power supply (+5V)
3	Vo	Contrast Adjust
4	RS	Register select signal
5	R/W	Data read /write
6	E	Enable signal
7	DB0	Data bus line
8	DB1	Data bus line
9	DB2	Data bus line
10	DB3	Data bus line
11	DB4	Data bus line
12	DB5	Data bus line
13	DB6	Data bus line
14	DB7	Data bus line

ABSOLUTE MAXIMUM RATING

Item	Symbol	Conditions	Min.	Max.	Unit
Power Supply Voltage	Vdd−Vss	−	0	7	V
LCD Driving Supply Voltage	Vdd−Vee	−	0	13	V
Input Voltage	Vin	−	−0.3	Vdd+0.3	V
Operating Temperature	Topr	Nor.	0	50	℃
Storage Temperature	Tstg	Nor.	−20	+70	℃

ELECTRICAL CHARACTERISTICS (Vdd = +5V, Ta = 25°C)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Logic Supply Voltage	Vdd	−	4.5	5	5.5	V
"H" Input Voltage	V_{IH}	−	2.2	−	−	V
"L" Input Voltage	V_{IL}	−	−	−	0.6	V
"H" Output Voltage	V_{OH}	−	2.4	−	−	V
"L" Output Voltage	V_{OL}	−	−	−	0.4	V
Supply Current	Idd	−	2	−	−	mA
LCD Driving Voltage	V_{LCD}	Vdd−Vo	4.0	−	4.5	V

REMARK

LCD option: STN, TN, FSTN

Backlight Option: LED,EL Backlight feature, other Specs not available on catalog is under request.

● OPTICAL CHARACTERISTICS

STN Type Ta=25°C

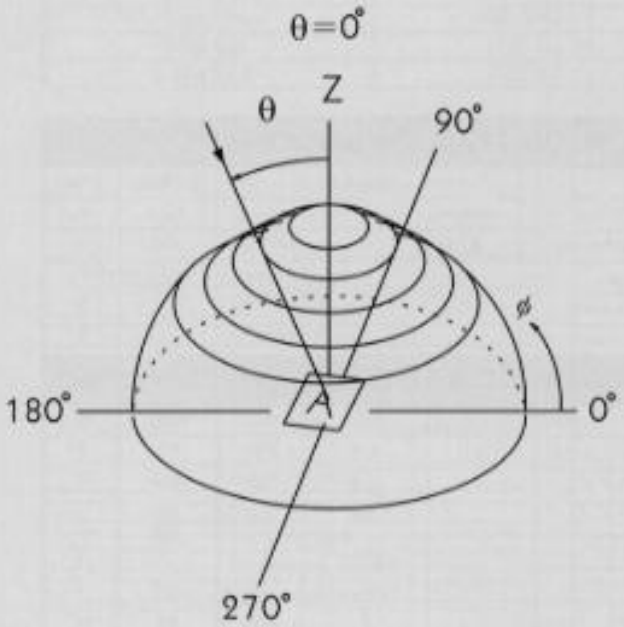
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing angle	ϕ2-ϕ1	K=2.0	60	— —	— —	deg.	A
Contrast ratio	K	ϕ=10 , θ = 0	5	— —	— —	— —	B
Response time (Rise)	tr	ϕ=10 , θ = 0	— —	150	250	ms	C
Response time (Fall)	tf	ϕ=10 , θ = 0	— —	200	300	ms	C

TN Type Ta=25°C

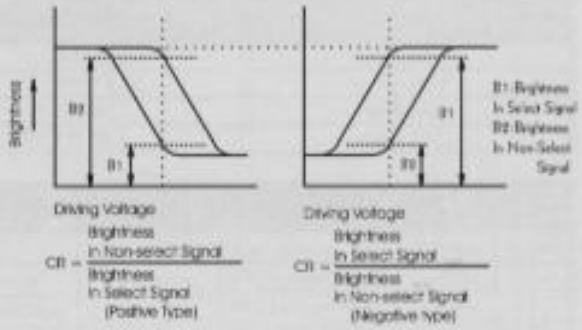
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing angle	ϕ2-ϕ1	K=2.0	— —	40	— —	deg.	A
Contrast ratio	K	ϕ=25 , θ = 0	— —	5	— —	— —	B
Response time (Rise)	tr	ϕ=25 , θ = 0	— —	80	120	ms	C
Response time (Fall)	tf	ϕ=25 , θ = 0	— —	60	90	ms	C

● MEASUREMENT METHOD OF OPTICAL CHARACTERISTICS

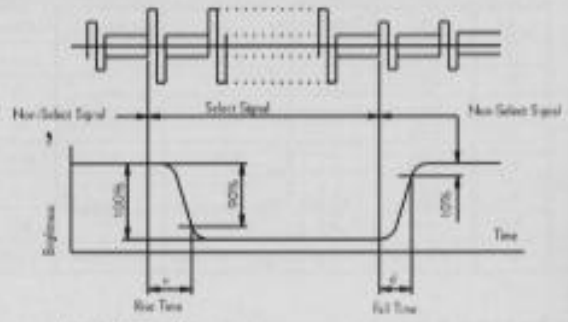
◆ **Definition of Viewing Angle θ and ϕ**



◆ **Definition of Contrast Ratio (CR)**



◆ **Definition of Optical Response Time**



In case of Negative type
wave from of changing brightness becomes reverse.
(Non Select Signals 0%,Select Signals 100%)

● ELECTRICAL CHARACTERISTICS

Vdd = 5V±5%
Vss = 0V

Item	Symbol	Condition	Standard value			Unit	Applicable terminal
			Min.	Typ.	Max.		
Power voltage	Vdd		4.5	5.00	5.5	V	Vdd
Input H- level voltage	VIH		2.2	—	Vdd	V	RS, R/$\overline{W}$, E DB0~DB7
Input L - level voltage	VIL		-0.3	—	0.6	V	
Output H - level voltage	VOH	-IOH = 0.205mA	2.4	—	—	V	DB0~DB7
Output L - level voltage	VOL	IOL = 1.2mA	—	—	0.4	V	
I/O leakage current	IIL	Vin = 0~Vdd	-1	—	1.0	μA	RS, R/$\overline{W}$, E DB0~DB7
Supply current	Idd	Vdd = 5V	2	—	—	mA	Vdd
LCD operating voltage	VLCD	Vdd—V0	3.0	—	11.0	V	V0

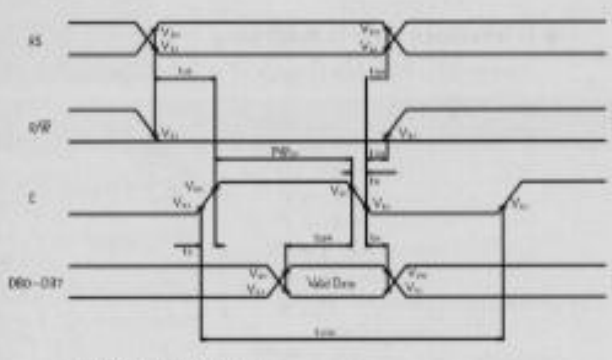
● TIMING CHARACTERISTICS

Vdd = 5V±5%
Vss = 0V

Item		Symbol	Min.	Max.	Unit
Enable cycle time		TCYCE	500	—	ns
Enable pulse width	"High" level	PWEH	220	—	ns
Enable rise / fall time		TER, TEF	—	25	ns
Set-up time	RS, R/$\overline{W}$, E	TAS	40	—	ns
Address hold time		TAH	10	—	ns
Data set-up time		TDSH	60	—	ns
Data delay time		TDDR	60	120	ns
Data hold time (writing)		TH	10	—	ns
Data hold time (reading)		TDHR	20	—	ns
Clock oscillating frequency		TOSC	270(Typ)		KHz

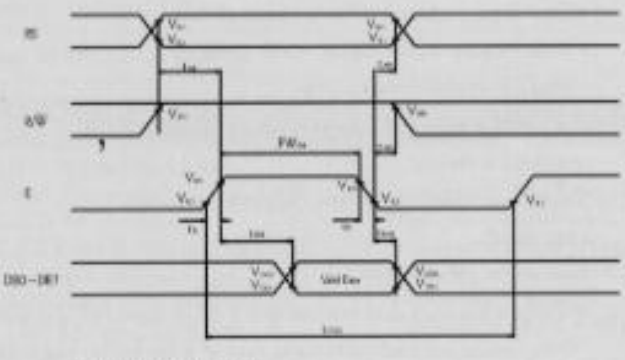
● TIMING CHART

◆ FIG.1 WRITE OPERATION



(Write Data from MPU to MODULE)

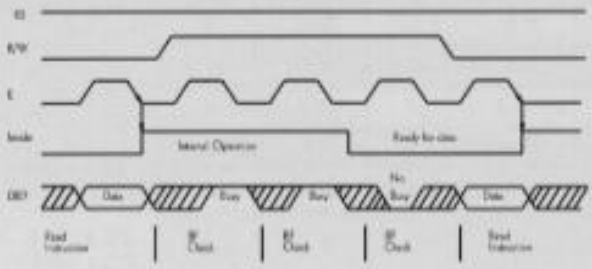
◆ FIG.2 READ OPERATION

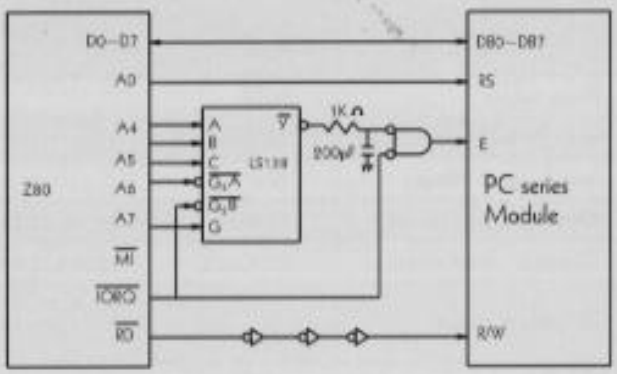


(Read Data from MODULE to MPU)

● INTERFACE WITH MPU

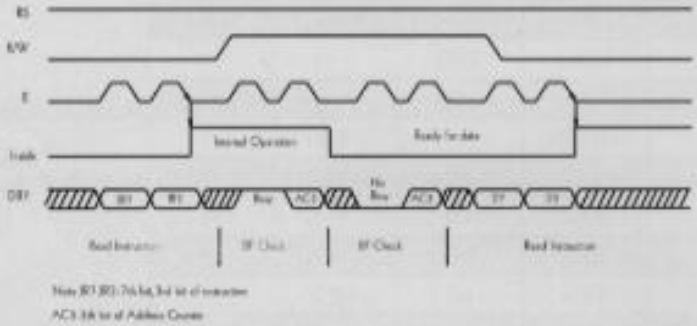
◆ Example of Interface with 8-bit MPU (Z80)

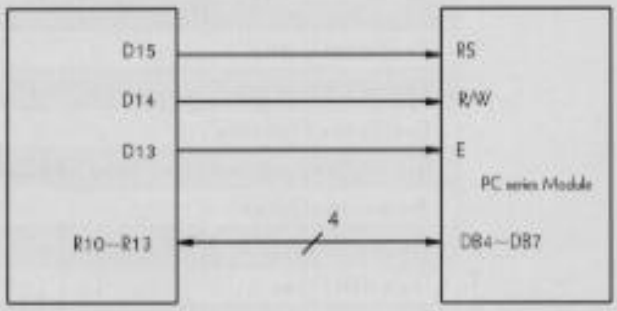




◆ Example of interface with 4-bit MPU

Interface with 4-bit MPU can be made through I / O port of 4-bit MPU. If there are enough I / O ports, data can be transfered by 8-bit, however, if there are not data transfer can be done by 4-bit in twice (select interface is 4-bit long), and timing sequence will be complicated in this case. Please take into account that 2 cycles of BF check is necessary, while 2 cycles of data transfer are also necessary.





Features

(1) Interface with 8-bit or 4-bit MPU is available.
(2) 192 kind of alphabets, numerals, symbols and special characters can be displayed by built-in character generator (ROM).
(3) Other preferred characters can be displayed by character generator (RAM).
(4) Various functions of instruction are available by programming.
- Clear display • Cursor at home • On / off cursor
- Blink character • Shift display • Shift cursor
- Read / write display data.....etc.

(5) Compact and light weight design which can be easily assembled in devices.
(6) Single power supply +5V drive (except for extended temp. type).
(7) Low power consumption.

*Interface between data bus line and 4-bit or 8-bit MPU is available. Data transfer are made in twice in case of 4-bit MPU, and once in case of 8-bit MPU.

◆ If interface data is 4-bit long

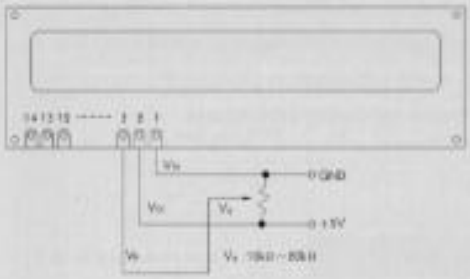
Data transfer are made through 4 bus lines from DB4 to DB7. (while the rest of 4 bus lines fromDB0 to DB3 are not used.) Data transfer with MPU are completed when 4-bit data are transfered in twice.
(first upper 4-bit data, then lower 4-bit data.)

◆ If interface data is 8-bit long

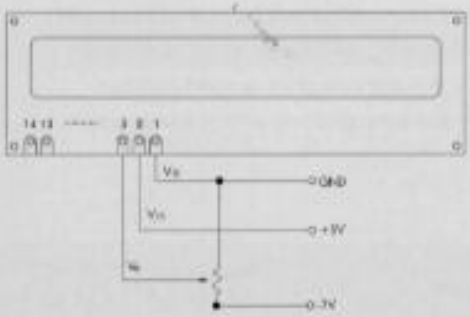
Data transfer are made through all of 8 bus lines from DB0 to DB7.

EXAMPLE OF POWER SUPPLY

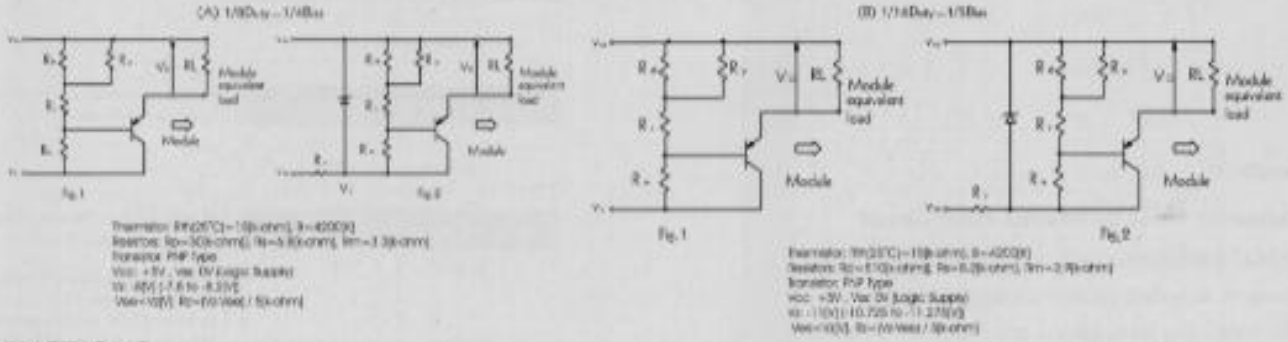
Normal Temperature Type



Extended Temperature Type



Examples of Temperature Compensation Circuits for Extended Temp Type. (Only for reference)



INSTRUCTIONS

Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	Executed Time(max.)
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears all display and returns the cursor to the home position (Address 0)	1.64mS
Cursor At Home	0	0	0	0	0	0	0	0	1	*	Returns the cursor to the home position (Address 0). Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	1.64mS
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets the cursor move direction and specifies or not to shift the display. These operations are performed during data write and read.	40μS
Display On / Off Control	0	0	0	0	0	0	1	D	C	B	Sets ON / OFF of all display (D), cursor NO / OFF (C), and blink of cursor position character (B)	40μS
Cursor / Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without changing DD RAM contents.	40μS
Function Set	0	0	0	0	1	DL	N	F	*	*	Sets interface data length (DL) number of display lines (L) and character font (F)	40μS
CG RAM Address Set	0	0	0	1	ACG						Sets the CG RAM address. CG RAM data is sent and received after this setting.	40μS
DD RAM Address Set	0	0	1	ADD							Sets the DD RAM address. DD RAM data is sent and received after this setting.	40μS
Busy Flag / Address Read	0	1	BF	AC							Reads Busy flag (FB) indicating internal operation is being performed and reads address counter counts.	0μS
CG RAM / DD RAM Data Write	1	0	WRITE DATA								Writes data into DD RAM or CG RAM.	40μS
CG RAM / DD RAM Data Read	1	1	READ DATA								Reads data from DD RAM or CG RAM.	40μS

Code		Description	Executed Time (max)
I/D = 1 : Increment I/D = 0 : Decrement S = 1 : With display shift S/C = 0 : cursor movement R/L = 1 : Shift to the right R/L = 0 : Shift to the left DL = 1 : 8-bit	DL = 0 : 4-bit N = 1 : 2lines N = 0 : 1line F = 1 : 5×10dots F = 0 : 5×7dots BF = 1 : Internal operation is being performed BF = 0 : Instruction acceptable	DD RAM : Display Data RAM CG RAM : Character Generator RAM ACG : CG RAM Address ADD : DD RAM Address Corresponds to cursor address. AC : Address Counter, used for both DD RAM and CG RAM * : Invalid	fcp or fosc = 250KHz However, when frequency changes, execution time also changes Example if fcp or fosc is 270KHz, 70μS x 250 / 270 = 37μS

● POWER SUPPLY RESET

The internal reset circuit will be operated properly when the following power supply conditions are satisfied. If it is not operated properly, please perform initial setting along with the instruction.

Item	Symbol	Measuring Condition	Standard Value			Unit
			Min.	Typ.	Max.	
Power Supply RISE Time	tree	—	0.1	—	10	mS
Power Supply CFF Time	toff	—	1	—	—	mS

Reset function

◆ **Initialization Made by Internal Reset Circuit**

HD44780 automatically initializes (resets) when power is supplied (builtin internal reset circuit). The following instructions are executed in initialization. The busy flag (BF) is kept in busy state until initialization ends. (BF=1) The busy state is 10 ms after Vdd reachs to 4.5V.

(1) Display clear

(2) Function set

DL= 1:8 bit long interface data

DL= 0:4 bit F= 0:5 x 7dots character font

N= 1:2 lines

N= 0:1 line

(3) Display ON / OFF control

D= 0:Display OFF C= 0:Cursor OFF

B= 0:Blink OFF

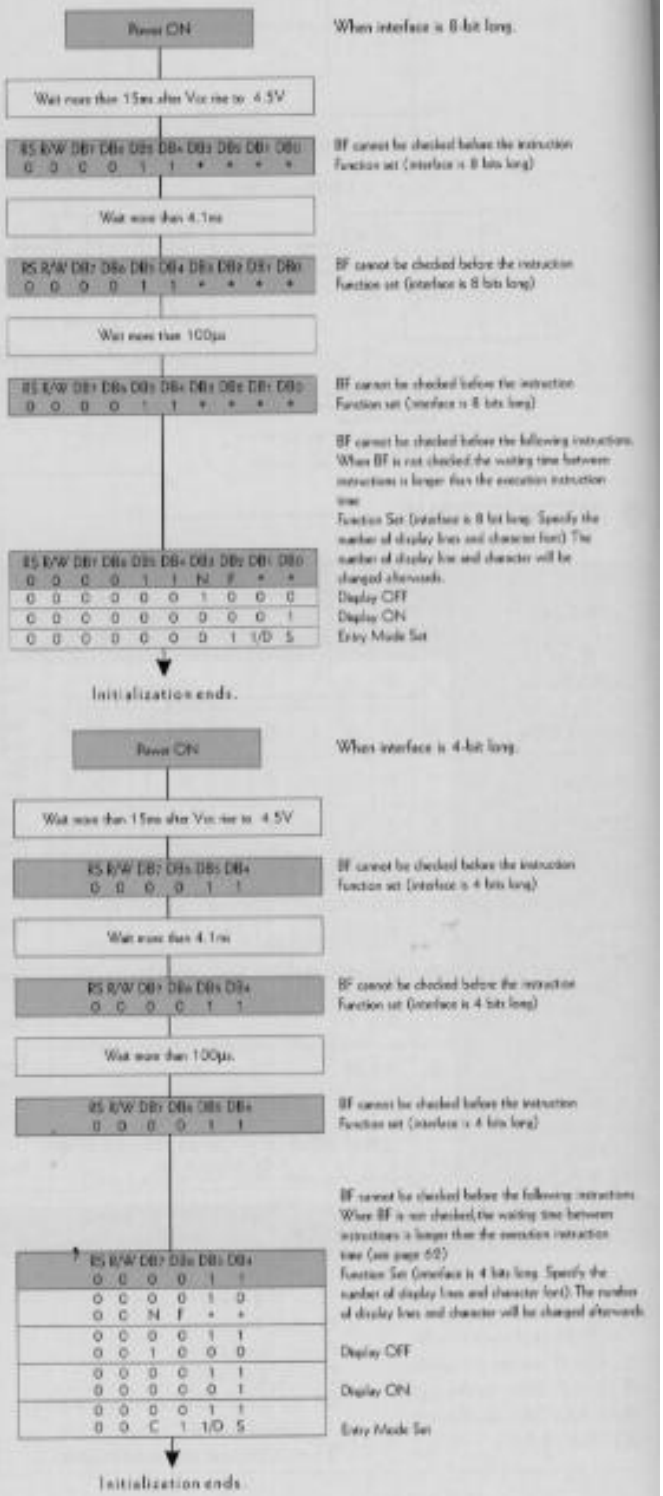
(4) Entry mode set

1 / D= 1:+1(increment) S= 0:No shift

Note:When conditions stated in power supply conditions using internal reset circuit are not satisfied.The internal reset circuit will not operate properly and initialization will not be performed. Please make initialization using MPU along with instruction.

◆ **Initialization along with instruction**

If power supply conditions are not satisfied, which for proper operation of internal rest circuit, it is required to make initialzation along with instruction. Please make following procedures.



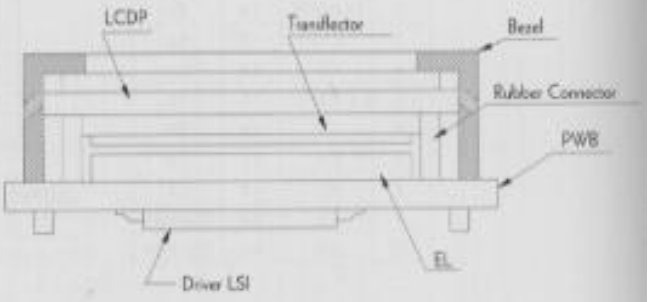
● BACKLIGHT FOR LCD MODULE

18-1 EL Backlight

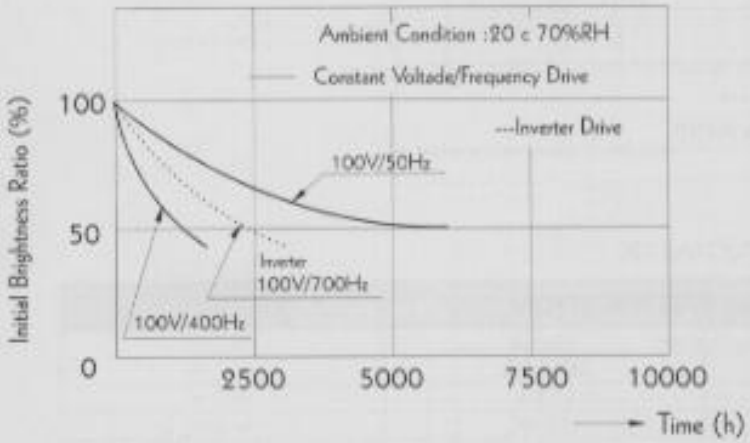
Flat surface light source offers simple and even illumination over large area.
It is extrmely thin structure type of illumination with little hear up.

Features

- Max.1.3mm thickness (Max. 1.5mm for lead portion)
- Wide driving condition of 60-1,000Hz and 150V AC Max.
- With inverter, step-up voltage from 1.5V battery is avaliable.
- Emitted colors are blue-green yellow-green and white.
- Operating characteristics of PC2002-A SERIES is 110V, 400Hz, 8mA, (Ta=20 C, 60% RH)
- Temperature Range: Operating 0°C~+50°C
  Storage -20°C~+60°C



Life Characteristice



Inverter for EL Backlight Drive

It is necessary to use inverter when you need to operate EL with battery or a DC power supply.

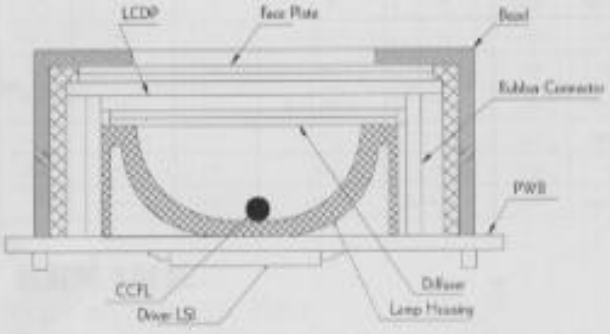
- Low inverter loss and high light efficiency because it is designed as suitable for EL.
- Less change of power consumption during operation under temperature change or extended hours, which is realized by characteristics of constant supply cuurrent, minimizes brightness change of EL.

18-2 CCFL Backlight (Cold Cathode Fluorescent Lamp)

Bright and white color of light source offers clear illumination of various and illumination over large area.

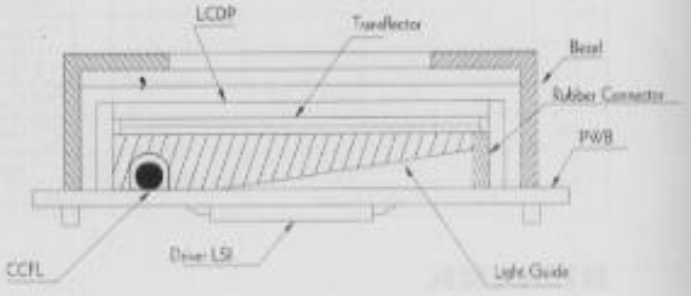
◆ Array Illumination

It is suitable to multi-color and / or dot matrix LCDP.



◆ Edge Illumination

It offers thin structure type of even illumination by emitting light from tube-like light source over large area.



18-3 LED Backlight

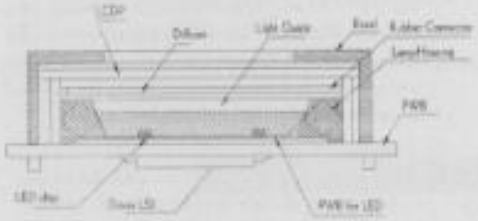
Long life, low power consumption and simple power supply. Three different colors of red, green and orange are available, or color can be changed alternatively. Two backlight types are available, array illumination and edge illumination.

Features

- Low voltage driving (DC) is available without inverter.
- Long life time 100,000 hours (average)
- No noise occurence.
- Various color of red, green and orange etc. (multi-color by alternative switch is also available)
- Operating characteristics of PC2002-A series is 4.2V, 210mA, 250cd / m^2

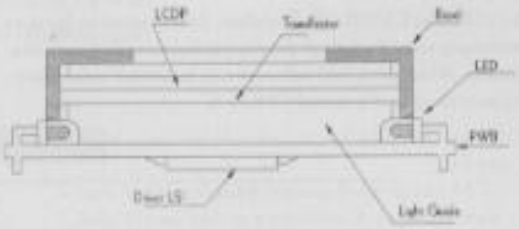
Array Illumination

Less quantity of chip offers even illumination.



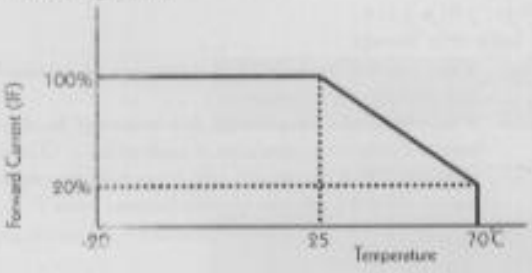
Edge Illumination

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

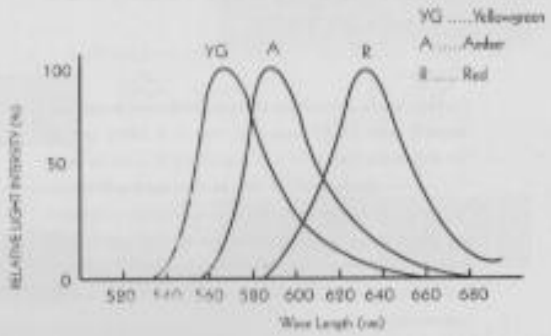


Electrical Characteristics (Reference Data)

Forward Current Derating Curve



Wave Length Vs Relative Light Intensity



● RELIABILITY CONDITIONS

LCD Module (Consumer Type)			
Item	**Test Condition**		**Applicable Standard**
High Temperature Storage	Storage At 60±2°C 96~100 hrs Surrounding Temperature, Then Storage At Normal Condition 4hrs		MIL-202E
Low Temperature Storage	Storage At -20±2°C 96~100 hrs Surrounding Temperature, Then Storage At Normal Condition 4hrs		MIL-202E
High Temperature /Humidity Storage	1. Storage 96~100hrs at 60±2°C, 90% RH Surrounding Temperature, Then Storage At Normal Condition 4hrs (Polarizer may fail in this enviroment). Or 2. Storage 96~100hrs at 40±2°C, 90% RH Surrounding Temperature, Then Storage At Normal Condition 4hrs		MIL-202E
Temperature Cycling	-20°C → 25°C → 70°C → 25°C (60Mins) (5Mins) (60Mins) (5Mins) 10 Cycle		MIL-202E
Vibration	10~55Hz(1 Minute) 1.5mm X,Y And Z Direction (Each 2hrs) (Each 3 Times)		MIL-202E
Drop Test	Packing Weight (Kg)	Drop Height(Cm)	MIL-810E
	0~45.4	122	
	45.4~90.8	76	
	90.8~454	61	
	Over 454	46	

Note: The afore mentioned is standard for periodical test.