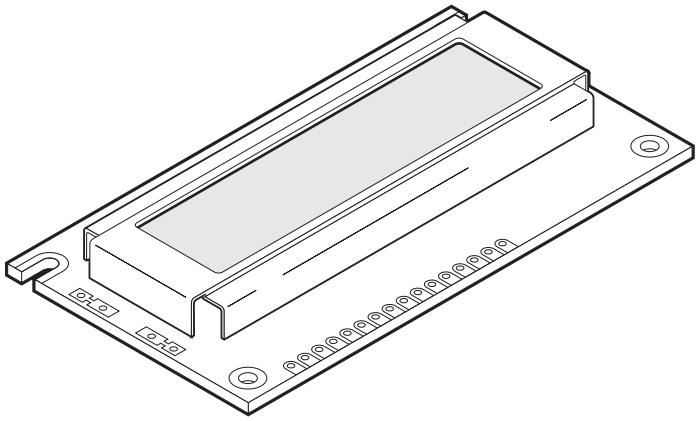
ALPHANUMERIC LCD DISPLAY (16 x 2)

Order Code

LED008 16 x 2 Alphanumeric Display
FRM010 Serial LCD Firmware (optional)



Contents

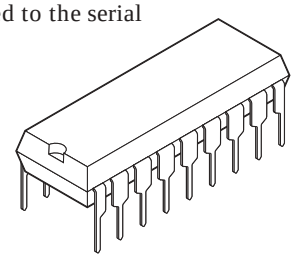
1 x 16x2 Alphanumeric Display
1 x data booklet

Introduction

Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

Further Information

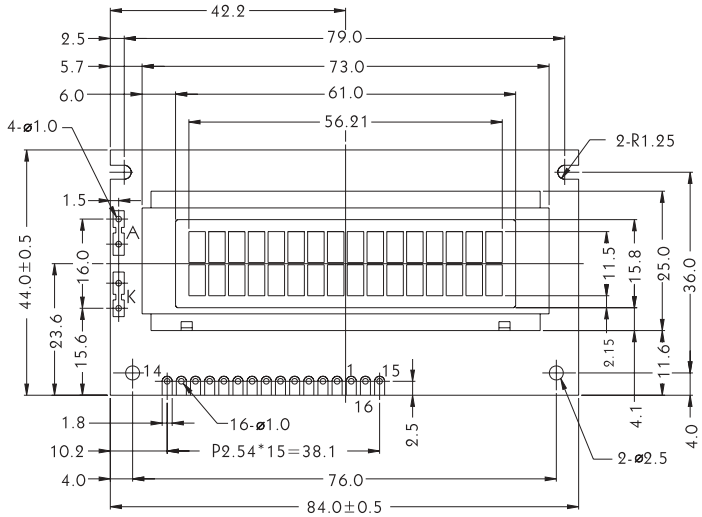
Available as an optional extra is the Serial LCD Firmware, which allows serial control of the display. This option provides much easier connection and use of the LCD module. The firmware enables microcontrollers (and microcontroller based systems such as the PICAXE) to visually output user instructions or readings onto an LCD module. All LCD commands are transmitted serially via a single microcontroller pin. The firmware can also be connected to the serial port of a computer.

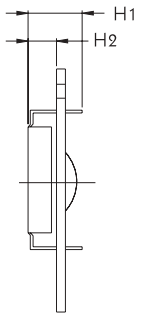


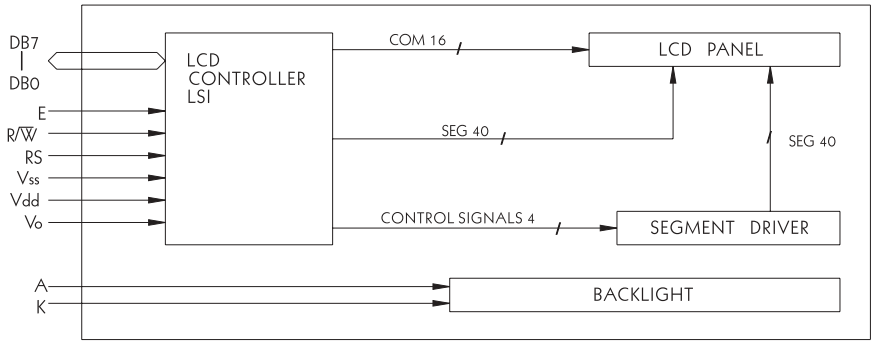
An example PICAXE instruction to print the text 'Hello' using the **serout** command is as follows:

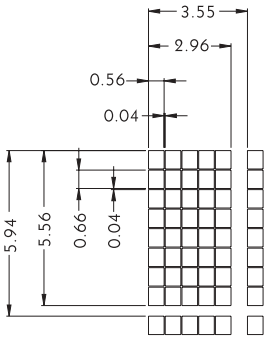
```
serout 7,T2400,("Hello")
```

Outline Dimension and Block Diagram









The tolerance unless classified ±0.3mm

MECHANICAL SPECIFICATION			
Overall Size	84.0 * 44.0	Module	H2 / H1
View Area	61.0 * 15.8	W/O B/L	5.1 / 9.7
Dot Size	0.56 * 0.66	EL B/L	5.1 / 9.7
Dot Pitch	0.60 * 0.70	LED B/L	9.4 / 14.0

PIN ASSIGNMENT		
Pin no.	Symbol	Function
1	Vss	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
15	A	Power supply for LED B/L (+)
16	K	Power supply for LED B/L (−)

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	°C
Storage Temperature	Tstg	Nor.	−20	+70	°C

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	4.3	−	4.8	V

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

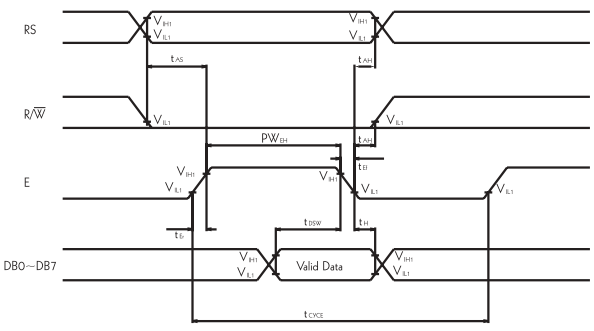
Timing Characteristics

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

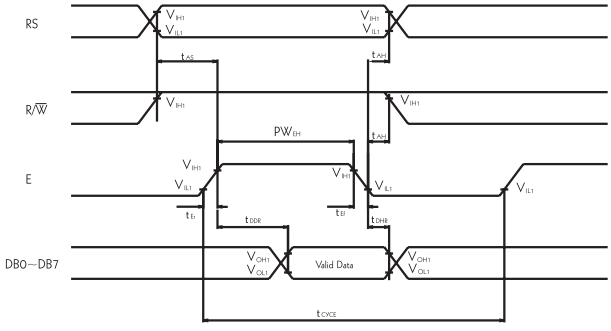
Timing Chart

◆ FIG.1 WRITE OPERATION



(Write Data from MPU to MODULE)

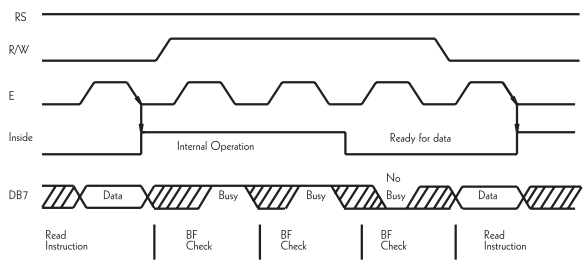
◆ FIG.2 READ OPERATION

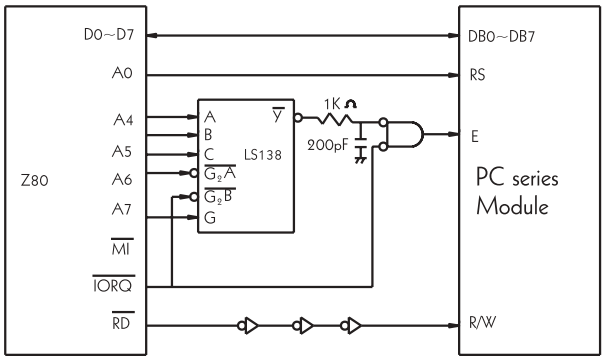


(Read Data from MODULE to MPU)

Interface with MPU

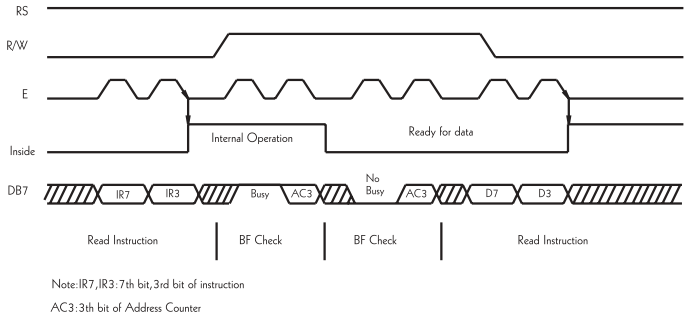
Example of Interface with 8-bit MPU (Z80)

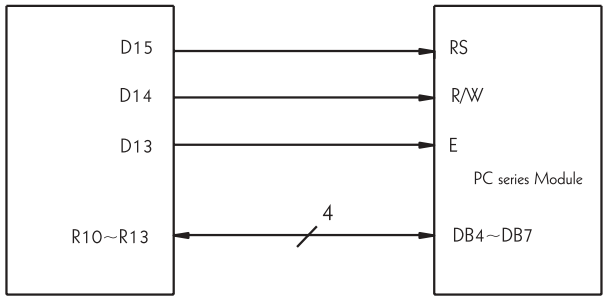




Example of interface with 4-bit MPU

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

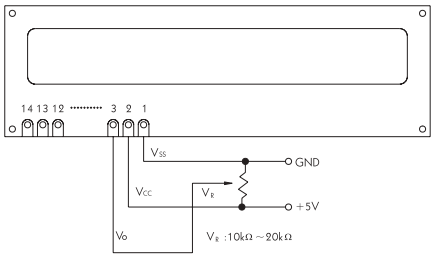
Data transfer are made through 4 bus lines from DB4 to DB7. (while the rest of 4 bus lines fromDB0 to DB3 are not used.) Data transfer with MPU are completed when 4-bit data are transfered in twice.
(first upper 4-bit data. then lower 4-bit data.)

If interface data is 8-bit long

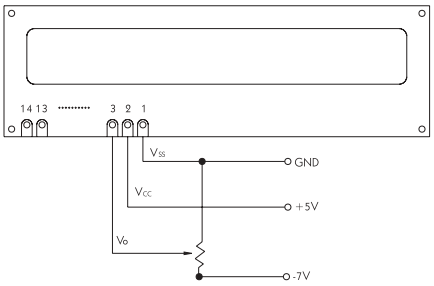
Data transfer are made through all of 8 bus lines from DB0 to DB7.

Example of Power Supply

Normal Temperature Type

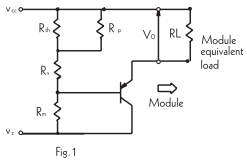


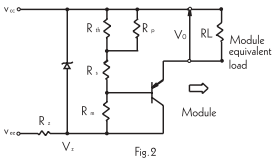
Extended Temperature Type



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

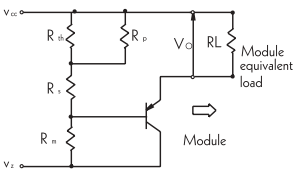
(A) 1/8Duty—1/4Bias

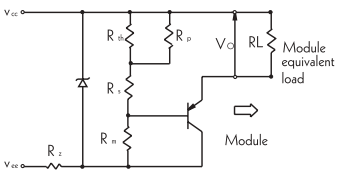




Thermistor: Rth(25°C)=15[k-ohm], B=4200[K]
Resistors: Rp=30[k-ohm]], Rs=6.8[k-ohm], Rm=3.3[k-ohm]
Transistor: PNP Type
Vcc: +5V , Vss: 0V (Logic Supply)
Vz: -8[V] (-7.8 to -8.2[V])
Vee<Vz[V]. Rz=(Vz-Vee) / 5[k-ohm]

(B) 1/16Duty—1/5Bias





Thermistor: Rth(25°C)=15[k-ohm], B=4200[K]
Resistors: Rp=510[k-ohm]], Rs=8.2[k-ohm], Rm=3.9[k-ohm]
Transistor: PNP Type
Vcc: +5V , Vss: 0V (Logic Supply)
Vz: -11[V] (-10.725 to -11.275[V])
Vee<Vz[V]. Rz=(Vz-Vee) / 5[k-ohm]

Instructions

Instruction	Code										Description	Executed Time(max.)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
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	1/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		Descripion	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. eecution 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**

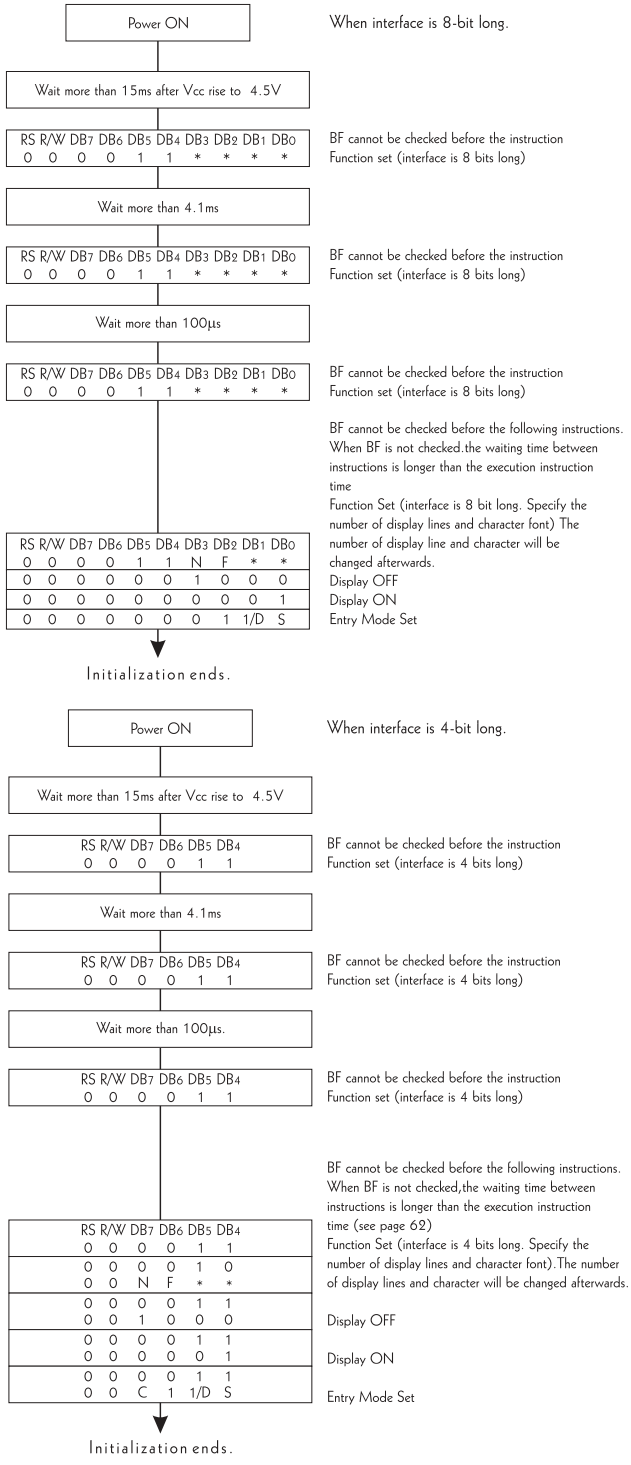
HD44780 automatically initializes (resets) when power is supplied (builtin internal reset circuit). The following instructions are executed in initialization. The busy flag (BF) is kept in busy state until initialization ends. (BF=1) The busy state is 10 ms after Vdd reachs to 4.5V.

(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.

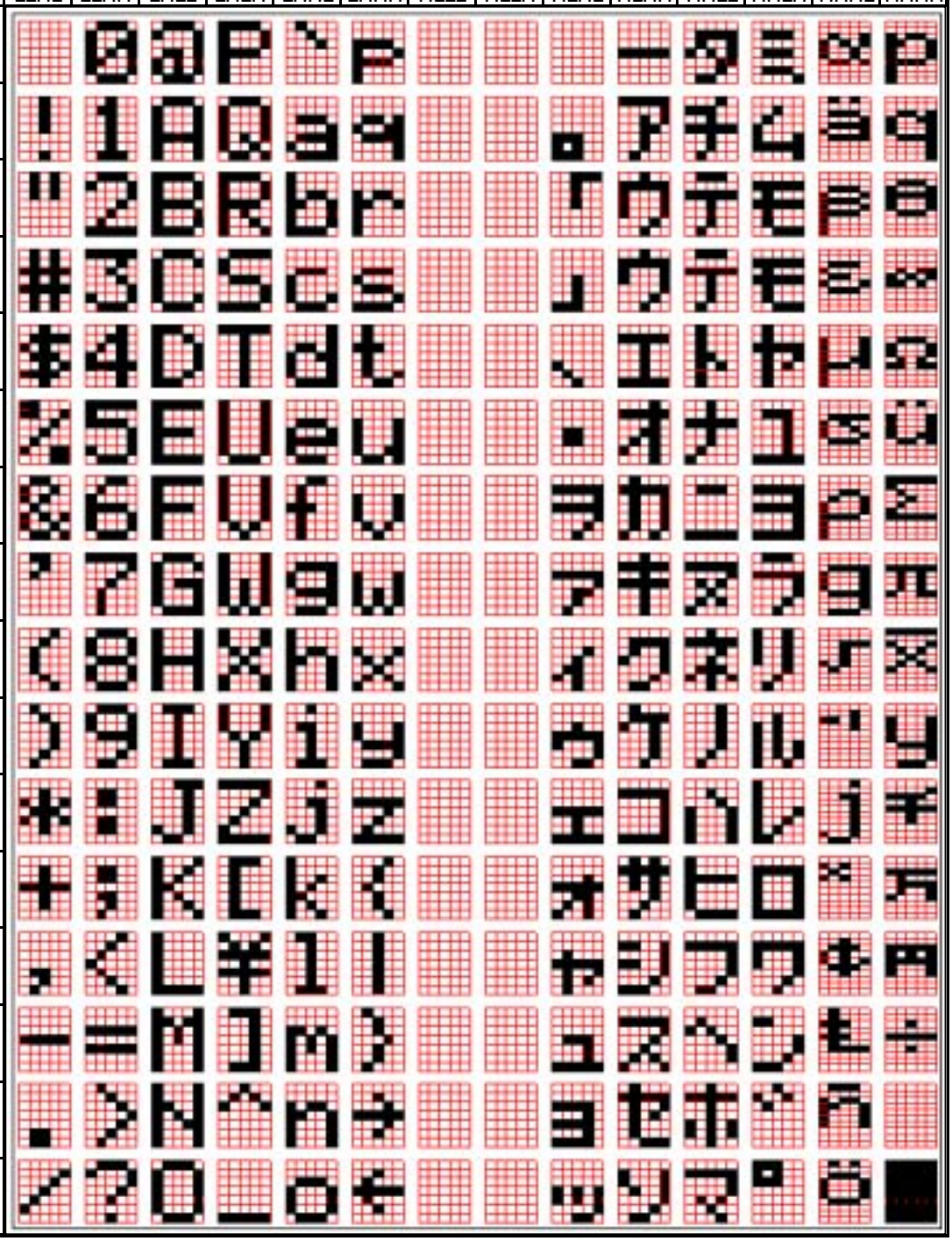
◆ **Initialization along with instruction**

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.



Standard Character Pattern (Powertip Module)

Standard Character Pattern (Elec & Eltek Module)

Upper(4bit) / Lower(4bit)	LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)														
LLLH	(2)														
LLHL	(3)														
LLHH	(4)														
LHLL	(5)														
LHLH	(6)														
LHHL	(7)														
LHHH	(8)														
HLLL	(1)														
HLLH	(2)														
HLHL	(3)														
HLHH	(4)														
HHLL	(5)														
HHLH	(6)														
HHHL	(7)														
HHHH	(8)														