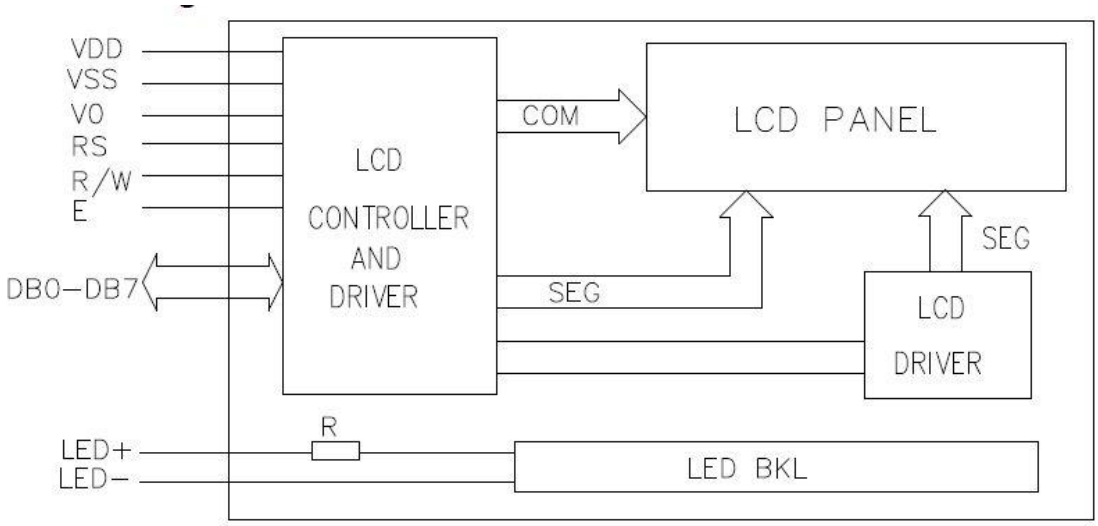
ALPHANUMERIC LCD

This document will tell you working of 16x2 alphanumeric lcd.

Basic Pin & Description:

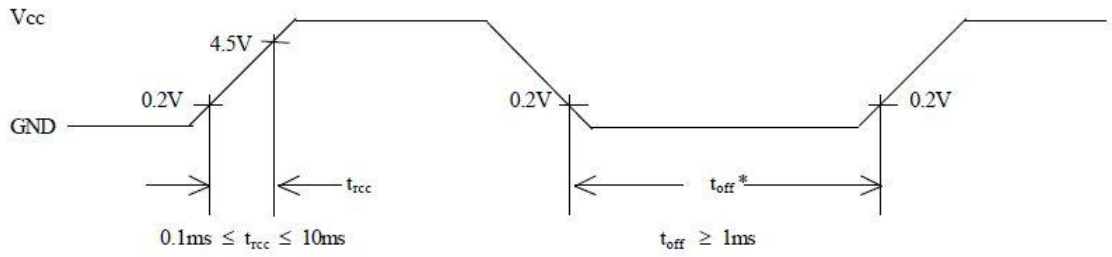
Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL



Initialization Protocol :

1. **Initialization using the Internal Reset Circuit**

The display can be initialized using the internal reset circuit if the Internal Power Supply Reset timing below is met.



Note: t_{off} represents the time of power off condition for a momentary power supply dip or when cycling power off then on.

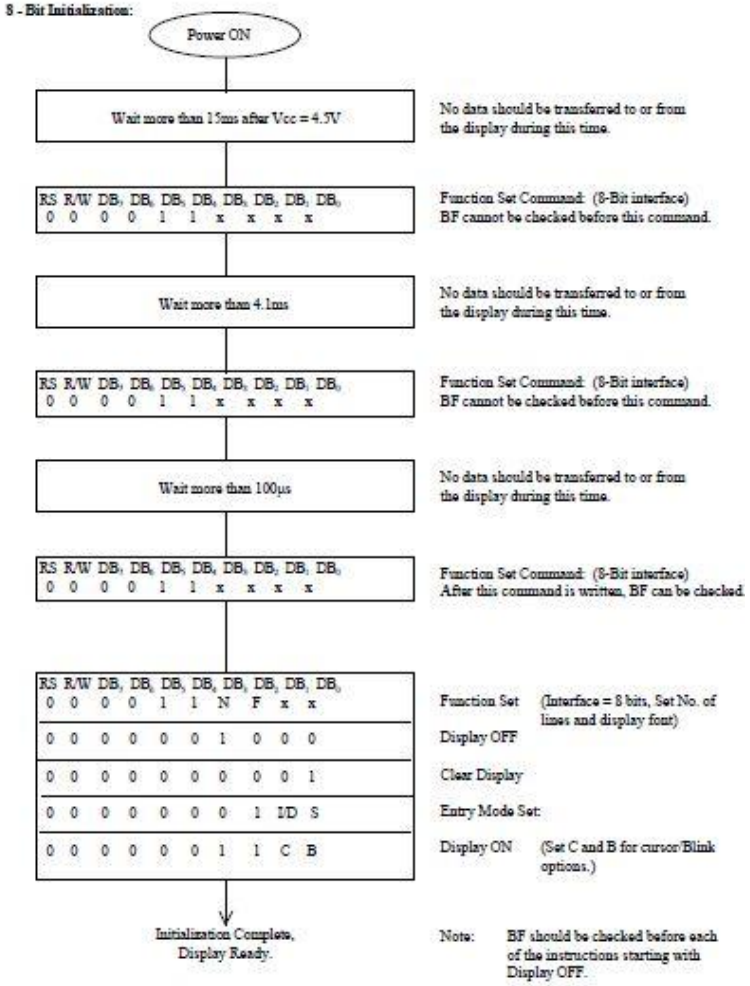
If the internal power supply reset timing cannot be met, the display will not operate normally. In this case, the display can be initialized through software.

Note: Variable power supply may affect timing hence initialization of lcd in that case software initialization is preferred.

2. Software Initialization

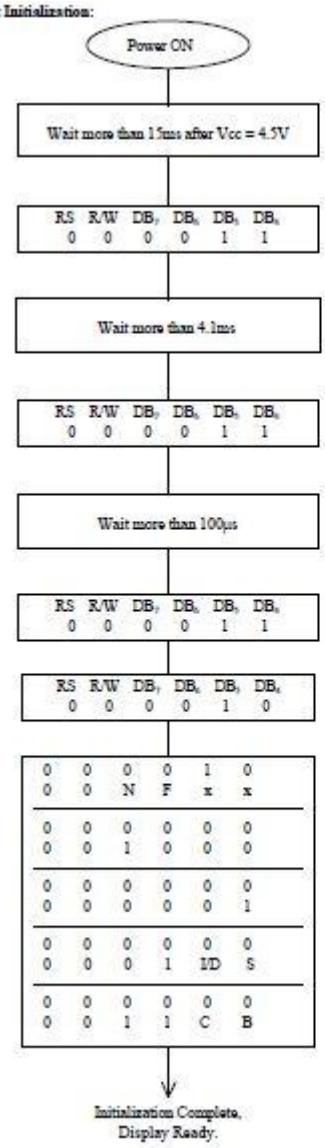
Although software initialization is not mandatory, it is recommended that this procedure always be performed

8 - Bit Initialization:



Note: BF should be checked before each of the instructions starting with Display OFF.

4 - Bit Initialization:



No data should be transferred to or from the display during this time.

Function Set Command: (8-Bit interface)

No data should be transferred to or from the display during this time.

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No data should be transferred to or from the display during this time.

Function Set Command: (8-Bit interface)
After this command is written, BF can be checked.

Function Set: Sets interface to 4 -bit

Function Set (Interface = 4 -bit, Set N and F for number of lines and character font)

Display OFF

Clear Display

Entry Mode Set:

Display ON (Set C and B for cursor/Blink options.)

Note: BF should be checked before each of the instructions starting with Display OFF.

Instruction Set:

Instruction	Code										Description	Execution time (max.) when fcp or fosc is 250 kHz
	RS	R/W	DB_7	DB_6	DB_5	DB_4	DB_3	DB_2	DB_1	DB_0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears entire display and sets DD RAM address 0 in address counter.	15.2ms
Return Home	0	0	0	0	0	0	0	0	1	x	Sets DD RAM address 0 in address counter. Also returns shifted display to original position. DD RAM contents remain unchanged.	15.2ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies shift or 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 entire display (D), cursor ON/OFF (C), and blink of cursor position character (B).	40µs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	Moves cursor and shifts display without changing DD RAM contents.	40µs
Function Set	0	0	0	0	1	DL	N	F	x	x	Sets interface data length (DL), number of display lines (N) and character font (F).	40µs
Set CG RAM Address	0	0	0	1	ACG						Sets CG RAM address. CG RAM data is sent and received after this setting.	40µs
Set DD RAM Address	0	0	1	ADD							Sets DD RAM address. DD RAM data is sent and received after this setting.	40µs
Read Busy Flag & Address	0	1	BF	AC							Reads busy flag (BF) indicating internal operation is being performed and reads address counter contents.	40µs
Write Data to CG or DD RAM	1	0	Write Data								Writes data into DD RAM or CG RAM.	40µs
Read Data from CG or DD RAM	1	1	Read Data								Reads data from DD RAM or CG RAM.	40µs
	I/D=1 : Increment I/D=0 : Decrement S=1 : Accompanies display shift S/C=1 : Display shift S/C=0 : Cursor move R/L=1 : Shift to the right										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	Execution time changes when frequency changes. Example: When fcp or fosc is 270kHz:

Scan Code:

Table 5.3
Standard Character Font Table

High order bit / Low order bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
XXXX0000	CG RAM (1)		0	@	P	`	p		ー	タ	ミ	α	p
XXXX0001	(2)	!	1	A	Q	a	q	。	ア	チ	ム	ä	q
XXXX0010	(3)	"	2	B	R	b	r	「	イ	ツ	メ	ß	θ
XXXX0011	(4)	#	3	C	S	c	s	」	ウ	テ	モ	ε	∞
XXXX0100	(5)	$	4	D	T	d	t	、	エ	ト	ヤ	μ	Ω
XXXX0101	(6)	%	5	E	U	e	u	・	オ	ナ	ユ	σ	ü
XXXX0110	(7)	&	6	F	V	f	v	ヲ	カ	ニ	ヨ	ρ	Σ
XXXX0111	(8)	'	7	G	W	g	w	ァ	キ	ヌ	ラ	g	π
XXXX1000	(1)	(	8	H	X	h	x	ィ	ク	ネ	リ	₋	x̄
XXXX1001	(2)	)	9	I	Y	i	y	ゥ	ケ	ノ	ル	⁻¹	y
XXXX1010	(3)	*	:	J	Z	j	z	ェ	コ	ハ	レ	j	千
XXXX1011	(4)	+	;	K	[	k	{	ォ	サ	ヒ	ロ	ˣ	万
XXXX1100	(5)	,	<	L	¥	l	|	ャ	シ	フ	ワ	¢	円
	(6)	-	=	M	]	m	}	ュ	ス	ヘ	ン	£	÷

Note: Software initialisation is always preferred.