

LCD-1602A

DATASHEET

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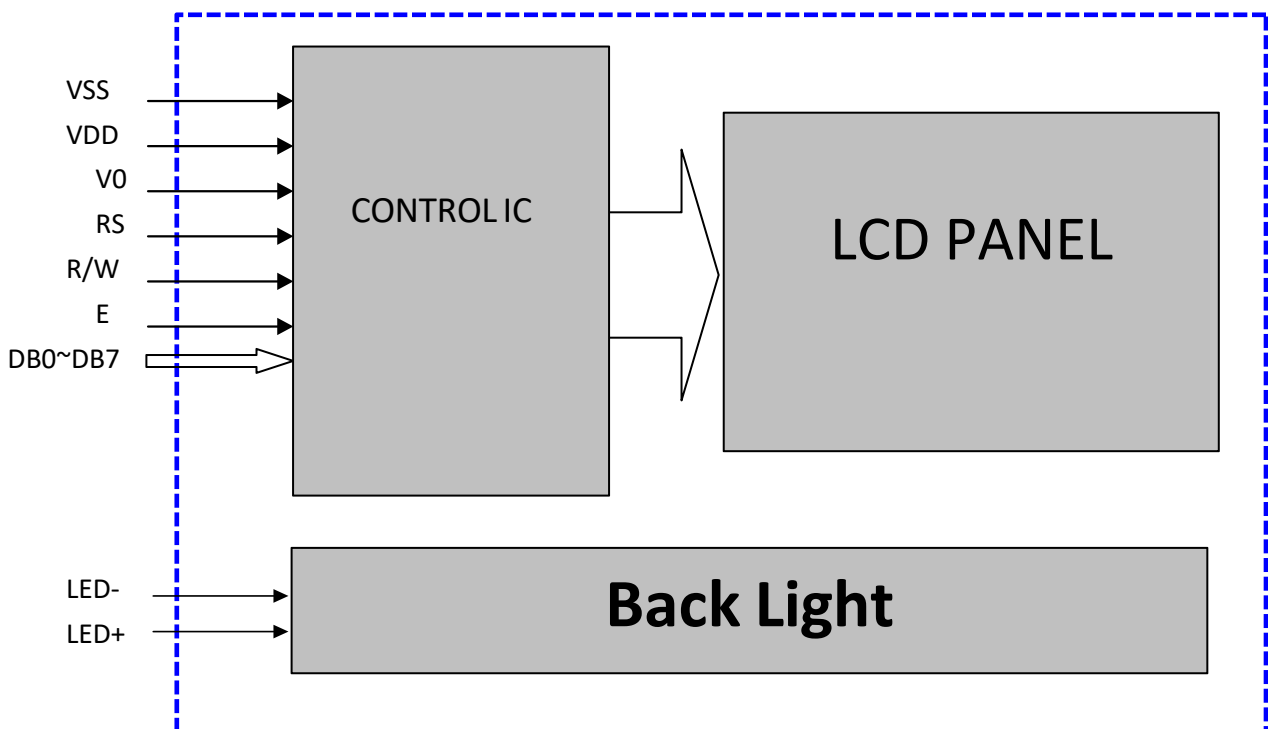
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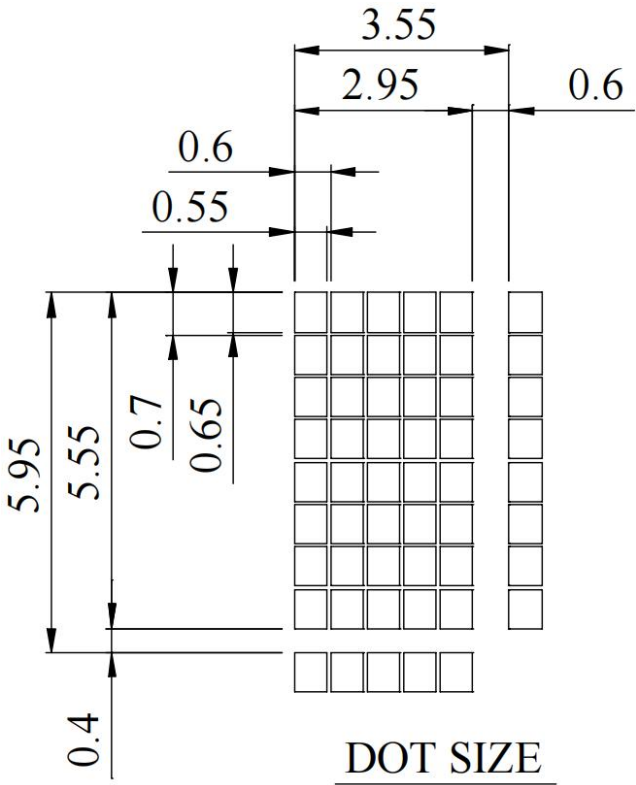
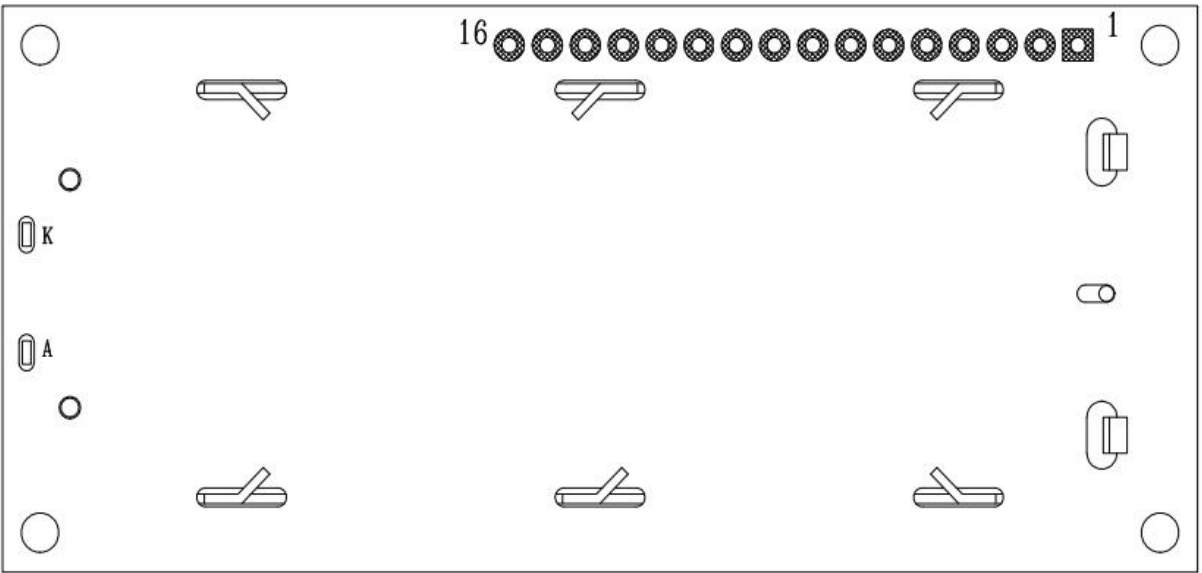
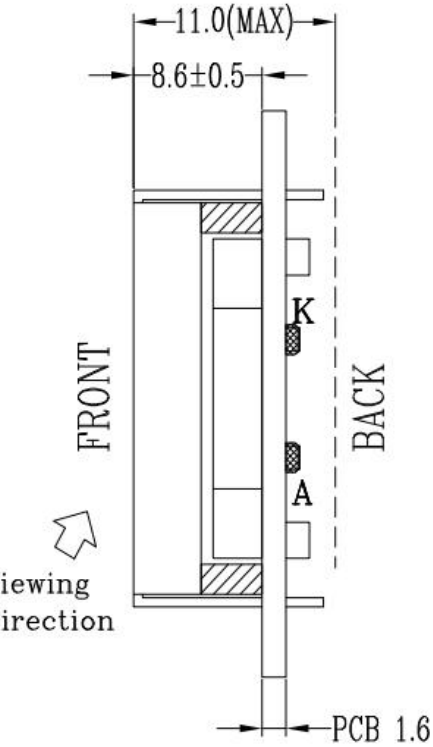
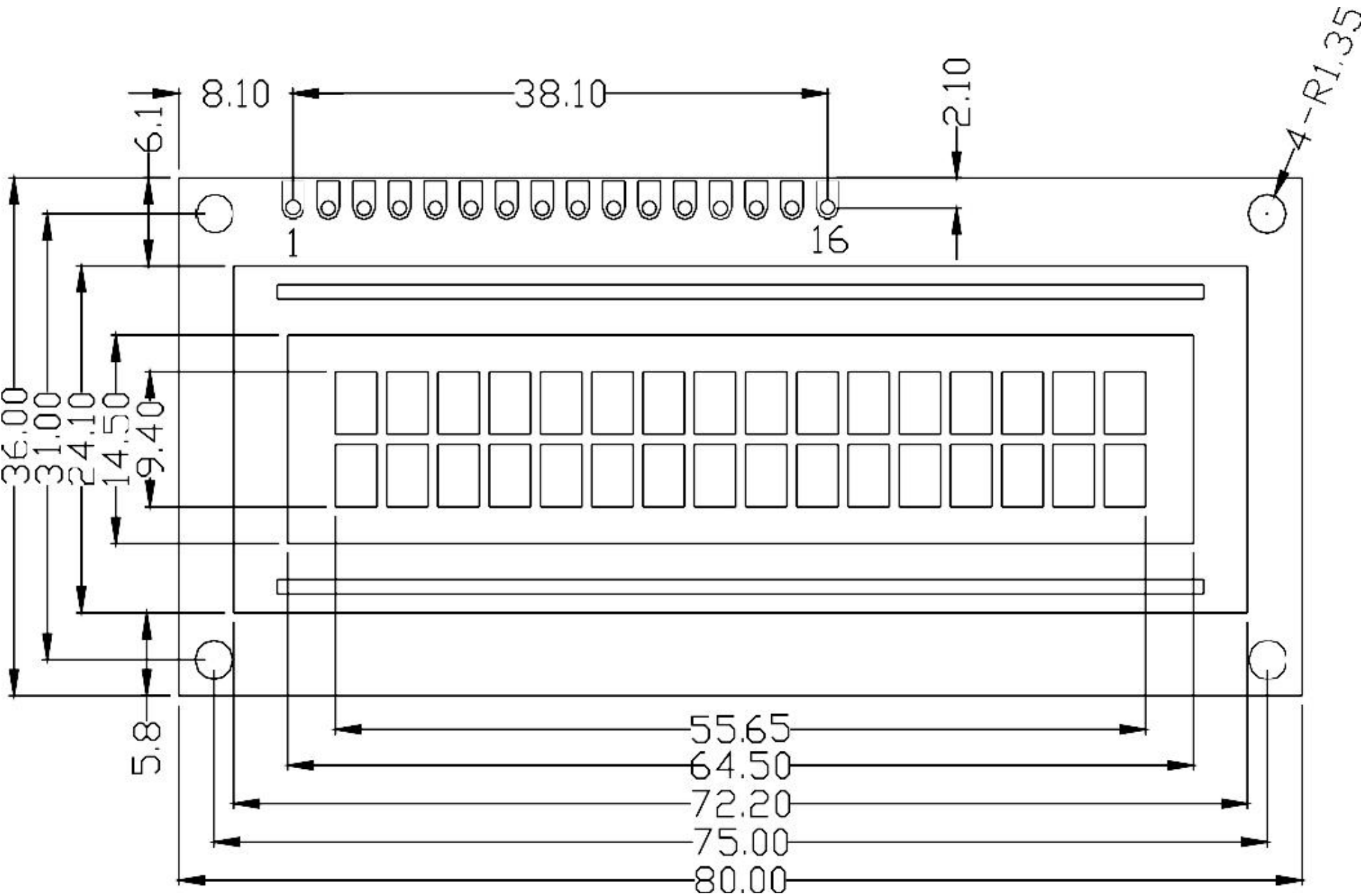
General Specification

Item	Parameters	Unit
Number of Characters	16 characters x 2 Lines	-
Module Dimension	80.0 x 36.0 x 11.0(MAX)	mm
View Area	64.50mm L x 14.50mm W	mm
Active Area	55.65 x 9.40	mm
Dot Size	0.55 x 0.65	mm
Dot pitch	0.60 x 0.70	mm
Character Size	2.95 x 5.55	mm
Character Pitch	3.55 x 5.95	mm
LCD Type	STN, Positive, Transflective, Grey	
Viewing Direction	6 O' clock	
Driving Scheme	1/16 Duty Cycle, 1/5 Bias	
Power Supply Voltage	5.0 V	
VLCD Adjustable For Best Contrast	5.0 V (VOP.)	
Operation temperature	-20°C to +70°C	
Storage temperature	-30°C to +80°C	

Block Diagram



Mechanical Drawing



Pin Description

Pin No.	Symbol	Level	Description
1	VSS	0V	Ground.
2	VDD	+5.0V	Power supply for logic operating.
3	V0	--	Adjusting supply voltage for LCD driving.
4	RS	H/L	A signal for selecting registers: 1: Data Register (for read and write) 0: Instruction Register (for write), Busy flag-Address Counter (for read).
5	R/W	H/L	R/W = "H" : Read mode. R/W = "L" : Write mode.
6	E	H/L	An enable signal for writing or reading data.
7	DB0	H/L	This is an 8-bit bi-directional data bus.
8	DB1	H/L	
9	DB2	H/L	
10	DB3	H/L	
11	DB4	H/L	
12	DB5	H/L	
13	DB6	H/L	
14	DB7	H/L	
15	LED+	+5.0V	Power supply for backlight.
16	LED-	0V	The backlight ground.

Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	TOP	0		+50	°C
Storage Temperature	TST	-10		+60	°C
Input Voltage	VI	VSS		VDD	V
Supply Voltage For Logic	VDD-VSS	-0.3		7	V
Supply Voltage For LCD	VDD-V0	-0.3		13	V

Electrical Characteristics

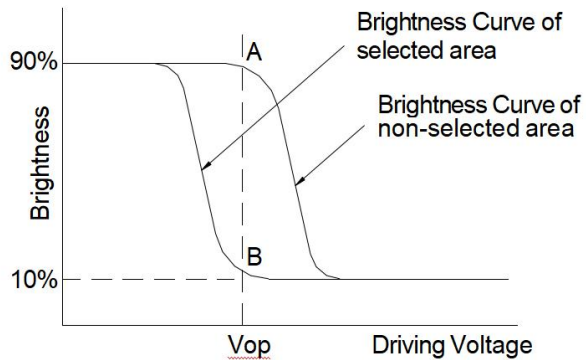
Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	VDD-VSS		4.5		5.5	V
Supply Voltage For LCD	VDD-V0	Ta=0: Ta=25: Ta=50:	 3.6	3.8	4.2	V V V
Input High Volt.	VIH		2.2		VDD	V
Input Low Volt.	VIL				0.6	V
Output High Volt.	VOH		2.4			V
Output Low Volt.	VOL				0.4	V
Supply Current	IDD	VDD=5V		1.2		mA

Optical Characteristics

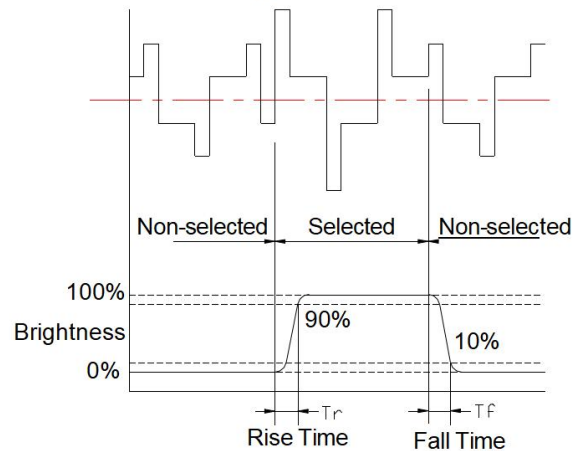
Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V)?	CR 2	10		105	deg
	(H)?	CR 2	-30		30	deg
Contrast Ratio	CR			3		
Response Time	T rise			150	200	ms
	T fall			150	200	ms

Note 1: Definition of Contrast Ratio “K”

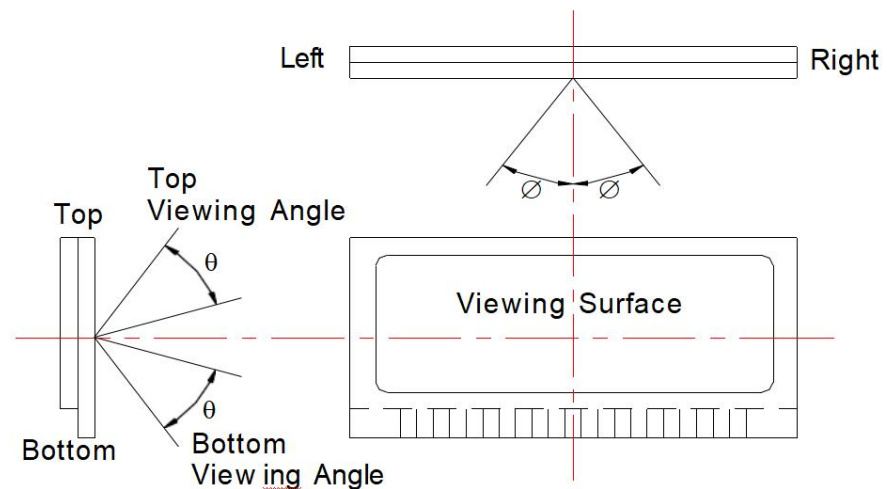
$$K = \frac{\text{Brightness of non-selected segment(A)}}{\text{Brightness of selected segment(B)}}$$



Note 2: Definition of Optical Response Time



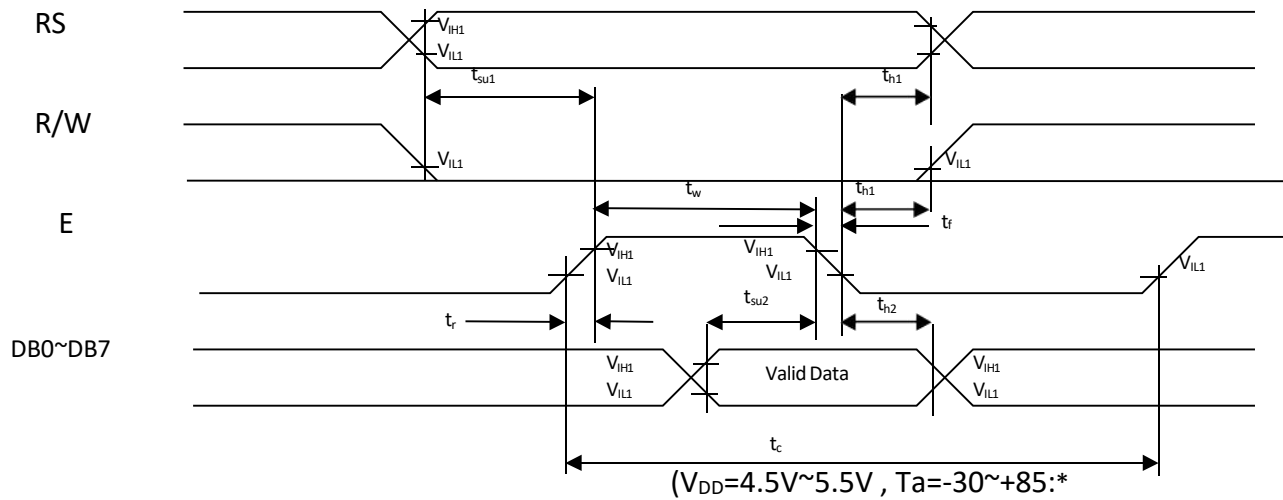
Note 3: Definition of Viewing Angle



Please select either top or bottom viewing angle

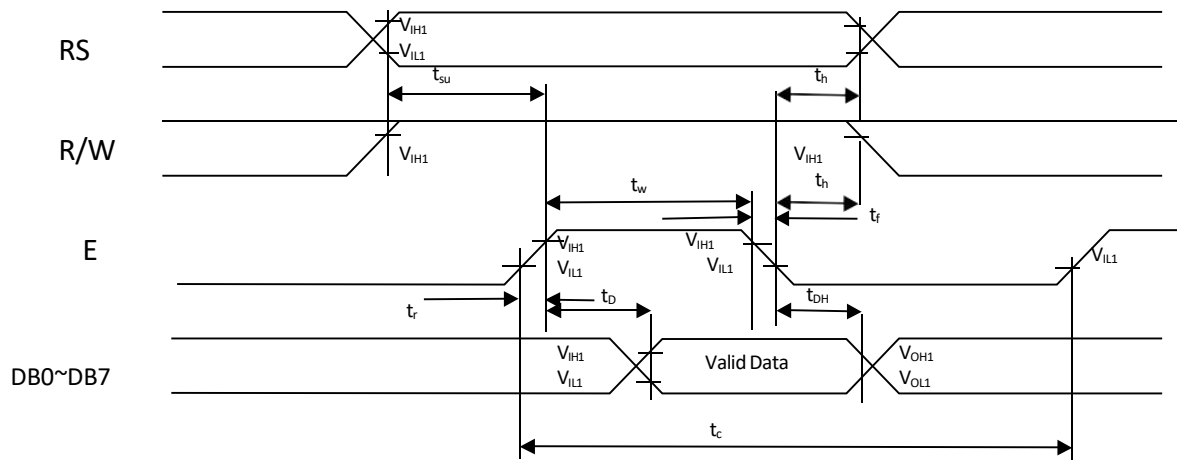
Time Characteristics

Write Operation



Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode	E cycle Time	t_c	500			ns
	E Rise/Fall Time	t_R, t_F			20	
	E Pulse Width (High, Low)	t_w	230			
	R/W and RS Setup Time	t_{su1}	40			
	R/W and RS Hold Time	t_{h1}	10			
	Data Setup Time	t_{su2}	80			
	Data Hold Time	t_{h2}	10			

Read Operation



($V_{DD}=4.5V\sim 5.5V$, $T_a=-30\sim +85:*$)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Read Mode	E cycle Time	t_c	500			ns
	E Rise/Fall Time	t_R, t_F			20	
	E Pulse Width (High, Low)	t_w	230			
	R/W and RS Setup Time	t_{su}	40			
	R/W and RS Hold Time	t_H	10			
	Data Output Delay Time	t_D			120	
	Data Hold Time	t_{DH}	5			

Function Description

The LCD display Module is built in a LSI controller, the controller has two 8-bit registers, an instruction register (IR) and a data register (DR).

The IR stores instruction codes, such as display clear and cursor shift, and address information for display data RAM (DDRAM) and character generator (CGRAM). The IR can only be written from the MPU.

The DR temporarily stores data to be written or read from DDRAM or CGRAM.

When address information is written into the IR, then data is stored into the DR from DDRAM or CGRAM. By the register selector (RS) signal, these two registers can be selected.

RS	R/W	Operation
0	0	IR write as an internal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB7)
1	0	Write data to DDRAM or CGRAM (DR to DDRAM or CGRAM)
1	1	Read data from DDRAM or CGRAM (DDRAM or CGRAM to DR)

Busy Flag (BF)

When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted.

When RS=0 and R/W=1, the busy flag is output to DB7.

The next instruction must be written after ensuring that the busy flag is 0.

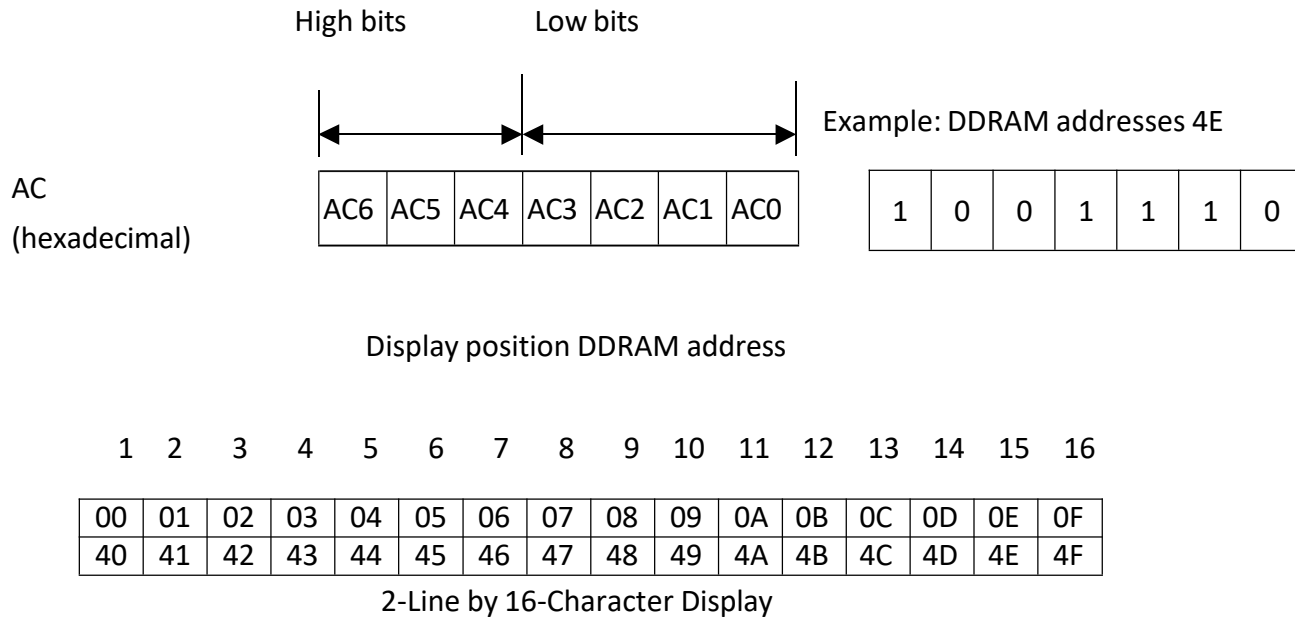
Address Counter (AC)

The address counter (AC) assigns addresses to both DDRAM and CGRAM.

Display Data RAM (DDRAM)

This DDRAM is used to store the display data represented in 8-bit character codes. Its extended capacity is 80 8 bits or 80 characters.

Below figure is the relationships between DDRAM addresses and positions on the liquid crystal display.



Character Generator ROM (CGROM)

The CGROM generate 5 8 dot or 5 10 dot character patterns from 8-bit character codes. See Table 2.

Character Generator RAM (CGRAM)

In CGRAM, the user can rewrite character by program.

For 5 8 dots, eight character patterns can be written, and for 5 10 dots, four character patterns can be written.

Write into DDRAM the character code at the addresses shown as the left column of table 1.

To show the character patterns stored in CGRAM.

Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character patterns

Table 1

For 5 * 8 dot character patterns

Character Codes (DDRAM data)								CGRAM Address								Character Patterns (CGRAM data)																							
7	6	5	4	3	2	1	0					5	4	3	2	1	0	7	6	5	4	3	2	1	0														
High				Low								High				Low								High				Low											
0 0 0 0 * 0 0 0								0 0 0								0	0	0					*	*	*					0	<div>Character pattern(1)</div>								
																0	0	1					*	*	*	0	0	0											
																0	1	0					*	*	*	0	0	0											
																0	1	1					*	*	*				0										
																1	0	0					*	*	*	0			0	0									
																1	0	1					*	*	*	0	0		0										
																1	1	0					*	*	*	0	0	0											
																1	1	1					*	*	*	0	0	0	0	0									
																0	0	0					*	*	*		0	0	0										
																0	0	1					*	*	*	0			0						0				
																0	1	0					*	*	*														
0 0 0 0 * 0 0 1								0 0 1								0	1	1					*	*	*	0	0		0	0	<div>Character pattern(2)</div>								
																1	0	0					*	*	*				0	0									
																1	0	1					*	*	*	0	0		0	0									
																1	1	0					*	*	*	0	0		0	0									
																1	1	1					*	*	*	0	0	0	0	0									
																0	0	0					*	*	*									<div>Cursor pattern</div>					
																0	0	1					*	*	*														
0 0 0 0 * 1 1 1								1 1 1								1	0	0													<div>Cursor pattern</div>								
																1	0	1																					
																1	1	0																					
																1	1	1																					

For 5 * 10 dot character patterns

Character Codes (DDRAM data)												CGRAM Address								Character Patterns (CGRAM data)																			
7	6	5	4	3	2	1	0									5	4	3	2	1	0	7	6	5	4	3	2	1	0										
High				Low												High				Low												High				Low			
0 0 0 0 * 0 0 0								0 0								0	0	0	0	*	*	*	0	0	0	0	0	0	0	0									
																0	0	0	1	*	*	*	0	0	0	0	0	0											
																0	0	1	0	*	*	*	0	0	0	0	0	0											
																0	0	1	1	*	*	*	0	0	0	0	0	0											
																0	1	0	0	*	*	*	0	0	0	0	0	0											
																0	1	0	1	*	*	*	0	0	0	0	0	0											
																0	1	1	0	*	*	*	0	0	0	0	0	0											
																0	1	1	1	*	*	*	0	0	0	0	0	0											
																1	0	0	0	*	*	*	0	0	0	0	0	0											
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																1	0	1	0	*	*	*	0	0	0	0	0	0											
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																				*	*	*	0	0	0	0													

■ : " High "

Table 2

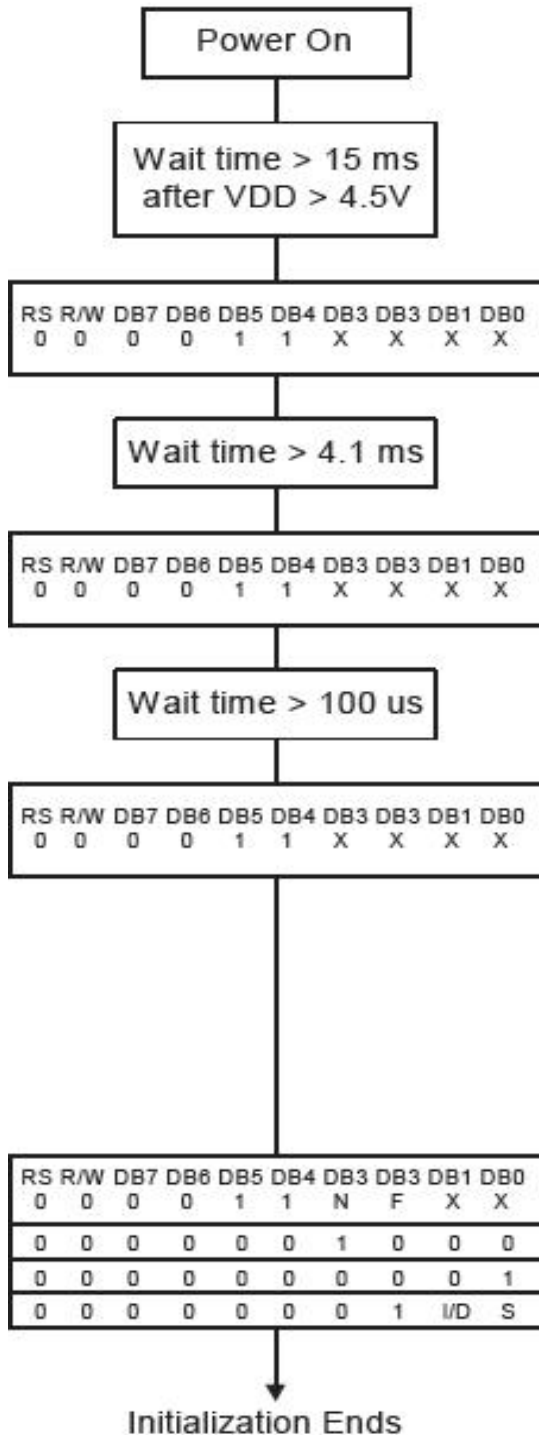
b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)			0	@	P	\	P				-	9	E	@	P
0001	(2)		!	1	A	Q	a	9			.	7	7	4	a	q
0010	(3)		"	2	B	R	b	r			7	4	9	x	p	@
0011	(4)		#	3	C	S	c	s			J	U	T	E	s	@
0100	(5)		\$	4	D	T	d	t			\	E	T	P	M	@
0101	(6)		%	5	E	U	e	u			.	7	7	4	a	q
0110	(7)		&	6	F	V	f	v			7	7	4	a	q	z
0111	(8)		'	7	G	W	g	w			7	7	4	a	q	x
1000	(1)		(	8	H	X	h	x			4	U	7	4	a	q
1001	(2)		)	9	I	Y	i	y			@	7	4	a	q	y
1010	(3)		*	:	J	Z	j	z			E	U	7	4	a	q
1011	(4)		+	;	K	[	k	[			7	7	4	a	q	x
1100	(5)		,	<	L	*	l	l			7	7	4	a	q	x
1101	(6)		-	=	M	]	m	]			7	7	4	a	q	x
1110	(7)		.	>	N	^	n	^			@	7	4	a	q	x
1111	(8)		/	?	O	_	o	+			7	7	4	a	q	x

Table of Commands

Instruction	Instruction Code										Description	Execution time (fosc=270KHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "00H" to DDRAM and set DDRAM address to "00H" from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1		Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39us
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39us
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L			Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39us
Function Set	0	0	0	0	1	DL	N	F			Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5 11 dots/5 8 dots)	39us
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39us
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39us
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	40us
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43us
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43us

Initializing of LCM

[8-Bit Interface]



(Wait time > 40ms
After VDD > 2.7V)

{ BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

{ BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

{ BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

BF can be checked after the following instructions .

Function set (Interface is 8 bits length .
Specify the number of display lines and
character font .)

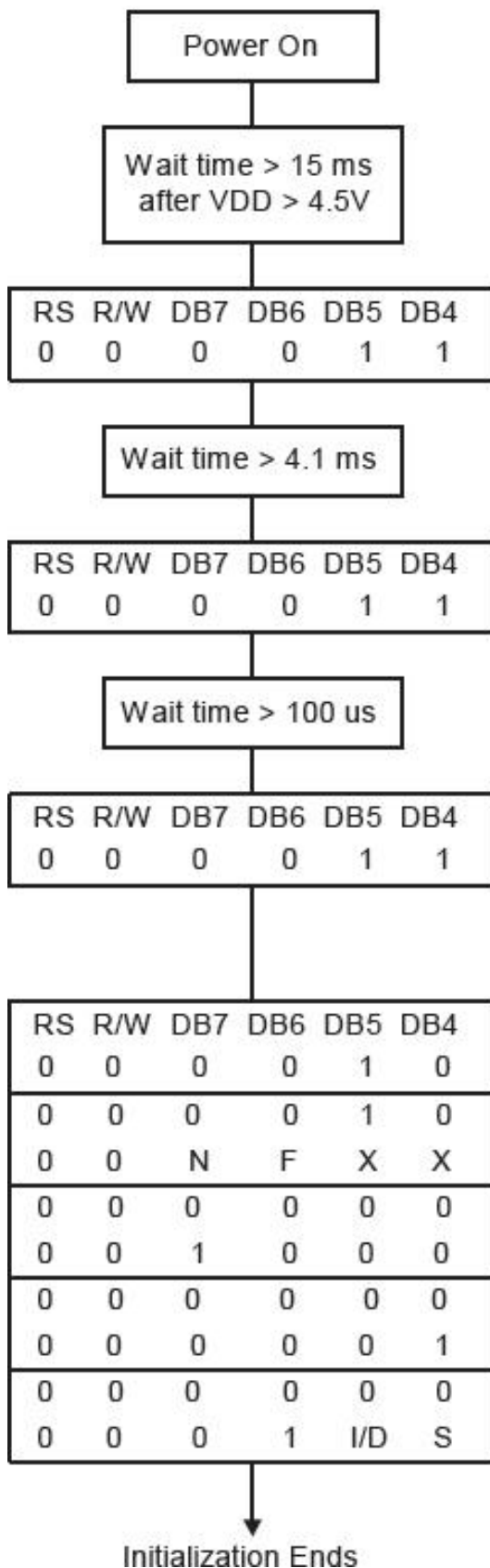
The number of display lines and character
font cannot be changed afterwards .

Display off

Display clear

Entry mode set

[4-Bit Interface]



(Wait time > 40ms
After VDD > 2.7V)

{ BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

{ BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

{ BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

BF can be checked after the following instructions .

Function set (Set interface to be 4 bits length)
Interface is 8 bits length .

Function set (Interface is 4 bits length .
Specify the number of the display lines
and character font .)

The number of display lines and character
font cannot be changed afterwards .

Display off

Display clear

Entry mode set

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	+80°C, 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C, 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C, 96hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C, 96hrs	1,2
High Temperature / Humidity Operation	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+50°C, 90% RH, 96hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	0°C,30min -> +25°C,5min - > +50°C,30min = 1 cycle 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-55Hz, 15mm amplitude. 60 sec in each of 3 directions X, Y, Z For 15 minutes	3
Static electricity test	Endurance test applying electric static discharge.	VS=800V, RS=1.5kΩ, CS=100pF One time	

Note 1: No condensation to be observed.

Note 2: Conducted after 4 hours of storage at 25°C, 0%RH.

Note 3: Test performed on product itself, not inside a container.

Precautions in use of LCD Modules

- Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
- Don't disassemble the LCM.
- Don't operate it above the absolute maximum rating.
- Don't drop, bend or twist LCM. (6)Soldering: only to the I/O terminals.
- Storage: please storage in anti-static electricity container and clean environment.