

	No.2673	DM1613
		16 characters x 1 line LIQUID CRYSTAL DOT MATRIX DISPLAY MODULE

General Description

The DM1613 is a liquid crystal dot matrix display module that consists of LCD panel LCD-5013, LCD control driver HD44780 and is capable of providing 16 characters x 1 line (5 x 7 dots / character + cursor) display. It contains a controller, a data RAM, and a character generator ROM required for providing display. Data interfacing is in 8-bit parallel or 4-bit parallel and data can be written in or read from a microprocessor.

General Specifications

1. Display method	1/5bias 1/16duty
2. Display content	16 characters x 1 line
3. Dots organizing 1 character	5 x 7 dots/character + cursor
4. Display data RAM	80 x 8 bits
5. Character generator ROM	160-character JIS font set + 32-character special font set Refer to Table 1.
6. Character generator RAM	64 x 8 bits 5 x 7 dots 8 characters
7. Instruction function	Refer to Table 2.
8. Circuit diagram	Refer to Fig. 3.

Outline

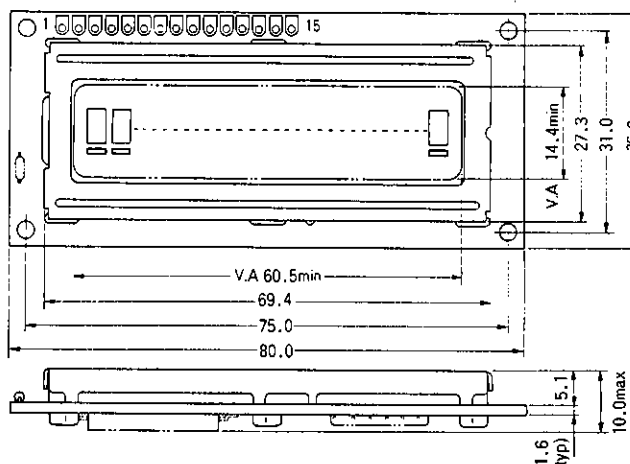
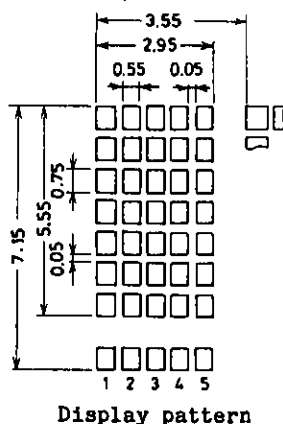
1. Module outline	36.0(W) x 80.0(L) x 10(T) (mm ³)
2. View area	60.5 x 14.4 (mm ²)
3. Dot size	0.55 x 0.75 (mm ²)
4. Dot pitch	0.60 x 0.80 (mm ²)
5. Character size(5x7 dots)	2.95 x 5.55 (mm ²)

Absolute Maximum Ratings at Ta=25°C

			unit
Maximum Supply Voltage	V _{DD} -V _{SS}	-0.3 to +7	V
Input Voltage	V _I	-0.3 to V _{DD} +0.3	V
LCD Drive Voltage	V _{DD} -V _O	-0.3 to +9	V
Operating Temperature	T _{opr}	0 to +50	°C
Storage Temperature	T _{stg}	-20 to +70	°C

Module Dimensions 5009

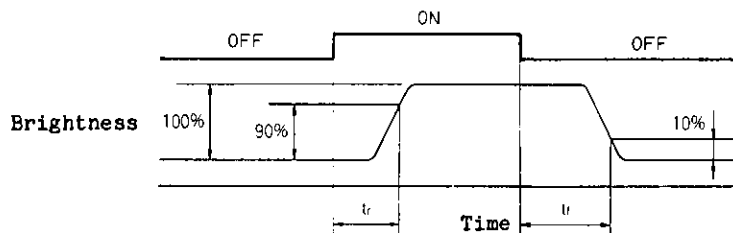
(unit: mm)



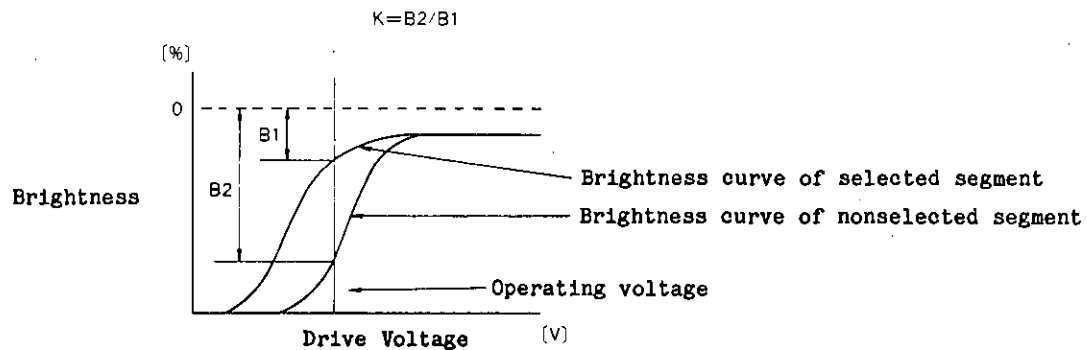
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Electro-optical Characteristics at $T_a=25^{\circ}\text{C}$, $V_{DD}-V_{SS}=5\text{V}$ unless otherwise specified				min	typ	max	unit
Input "High" Voltage	V_{IH}			2.2		5.0	V
Input "Low" Voltage	V_{IL}			0		0.6	V
Output "High" Voltage	V_{OH}	DB0 to DB7, $-I_{OH}=0.2\text{mA}$		2.4			V
Output "Low" Voltage	V_{OL}	DB0 to DB7, $I_{OL}=1.2\text{mA}$				0.4	V
Pull-up MOS Current	I_P	DB0 to DB7, RS, R/W		50	125	250	μA
Current Dissipation	I_{DD}	No input/output current included			1.5	3.0	mA
Oscillation Frequency	F_{OSC}			190	270	350	kHz
Viewing Angle	$\phi_{2-\phi 1}$	$K=1.4, \theta=0^{\circ}$		20	30		degree
Contrast Ratio	K	$\phi=20^{\circ}, \theta=0^{\circ}$		3.0			
Rise Time	t_r	$\phi=20^{\circ}, \theta=0^{\circ}$			150	250	ms
Fall Time	t_f	$\phi=20^{\circ}, \theta=0^{\circ}$			150	250	ms
LCD Drive Voltage	$V_{DD}-V_O$	$T_a=0^{\circ}\text{C}, \phi=20^{\circ}, \theta=0^{\circ}, K \geq 3$		4.4	4.5	4.6	V
(Recommended Value)		$T_a=25^{\circ}\text{C}, \phi=20^{\circ}, \theta=0^{\circ}, K \geq 3$		4.0	4.1	4.2	V
1/16 duty		$T_a=50^{\circ}\text{C}, \phi=20^{\circ}, \theta=0^{\circ}, K \geq 3$		3.4	3.5	3.6	V

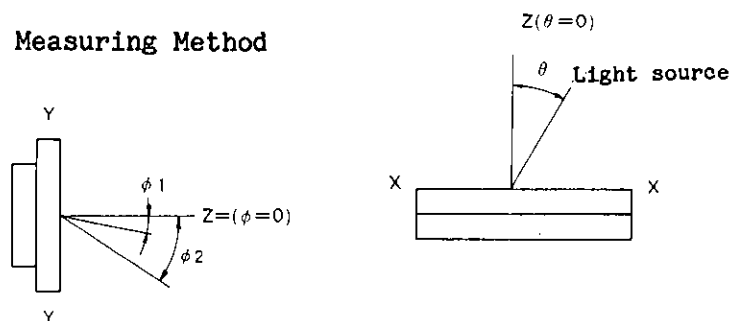
(1) Test Condition for Response Time (t_r , t_f)



(2) Definition of Contrast Ratio (K)



(3) Contrast Ratio Measuring Method



Angles ϕ and θ are defined as shown above.

The light source is placed in the θ direction at an angle of 30° and the sensor is placed in the ϕ direction to measure the contrast.

Pin Description

No.	Pin Name	Function
1	V _{SS}	(-) power supply pin 0V
2	V _{DD}	(+) power supply pin +5V
3	V _O	Pin for applying LCD drive voltage
4	RS	Input pin, HI=Data, LOW=Instruction
5	R/W	Input pin, HI=Read, LOW=Write
6	E	Input pin, Enable signal
7	DB0	Data bus line
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	
15	NC	

Timing Characteristics

			min	typ	max	unit
Enable Cycle Time		t_{cycE}	1000			ns
Enable Pulse Width	High level	PW_{EH}	450			ns
Enable Rise/Fall Time		t_{Er}, t_{Ef}			25	ns
Setup Time	RS, R/W, E	t_{As}	140			ns
Address Hold Time		t_{AH}	10			ns
Data Delay Time		t_{DDR}			320	ns
Data Setup Time		t_{DSW}	195			ns
Data Hold Time		$t_H(t_{DHR})$	10(20)			ns

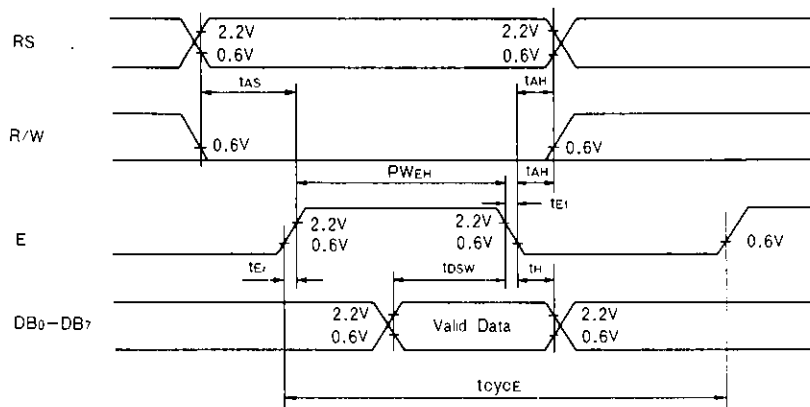
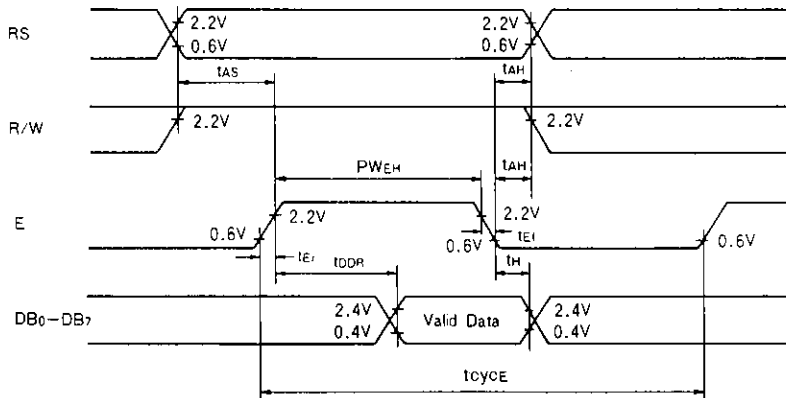
Write Operation**Fig. 1 Interface Timing (Data Write)****Read Operation****Fig. 2 Interface Timing (Data Read)**

Table 1 Character Code

Hi-order 4 bits Low-order 4 bits	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
xxxx0000	CG RAM (1)		0	a	P	`	P		—	9	3	o	p
xxxx0001	(2)	!	1	A	O	a	9	a	7	+	4	ä	q
xxxx0010	(3)	"	2	B	R	b	r	7	i	u	x	p	ö
xxxx0011	(4)	#	3	C	S	c	s	j	o	t	e	e	∞
xxxx0100	(5)	\$	4	D	T	d	t	\	I	t	†	μ	ö
xxxx0101	(6)	%	5	E	U	e	u	.	†	†	1	e	ü
xxxx0110	(7)	&	6	F	V	f	v	7	†	†	†	p	z
xxxx0111	(8)	'	7	G	W	g	w	7	†	†	†	g	π
xxxx1000	(1)	(	G	H	X	h	x	4	o	*	†	r	∞
xxxx1001	(2)	)	9	I	Y	i	y	9	†	†	†	†	†
xxxx1010	(3)	*	†	J	Z	j	z	†	†	†	†	j	†
xxxx1011	(4)	+	†	K	L	k	l	†	†	†	†	†	†
xxxx1100	(5)	.	<	L	†	†	†	†	†	†	†	†	†
xxxx1101	(6)	—	=	M	I	m	)	†	†	†	†	†	†
xxxx1110	(7)	†	>	N	†	n	†	†	†	†	†	†	†
xxxx1111	(8)	/	?	O	—	o	†	†	†	†	†	ö	†

(Note) The CG RAM is a character generator RAM used to store the character patterns that can be program-rewritten, as desired, by the user.

Table 2 Instruction Function

Instruction	Code										Contents	Execution Time ($f_{OSC}=250kHz$)	
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Display clear	0	0	0	0	0	0	0	0	0	1	Clears all display and returns the cursor to the home position (address 0).	82 μ s to 1.64ms	
Cursor home	0	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. The DD RAM contents remain unaffected.	40 μ s to 1.6ms
Entry mode set	0	0	0	0	0	0	0	0	1	I/D	S	Sets the cursor move direction and specifies whether or not to shift the display. These operations are performed during data write and read.	40 μ s
Display ON/OFF control	0	0	0	0	0	0	0	1	D	C	B	Sets all display ON/OFF(D), cursor ON/OFF(C), cursor position character blink (B).	40 μ s
Cursor/display shift	0	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without affecting the DD RAM contents.	40 μ s
Function set	0	0	0	0	1	DL	N	F	*	*	*	Sets the interface data length (DL), number of display lines (L), and character font (F).	40 μ s
CG RAM address set	0	0	0	1	A_{CG}						Sets the CG RAM address. RAM data is sent/received after this setting.	40 μ s	
DD RAM address set	0	0	1	A_{DD}						Sets the DD RAM address. DD RAM data is sent/received after this setting.	40 μ s		
Busy flag/address read	0	1	BF	AC						Reads the contents of busy flag (BF) indicating internal operation is in progress and reads the contents of address counter.	1 μ s		
CG RAM/DD RAM data write	1	0	Write Data						Writes data into the DD RAM or CG RAM.	40 μ s			
CG RAM/DD RAM data read	1	1	Read Data						Reads data from the DD RAM or CG RAM.	40 μ s			
	I/D=1: Increment (+1) I/D=0: Decrement (-1) S=1: Accompanied by display shift S/C=1: Display shift S/C=0: Cursor move R/L=1: Right-shift R/L=0: Left-shift DL=1: 8 bits DL=0: 4 bits N=1: 2 lines N=0: 1 line F=1: 5 x 10 dots F=0: 5 x 7 dots BF=1: Internally operating BF=0: Possible to accept instruction										DD RAM: Display data RAM CG RAM: Character generator RAM A_{CG} : CG RAM address A_{DD} : DD RAM address Corresponds to cursor address. AC: Address counter used for both DD RAM and CG RAM.	The change in the frequency (f_{OSC}) also causes the execution time to be changed. (Example) When $f_{OSC}=270kHz$, $40\mu s \times \frac{250}{270}$ 37 μ s.	

Fig. 3 Circuit Diagram DM1613

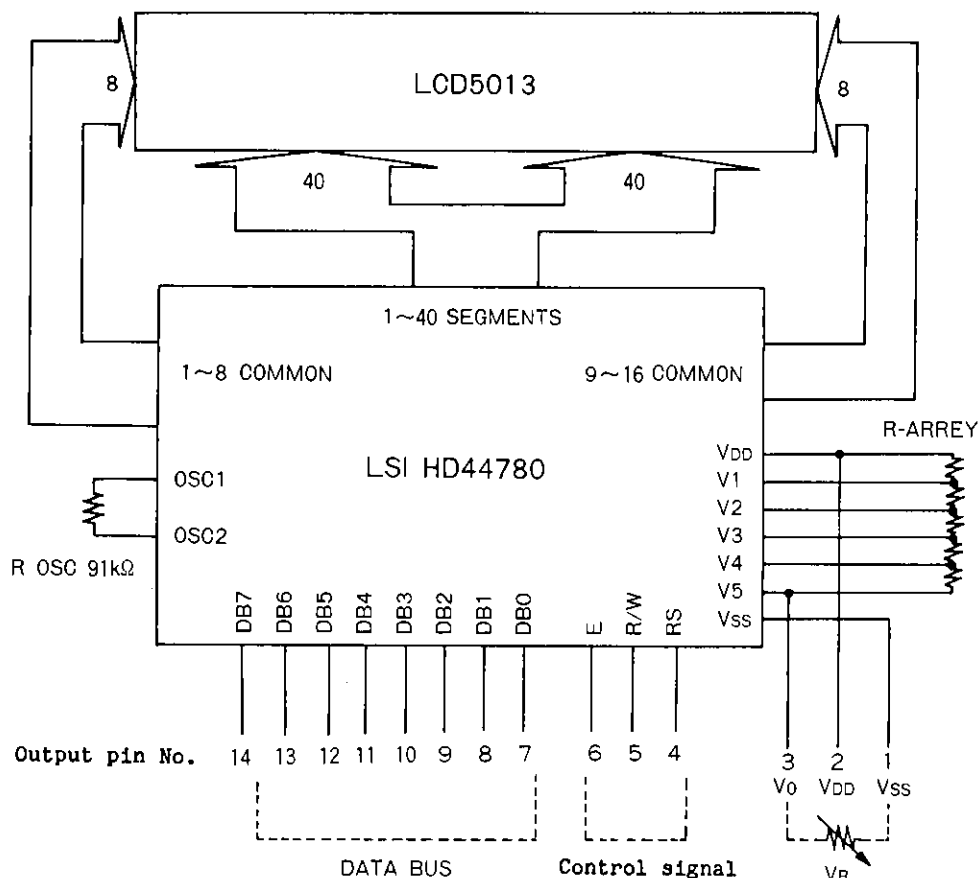
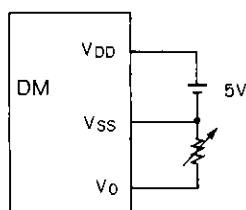


Fig. 4 Sample Power Supply



$V_{DD}-V_o$: LCD drive voltage

The LCD drive voltage can be varied from approximately 3V to 5V by a variable resistor of 5kohms connected across V_{SS} and V_o .

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