

### 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.

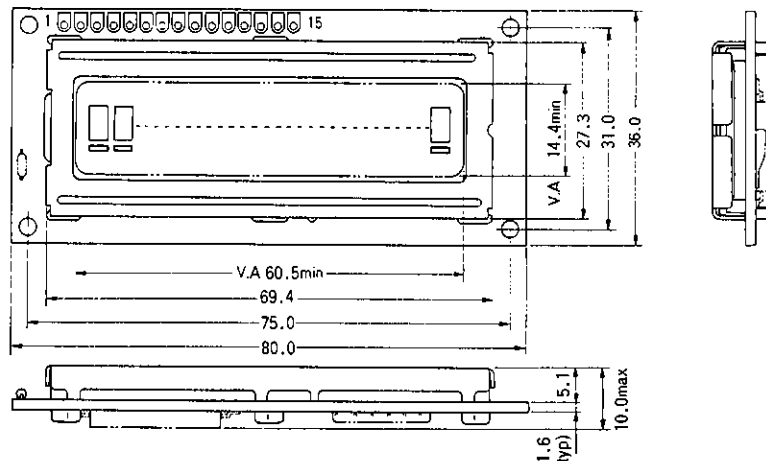
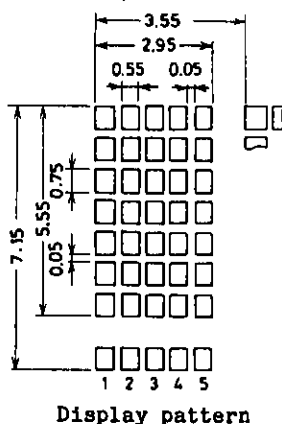
### Outline

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

### 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

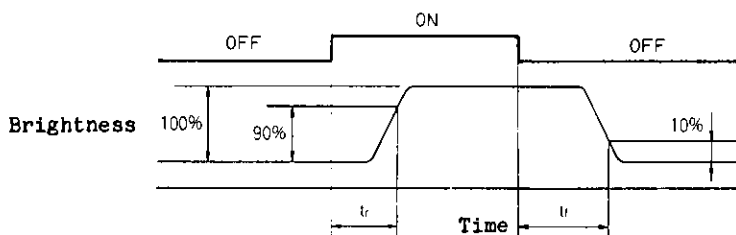
### Module Dimensions 5009 (unit: mm)



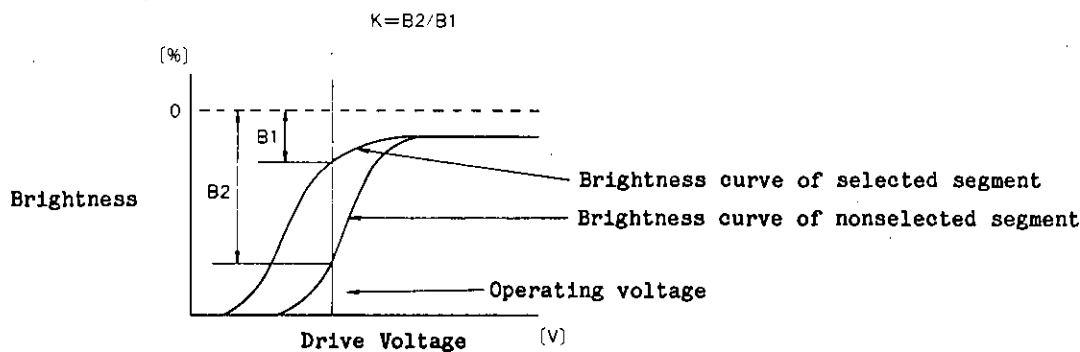
**Electro-optical Characteristics at Ta=25°C, V<sub>DD</sub>-V<sub>SS</sub>=5V unless otherwise specified**

		min	typ	max	unit
Input "High" Voltage	V <sub>IH</sub>	2.2		5.0	V
Input "Low" Voltage	V <sub>IL</sub>	0		0.6	V
Output "High" Voltage	V <sub>OH</sub>	2.4			V
					DB0 to DB7, -I <sub>OH</sub> =0.2mA
Output "Low" Voltage	V <sub>OL</sub>			0.4	V
					DB0 to DB7, I <sub>OL</sub> =1.2mA
Pull-up MOS Current	I <sub>P</sub>	50	125	250	μA
					DB0 to DB7, RS, R/W
Current Dissipation	I <sub>DD</sub>		1.5	3.0	mA
					No input/output current included
Oscillation Frequency	F <sub>OSC</sub>	190	270	350	kHz
Viewing Angle	φ <sub>2</sub> -φ <sub>1</sub>	20	30		degree
					K=1.4, θ=0°
Contrast Ratio	K	3.0			
					φ=20°, θ=0°
Rise Time	t <sub>r</sub>		150	250	ms
Fall Time	t <sub>f</sub>		150	250	ms
LCD Drive Voltage	V <sub>DD</sub> -V <sub>O</sub>	4.4	4.5	4.6	V
(Recommended Value)		4.0	4.1	4.2	V
1/16 duty		3.4	3.5	3.6	V
					Ta=0°C, φ=20°, θ=0°, K≥3
					Ta=25°C, φ=20°, θ=0°, K≥3
					Ta=50°C, φ=20°, θ=0°, K≥3

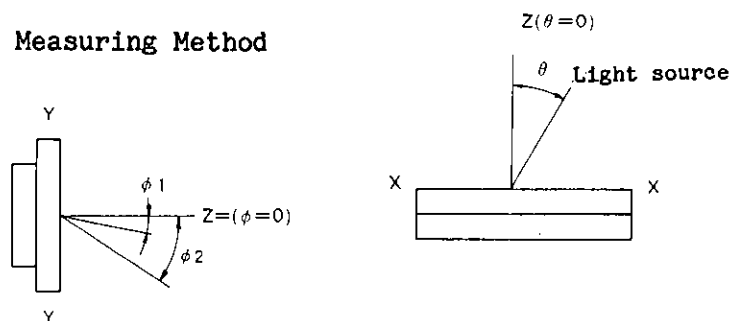
(1) Test Condition for Response Time (t<sub>r</sub>, t<sub>f</sub>)



(2) Definition of Contrast Ratio (K)



## (3) Contrast Ratio Measuring Method



Angles  $\phi$  and  $\theta$  are defined as shown above.

The light source is placed in the  $\theta$  direction at an angle of  $30^\circ$  and the sensor is placed in the  $\phi$  direction to measure the contrast.

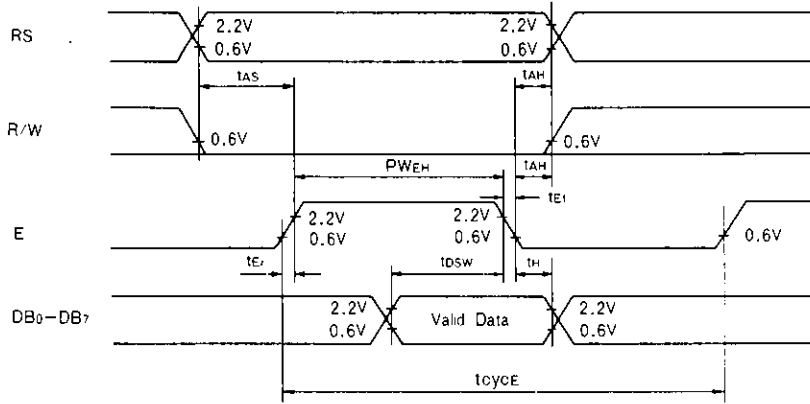
## Pin Description

No.	Pin Name	Function
1	VSS	(-) power supply pin 0V
2	VDD	(+) power supply pin +5V
3	V <sub>O</sub>	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

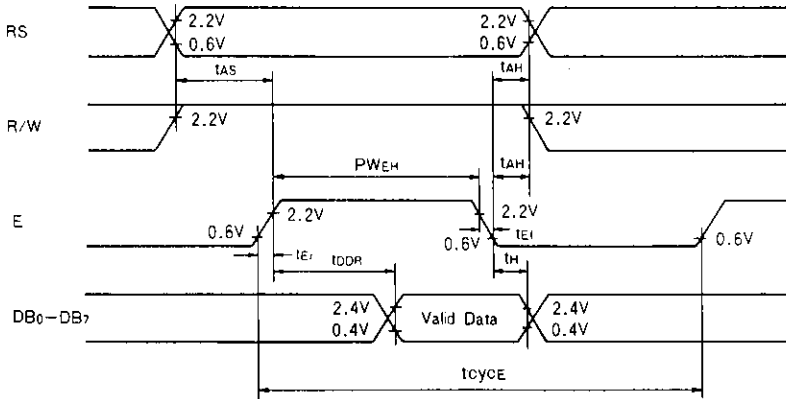
			min	typ	max	unit
Enable Cycle Time		$t_{cycE}$	1000			ns
Enable Pulse Width	High level	$PW_{EH}$	450			ns
Enable Rise/Fall Time		$t_{Er}, t_{Ef}$			25	ns
Setup Time	RS, R/W, E	$t_{As}$	140			ns
Address Hold Time		$t_{AH}$	10			ns
Data Delay Time		$t_{DDR}$			320	ns
Data Setup Time		$t_{DSW}$	195			ns
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	E	e	P	
xxxx0001	(2)	!	1	A	O	a	g	u	7	#	4	a	g
xxxx0010	(3)	"	2	B	R	b	r	T	i	u	x	P	e
xxxx0011	(4)	#	3	C	S	c	s	J	o	T	E	e	w
xxxx0100	(5)	\$	4	D	T	d	t	\	I	I	+	P	a
xxxx0101	(6)	%	5	E	U	e	u	.	*	+	1	e	0
xxxx0110	(7)	&	6	F	V	f	v	3	0	2	3	P	Z
xxxx0111	(8)	'	7	G	W	g	w	7	+	x	7	g	w
xxxx1000	(1)	(	8	H	X	h	x	4	0	*	U	s	x
xxxx1001	(2)	)	9	I	Y	i	y	5	6	7	U	'	y
xxxx1010	(3)	*	#	J	Z	j	z	8	0	1	v	j	7
xxxx1011	(4)	+	;	K	I	k	i	*	9	E	0	*	7
xxxx1100	(5)	,	<	L	*	l	!	+	9	7	7	e	7
xxxx1101	(6)	-	=	M	I	m	i	)	2	x	\	t	+
xxxx1110	(7)	.	>	N	^	n	+	3	E	t	+	n	
xxxx1111	(8)	/	?	O	_	o	+	w	y	7	#	o	■

(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 $\mu$ s to 1.64ms
Cursor 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. The DD RAM contents remain unaffected.	40 $\mu$ s to 1.6ms
Entry mode set	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 $\mu$ s
Display ON/OFF control	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 $\mu$ s
Cursor/display shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without affecting the DD RAM contents.	40 $\mu$ 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 $\mu$ s
CG RAM address set	0	0	0	1	ACG					Sets the CG RAM address. RAM data is sent/received after this setting.		40 $\mu$ s
DD RAM address set	0	0	1	ADD					Sets the DD RAM address. DD RAM data is sent/received after this setting.		40 $\mu$ 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 $\mu$ s	
CG RAM/DD RAM data write	1	0	Write Data					Writes data into the DD RAM or CG RAM.		40 $\mu$ s		
CG RAM/DD RAM data read	1	1	Read Data					Reads data from the DD RAM or CG RAM.		40 $\mu$ 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 ACG: CG RAM address ADD: 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 $\mu$ s.

Fig. 3 Circuit Diagram DM1613

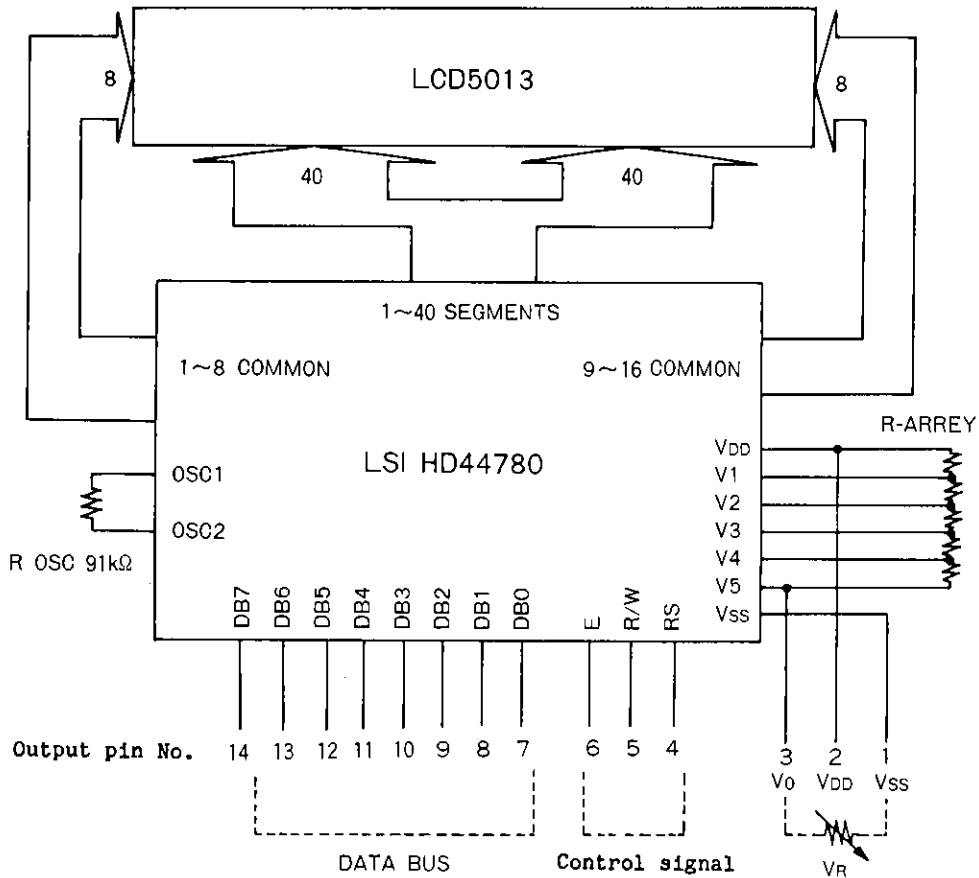
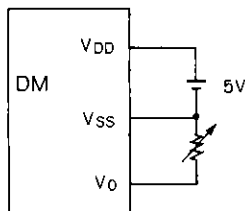


Fig. 4 Sample Power Supply



$V_{DD}-V_0$ : 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  $V_0$ .

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