



SPEC. NO	QE-개발-01-9131
ISSUED DATE	99. 11. 30


CUSTOMER	:
M O D E L	: OCM-16216D-5-A2026
DESCRIPTION	: LCD MODULE

THIS SPECIFICATION IS APPLIED FOR LCD MODULE DELIVERED TO YOUR COMPANY BY ORION DISPLAY TECHNOLOGY CO., LTD

◆ CUSTOMER APPROVAL

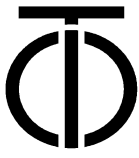
	CHECKED	CHECKED	APPROVAL
APPROVAL			
REMARK			

◆ SUPPLIER APPROVAL

PREPARED	CHECKED		APPROVAL
			CW RYU

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 ORION DISPLAY TECHNOLOGY CO.,LTD.

	<b>제 품 시 방 서</b> <b>LCD MODULE SPECIFICATION</b>	Document No.	QE-개발-01-9131
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**1. 내용**

- 1) 제품규격 : 첨부 규격에 따른다.
- 2) 검사규격 : 출하검사규격에 따른다.
- 3) 포장규격 : 제품포장규격에 따른다.

**2. 작성, 검토 및 승인**

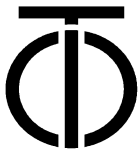
관 리 분 : \_\_\_\_\_  접수부서 :

비관리분 : \_\_\_\_\_  접 수 자 :

본 품질지침서(EI)는 다음 책임자에 의해 작성(개정), 검토 및 승인이 되어야 효력이 있다.

구 분	작성부서		합의부서		합의부서	
	서명	일자	서명	일자	서명	일자
작성(개정)		99. 11. 30				
검 토		99. 11. 30				
검 토		99. 11. 30				
승 인	CW RYU	99. 11. 30				



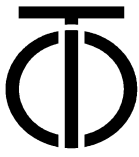
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NOTE: When using this specification, the reader should keep the followings in mind.

1. This specification may, wholly or partially, be subjected to change without notice.
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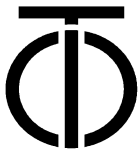
## 1. FEATURES

OEM-16216D-5-A2026 is a low-power consumption dot-matrix LCD Module with a built-in controller. The controller has a built-in CG ROM, CG RAM for user's patterns and DD RAM. All the display functions are controlled by instructions and the module can be easily interfaced with a MPU.

- Format : 16 Char. X 2 Lines
- Display type : STN-YELLOW, Positive, 6 o'clock, Indoor, Single power, Transmissive
- Driving method : 1/16 duty
- Capable of interfacing to 4-bit or 8-bit MPU.
- Instruction functions are available by programming
  - \* Display clear , Cursor home , Display ON/OFF , Cursor ON/OFF
  - \* Display character blink , Display shift , Cursor shift
- Internal automatic reset circuit at power on.
- Internal oscillation circuit.
- Built in memory capacity
  - \* CG ROM ( Character generator ROM )
    - └────────── 160 characters with 5x7 dots and
    - └────────── 32 characters with 5x10 dots
  - \* CG RAM ( Character generator RAM )
    - └────────── 8 characters with 5x7 dots or
    - └────────── 4 characters with 5x10 dots
  - \* DD RAM ( Display data RAM )
    - └────────── Max. 80 characters ( 80 X 8 bit )
- Model Type : COB
- Controller IC : KS0066 or equivalent
- Driver IC : KS0065 or equivalent
- LED backlighting ( LED PANEL )
- Emitted color : Yellow - Green ( Peak wave length :  $\lambda_p = 570 \text{ nm}$  )

## 2. MECHANICAL DATA

ITEM	WIDTH	HEIGHT	THICKNESS	UNIT
Module size	80.0	36.0	13.0	mm
Viewing area	65.6	13.8	-	mm
Character	Construction	5 x 7		dots
	Size	2.95	4.35	-
	Pitch	3.65	5.05	-
Dot	Size	0.55	0.50	-
	Pitch	0.60	0.55	-
Diameter of mounting hole	2.5			mm
Weight	About 35			g

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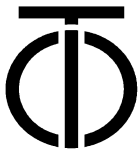
### 3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	CONDITION	STANDARD VALUE		UNIT
			MIN.	MAX.	
Power supply for logic	$V_{DD}-V_{SS}$	$T_a=25^{\circ}\text{C}$	0	7.0	V
Power supply for logic	$V_{DD}-V_{SSS}$	$T_a=25^{\circ}\text{C}$	0	7.0	V
Power supply for LCD	$V_{DD}-V_L$	$T_a=25^{\circ}\text{C}$	0	13.5	V
Input voltage	$V_{IN}$	$T_a=25^{\circ}\text{C}$	$V_{SSS}$	$V_{DD}$	V
Operating temperature	$T_{op}$	-	0	50	$^{\circ}\text{C}$
Storage temperature	$T_{STG}$	-	-20	70	$^{\circ}\text{C}$
LED forward current	$I_F$	$T_a=25^{\circ}\text{C}$	-	120	mA
LED reverse voltage	$V_R$	$T_a=25^{\circ}\text{C}$	-	8.0	V
LED power consumption	$P_D$	$T_a=25^{\circ}\text{C}$	-	520	mW

### 4. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN.	TYP.	MAX.	
Power supply for logic	$V_{DD}$	$T_a = 25^{\circ}\text{C}$	2.2	-	$V_{DD}$	V
Input high voltage	$V_{IH}$	-	2.2	-	$V_{DD}$	V
Input low voltage	$V_{IL}$	-	$V_{SSS}$	-	0.6	V
Output high voltage	$V_{OH}$	$I_{OH} = -0.205 \text{ mA}$	2.4	-	$V_{DD}$	V
Output low voltage	$V_{OL}$	$I_{OL} = 1.2 \text{ mA}$	$V_{SSS}$	-	0.4	V
Power supply current	$I_{DD}$	$V_{DD}=5.0\text{V}, V_{LCD}=4.6\text{V}$	-	1.5	3.0	mA
Brightness	L	$V_{LED}=4.2\text{V}, I_F=75\text{mA}$	10	15	-	NIT
LED B/L forward voltage	$V_F$	$I_F=75\text{mA}, T_a = 25^{\circ}\text{C}$	-	4.2	-	V
Power supply for LCD ( Note 1 ) = $V_{LCD}$	$V_{DD}-V_L$	$T_a = 0^{\circ}\text{C}$	-	-	-	V
		$T_a = 25^{\circ}\text{C}$	-	4.4	-	V
		$T_a = 50^{\circ}\text{C}$	-	-	-	V

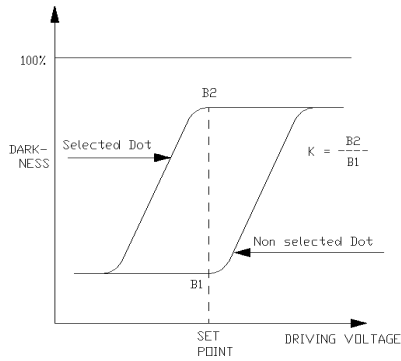
Note 1 : Power supply for LCD is available with  $R_L$  in accordance with contrast.

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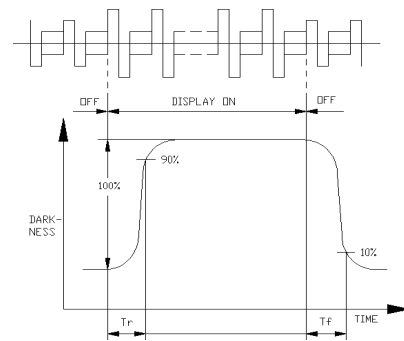
5. ELECTRO-OPTICAL CHARACTERISTICS ( STN ) ( Ta = 25 ℃ )

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast ratio	K	2.0	4.0	-	-	1
Response time ( rise )	$T_r$	-	150	250	ms	2
Response time ( fall )	$T_f$	-	150	250	ms	2
Viewing angle	$\phi$	-20 ~ +50			deg.	3,4
	$\theta$	-55 ~ +55				

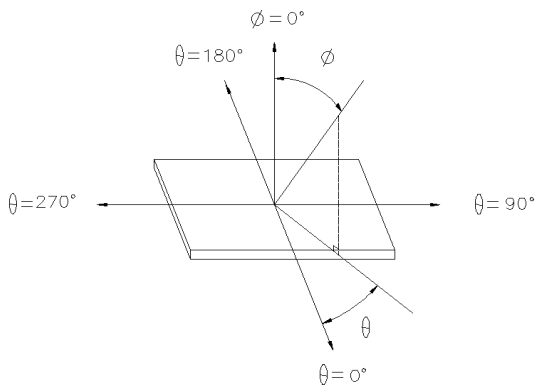
NOTE1. Definition of contrast K



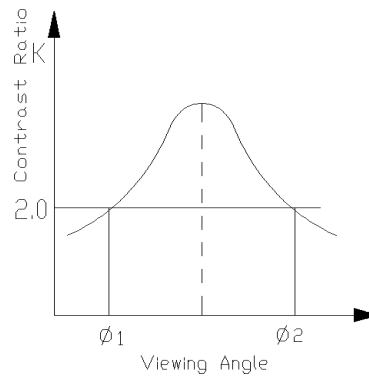
NOTE2. Definition of optical response

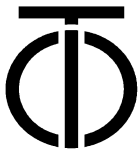


NOTE3. Definition of angle  $\theta$  and  $\phi$



NOTE4. Definition of viewing angle  $\phi_1$  and  $\phi_2$



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## 6. QUALITY SPECIFICATION

### 6.1 Acceptable Quality Level

INSPECTION ITEM	SAMPLING PROCEDURES	A.Q.L
MAJOR	MIL-STD-105E Inspection Level II Normal Inspection Single sample inspection	1.0
MINOR	MIL-STD-105E Inspection Level II Normal Inspection Single sample inspection	2.5

Major defect :

A major defect is a defect that could result in failure or materially reduce that the usability of the unit of product for its intended purpose.

Minor defect :

A minor defect is one that does not materially reduce the usability of the product for its intended purpose or is a departure from established standards giving no significant bearing on the effective use or operation of the unit.

### 6.2 Inspection Conditions

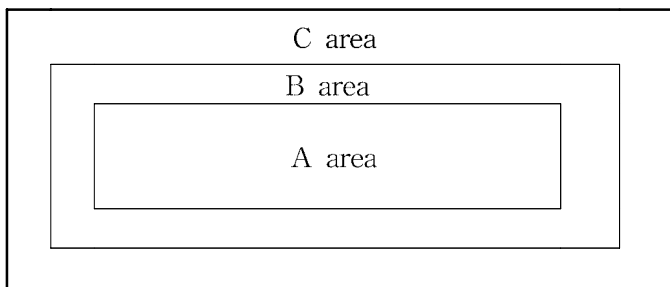
6.2.1 The environmental conditions for inspection shall be as follows

- Room Temperature :  $25 \pm 3^{\circ}\text{C}$
- Humidity Temperature :  $65 \pm 20\% \text{RH}$

6.2.2 The external visual inspection

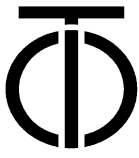
- The inspection shall be performed by using 40Watts fluorescent lamp for illumination and the distance between LCD and eyes of the inspector shall be 30cm or more.

### 6.3 Definition of the Area

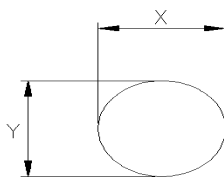


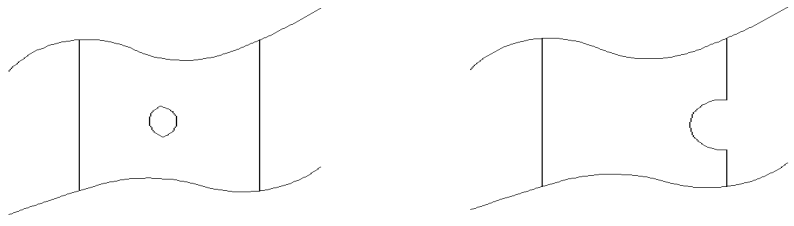
A area: Active Area  
 B area: Viewing Area  
 C area: Out of Viewing Area

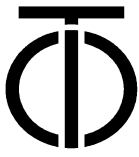


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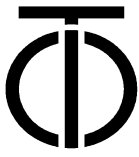
6.4 Inspection Standards

Class of defects	Inspection Item	Criteria of defects				Remarks
MAJOR	Display on inspection	1) No Display 2) Abnormal Operation 3) Short Circuit 4) Pattern Open 5) Off Viewing angle				
	Missing	Component missing				
MINOR	Spot/Dent	Size	Defect size		Acceptable Number	
		A Size	$\phi \leq 0.1$ mm		Ignore	
			$0.1 < \phi \leq 0.2$ mm		1	
			$\phi > 0.2$ mm		0	
		B Size	$\phi \leq 0.1$ mm		Ignore	
			$0.1 < \phi \leq 0.2$ mm		2	
	$\phi > 0.2$ mm		0			
	Cell Size (Viewing Area Criteria) ※ A size $< 2500\text{mm}^2$ Spot size = $(X+Y)/2$ B size $\geq 2500\text{mm}^2$					
						
	Scratch	POSITIVE		NEGATIVE		
Width X Length		Acceptable Number	Width X Length	Acceptable Number		
0.1 X 1.5 mm		3	0.1 X 1.5 mm	3		
0.08 X 3.0 mm		2	0.08 X 3.0 mm	2		
0.05 X 5.0 mm		1	0.05 X 5.0 mm	1		
※ Scratches should be separated more than 10mm each other						
Bubble	1) Round bubble should be treated as spot(positive) 2) Line bubble should be treated as scratch(positive)					

Class of defects	Inspection Item	Criteria of defects		Remarks
MINOR	Pattern Misalignment	Voids in segment  		
	Stain	Stains which cannot be removed even when wiped slightly with a soft cloth.		
	Rainbow	More than 2 colors are noticeable in the viewing direction.		

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Class of defects	Inspection Item	Criteria of defects	Remarks
MINOR	PCB damage	Damage on gold or copper foil	
	Parts alignment	1) IC lead width is more than 50% beyond land pattern 2) Chip component is off center and more than 50% of the leads is off the pad out line.	
	Conductive foreignmatter (solderball, soldersplash)	Conductive foreign matter is not allowed	
	Bezel claw	Bezel claw missing or not bent	

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## 7. RELIABILITY

- Operating life time : Longer than 50,000 hours  
( at room temperature without direct irradiation of sunlight )
- Reliability characteristics shall meet following requirements.

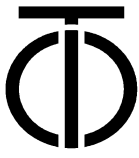
ITEM	TEST	CRITERION
High temp.	70℃ / 200 Hrs	* Total current consumption should be below double of initial value
Low temp.	-20℃ / 200 Hrs	
High humidity	40℃ X 90%RH / 200 Hrs	
Thermal shock	-20℃ → 25℃ → 70℃ → 25℃ / 5 Cycles (30min) (5min) (30min) (5min)	* Contrast ratio should be within initial value ±50%
Vibration	1.Operating time : Thirty minutes exposure in each direction( x,y,z ) 2.Sweep frequency (1min) : 10Hz →55Hz →10Hz 3.Amplitude : 0.75mm double amplitude	* No defect in cosmetic and operational function is allowable

\* Remarks : Samples subjected to the tests shall be “ Not operating ” condition .

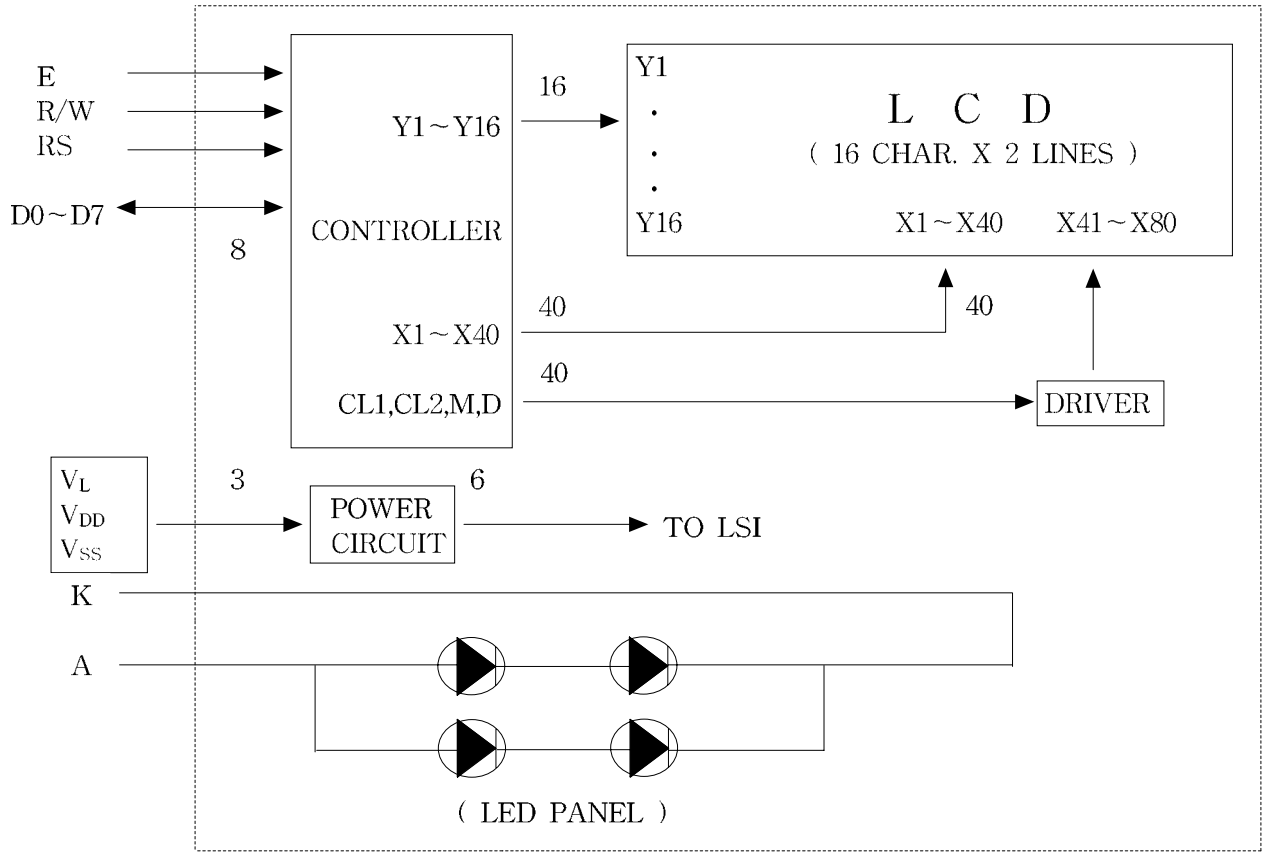
## 8. PIN CONNECTIONS

PIN NO.	SYMBOL	LEVEL	FUNCTION		
1.	V <sub>SS</sub>	-	GND	Ground	POWER SUPPLY
2.	V <sub>DD</sub>	-	5 V	Power supply for logic	
3.	V <sub>L</sub>	-	-	Operating voltage for LCD driving	
4.	RS	H / L	H : Data input L : Instruction data input		
5.	R/W	H / L	H : Data read ( CPU ← LCM ) L : Data write ( CPU → LCM )		
6.	E	H,H→L	Enable ( Operating start signal for data read / write )		
7.	D0	H / L	Data bus line		
8.	D1	H / L			
9.	D2	H / L			
10.	D3	H / L			
11.	D4	H / L			
12.	D5	H / L			
13.	D6	H / L			
14.	D7	H / L			
15.	A	(+)	LED Anode		
16.	K	(-)	LED Cathode		

\* In case of 4 bits instruction, data is transferred by twice using only 4 buses of D4 to D7, and D0 to D3 are not used, first operation is higher order 4 bits and second is lower 4bits of 8 bits, but in case of 8 bits instruction data is transferred by data bus of D0 to D7.

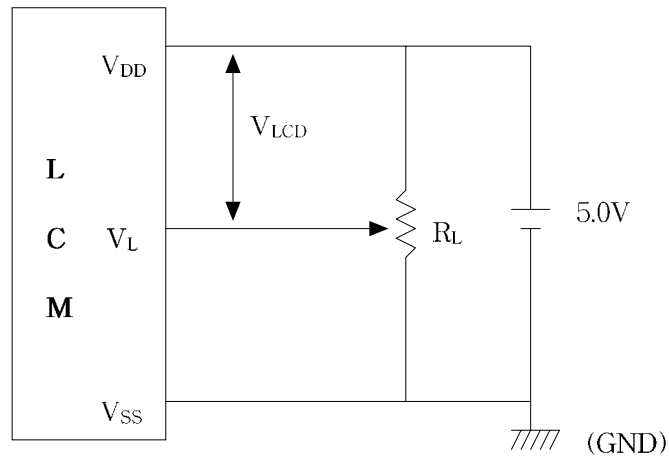
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## 9. BLOCK DIAGRAM

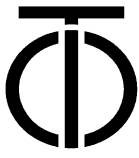


## 10. POWER SUPPLY

( SINGLE POWER )

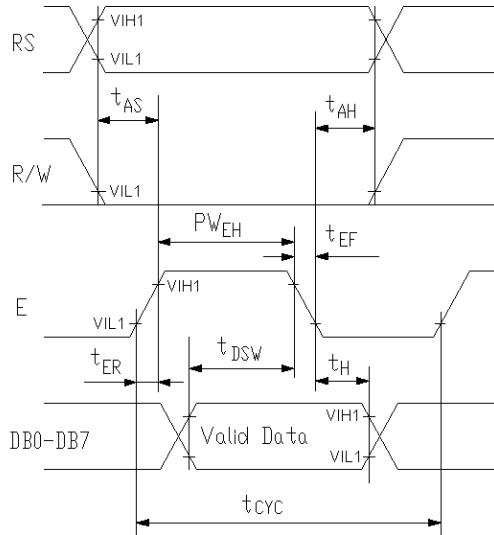


( $R_L = 10 \sim 20 \text{ Kohm}$ )

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## 11. TIMING DIAGRAM

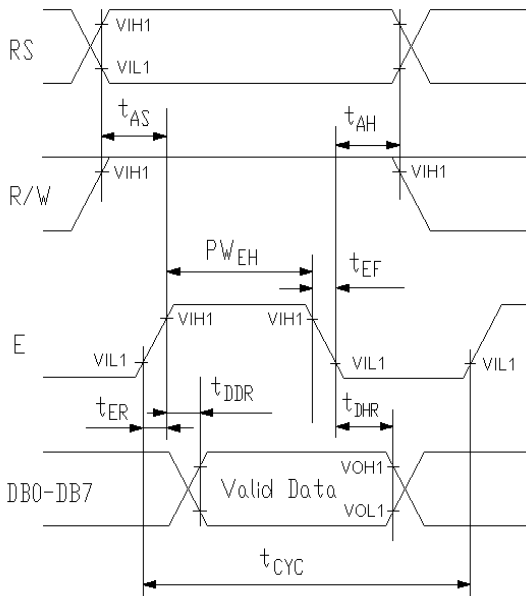
### • WRITE OPERATION



### • TIMING OF DATA WRITE

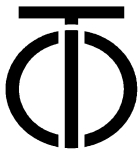
ITEM	SYMBOL	VALUE
Enable cycle time	$t_{CYC}$	500 ns min.
Enable Pulse width	$PW_{EH}$	220 ns min.
Enable rise/fall time	$t_{ER}, t_{EF}$	25 ns max.
Address set up time	$t_{AS}$	40 ns min.
Address hold time	$t_{AH}$	10 ns min.
Data set up time	$t_{DSW}$	60 ns min.
Data hold time	$t_H$	10 ns min.

### • READ OPERATION



### • TIMING OF DATA READ

ITEM	SYMBOL	VALUE
Enable cycle time	$t_{CYC}$	500 ns min.
Enable Pulse width	$PW_{EH}$	220 ns min.
Enable rise/fall time	$t_{ER}, t_{EF}$	25 ns max.
Address set up time	$t_{AS}$	40 ns min.
Address hold time	$t_{AH}$	10 ns min.
Data set up time	$t_{DDR}$	120 ns max.
Data hold time	$t_{DHR}$	20 ns min.

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## 12. INSTRUCTION SET ( $R_{osc} = 91 \text{ kHz}$ )

INSTRUCTION	CODE										DESCRIPTION	$f_{osc} = 250\text{kHz}$	
	RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0			
Clear display	0	0	0	0	0	0	0	0	0	0	1	Clears entire display	1.64 $\mu\text{s}$
Return home	0	0	0	0	0	0	0	0	0	1	*	Returns display being shifted to original position	1.64 $\mu\text{s}$
Entry mode set	0	0	0	0	0	0	0	1	I/D	S		Sets cursor move direction and specifies shift of display	40 $\mu\text{s}$
Display on/off control	0	0	0	0	0	0	1	D	C	B		D : Display ON/OFF C : Cursor ON/OFF B : Cursor blink/not	40 $\mu\text{s}$
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	*	*		Moves cursor and shifts display	40 $\mu\text{s}$
Function set	0	0	0	0	1	DL	N	F	*	*		DL : Interface data length L : Number of display lines F : Character font	40 $\mu\text{s}$
Set CG RAM address	0	0	0	1	CG RAM address						Sets CG RAM address	40 $\mu\text{s}$	
Set DD RAM address	0	0	1	DD RAM address: corresponds to cursor address						Sets DD RAM address	40 $\mu\text{s}$		
Read busy flag and address	0	1	BF	Address counter used for both DD and CG RAM address						BF : Busy flag Reads address counter contents	1 $\mu\text{s}$		
Write data to CG or DD RAM	1	0	Write data						Writes data into DD RAM or CG RAM.	40 $\mu\text{s}$			
Read data from CG or DD RAM	1	1	Read data						Reads data from DD RAM or CG RAM.	40 $\mu\text{s}$			

### \*\* REMARK \*\*

I/D=1: Increment

S =1: Accompanies display shift

S/C=1: Display shift

R/L=1: Shift to the right

DL =1: 8 bits

N =1: 2 lines

F =1: 5 x 10 dots

BF =1: Internally operating

DD RAM : Display data RAM

\* : No effect (Don't care)

I/D =0: Decrement

S/C =0: Cursor move

R/L =0: Shift to the left

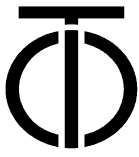
DL =0: 4 bits

N =0: 1 line

F =0: 5 x 7 dots

BF =0: Can accept instruction

CG RAM : Character generator RAM

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### 13. INITIALIZATION SEQUENCE

POWER ON

( 8-Bit interface )

↓

Wait more than 15 ms after  
V<sub>DD</sub> rises to 4.5 V

\*\* In case of 4-bits interface, refer to PIN CONNECTIONS and INSTRUCTION SET.

↓

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

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

↓

Wait more than 4.1 ms

↓

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

BF cannot be checked before this instruction.

↓

Wait more than 100 μs

↓

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

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

BF can be checked after the following instruction.  
When BF is not checked, the waiting time between instructions is longer than the execution instruction time.

↓

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*
0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	I/D	S
0	0	1	ADDR:DD		RAM		Address(1)		
1	0	DATA (2)							

Function Set(Interface is 8 bits long. Specify the number of display lines and character font.)  
The number of display lines and character font cannot be changed afterwards.

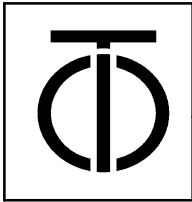
- Display off
- Display clear
- Entry mode set —→ Initialization ends.

\* : No effect

- (1) ADDR is the setting data of cursor position to debug.  
In data, MSB(D7) should be '1' and other 7 bits ( D0 to D6 ) are cursor position.
- (2) DATA means the ASCII CODES.

### 14. DD RAM ADDRESS

DIGIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	DISPLAY POSITION
1 LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	DD RAM ADDRESS
2 LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	



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15. FONT TABLE

Upper 4bit lower 4bit	LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)														
LLH	(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)														



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## 16. PRECAUTION FOR USING

### ● HANDLING

- \* Refrain from storing mechanical shock and from applying any force to LCD MODULE. It may cause mis\_operation or damage of LCD.
- \* Do not touch, press or rub the display panel with a hard, stiff tool or object as the polarizers in the panel are easily scratched.
- \* If LCD is broken and liquid crystal material flow out, ingestion, inhalation, or contact with skin should be avoided. If liquid crystal material contact with skin, wash immediately with alcohol and rinse thoroughly with water.
- \* Never use organic solvents to clear the display panel as these solvent may adversely affect the polarizer. To clean the display panel dampen a bit of absorbent cotton with petroleum benzene and gently wipe the panel, or contaminations by using a scotch tape.
- \* Refrain from discharge of high electro-static voltage, it will damage C-MOS LSI in the MODULE.
- \* Do not leave the MODULE in high temperature, especially in high humidity for a long time. It is recommended to store the MODULE where the temperature is in the range of 0°C to 35°C and the humidity is lower than 70%.
- \* Store the MODULE without exposure to direct sunlight or fluorescent lamp.
- \* Ultra violet cut filter is necessary for outdoor operation.
- \* Avoid condensation of water, it may cause misoperation or disconnection of electrode.

### ● OPERATION

- \* Never connect or disconnect the LCD MODULE from the main system while power is being supplied.
- \* When supplying the M signal from the external unit to a GRAPHIC MODULE, set the duty to 50%±1%.  
If the duty deviates too greatly from the value, a DC voltage will be applied to the liquid crystal, which could induce an electrochemical reaction and reduce the life of the MODULE.
- \* Do not exceed the maximum rating values under the worst conditions taking account of the supply voltage variation, input voltage variation, and environmental temperature, etc. Otherwise LCD module may be damaged.



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17. EXTERNAL DIMENSION

