

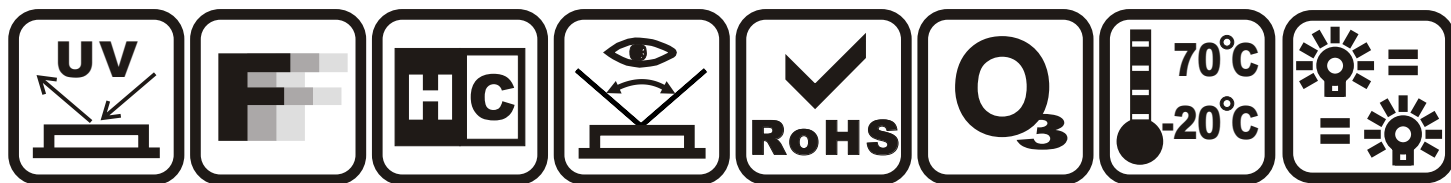


*classic mono LCDs*

# **SPECIFICATION**

## **GRAPHIC TYPE**

### **DOT MATRIX LCD MODULE**



**ITEM NUMBER:**

**FDCG12232G-FSWFBW-51AN**

**ESTABLISHED DATE:**

**1999.06**

**INITIAL ISSUED DATE:**

**2002.02**

**DATASHEET VERSION:**

**2008 VERSION**

**ISSUED BY:**  **CHECKED BY:**  **APPROVED BY:** 

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  - 4.2: listing out definitely the tolerance.

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FORDATA's 2006 version logo. FORDATA is an integrated manufacturer of flat panel display (FPD). FORDATA supplies TN, HTN, STN, FSTN monochrome LCD panel; COB, COG, TAB LCD module; and all kinds of LED backlight.

#### *classic mono LCDs*



##### **FAST RESPONSE TIME**

This icon on the cover indicates the product is with high response speed; Otherwise not.



##### **PROTECTION CIRCUIT**

This icon on the cover indicates the product is with protection circuit; Otherwise not.



##### **HIGH CONTRAST**

This icon on the cover indicates the product is with high contrast; Otherwise not.



##### **LONG LIFE VERSION**

This icon on the cover indicates the product is long life version (over 9K hours guaranteed); Otherwise not.



##### **WIDE VIEWING SCOPE**

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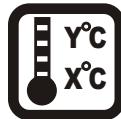
##### **Anti UV VERSION**

This icon on the cover indicates the product is against UV line. Otherwise not.



##### **RoHS COMPLIANCE**

This icon on the cover indicates the product meets ROHS requirements; Otherwise not.



##### **OPERATION TEMPERATURE RANGE**

This icon on the cover indicates the operating temperature range (X-Y).



##### **3TIMES 100% QC EXAMINATION**

This icon on the cover indicates the product has passed FORDATA's thrice 100% QC. Otherwise not.



##### **TWICE SELECTION OF LED MATERIALS**

This icon on the cover indicates the LED had passed FORDATA's twice strict selection which promises the product's identical color and brightness; Otherwise not.



##### **Vlcm = 3.0V**

This icon on the cover indicates the product can work at 3.0V exactly; otherwise not.

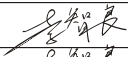
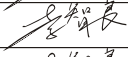
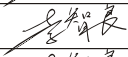
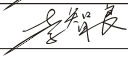


##### **N SERIES TECHNOLOGY (2008 developed)**

FORDATA adopts new structure, new craft, new technology and new materials inside both LCD module and LCD panel to improve the "RainBow"

## BOOKBINDING AREA

**FORDATA ELECTRONIC CO.,LTD**  
PROFESSIONAL LCD SUPPLIER FROM CHINA**STANDARD  
DOC.****REVISION RECORD****PAGE****1/20**

NO.	DATE	DESCRIPTION	ITEM	PAGE	APPROVED
1	2005.05	INITIAL ISSUED	ALL	ALL	LU BOO
2	2007.04	Added further information of LED backlight	4	4/20	
3	2008.01	Adopt logos on the cover for fast reference	-	Cover	
4	2008.10	Deleted "N = No Ic" from CODE2	-	Code System	
5	2008.10	Added CODE "B" for DFSTN version in CODE7	-	Code System	

# BOOKBINDING AREA

 <b>FORDATA ELECTRONIC CO.,LTD</b> <b>PROFESSIONAL LCD SUPPLIER FROM CHINA</b>	<b>STANDARD</b> <b>DOC.</b>	<b>CODE SYSTEM</b>	<b>PAGE</b>	<b>2/20</b>
		STANDARD COB		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
FD	C	C	08	01	A	F	L	Y	Y	B	W	5	2	L	E

No.	REMARKS	DESCRIPTION
1	COMPANY ABBRAVIATED	FD = FORDATA
2	IC packing	C = Chip On Board      G = Chip On Glass      T = TAB
3	LCM type	C = Character      G = Graphic
4	Chyaracter	08, 10, 12, 16, 20, 24, 40, = Character number Per line
	Graphic	80, 100, 120, 122, 128, 160 ... .. = Row Dots Quantity
5	Character	01, 02, 04, = Character Lines
	Graphic	32, 64, 80, 128, 160 ... .. =Column Dots Quantity
6	Serial Number	A~Z
7	Polarizer type	R = Positive Reflective      F = Positive Transflective M = Positive Transmissive      N = Negative Transmissive E = Negative, Transflective B = Negative, Dual optical compensation (for FSTN type only)
8	Backlight type	N = No Backlight      S = Edge Type LED Backlight L = Array Type LED Backlight      F = EL backlight with Invertor E = EL backlight without Invertor      T = CCFL backlight with Invertor C = CCFL backlight without Invertor
9	Backlight color	N = No Backlight      Y = Yellow-Green      W = White R = Red      A = Amber      C = Blue-Green B = Blue      G = Green
10	LCD panel type	T = TN      H = HTN      Y = Yellow-Green STN G = Gray STN      B = Blue STN      F = FSTN
11	Viewing angle	B = Bottom 6:00      T = Top 12:00      R = Right 3:00      L = Left 9:00
12	Operation temperature range	S = 0°C ~ 50°C (Single Supply Voltage)      D = 0°C ~ 50°C (Dual Supply Voltage) W = -20°C ~ 70°C (Single Supply Voltage)      H = -20°C ~ 70°C (Dual Supply Voltage) T = -30°C ~ 80°C (Single Supply Voltage)      E = -30°C ~ 80°C (Dual Supply Voltage)
13	Driving Voltage	1 : V <sub>lcm</sub> = 3.0V, No / EL / CCFL Backlight or V <sub>lcm</sub> = 3.0V, V <sub>led</sub> = LED voltage, (Via AK) 2 : V <sub>lcm</sub> = 3.6V, V <sub>led</sub> = 5.0V (Not via AK) 3 : V <sub>lcm</sub> = 3.6V, V <sub>led</sub> = LED voltage, (Not via AK) 4 : V <sub>lcm</sub> = 5.0V, V <sub>led</sub> = LED voltage, (Not via AK) 5 : V <sub>lcm</sub> = 5.0V, V <sub>led</sub> = 5.0V (Not via AK) 6 : V <sub>lcm</sub> = 5.0V, No / EL / CCFL Backlight or V <sub>lcm</sub> = 5.0V, V <sub>led</sub> = LED voltage, (Via AK) 7 : V <sub>lcm</sub> = 3.6V, No / EL / CCFL Backlight or V <sub>lcm</sub> = 3.6V, V <sub>led</sub> = LED voltage, (Via AK) 8 : V <sub>lcm</sub> = 3.0V, V <sub>led</sub> = 5.0V 9 : V <sub>lcm</sub> = 3.0V, V <sub>led</sub> = LED voltage, (Not via AK)
14	Backlight Connect Method	0 = PIN1 LED-, PIN2 LED+ 1 = PIN15(17/19) LED+, PIN16(18/20) LED- 2 = PIN15(17/19) LED-, PIN16(18/20) LED+ 3 = PIN15(17/19) LED+, PIN16(18/20) NC 4 = PIN15(17/19) NC, PIN16(18/20) LED+ 5 = PINA LED+, PINK LED- 6 = No / EL / CCFL Backlight
15	IC Manufacturer	X = SAMSUNG      L = SUNPLUS      S = SITRONIX T = TOSHIBA      E = EPSON      H = HOLTEK Q = ASLIC      N = CIMTEK      P = PRINCETON
16	Font Set	R = English - Russia      E = English - Japanese U = English - Europe      H = English - Hebrew K = English - Europe      N = NO FONT SET

 <b>FORDATA ELECTRONIC CO.,LTD</b> PROFESSIONAL LCD SUPPLIER FROM CHINA	<b>STANDARD DOC.</b>	<b>CONTENTS</b>	<b>PAGE</b>	<b>3/20</b>
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## 1. GENERAL SPECIFICATIONS

ITEM	NOMINAL DIMENSIONS / AVAILABLE OPTIONS
DISPLAY FORMAT	122 X 32 DOT MATRIX
LCD PANEL OPTIONS	FSTN (Silver-gray color)
POLARIZER OPTIONS	Positive, Transflective
BACKLIGHT OPTIONS	Edge type LED backlight (White color)
VIEWING ANGLE OPTIONS	6:00 ( Bottom )
TEMPERATURE RANGE OPTIONS	Wide temperature range ( - 20℃ ~ 70℃ )
CONTROLLER IC	AVANT
DISPLAY DUTY	1/32
DRIVING BIAS	1/7

## 2. MECHANICAL SPECIFICATIONS

<b>OVERALL SIZE</b>	LED backlight version : 84.0 x 44.0 x max 15.0				mm
<b>VIEWING AREA</b>	64.0W x 17.9H	mm	<b>HOLE-HOLE</b>	76.0W x 36.0H	mm
<b>DOT SIZE</b>	0.40W x 0.45H	mm	<b>DOT PITCH</b>	0.04W x 0.04H	mm
<b>WEIGHT (EL BKL)</b>	86.0	g	<b>WEIGHT (LED BKL)</b>	105.0	g

## 3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	CONDITION	MIN	MAX	UNIT
POWER SUPPLY ( LOGIC)	Vdd	25℃	-0.3	7.0	V
POWER SUPPLY (LCD)	V0	25℃	Vdd -13.5	Vdd +0.3	V
INPUT VOLTAGE	Vin	25℃	-0.3	Vdd +0.3	V
OPERATING TEMPERATURE	Vopr	—	-20	70	℃
STORAGE TEMPERATURE	Vstg	—	-30	80	℃

## 4. ELECTRONICAL CHARACTERISTIC\*

ITEM	SYMBOL	CONDITION	STANDARD			UNIT
			MIN	TYP	MAX	
Input voltage	Vdd	+5V	4.7	5.0	5.5	V
Supply current	Idd	Vdd=5V	—	0.9	—	mA
Recommended LCD driving voltage for normal temp. Version module	Vdd - V0	-20℃	4.90	—	5.60	V
		0℃	4.75	—	5.45	
		25℃	4.60	4.80	5.30	
		50℃	4.45	—	5.15	
		70℃	4.25	—	4.95	
LED forward voltage	Vf	25℃	2.9	—	3.4	V
LED forward current	If	25℃	—	15	20	mA
LED reverse Current	Ir	25℃	—	10	—	μA
LED color range	X coordinate	25℃ If = 15mA	0.25	—	0.28	—
	Y coordinate	25℃ If = 15mA	0.26	—	0.29	—
LED illuminance (Without LCD)	Lv	25℃ If = 15mA	—	—	—	cd/m <sup>2</sup>
LED life time	—	25℃ If = 15mA	9K**	—	—	Hours

\* The above data are for reference only.

\*\* The warranty period of FORDATA LCD module is 1YEAR counted from the date shown on the label of products.

\*\* If you wanted to drive the LED BKL uninterruptedly exceed 12hours/day, you are not suggested this version



## 5. OPTICAL CHARACTERISTICS

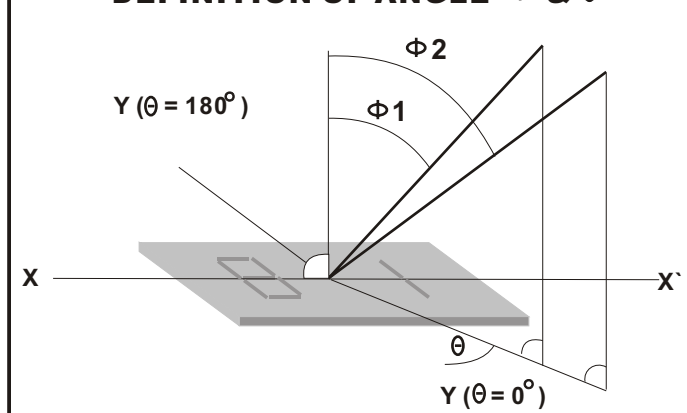
### FOR TN TYPE LCD MODULE ( $T_A=25^\circ\text{C}$ , $V_{dd}=5.0\text{V} \pm 0.25\text{V}$ )

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
VIEWING ANGLE	$\Phi 2 - \Phi 1$	K=4	30	—	—	deg
	$\theta$		25			
CONTRAST RATIO	K	—	—	2	—	—
RESPONSE TIME(RISE)	$T_R$	—	—	120	150	ms
RESPONSE TIME(FALL)	$T_F$	—	—	120	150	ms

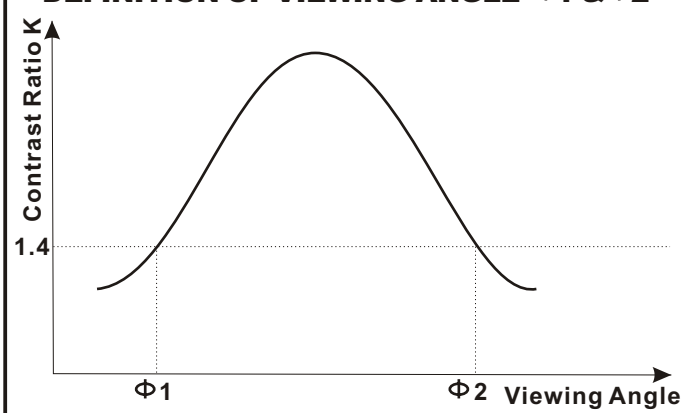
### FOR STN TYPE LCD MODULE ( $T_A=25^\circ\text{C}$ , $V_{dd}=5.0\text{V} \pm 0.25\text{V}$ )

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
VIEWING ANGLE	$\Phi 2 - \Phi 1$	K=4	40	—	—	deg
	$\theta$		60			
CONTRAST RATIO	K	—	—	6	—	—
RESPONSE TIME(RISE)	$T_R$	—	—	150	250	ms
RESPONSE TIME(FALL)	$T_F$	—	—	150	250	ms

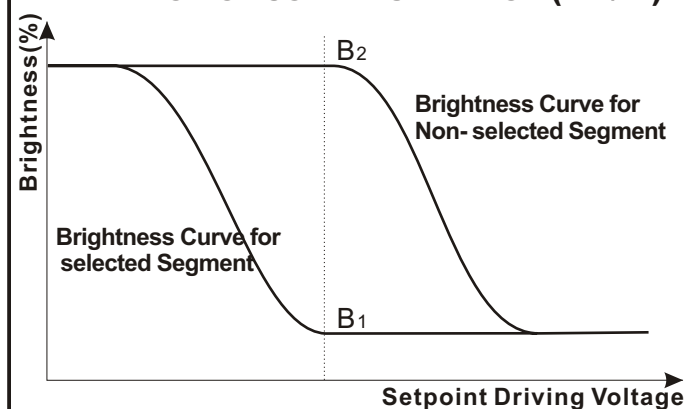
#### DEFINITION OF ANGLE $\Phi$ & $\theta$



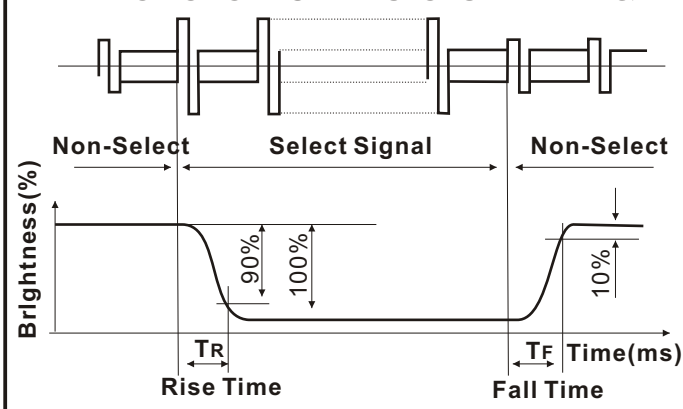
#### DEFINITION OF VIEWING ANGLE $\Phi 1$ & $\Phi 2$



#### DEFINITION OF CONTRAST RATIO $K(=B_2/B_1)$

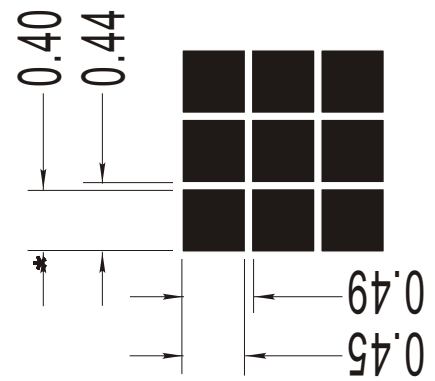
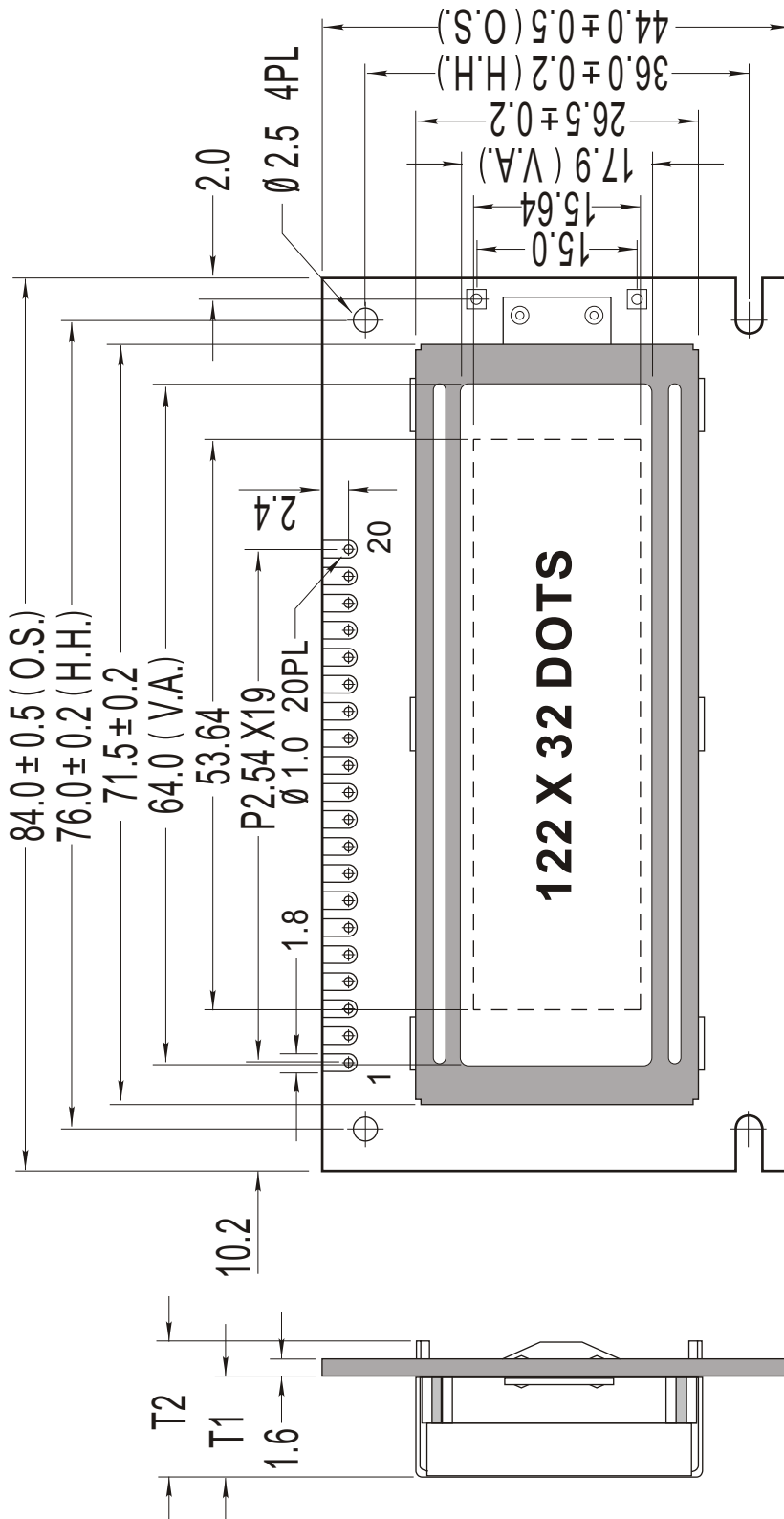


#### DEFINITION OF OPTICAL RESPONSE TIME $T_R$ & $T_F$





## 7.EXTERNAL DIMENSIONS



ITEM	T1	T2	UNIT
LED backlight	9.4	15.0	mm
EL or without backlight	4.8	10.0	mm



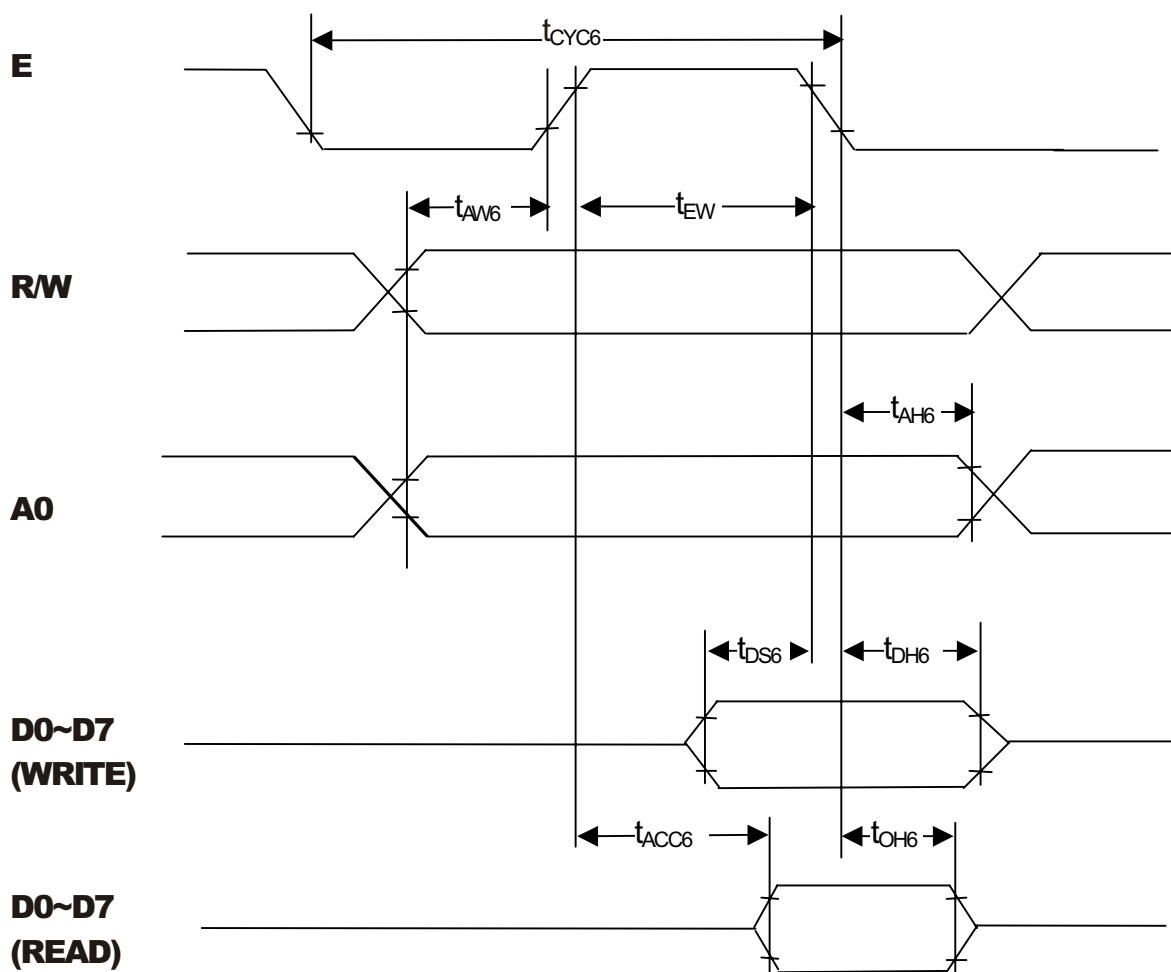


## 6. AC CHARACTERISTIC

 $V_{dd}=5.0V\pm 10\%, V_{SS}=0V, T_a = -20 \sim +75^{\circ}C$ 

Parameter		Symbol	Min	Max	Condition	Unit
Address set up time		$t_{AW6}$	20	—	—	ns
Address hold time		$t_{AH6}$	10	—		ns
System cycle time		$t_{CYC6}$	1000	—		ns
E pulse width	Read	$t_{EW}$	100	—		ns
	Write		80	—		ns
Data set up time		$t_{DS6}$	80	—		ns
Data hold time		$t_{DH6}$	10	—		ns
Access time		$t_{ACC6}$	—	90	$C_L=100pF$	ns
Output disable time		$t_{OH6}$	10	60		ns

\*Input signal rise time and fall time are less than 15ns.

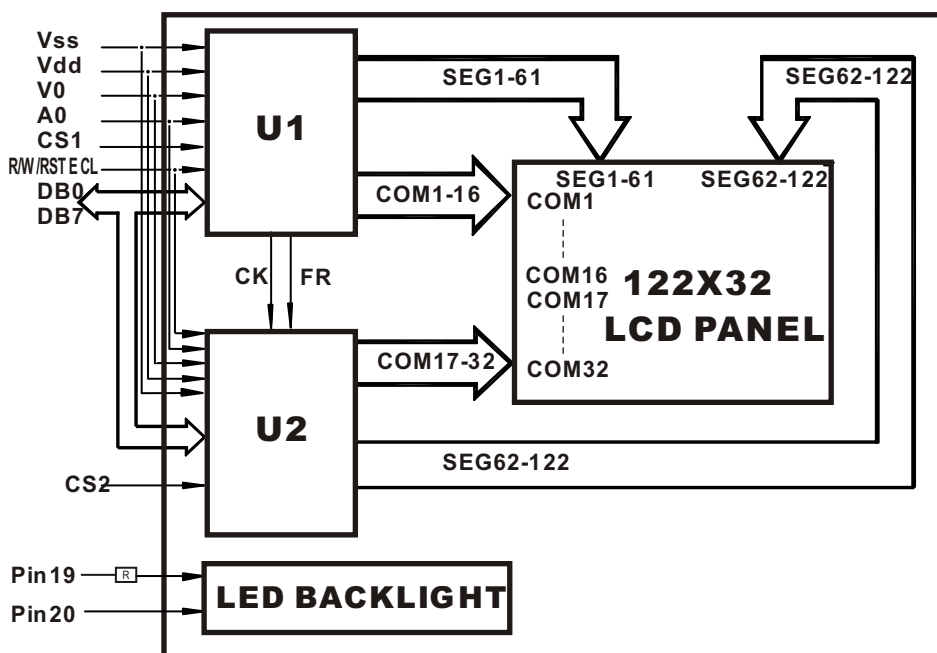




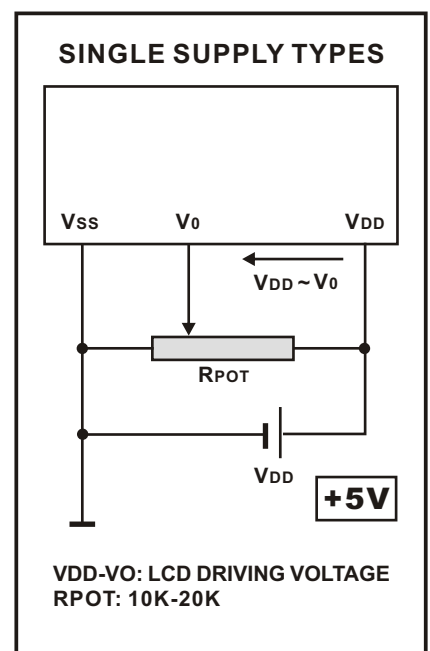
## 8. PIN ASSIGNMENT

PIN NO.	SYMBOL	FUNCTION		REMARK
1	Vss	Power Supply	0V	
2	Vdd		+5V	
3	V0		Contrast Adjust	
4	A0	H/L H: Data; L: Instruction code		
5	CS1	Chip 1 Enable signal		
6	CS2	Chip 2 Enable signal		
7	CL	Clock Input (2K Hz)		
8	E	Enable Signal		
9	R/W	Read / Write		
10	DB0	Data Bit 0		
11	DB1	Data Bit 1		
12	DB2	Data Bit 2		
13	DB3	Data Bit 3		
14	DB4	Data Bit 4		
15	DB5	Data Bit 5		
16	DB6	Data Bit 6		
17	DB7	Data Bit 7		
18	RST	Reset Signal		
19	LED+	Anode of LED Unit		+5V
20	LED-	Cathode of LED Unit		0V

## 9.1 . BLOCK DIAGRAM

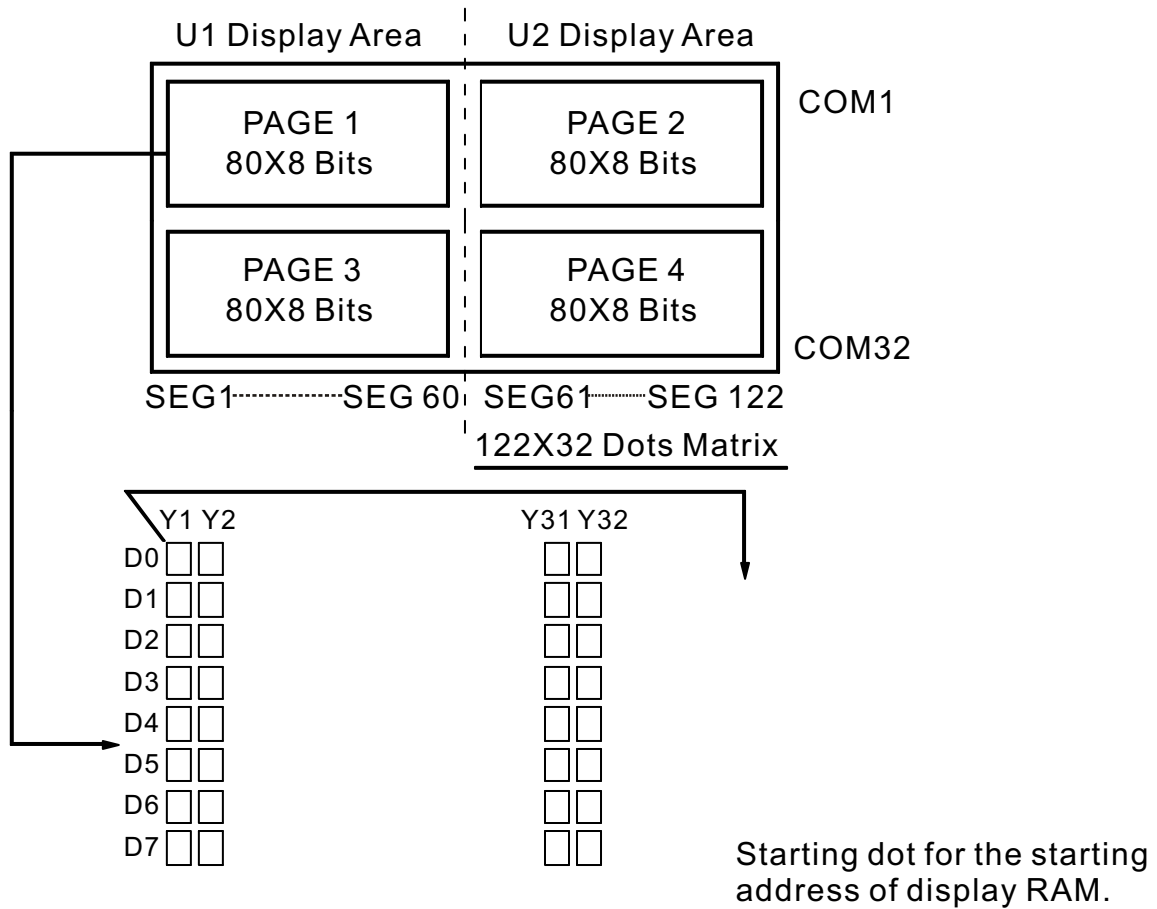


## 9.2 . POWER SUPPLY

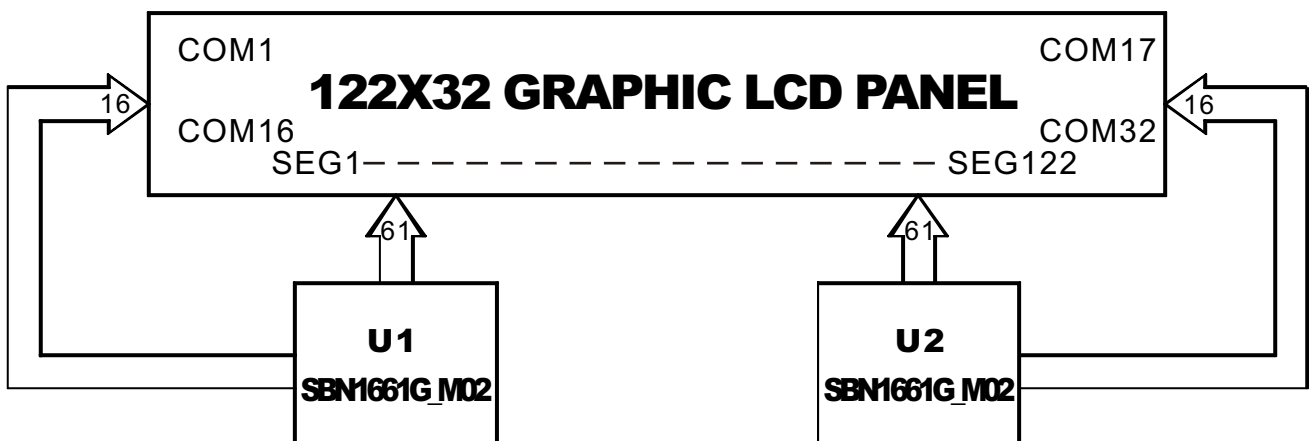




## 10. RELATION BETWEEN DISPLAY PATTERN AND DRIVERS



Each segment driver has 4 pages RAM, and each page has 80x8 bits RAM. D0~D7 are 8 bits transmitted data, where D0 is LSB and D7 is MSB.





## 11. INSTRUCTIONCODE

Instruction	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0	Description
Display on/off	0	0	1	0	1	0	1	1	1	0/1	Whole disp on/off 1: on 0: off
Display Start line	0	0	1	1	0	DISPLAY START ADDRESS (1-31)					Determine the disp line correspond to the COM0
Page address set	0	0	1	0	1	1	1	0	Page (0-3)		Set the page of disp data RAM
Column address set	0	0	0	Column address(0-79)							Set the column address of disp data RAM
Status read	0	1	B U S Y	A D C	O N / O F F	R E S E T	0	0	0	0	<b>BUSY</b> 0: ready 1: working <b>ADC</b> 0: counter clockwise 1: clockwise output <b>ON/OFF</b> 0: disp on 1: disp off <b>RESET</b> 0: normal 1: reset
Write display data	1	0	Write data								Write data to disp RAM
Read display data	1	1	Read data								Read data from disp RAM
											Access the predetermind address of the disp RAM
ADC select	0	0	1	0	1	0	0	0	0	0/1	Determine the mode reading of the disp RAM 0: clockwise output 1: counter clockwise output
Static drive on/off	0	0	1	0	1	0	0	1	0	0/1	Select the dynamic or static driving 1: static driving 0: dynamic driving
Duty ratio select	0	0	1	0	1	0	1	0	0	0/1	Select the duty ratio 0: 1/16 1: 1/32
Read Modify write	0	0	1	1	1	0	0	0	0	0	Increment the column address register when writing but no change when reading
END	0	0	1	1	1	0	1	1	1	0	Release from the Read Modify Write mode
Reset	0	0	1	1	1	0	0	0	1	0	Set the display start line register to 1st line, page add register to 3.
Power save (dual command)	0 0	0 0	1 1	0 0	1 1	0 0	1 0	1 1	1 0	0 1	Set the power save mode by selecting disp off and static driving on.

 <b>FORDATA ELECTRONIC CO.,LTD</b> PROFESSIONAL LCD SUPPLIER FROM CHINA	<b>PRODUCT SPEC.</b>	<b>MODE NO.</b>	<b>PAGE</b>	<b>11/20</b>
		<b>FDCG12232G-FSWFBW-51AN</b>		

## 12. INSTRUCTION DESCRIPTION

### A. Display On / Off

This instruction executes whole display On/Off no relation with the data in the Display Data RAM and internal conditions.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	0	1	0	1	1	1	D

D    0 : Display On  
       1: Display Off

When the static driving mode is selected ( static drive On ) in display Off status, the internal circuits put on the power save mode.

### B. Display Start Line

This instruction set the line address. The selected line in the Display Data RAM correspond to the COM0 which display at the top of LCD panel

The display area is set automatically from the selected line to the line which increased the one or page switching are available by this instruction.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	1	0	A4	A3	A2	A1	A0

A4	A3	A2	A1	A0	Line Address
0	0	0	0	0	0
				1	1
1	1	1	1	0	1E
1	1	1	1	1	1F



### C. Page Address Set

When MPU access the display Data RAM, the page address corresponded to the row address must be selected.

The access in the display Data RAM is available by setting the page and column address. The display is no change when the page address is changed.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	0	1	1	1	0	A1	A0

A1	A0	Page
0	0	0
0	1	1
1	0	2
1	1	3

### D. Column Address Set

This instruction set the column address in the Display Data RAM.

When the MPU access the Display Data RAM continuously, the column address increase 1 automatically, therefore, the MPU can access the data only without address setting.

The increment of the column address is stopped by the address of 50H automatically, but the page address is no change even if the column address increase to 50H and stop.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	0	A6	A5	A4	A3	A2	A1	A0

A6	A5	A4	A3	A2	A1	A0	ColumnAdd.
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
1	0	0	1	1	1	0	4E
1	0	0	1	1	1	1	4F

This instruction read out the internal status.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	1	BUSY	ADC	ON/OFF	RESET	0	0	0	0

The instruction can be input after the BUSY status change to 0.

0: Counter clockwise Output (Inverse)

Column Address 79 - n  $\longleftrightarrow$  Segment Driver n

1: Clockwise Output (Normal)

Column Address n       $\longleftrightarrow$       Segment Driver n

0 : Whole Display On

1 : Whole Display Off

**(Note)** The data 0 = On and 1 = Off of Display On/ Off status read out is inverted with the Display On/Off instruction data of 1 = On and 0 = Off

0: \_\_\_\_\_

### 1: Initialization Period

## F. Write Display Data

The column ( segment ) address increase 1 automatically when writing, therefore, the MPU can write the 8-bit data into the Display Data RAM without address setting.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
<b>61SEG</b>	1	0	WriteData							

 <b>FORDATA ELECTRONIC CO.,LTD</b> PROFESSIONAL LCD SUPPLIER FROM CHINA	<b>PRODUCT SPEC.</b>	<b>MODE NO.</b>	<b>PAGE</b>	<b>14/20</b>
		<b>FDCG12232G-FSWFBW-51AN</b>		

## G. Read Display Data

This instruction read out the 8-bit data from Display Data RAM which addressed by the column and page address. In case of the Read Modify Write Mode is Off, the column address increase 1 automatically after each read out, therefore, the MPU can read out the 8-bit data from the Display Data RAM continuously without address setting.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	1	1	Read Data							

## H. ADC Select

This instruction set the correspondence of column address in the Display Data RAM and segment driver out. Therefore, the order of segment output can be changed by the software, and no restriction of the LSI placement against the LCD panel.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	0	1	0	0	0	0	D

D 0 : Clockwise Output (Inverse)  
 1: Counter Clockwise Output (Normal)

## I. Static Drive On/ Off

This instruction executes the all common output terms on and whole display on obligatory

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	0	1	0	0	1	0	D

D 0: Static Drive Off (Normal Operation)  
 1: Static Drive On (Whole Display Turns On)

When the Display Off mode is selected ( Display Off ) in Static Driver On status, the internal circuits put on the power save mode.





## J. Duty ratio Select

This instruction set the LCD driving duty ratio.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	0	1	0	1	0	0	D

D 0 : 1/16 Duty  
 1 : 1/32 Duty

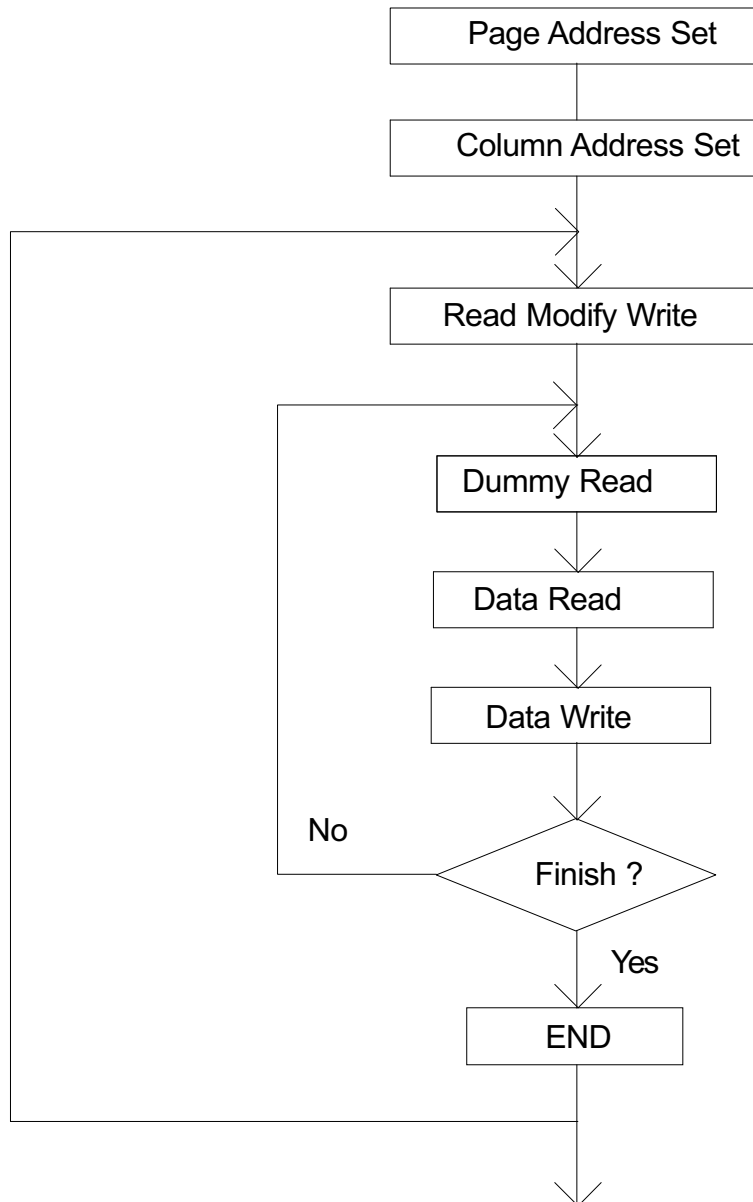
## K. Read Modify Write

After this instruction is executed, the column address increase 1 automatically when Display Data Write Instruction execution, but the address is not changed when the Display Data Read Instruction execution.

This status continues during End instruction execution. When the End instruction is entered the column address back to the address where Read Modify Write instruction entering. By this function, the load of MPU for example cyclic data writing operation like as cursor blink etc., can be reduced.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	1	1	0	0	0	0	0

**(Note)** During the Read Modify Write mode, any instruction except Column Address Set can be executed.

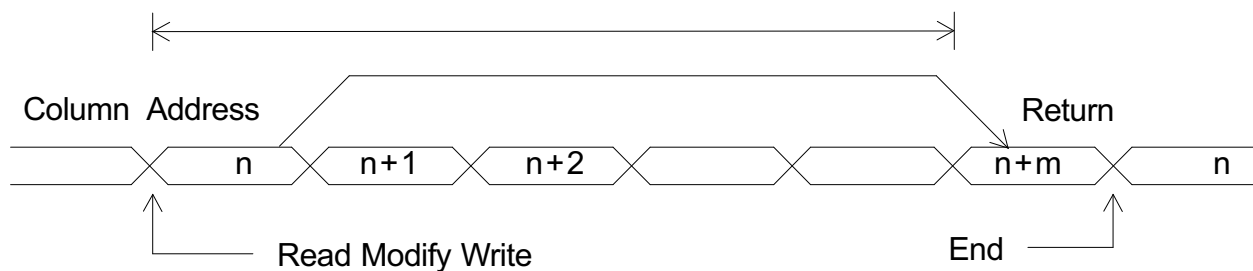
**L. Sequence of cursor display**



### M. End

This instruction release the Read Modify Write mode and the column address back to the address where the Read Modify Write mode setting.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	1	1	0	1	1	1	0



### N. Reset

This instruction executes the following initialization.

Initialization

- 1) Set the first line in the Display Start Line Register.
- 2) Set the page 3 in the Page Register.

In this time, there are no influence to the Display Data RAM.

	A0	R/W	D7	D6	D5	D4	D3	D2	D1	D0
Code	0	0	1	1	1	0	0	0	1	0

**(Note)** The initialization when the power terms on can not be executed by Reset instruction

### O. Power Save ( Dual Command )

When both of Display Off and Static Drive On are executed, the internal put on the power save mode and the current consumption is reduced as same as stand by current. The internal status in this mode are as following:

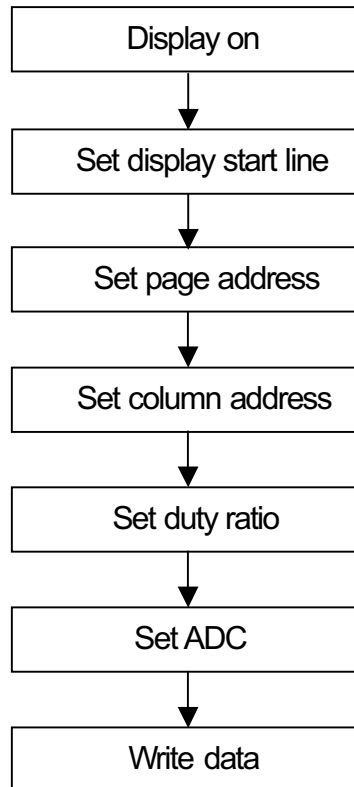
- 1) Stop the LCD driving. Segment and Common drivers output Vdd level
- 2) Stop the oscillation or inhibit the external clock input
- 3) Keeping the display data and operating mode.

The power save mode is released by Display on or static drive off instruction.

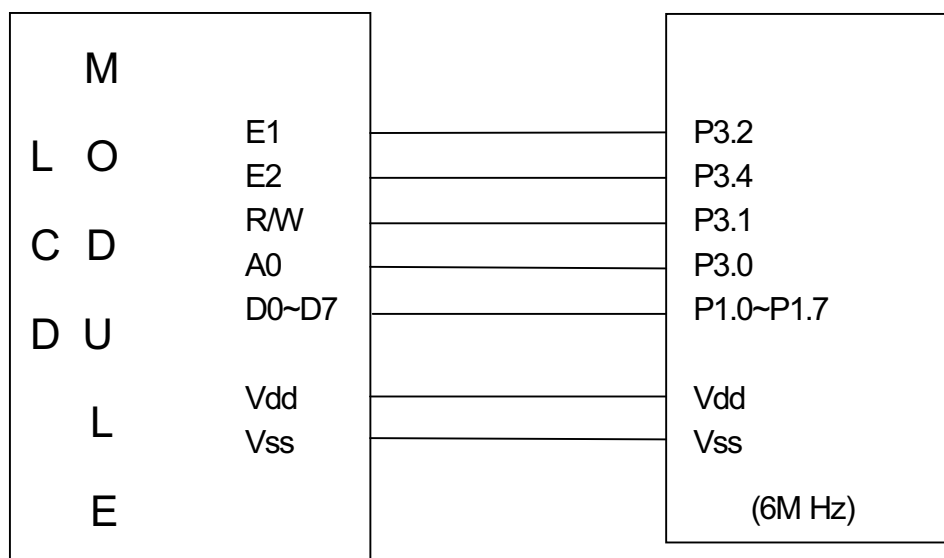


### 13. APPLICATION EXAMPLE

#### Application Flowchart

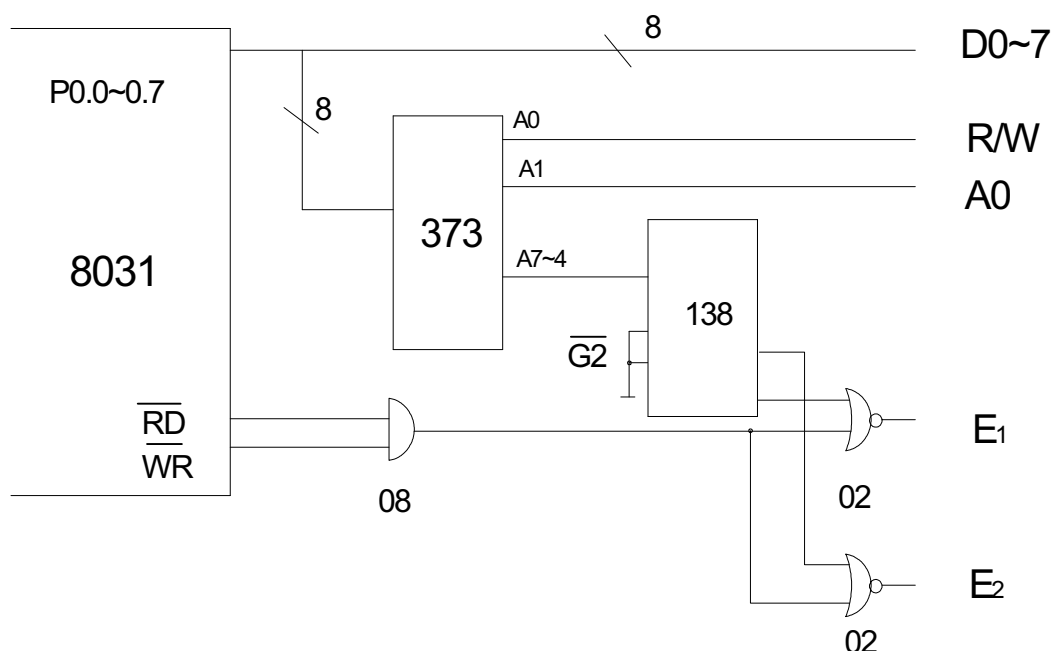


#### Application Circuit

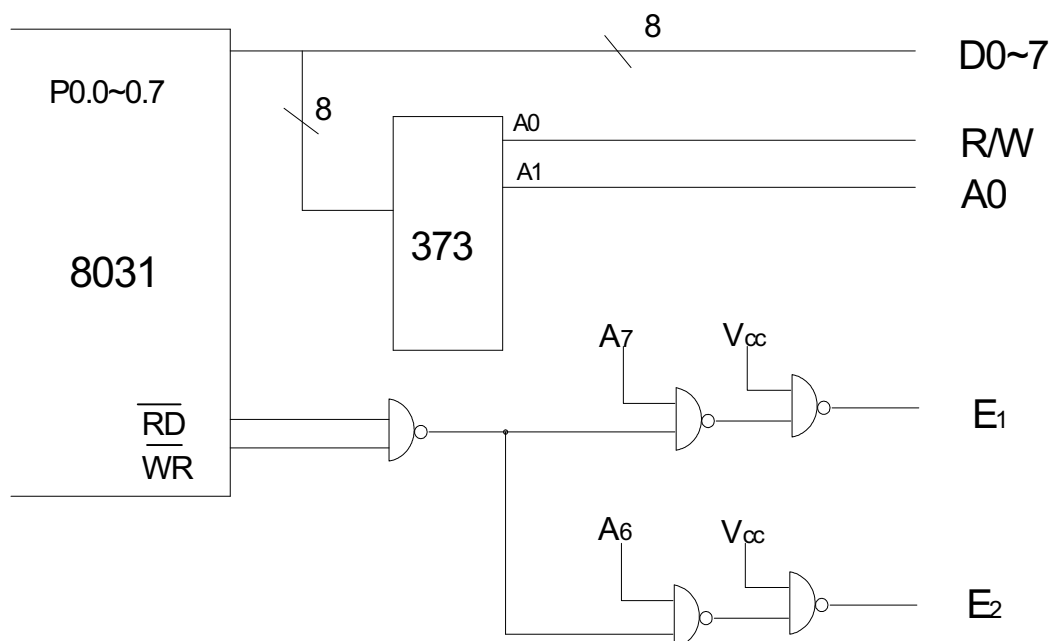




### Application Circuit 1



### Application Circuit 2

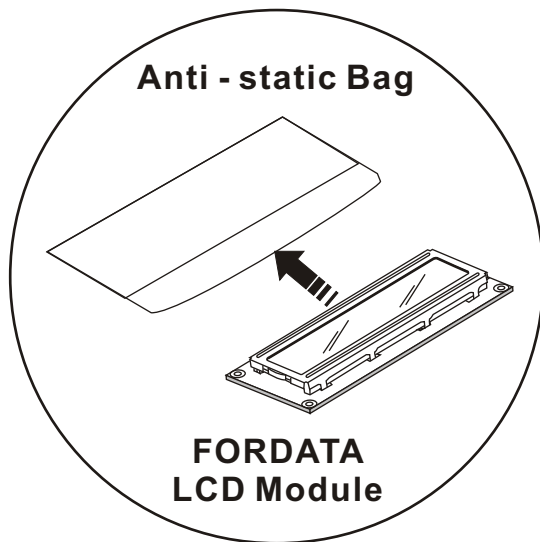



**14. PACKING DETAIL**

WITH LED BKL	WITHOUT LED BKL
45 PCS/BOX	45 PCS/BOX
10 BOXES/CARTON	10 BOXES/CARTON
450 PCS/CARTON	450 PCS/CARTON
20.00 KGS/CTN(G.W.)	18.00 KGS/CTN(G.W.)
0.07 M <sup>3</sup> /CARTON	0.07 M <sup>3</sup> /CARTON

**NOTE**

1. The weight is estimated for reference only.
2. Packing detail may be changed without notice.


**BOX**
**CARTON**
