SPECIFICATION

Graphic Type STN Dot Matrix LCD Module

JM12864A

Kentec GmbH - Elektronische Bauelemente - www.kentec.net

● GENERAL SPECIFICATION

128 X 64 dots display

SAM SUNG LCD driver:KS0107B and KS0108B

Interface with 8-bit MPU (directly connected to M6800 serial MPU)

Display Specification

Display dot: 128 X 64

Display type: STN and FSTN

Display color-Display background color: Yellow-Green,Blue-Gray, Black-White

Polarizer mode: Positive,Negative;Reflective ,Transflective,Transmissive

Viewing angle: 6:00 and 12:00

Display duty: 1/64

Driving bias: 1/9

Display RAM：8192 bits

Mechanical characteristics (Unit:mm)

External dimension：78.0 X 70.0 X 10.0 (13.0 for Side LED Backlight;

15.0 for Bottom LED Backlight）
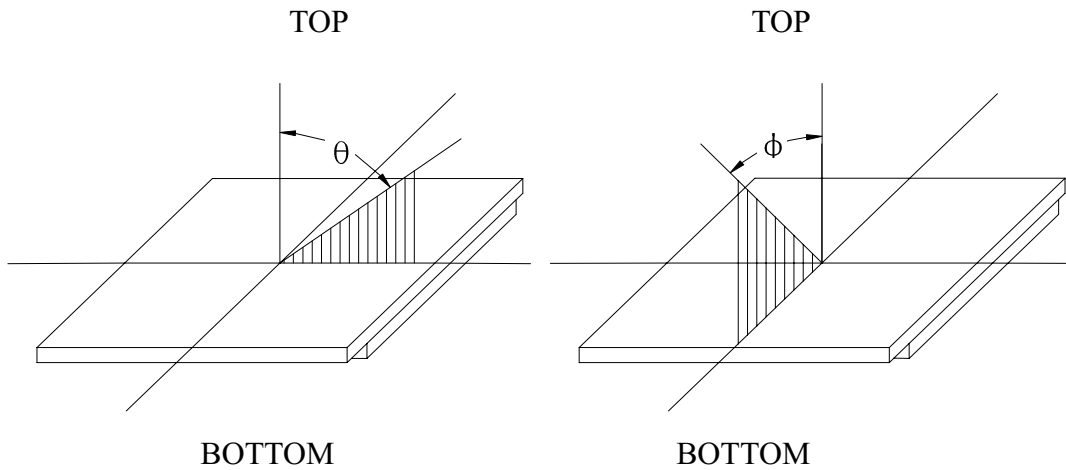
View area：62.0 X 44.0

Dot size：0.39 X 0.55

Dot pitch：0.44 X 0.60

Weight: 56g (75g for Side LED backlight;82g for Bottom LED Backlight）

POWER: negative power，+5V

● Optical Characteristics

(1) Definition of viewing Angle

TOP   TOP

θ ϕ

BOTTOM   BOTTOM

(2) Definition of Contrast Ratio:
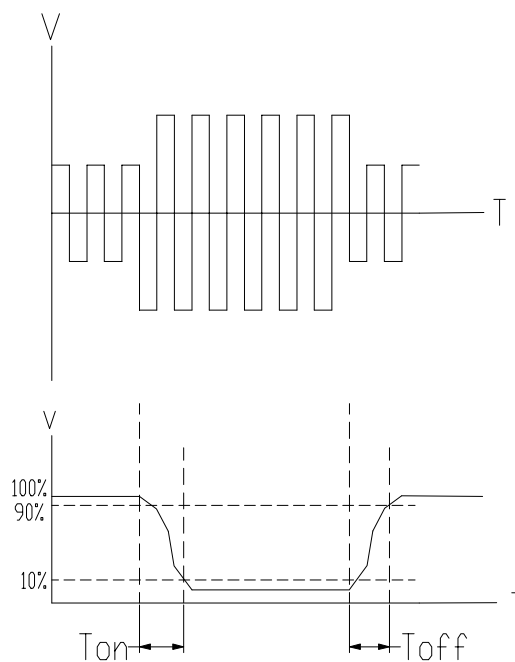
$$\text{Contrast Ratio} = \frac{\text{Reflectance value of non-selected state brightness}}{\text{Reflectance value of selected state brightness}}$$

Test condition : standard A light source

(3) Response Time

Response time is measured as the shortest period of time possible between the change in state of an LCD segment as demonstrated below

V

T

V

100%
90%

10%

Ton   Toff

● **External Dimension**

70.0±0.5
65.0±0.3
58.0±0.3
44.0±0.3
38.35

2.5±0.3
5.0±0.3
1.0±0.3

76.0±0.3
68.0±0.3
62.0±0.3
56.27

78.0±0.5
13.0
15X2.54
16−Ø1.0
2.54

4−Ø2.5

3.0
(MAX) 10.0
1.6

MAX:15.0mm FOR BOTTOM LED BACKLIGHT
(13.0 FOR SIDE LED BACKLIGHT)

0.39
0.55
0.05
0.05

Unit:mm

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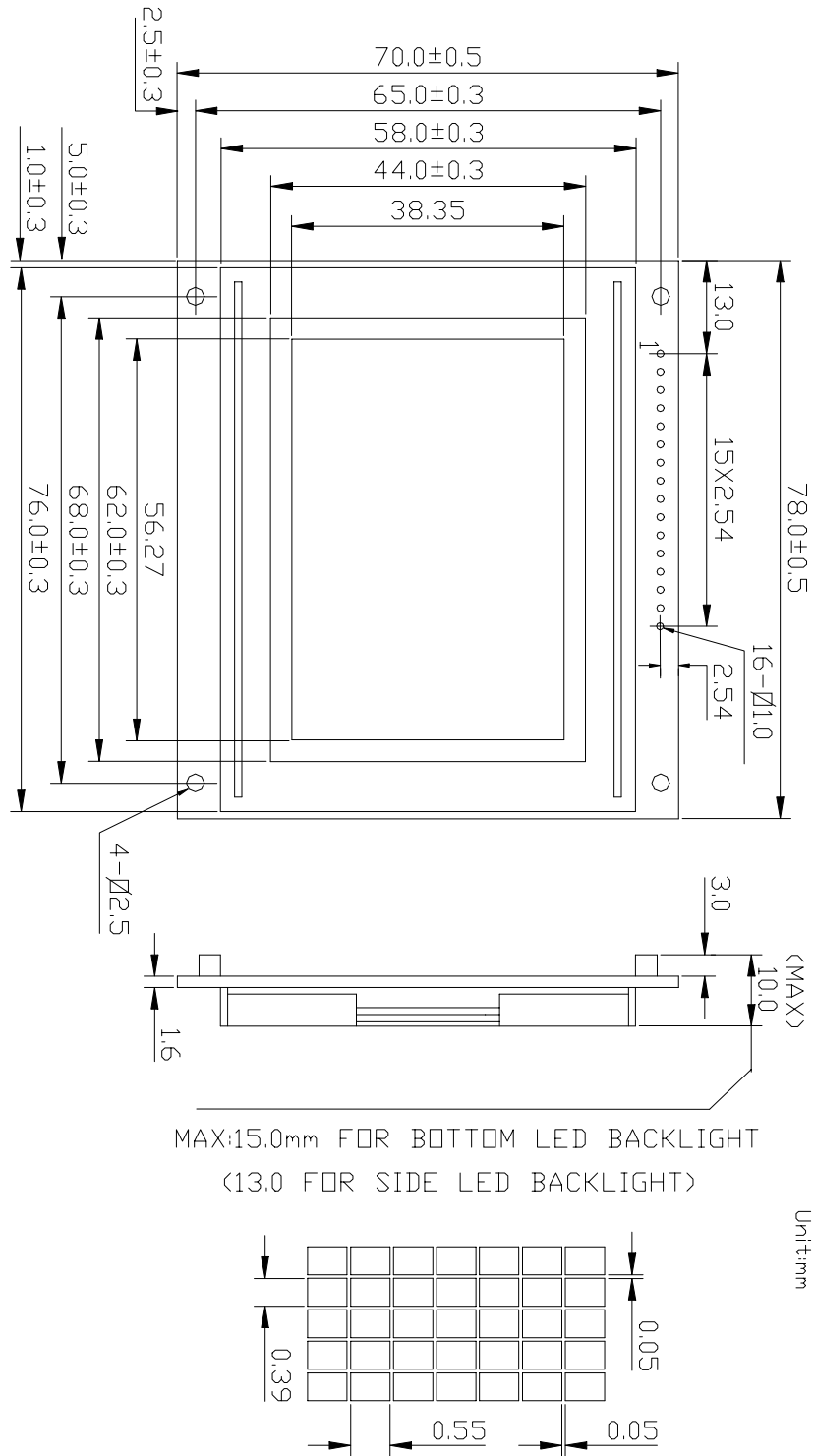
● **Absolute Maximum Ratings For Side LED Backlight**

Parameter	Symbol	Test condition	Min	Type	Max	Unit
LED Forward Consumption Current	I_f	Ta=25℃ Vf=4.1V	-	83	-	mA
LED Allowable Dissipation	P_d		-	350	-	mW

● **Absolute Maximum Ratings For Bottom LED Backlight**

Parameter	Symbol	Test condition	Min	Type	Max	Unit
LED Forward Consumption Current	I_f	Ta=25℃ Vf=4.1 V	-	192	-	mA
LED Allowable Dissipation	P_d		-	790	-	mW

● **Absolute Maximum Ratings**

Item	Symbol	Condition	Standard Value		Unit
			Min	Max	
Supply Voltage for logic	Vdd	Ta=25℃	-0.3	7.0	V
Supply Voltage for LCD	Vee		Vdd-19.0	Vdd+0.3	V
Input Voltage	Vr		-0.3	Vdd+0.3	V
Operating Temperature	Top	-	0	50	℃
Storage Temperature	Tstg	-	-20	70	℃

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● Electrical Characteristics (Ta=25℃, Vdd= 5.0V)

Item	Symbol	Condition	Standard Value			Unit
			Min	Type	Max	
Supply Voltage for logic	Vdd-Vss	-	4.5	5.0	5.5	V
Supply Current for logic	Idd	Vdd=5.0	-	4.0	-	mA
Driving Current for LCD	Iee	Vee=-7.8	-	2.8	-	mA
Driving Voltage for LCD	Vdd-Vee	25℃	-	12.8	-	V
Input Voltage"H" level	V_{IH}	H	0.7Vdd	-	Vdd	V
Input Voltage "L" level	V_{IL}	L	0	-	0.8	V

● Block Diagram

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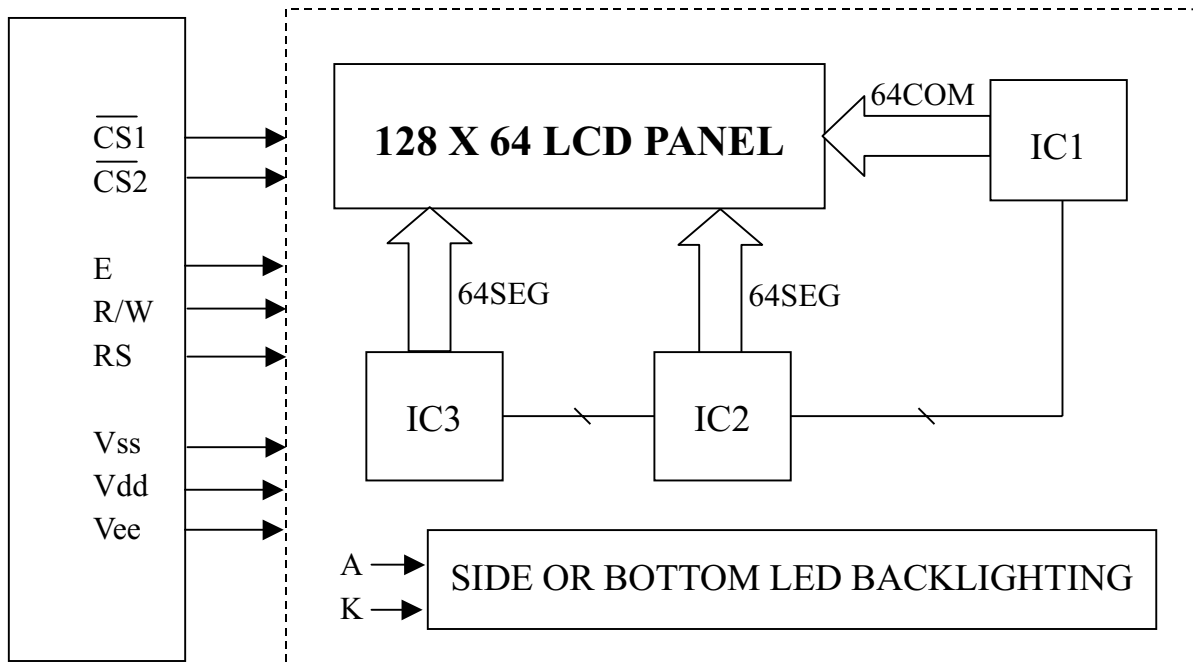
- ## Pin assignment

Pin NO.	Symbol	Function		Remark
1	C̄S̄1	Chip Select Signal For IC3 When L		
2	C̄S̄2	Chip Select Signal For IC2 When L		
3	Vss	Power Supply	0V	
4	Vdd		+5V	
5	Vee		For LCD	Variable
6	RS	Register Select (H:Data L:Instruction)		
7	R/W	L:MPU to LCM H:LCM to MPU		
8	E	Enable		
9	DB0	Data Bit 0		
10	DB1	Data Bit 1		
11	DB2	Data Bit 2		
12	DB3	Data Bit 3		
13	DB4	Data Bit 4		
14	DB5	Data Bit 5		
15	DB6	Data Bit 6		
16	DB7	Data Bit 7		
	A	Anode of LED Unit		
	K	Cathode of LED Unit		

● MPU Interface

Characteristic	Symbol	Min	Typ	Max	Unit
E Cycle	t_C	1000	-	-	ns
E High Level Width	t_{WH}	450	-	-	ns
E Low Level Width	t_{WL}	450	-	-	ns
E Rise Time	t_R	-	-	25	ns
E Fall Time	t_F	-	-	25	ns
Address Set-Up Time	t_{ASU}	140	-	-	ns
Address Hold Time	t_{AH}	10	-	-	ns
Data Set-Up Time	t_{DSU}	200	-	-	ns
Data Delay Time	t_D	-	-	320	ns
Data Hold Time(Write)	t_{DHW}	10	-	-	ns
Data Hold Time(Read)	t_{DHR}	20	-	-	ns
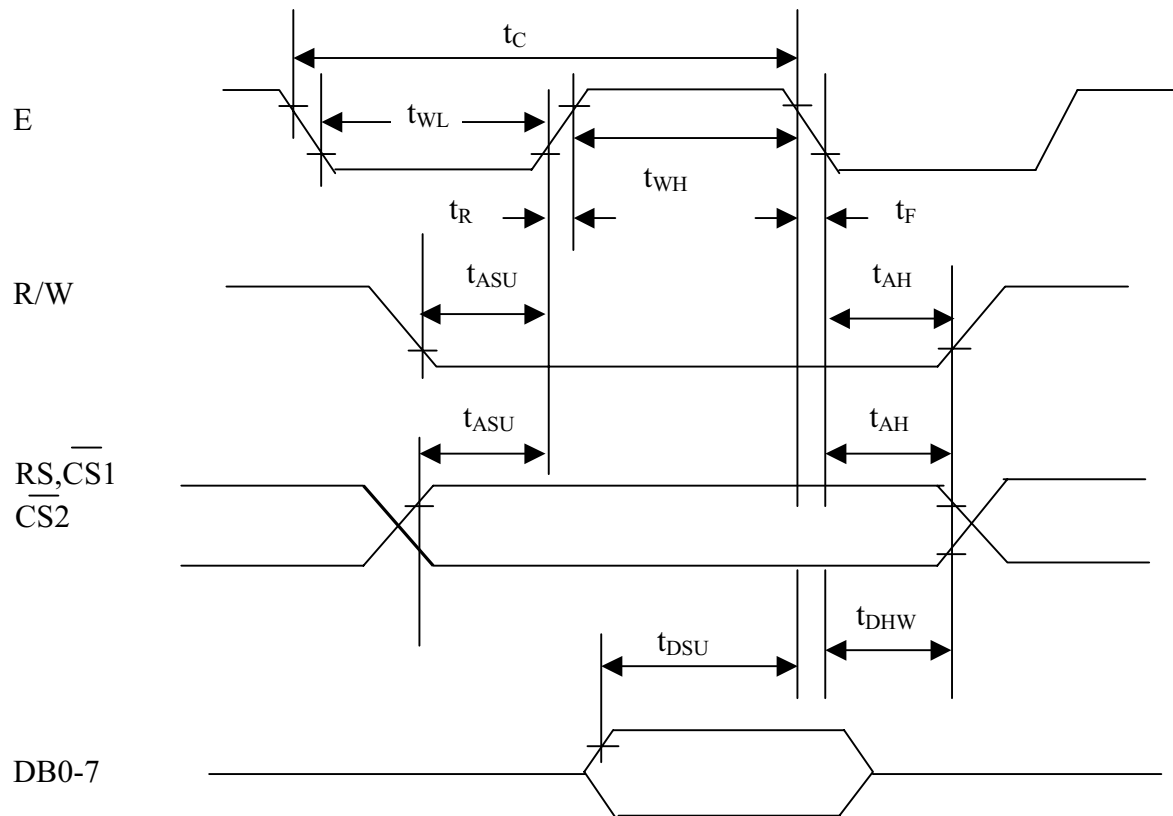
MPU writing timing
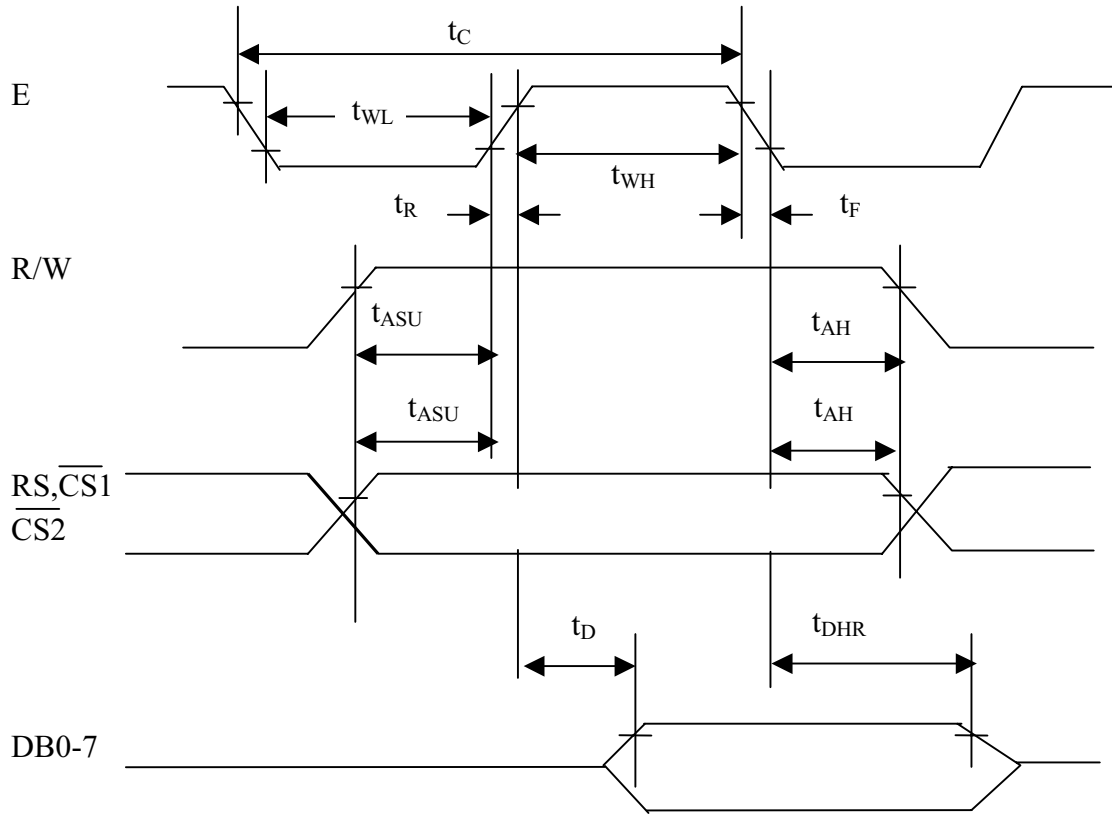
MPU read timimg

● **Reflector of Screen and Display RAM**
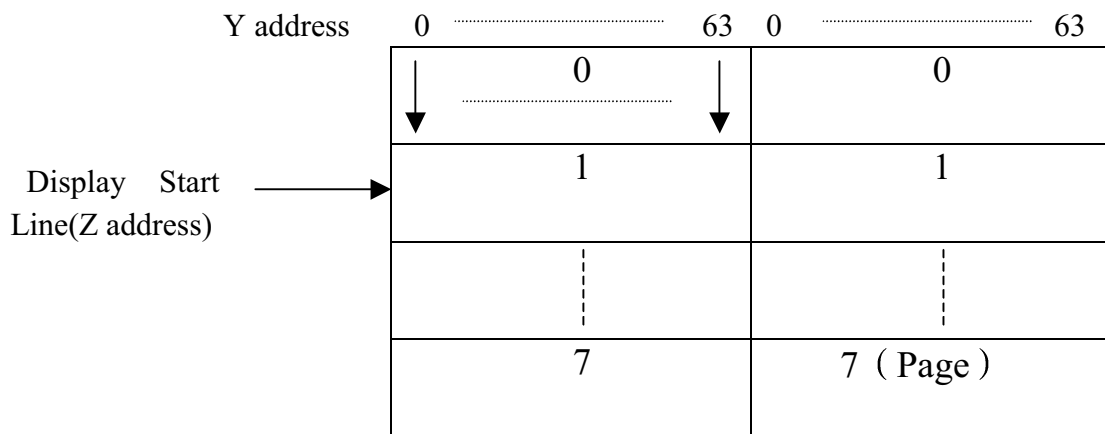
Correspondence with data bits and arrow direction

$\longrightarrow$ DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7

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● DISPLAY CONTROL INSTRUCTION

Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display ON/OFF	L	L	L	L	H	H	H	H	H	L/H	Controls the display on or off. Internal status and display RAM data is not affected. L:OFF，H:ON
Set address (Y address)	L	L	L	H	Y address（0~63）						Sets the Y address in the Y address counter.
Set Page (X addres）	L	L	H	L	H	H	H	Page（0~7）			Sets the X address at the X address register.
Display Start Line (Z addres）	L	L	H	H	Display start line (0~63)						Indicates the display data RAM displayed at the top of the screen.
Status Read	L	H	BUSY	L	ON/OFF	RESET	L	L	L	L	BUSY L:Ready H:In operation ON/OFF L:Display ON H:Display OFF RESET L:Normal H:Reset
Write Display Data	H	L	Write Data								Writes data (DB0:7) into display data RAM,After writing instruction,Y address is increased by 1 automatically.
Read Display Data	H	H	Read Data								Reads data (DB0:7) from display data RAM to the data bus.

1.Display   On/Off

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	1	1	1	D

The display data appears when D is 1 and disappears when D is 0.

Though the data is not on the screen with D=0,it remains in the display data RAM.

Therefore, you can make it appear by changing D=0 into D=1.

2.Set Address(Y Address)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Y address (AC0-AC5) of the display data RAM is set in the Y address counter.

An address is set by instruction and increased by 1 automatically by read or write operations of display data.

3.Set Page(X Address)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	1	1	AC2	AC1	AC0

X address (AC0-AC2) of   the display data RAM is set in the X address register.

Writing or reading to or from MPU is executed in this specified page until the next page is set.

4.Display Start Line(Z Address)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	AC5	AC4	AC3	AC2	AC1	AC0

Z address (AC0-AC5) of the display data RAM is set in the display start line register and displayed at the top of the screen.

When the display duty cycle is 1/64 or others(1/32-1/64),the data of total line number of LCD screen, from the line specified by display start line instruction ,is displayed.

5.Status Read

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	BUSY	0	ON/OFF	RESET	0	0	0	0

● BUSY

When BUSY is 1,the Chip is executing internal operation and no instructions are accepted.

When BUSY is 0,the Chip is ready to accept any instructions.

● ON/OFF

When ON/OFF   is 1,the display is on.

When ON/OFF   is 0,the display is off.

● RESET

When RESET is 1,the system is being initialized.

In this condition, no instructions except status read can be accepted.

When RESET is 0,initializing has finished and the system is in the usual operation condition.

6.Write Display Data

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	D7	D6	D5	D4	D3	D2	D1	D0

Writes data (D0-D7) into the display data RAM.

After writing instruction, Y address is increased by 1 automatically.

7.Read Display Data

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Reads data (D0-D7) from the display data RAM.

After reading instruction, Y address is increased by 1 automatically.

● **APPLICATION EXAMPLE**

Application Circuit

```
┌─────────────────────────┐        ┌─────────────────────────┐
│    M                    │        │                         │
│         E               │────────│   P3.2          8       │
│        ‾CS1‾            │────────│   P3.4                  │
│  L    O  ‾CS2‾          │────────│   P3.5                  │
│          R/W            │────────│   P3.1          0       │
│  C    D  RS             │────────│   P3.0                  │
│      DB0~DB7            │────────│   P1.0~P1.7     3       │
│  D    U                 │        │                         │
│                         │        │                         │
│          Vdd            │────────│   Vdd           1       │
│       L  Vss            │────────│   Vss                   │
│                         │        │                         │
│       E                 │        │        (6M Hz)          │
└─────────────────────────┘        └─────────────────────────┘
```

Application Flowchart

```
        ┌─────────────────────┐
        │     display on      │
        └─────────────────────┘
                   │
                   ▼
        ┌─────────────────────┐
        │   set page address  │
        └─────────────────────┘
                   │
                   ▼
        ┌─────────────────────┐
        │    set Y address    │
        └─────────────────────┘
                   │
                   ▼
        ┌─────────────────────┐
        │ write data （TAB5） │
        └─────────────────────┘
                   │
                   ▼
        ┌─────────────────────┐
        │ write data （TAB6） │
        └─────────────────────┘
```

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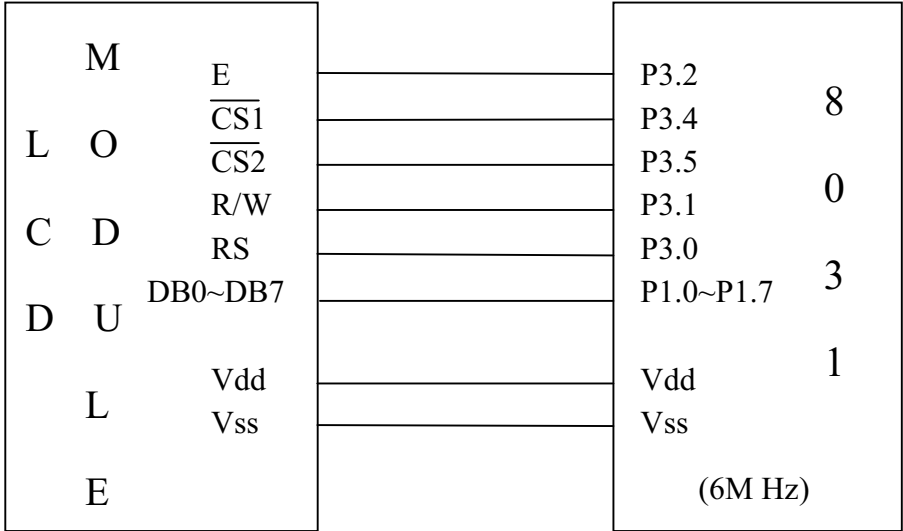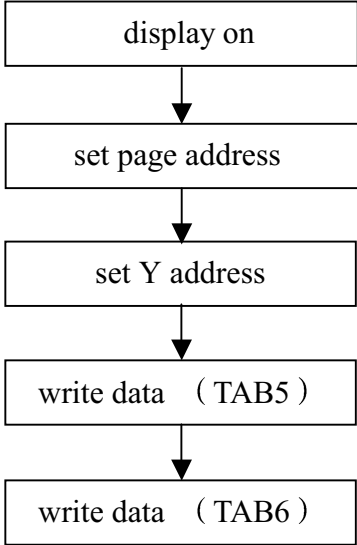
Program Example

```
;*************** THIS IS A 51 PROGRAM (128*64) ******
;  1      2     3      4     5     6      7     8      9--16
; CS1   CS2   Vss    Vdd   Vee   RS    R/W    E    DB0--DB7
; P3.4  P3.5                     P3.0  P3.1  P3.2    P1
;**************************************************
;
        RS      EQU   P3.0
        R/W     EQU   P3.1
        E       EQU   P3.2
        CS1     EQU   P3.4
        CS2     EQU   P3.5
;**************************************************
;
ORG     0000H
RESET:  MOV   R7, #04H
        LCALL   DELAYXMS
        CLR   E
        SETB   RS
        SETB   CS1
        CLR   CS2
        CLR   RS
        MOV    P1, #3FH    ;DISPLAY ON
        LCALL    WRITE
        MOV   R7, #01H
        SETB   CS2
        CLR   CS1
        CLR   RS
        MOV   P1, #3FH    ;DISPLAY ON
        LCALL    WRITE
  MAIN:
        MOV   R7, #0FH
        MOV   DPTR, #TAB5
        LCALL    ZXL
        MOV   R7,#0FH
        LCALL   DELAYXMS
        MOV   DPTR,#TAB6
        LCALL   ZXL
        MOV   R7,#0FH
        LCALL   DELAYXMS
```

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```
        LJMP MAIN
;*********************************************
 ZXL:
        CLR     CS1
        SETB    CS2
        LCALL   PAGE
        LCALL   COM
        CLR     CS2
        SETB    CS1
        LCALL   PAGE
        LCALL   COM
        RET
;*************************************************
 ZXL0:   CLR     E
        CLR     CS1
        SETB    CS2
        CLR     RS
        SETB    R/W
        SETB    E
        MOV     A,   P1
        LCALL   PAGE
        LCALL   COM0
        CLR     CS2
        SETB    CS1
        LCALL   PAGE
        LCALL   COM0
        CLR     CS1
        CLR     RS
        MOV     P1,  #3FH
        LCALL   WRITE
        RET
;*************************************************
 PAGE:   CLR     E
        CLR     RS
        MOV     P1,  #0C0H
        LCALL   WRITE
        MOV     P1,  #40H
        LCALL   WRITE
        MOV     R0,  #08H
```

```
              MOV    R2,  #0B8H
              MOV    P1,  #0B8H
              LCALL    WRITE
              RET
;***************************************************
   COM:   MOV    R1,  #40H
              SETB    RS
   J4:     CLR   A
              MOVC A,     @A+DPTR
              MOV    P1,    A
              LCALL    WRITE
              INC  DPTR
              DJNZ  R1,  J4
              CLR     RS
              INC  R2
              MOV    P1,   R2
              LCALL    WRITE
              MOV   P1,  #40H
              LCALL   WRITE
              DJNZ  R0,  COM
              RET
;***********************************
;          CPL
;***********************************
 COM0:   MOV    R1,  #41H
   J40:      DEC    R1
              CLR     A
              ORL     A,   R1
              JZ    J50
              SETB   RS
              CLR   A
              MOVC A,    @A+DPTR
              CPL  A
              MOV    P1,   A
              LCALL    WRITE
              INC  DPTR
              SJMP   J40
   J50:     DEC  R0
              CLR    A
```

```
            ORL  A,  R0
            JZ   J60
            CLR   RS
            INC   R2
            MOV  P1,  R2
            LCALL   WRITE
            MOV   P1,  #40H
            LCALL   WRITE
            SJMP  COM0
   J60:    RET
;***************************************************
 WRITE:
            CLR    R/W
            CLR    E
            SETB   E
            LCALL   DELAY2MS
            CLR    E
            RET
;*********************************
DELAY2MS:   MOV   R6,   #02H
  DELAY0:   MOV    R5,   #0FH
  DELAY1:   DJNZ   R5,   DELAY1
            DJNZ   R6,   DELAY0
            RET
;*************************************
DELAYXMS:   MOV   R5,  #40H
       D1:  MOV   R6,  #0FFH
       D2:  DJNZ   R6,  D2
            DJNZ   R5,  D1
            DJNZ   R7,  DELAYXMS
            RET
TAB5: DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
      DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
```

DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH

DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
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DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
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DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
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DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH
DB 55H,0AAH,55H,0AAH,55H,0AAH,55H,0AAH

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TAB6: DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H

        DB        00H,00H,00H,00H,00H
        DB 08H,18H,78H,70H,00H,00H,0E0H,78H
        DB 10H,10H,90H,10H,10H,10H,90H,10H
        DB 10H,10H,0D0H,78H,30H,20H,00H,00H
        DB 00H,00H,00H,00H,00H,00H,00H,00H
        DB 00H,00H,0F8H,0F0H,20H,00H,00H,00H
        DB 00H,00H,0F8H,0F0H,20H,00H,0E0H,0C0H
        DB 80H,00H,00H,00H,0F8H,0F0H,20H,00H,00H,00H,00H

        DB     00H,00H,01H,02H,0EH
        DB 1CH,08H,00H,00H,00H,0C0H,0A0H,98H
        DB 8CH,87H,83H,81H,0F8H,0F0H,0A0H,81H
        DB 83H,86H,8EH,9CH,0C0H,80H,00H,00H
        DB 00H,00H,00H, 00H,00H,00H,00H,08H
        DB 08H,08H,0FFH,0FFH,08H,08H,0CH,0EH
        DB 08H,00H,0FFH,0FFH,00H,00H,0FFH,0FFH
        DB 00H,00H,00H,00H,0FFH,0FFH,00H,00H,00H,00H,00H,00H

        DB     00H,00H,04H,04H,04H
        DB 0FCH,0FEH,01H,00H,00H,80H,0C0H,60H
        DB 30H,1CH,0FH,03H,0FFH,0FFH,03H,1CH
        DB 38H,60H,0E0H,0C0H,80H,80H,00H,00H
        DB 00H,00H,00H,00H,00H,20H,60H
        DB 60H,30H,3FH,1FH,18H,08H,08H,84H
        DB 60H,38H,1FH,07H,00H,00H,0FFH,7FH
        DB 00H,00H,00H,00H,0FFH,0FFH,00H,00H,00H,00H,00H
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DB   00H,00H,00H,00H,00H,01H
DB 03H,07H,00H,01H,01H,00H,00H,00H
DB 00H,00H,00H,00H,0FH,07H,00H,00H
DB 00H,00H,00H,01H,01H,01H,01H,00H
DB 00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,04H,04H,02H,01H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,0FH,07H,00H,00H,00H,00H,00H

DB   00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H

DB   00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,66H
DB 89H,89H,92H,67H,00H,00H,0FFH,10H
DB 10H,0FFH,00H,00H,0FFH,89H,9DH,81H
DB 0E3H,00H,0FFH,02H,1CH,20H,0FFH,00H
DB 0C7H,0A1H,91H,8DH,83H,0E1H,00H,0FFH
DB 08H,08H,0FFH,00H,00H,0FFH,89H,9DH,81H,0E3H
DB 00H,0FFH,02H,1CH,20H,0FFH,00H,00H

DB   00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
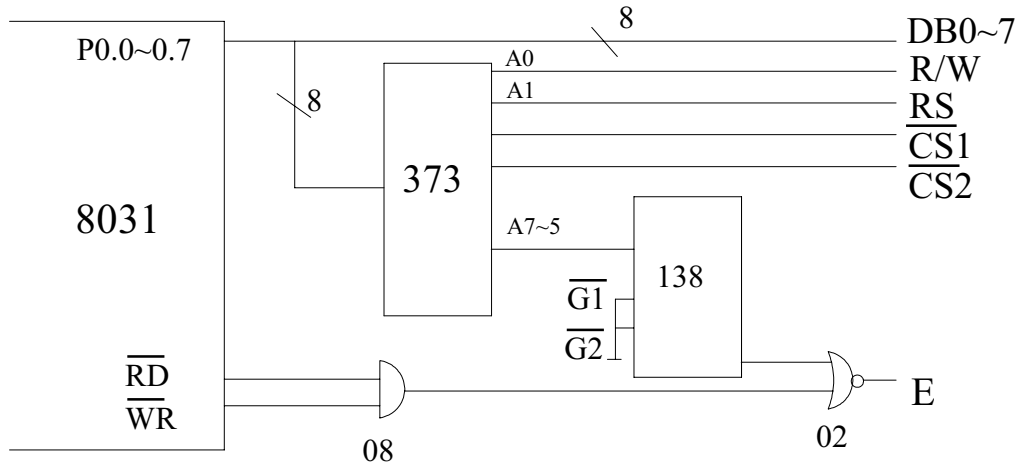DB 00H,00H,00H,00H,00H,00H,00H,00H

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DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H

DB    00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,0F8H,0F0H,10H,10H
DB 10H,10H,10H,10H,10H,10H,0F0H,0F8H
DB 10H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,80H,0C0H,0F0H,0BCH,18H
DB 00H,00H,00H,00H,0FCH,0FCH,08H,00H
DB 80H,80H,0C0H,60H,70H,60H,00H,00H,00H,00H,00H

DB    00H,00H,00H,00H,0C0H
DB 80H,00H,00H,00H,3FH,1FH,91H,0D1H
DB 91H,11H,11H,0D1H,91H,91H,0BFH,9FH
DB 80H,80H,80H,0C0H,0C0H,80H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,08H
DB 08H,04H,03H,01H,0FFH,0FFH,01H,10H
DB 08H,08H,08H,84H,7FH,0FFH,0C2H,0C3H
DB 0C1H,0C1H,0C0H,0C0H,0C0H,0E0H,0FFH,60H
DB 00H,00H,00H

DB    00H,00H,00H,00H,0FFH
DB 0FFH,11H,11H,11H,11H,11H,0FFH,0FFH
DB 00H,00H,00H,0FFH,0FFH,10H,10H,10H
DB 10H,10H,10H,0FFH,0FFH,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 10H,10H,10H,10H,11H,10H,10H,10H
DB 10H,10H,10H,0FFH,0FFH,12H,10H,10H
DB 10H,10H,10H,10H,10H,18H,1CH,18H,00H,00H,00H

DB    00H,00H,00H,00H,0FH
DB 07H,02H,02H,02H,02H,02H,07H,03H
DB 00H,00H,00H,07H,03H,01H,01H,01H
DB 01H,01H,01H,07H,03H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
```

DB 00H,00H,00H,0FH,07H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H

DB   00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H

DB   00H,00H,00H,60H,80H,81H
DB 81H,7FH,01H,00H,00H,81H,0FFH,81H
DB 00H,00H,0FFH,02H,1CH,20H,0FFH,00H
DB 3CH,42H,81H,0A1H,62H,0E7H,00H,00H
DB 0FFH,08H,08H,0FFH,00H,00H,7FH,80H
DB 80H,7FH,00H,0E0H,1CH,13H,13H,1CH
DB 0E0H,00H,00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H

DB   00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H
DB 00H,00H,00H,00H,00H,00H,00H,00H,00H,00H,00H
END
;********* THE END OF PROGRAM (128*64) *******

● **Application Circuit 1**

● **Application Circuit 2**