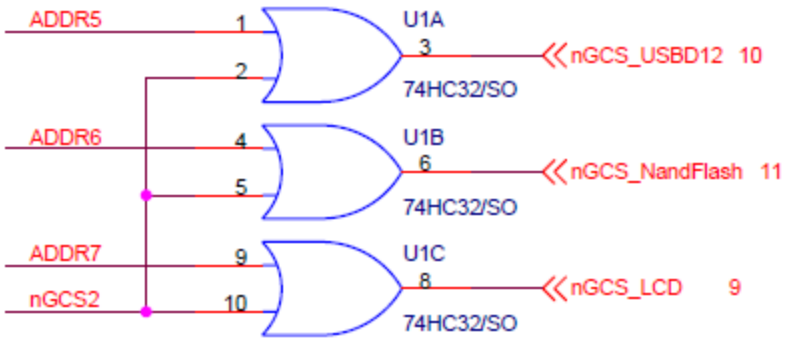
uCdragon chip selects

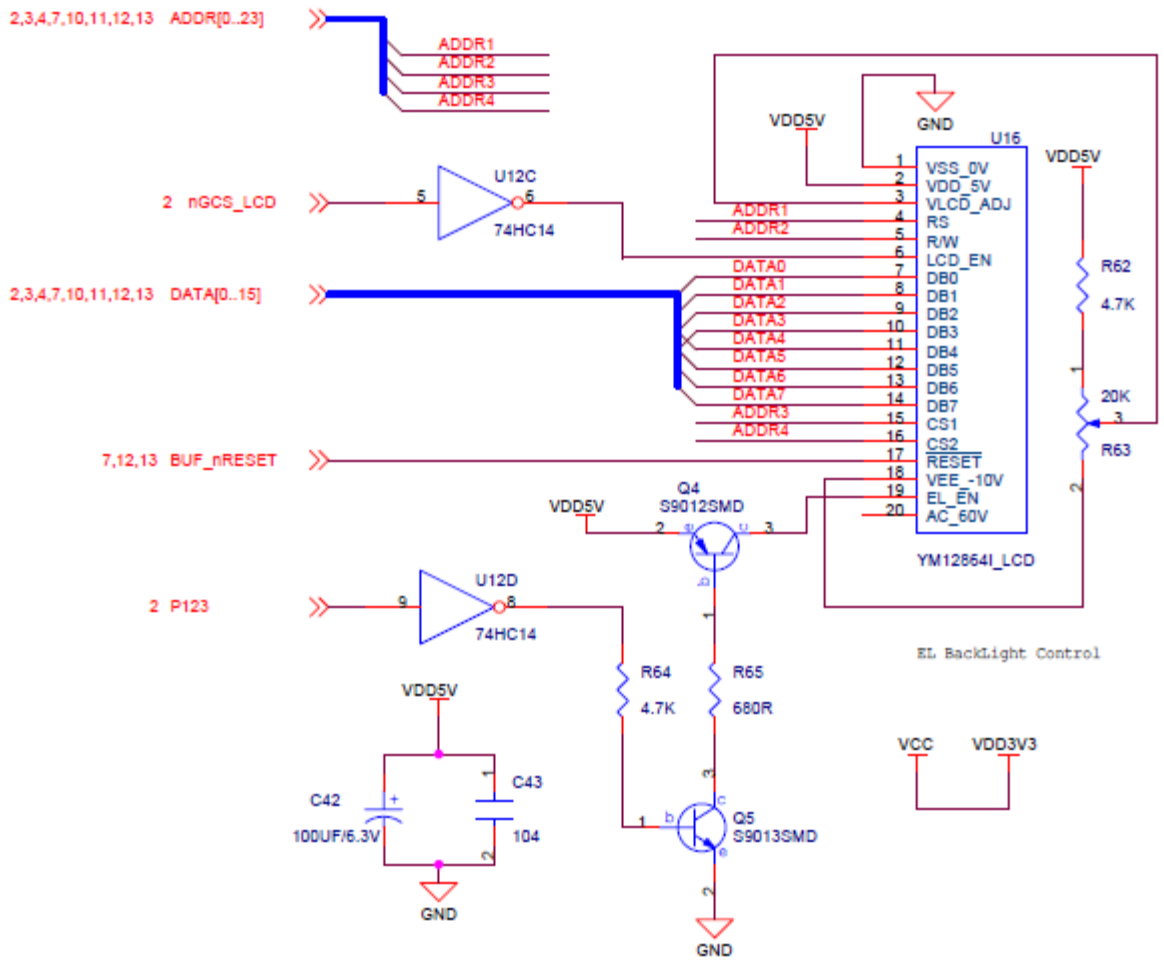


LCD:

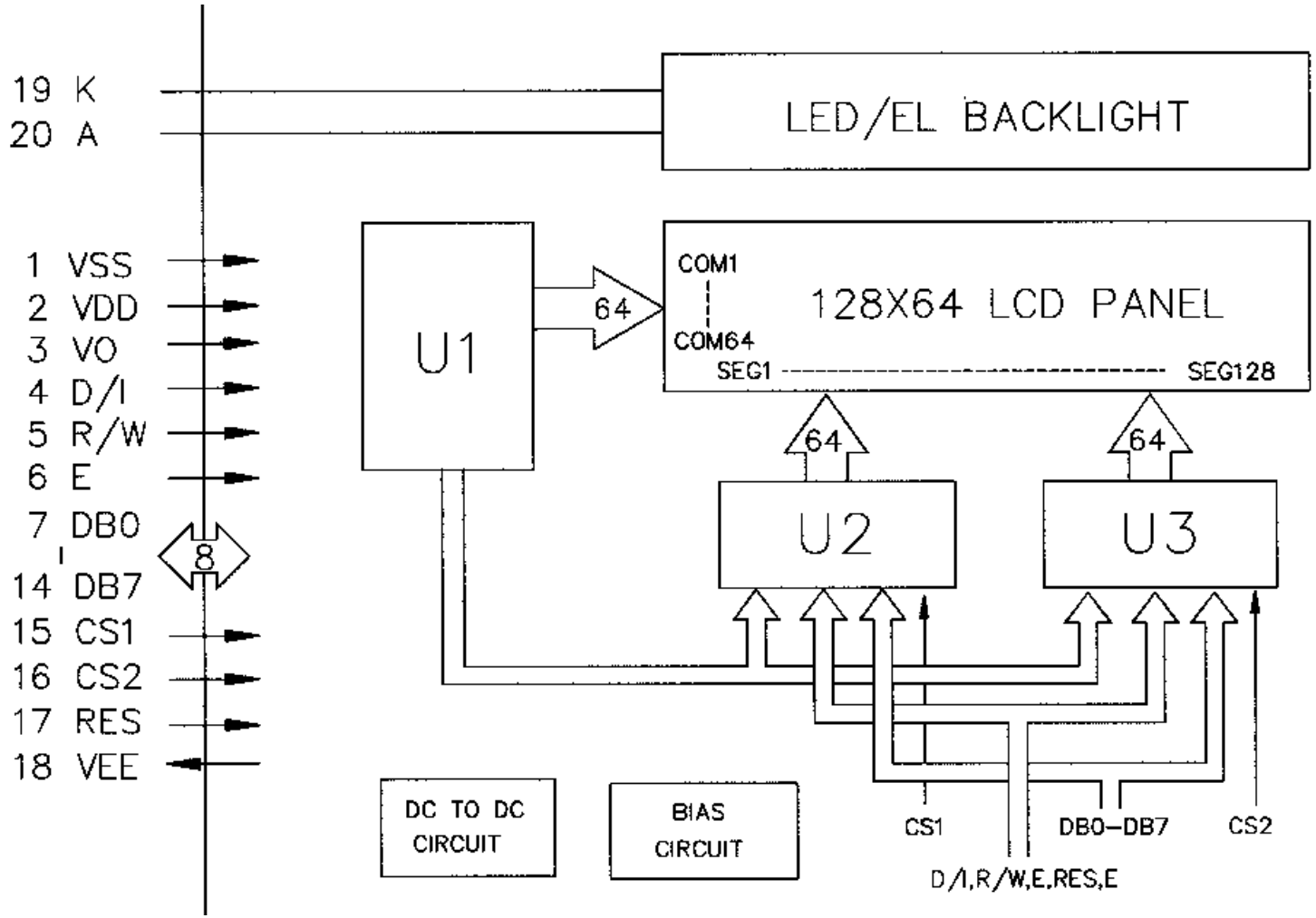
nGCS2 = 0x82000000

A7 = 0
A6 = 1
A5 = 1

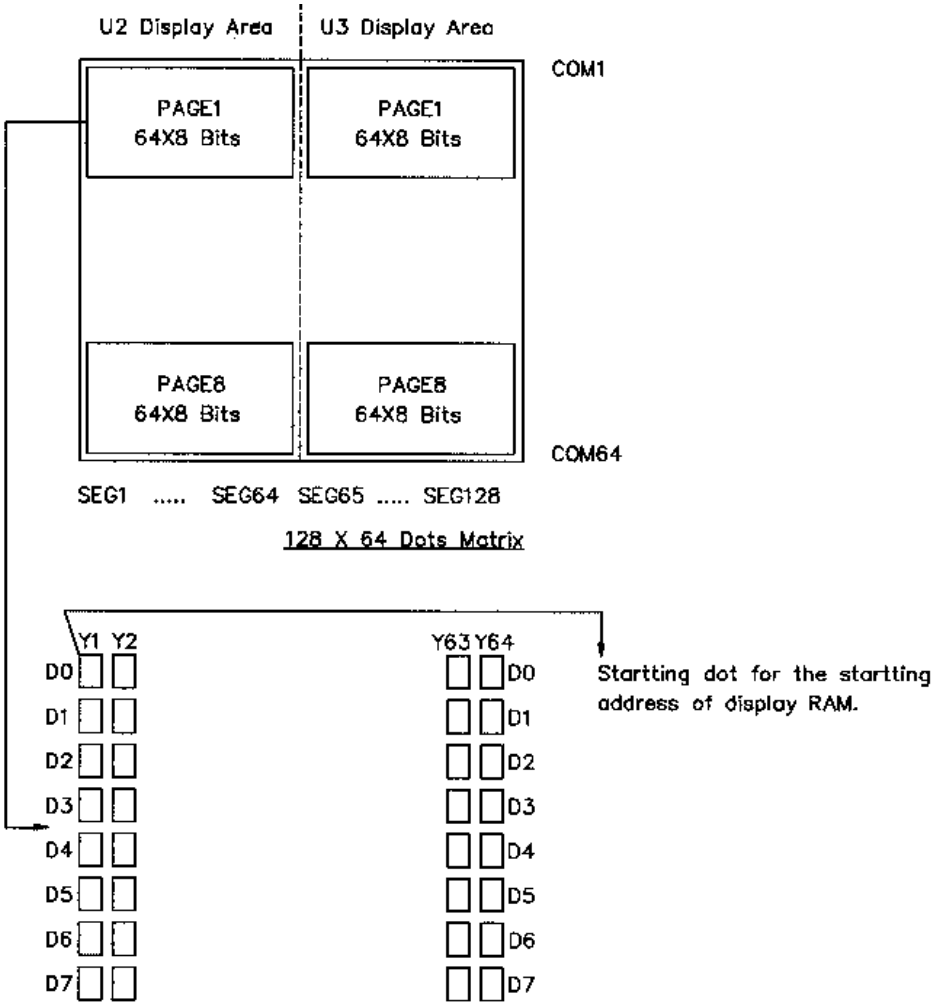
LCD on uCdragon



LCD module block diagram



LCD display memory



Display control instructions

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 address)	L	L	H	L	H	H	H	Page (0~7)			Sets the X address at the X address register.
Display Start Line (Z address)	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	Read status. 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.

Display control instructions

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)

S	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.

Source: KS108B Data Sheet

Display control instructions

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.

Source: KS108B Data Sheet

Display control instructions

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.

Source: KS108B Data Sheet

LCD addresses on uCdragon

```
//assign LCD_ENABLE  =   ( (!nGCS2) && (!ADDR[5]) && (!ADDR[6]) && ( ADDR[7]) ) ;
//ADR1  :  R/S
//ADR2  :  R/W
//ADR3  :  CS1
//ADR4  :  CS2
/* Addresses of LCD controller */
#define Lcd_Left_Command_Write          (*(volatile unsigned char *) 0x82000068)
#define Lcd_Right_Command_Write         (*(volatile unsigned char *) 0x82000070)

#define Lcd_Left_Status_Read            (*(volatile unsigned char *) 0x8200006c)
#define Lcd_Right_Status_Read           (*(volatile unsigned char *) 0x82000074)

#define Lcd_Left_Data_Write             (*(volatile unsigned char *) 0x8200006a)
#define Lcd_Right_Data_Write            (*(volatile unsigned char *) 0x82000072)

#define Lcd_Left_Data_Read              (*(volatile unsigned char *) 0x8200006e)
#define Lcd_Right_Data_Read             (*(volatile unsigned char *) 0x82000076)
```

Basic LCD functions

```
void Lcd_Command_Left(char a) {
  while ((Lcd_Left_Status_Read & LCD_Busy) == LCD_Busy) ;  //busy wait
  Lcd_Left_Command_Write = a;
}
void Lcd_Command_Right(char a) {
  while ((Lcd_Right_Status_Read & LCD_Busy) == LCD_Busy) ;  //busy wait
  Lcd_Right_Command_Write = a;
}
void Lcd_Data_Left_WR(char a) {
  while ((Lcd_Left_Status_Read & LCD_Busy) == LCD_Busy) ;  //busy wait
  Lcd_Left_Data_Write = a;
}
void Lcd_Data_Right_WR(char a) {
  while ((Lcd_Right_Status_Read & LCD_Busy) == LCD_Busy) ;  //busy wait
  Lcd_Right_Data_Write = a;
}
```

Blank the LCD

```
/* Blank the LCD */
void Lcd_Blank () {
 char i,j;
 for (i=0; i<8; i++) {
    Lcd_Command_Left(LCD_SetX | i);              //New page
            Lcd_Command_Left(LCD_SetY);          //New column
    Lcd_Command_Right(LCD_SetX | i);              //New page
            Lcd_Command_Right(LCD_SetY);         //New column
            for (j=0; j<64; j++) {
               Lcd_Data_Left_WR (0);
               Lcd_Data_Right_WR (0);
            }
 }
}
```

LCD initialization

```
void Lcd_Init () {
  int timeout = 10000;
  Lcd_Command_Left(LCD_SetStart);                    //start column 0 - left
  Lcd_Command_Right(LCD_SetStart);                   //start column 0 - right
  do {
            Lcd_Command_Left(LCD_On);                //left LCD on
            timeout--;
  }
  while ((Lcd_Left_Status_Read & LCD_Stat_On) && (timeout != 0));
  timeout = 10000;
  do {
            Lcd_Command_Right(LCD_On);
            timeout--;
  }
  while ((Lcd_Right_Status_Read & LCD_Stat_On) && (timeout != 0));
  Lcd_Blank ();                                      // blank LCD to start
}
```